Foreword

This Summary of Research presents a listing and description of the research activity and productivity of the faculty, civilian and military, and midshipmen at the United States Naval Academy for the 1998 - 1999 academic year. A total of 2.9 million dollars was devoted to research. The funding categories break down into approximately 71% Navy, 10% non-Navy DoD, 16% non-DoD federal, and 3% private research foundations.

The Chief of Naval Research, Naval Surface Warfare Center, Naval Research Laboratory, and Naval Space Command are the primary Navy sponsors of faculty and midshipman research. Among non-DoD federal sponsors, the National Science Foundation and the Department of Energy have been the main sources of funding.

Midshipman activities in research at the Naval Academy continued with students participating in independent research courses and honors projects. Twelve members of the Class of 1999 completed the Trident Scholar Program during this academic year. Their research achievements included non-invasive detection of CH-46 aft gearbox faults, model-based control of combustion, study of optical variability of the Chesapeake Bay, development and implementation of an adaptive error correction coding scheme for a full duplex communications channel, development of error statistics of time-delay embedding prediction on chaotic time-series, study of reduction in copper electrode life due to the resistance welding of aluminum, analysis of the use of thermal spraying to enhance the bonding characteristics of a urethane coated propeller, incorporation of a magnetotail into the global model of the Saturnian Magnetosphere, study of the effect of externally retrofitted carbon fiber reinforced polymer composites on the ductility of reinforced concrete beams, and study of the proposed multilateral force as America's nuclear solution for NATO. Midshipman James B. Coleman, whose Trident project was supervised by Associate Professor David R. Smith and Adjunct Associate Professor Richard W. Spinrad of the Oceanography Department and Associate Professor Steven N. Montgomery of the Physics Department, was awarded the Harry E. Ward Trident Scholar Prize for his outstanding work on the project titled "Optical Variability of the Chesapeake Bay."

Professor John M. Hill of the English Department was the recipient of the Research Excellence Award in 1999. Professor Hill is a nationally known scholar in the field of Old English literature whose work has received widespread critical acclaim, several examples of which can be found in this year's Summary of Research.

Research at the Naval Academy continues to play a key role in maintaining an atmosphere of scholarship in which midshipmen are exposed to the technical needs of the Navy as well as experience an analytic approach to problem solving, an important ingredient of our teaching mission.

W. C. MILLER
Academic Dean and Provost

REZA MALEK-MADANI
Director of Research and Scholarship

Division of
Engineering and Weapons

CAPT William R. Rubel, USN
Director

Aerospace Engineering

Professor Maido Saarlas
Chair

Research in the Aerospace Engineering Department covered a broad range of topics from astrophysics to practical engineering design of propellers. The publications and presentations by the departmental faculty reflect interest in both highly theoretical topics and very practical long time concerns to the flying community. Although the capstone courses are not explicitly listed, midshipmen and faculty advisors were aligned with research and current interest in other government agencies. Scientists and engineers from National Air and Space Administration (NASA), the Naval Space Command, and the Center for Naval Analyses assisted in review and evaluation of midshipmen projects. This occasionally leads to follow-on research and midshipmen opportunities. By use of numerical methods and sophisticated computer graphics techniques, extensive work of interest to the Navy and Coast Guard was carried out and published concerning ship hull-superstructure interaction.

The research efforts of the aerospace engineering faculty and students have benefitted the Academy in three fundamental areas: midshipmen have had opportunities to participate in research work at the leading edge of both aeronautical and astronautical engineering technology, and the Defense Department has been the beneficiary of the Academy's extensive computer and manpower resources. Also, faculty participation in developments in the field of aerospace engineering has enhanced the learning process in the classroom, from the most fundamental courses to sophisticated design course projects.

Support for research has come from various sources including NASA, the Naval Space Command, the Naval Research Laboratory, the U.S. Air Force Academy, and others. Ongoing research, in cooperation with other engineering departments (to be reported in the future) into composite materials is being supported by the Great Lakes Composite Consortium.

Sponsored Research

Recovery of Pulsed Signals Buried in Noise

Researchers: Professor William J. Bagaria,
Associate Professor Colin P. Ratcliffe (Mechanical Engineering Department)
and Lieutenant Colonel Billy R. Smith, USAF
Sponsors: Naval Space Command and Naval Research Laboratory

Pulsars that are in the Milky Way Galaxy can be used for orbital velocity and position determination. However, the pulsar signal is about 100 orders of magnitude lower than the background noise. Vibration techniques, such as cross-correlation, are being used to detect the pulsar signal, and the Doppler shift in near real time. Once the signals from three or more pulsars are measured, the velocity and position of an object, like the earth, can be determined.

Space Mission Analysis and Design Space Technology Series

Researcher: Associate Professor Daryl G. Boden
Sponsor: United States Air Force Academy

The Space Technology Series is a series of books that focus on the process of moving from a mission need, through the systems' acquisition phases, to an operational space mission. The Department of Astronautics at the United States Air Force Academy has provided program management and editorial support for the project for the past ten years. Funding for the project has come from numerous sources, including the U.S. Navy.

The series includes books describing all aspects of space mission design. As the number of books increases, the level of detail of the books increases (with more detail on a particular topic). A goal of the series is to capture the knowledge and experience of engineers who have worked in the space business from its inception before these engineers retire.

The Aerospace Engineering Department is a partner in the program management of this project. Specific tasks performed by this researcher included looking for funding support from Navy agencies, providing editorial support for the books, identifying potential authors to contribute to the books, and writing selected chapters.

Asymmetric Changes in the C IV Emission Profiles of the Seyfert I AGN NGC 3516 and NGC 4151

Researcher: Visiting Professor Richard P. Fahey (Naval Space Command Research Chair),
A.G. Michalitsianos and D.M. Kazanas
Sponsor: NASA/Goddard Space Flight Center

The C IV λ1549 emission feature in the spectra of the AGN NGC 3516 and NGC 4151 shows two narrow peaks, about 1-2,000 km s^{-1} wide and 3,000 km s^{-1} apart. Both peaks vary in response to changes in the activity level of the system, but the blueward of these peaks varies in amplitude and in total flux by more than a factor of 2 relative to the redward one. Moreover, the ratio of the blueward to redward amplitude, or the blueward to redward flux, correlates strongly with the strength of the continuum, *e.g.*, at 1300 A, in a way similar to the Baldwin effect. When examined at the resolution of the International Ultraviolet Explorer (IUE), the pair of peaks seem to be a result of asymmetric absorption of light from a single Lorentzian-shaped emission feature at almost the same wavelength. At the resolution of the Goddard High Resolution Spectrometer (GHRS), the C IV λ1549 absorption feature has the appearance of a deep, rectangular well, indicating saturation, with several weak, narrow Gaussian emission lines superimposed. We suggest that this effect could be due to a wind between the observer and the source of the predominant emission line. The current study extends our previous findings, and leads to the possibility that several Seyfert I AGN share this same behavior.

Independent Research

Stress Analysis of Hollow Helical Springs Including Curvature and Pitch

Researcher: Professor William J. Bagaria

Helical Springs of low pitch angle, fabricated from solid bar, have been extensively analyzed. Significant weight reduction can be achieved by fabricating them from hollow bar. This necessitates the reformulation of the entire theory. Test data is being collected to verify the theory. In addition, design charts are being created to aid the designer in quickly determining the necessary parameters of the spring.

Wing Gust Load Alleviation Using Fuzzy Logic to Control Active Ailerons

Researchers: Professor William J. Bagaria and Professor Gabriel N. Karpouzian

Currently, the structural design of a wing must account for the shear and bending loads due to both maneuvering and gusts. Active ailerons can be used to alleviate the gust loads by the appropriate deflections of the ailerons when a gust is sensed. This allows the design of a lighter wing. Using fuzzy logic to control the ailerons allows the gust loads to be alleviated without having to use a classical feedback control system. This results in a faster response, with little or no overshoot.

Analysis and Practical Applications of the Newly Discovered Mikkola-Innanen Orbits

Researcher: Professor William J. Bagaria

Using numerical methods, Mikkola and Innanen studied the long term stability of the Solar System. In doing so, they discovered new stable solar orbits which are also gravitationally bound with each planet. A satellite in this type of solar orbit has a motion relative to the planet such that the satellite also orbits the planet. This work is determining the analytical equations that govern the M-I orbits so that they may be used for practical engineering and scientific purposes.

Research in Automating Space Mission Operations

Researcher: Associate Professor Daryl G. Boden

Research in Automating Space Mission Operations is a joint Navy/NASA/Industry/academia research and development project which uses existing facilities in the Aerospace Engineering Department at the U.S. Naval

Academy (USNA). The goals of the project are to test and evaluate automation techniques for command and control of space systems. The project is unique because it uses the UHF Follow-On (UFO) Flight #1 spacecraft as an on-orbit test article, providing the means to qualify software applications for use in space. The laboratory is also used to support USNA classes and associated laboratories, as well as midshipmen and faculty research projects.

Rapid Extraction of a Pulsed Signal Buried in Noise

Researchers: Professor William J. Bagaria,
Associate Professor Colin P. Ratcliffe (Mechanical Engineering Department),
Associate Professor Sonia M. Garcia (Mathematics Department) and
Visiting Professor Richard P. Fahey (Naval Space Command Research Chair)

The motivation for this research was the need to extract pulsed signals that are buried in noise. The signals of interest have a "short" pulse duration compared to the period of the signal and they are "weak." A consideration when analyzing these signals is that the length of the recorded signal be as short as possible. In this way, factors which might change the period of the signal over the short term, such as a variable Doppler shift, can be detected. If the signal is recorded and analyzed over a long period of time, the short time variations would be averaged out.

The paper resulting from this research is divided into three parts. First, the classical theory is reviewed. Second, a method is presented that allows the rapid determination of the period of the signal, and the start time of the first pulse of the signal in the recorded data. Third, a method is presented by which the temporally average wave form shape of the pulsed signal can be recovered from the noisy data.

Flow Simulation of a Co-Flowing Laminar Diffusion Flame

Researcher: LCDR David D. Myre, USN
Advisor: Professor Catherine Mavriplis, Department of Civil, Mechanical and Environmental Engineering
George Washington University, Washington, D.C.

A computational study of a methane-air co-flowing laminar diffusion flame was compared with results in the literature, including experimental studies and other numerical calculations. The computational method solves the incompressible Navier-Stokes equations with variable properties and a Boussinesq buoyancy term. This solution is coupled to the convection-diffusion of a conserved scalar representing a mixture fraction. The energy equation is solved using heat addition incorporating an expression developed by R. W. Bilger of the University of Sydney. This expression directly relates the conserved scalar mixture fraction to the consumption of methane. The numerical calculation uses the spectral-element method, which combines the best attributes of the finite element method and spectral methods for the solution of complex incompressible flows. The spectral-element method takes advantage of the high accuracy possible using spectral methods and the generality and geometric flexibility of the finite element method. The velocity, temperature and mixture fraction fields are presented for several co-flowing axisymmetric cases, and these are then be compared to experimental and other numerical results.

Analysis of Contour Smoothed Concentration Data

Researcher: LCDR David D. Myre, USN
Advisor: Professor J. Houston, Department of Chemistry
George Washington University, Washington, D.C.

Previously, workers at the National Institute of Standards and Technology (NIST) and George Washington University (GWU) measured laser-induced fluorescence from hydroxyl radical laser light scattering, laser-induced luminescence from soot particles, and quantitative concentrations for carbon dioxide, carbon monoxide, and methane using tunable diode laser absorption spectroscopy (TDLAS). A steady and time-varying co-flowing, axisymmetric flame system was set-up to reproduce conditions established by Smyth and co-workers. A co-flowing methane-air laminar diffusion flame was modulated at a 10 Hz rate and data were taken by synchronizing the data acquisition to the correct phase angle in 10% (10 ms) phase increments. The latter measurement can be used to calculate mixture fraction. To improve the quality of this calculation, a contour-aligned smoothing technique used by groups at the University of Sydney and at Yale University was applied to the data as previously described. Mixture fraction is a conserved scalar that is given a value of one in the fuel stream and zero in the air stream. Since carbon dioxide, carbon monoxide, and methane account for about 99% of the fuel in the flow an approximation of mixture fraction can be made from the concentration of these constituents. Analysis of this data has continued by examining the concentration data as a function of mixture fraction at all heights in the flame. Derived parameters such as scalar dissipation and heat release have been obtained by calculating gradients in the mixture fraction field and by correlating density and diffusivity to an experimental temperature field also obtained from NIST. Correlation of the production of CO and CO_2 to mixture fraction will be made in both a steady flame case and modulated flame cases. This will be compared to existing experimental and numerical databases. In addition, derived values of scalar dissipation and heat release can be used to compare to numerical calculations.

Research Course Projects and Trident Scholar Projects

Prototype Communications Satellite (PCSAT)

Researcher: Midshipman 1/C Christopher K. Morgan, USN
Faculty Advisor: Associate Professor Daryl G. Boden

PCSAT is a simple communications satellite designed to provide a space-based node to the Amateur Position Reporting System (APRS). Conceived by CDR (ret) Robert Bruninga of the USNA Satellite Ground Station (SGS), and operating in the amateur radio band, it will receive position and identification data from amateur

radio operators participating in APRS, and then rebroadcast that data to the USNA SGS for integration into the APRS database. In this project, the preliminary design of the satellite was determined. Fabrication of the satellite is currently underway, with testing planned for fall 2000 and launch expected prior to March 2001.

Design and Construction of a Semi-Span Rectangular Wing with Leading Edge and Trailing Edge Oscillatory Flaps

Researchers: Midshipman 1/C Travis G. Deaton, USN and Midshipman 1/C Thomas J. Weaver, Jr., USN
Faculty Advisor: Professor Gabriel N. Karpouzian

A semi-span rectangular wing was designed and built, having a 18-inch semi span and a 6-inch chord length. The wing has leading edge and trailing edge flaps along the span which are allowed to oscillate. Each flap is driven by a motor to oscillate about its hinge line along the wing span at various amplitudes and frequencies. The choice of this design was made to simplify the complexity of the mechanism that oscillates the flaps. It was borne out of a previous design of a F/A-18 wing model which created difficulty in driving the flaps having swept uneven hinge lines. With this new wing model, the work aims at studying the effect of flap oscillations of the aerodynamic performance. The motor that drives the flaps to oscillate has enough power to overcome the dynamic loads at the leading edge as the latter oscillates in a relatively high speed air flow. This sizing of power requirement was a challenge in itself. The next phase of the project is to install the wing and the mechanism in a wind tunnel and run tests to obtain measurements of aerodynamic loads for various oscillatory modes of the flaps.

Mechanical Properties of Silica Aerogels

Researcher: Midshipman 1/C Kelly A. George, USN
Advisors: Associate Professor Michael D. A. Mackney and LCDR David D. Myre, USN

The Advanced Research Projects Agency (ARPA) project referred to as the Integrated Biosensor Program (IBP) has the mission of developing a micro-unmanned aerial vehicle (μ-UAV) carrying a biosensor for the detection and identification of biological weapons. The material selected as the filter medium for the biosensor is silica aerogel. Aerogel is an innovative low-density porous material capable of filtering microbes out of the air. It also has a very high strength to weight ratio, which gives the material potential applications for structural components of the μ-UAV. In order to facilitate the development of aerogel structural components, the United States Naval Academy Aerospace Engineering Department was assigned the task of determining the mechanical properties of silica aerogels. The extremely low weight, density, and tensile and shear strength make working with silica aerogels very challenging. These properties also restrict the use of traditional engineering testing methods for determining mechanical properties. Concurrent to this effort was the purchase and integration of a lightweight materials test machine for testing in the appropriate load ranges. Once this machine was on-site, fixtures and techniques were developed, and these were subsequently tested. Difficulty was encountered in converting the data to a useable form due to software incompatibilities in the new machine, but our efforts resulted in a significant advance in our understanding of the handling and testing aerogels.

Evaluating Methods for Calculating Lift and Drag of Aircraft Fuselages

Researcher: Midshipman 1/C Josue M. Diaz, USN
Faculty Advisor: Professor Maido Saarlas

The purpose of this project was to collect and evaluate methods that can be utilized for practical preliminary design as one calculates the lift and drag of aircraft bodies. Since a large body of information exists, the emphasis was on determining methods that do not require an extensive computational effort. This information is of interest for Naval UAV applications as well as for the Aerospace Engineering Department design course, EA440. A summary report will be published shortly.

Establishing the State-of-the-Art of Pusher Propellers

Researcher: Midshipman 1/C Mark C. Parrella, USN
Faculty Advisor: Professor Maido Saarlas

Although propellers have been studied for well over one hundred years and a considerable body of data and reports have been accumulated, there seems to be a peculiar lack of information available on pusher type of propellers. With the current naval interest in pushers for unmanned areal vehicles (UAV) and the lack of available design data, the purpose of this project was to discover the sources of existing information and to establish the directions of additional research and development. After considerable literature research, only a handful of useful references could be found. The literature phase of this research will be continued before embarking on follow-up research activity.

Applicability of the XCASTLE Flight Simulation

Researcher: Midshipman 1/C Mark W. Sand, USN
Faculty Advisor: Major David G. Schnorenberg, USMC

The Aerospace Engineering Department has an on-going need to conduct flight simulation. The XCASTLE simulation package, designed by the Flight Simulation Branch, Manned Flight Simulator, Naval Aircraft Warfare Center Aircraft Division, Patuxent River, offers the ability to perform both real time and compressed time flight simulation. The software is designed to run on a variety of different airframe models, as well as offering the ability to change airframe design parameters. The purpose of this project was to install a newly released PC version of XCASTLE for a general aviation light aircraft model and complete all software and hardware configurations necessary to run the simulation package on a Windows based PC using commercially available interfaces and controllers. Once all configuration issues have been resolved, specific aerospace engineering course applications can be explored.

Publications

BODEN, Daryl G., Associate Professor, "Introduction to Astrodynamics," Space Mission Analysis and Design, 3rd Edition, Chapter 6, Torrance, CA: Microcosm, Inc., 1999.

Space Mission Analysis and Design addresses the art and science of designing a space mission from concept to preliminary design. Chapter 6 explains the terms used to describe satellite orbits, provides equations necessary to calculate classical orbital elements from position and velocity, and shows how to predict the future position and velocity of a satellite. The chapter also discusses orbit perturbations and orbit maneuvering strategies.

BODEN, Daryl G., Associate Professor, and Stephen J. Hoffman, "Orbit Selection and Astrodynamics," Human Space Mission Analysis and Design, Chapter 9, New York: McGraw-Hill, 1999.

Human Space Mission Analysis and Design describes the process for designing human space missions with a goal of achieving low-Earth orbit, a lunar mission, or a mission to Mars. Chapter 9 specifically describes the design as it applies to the three different missions. Numerous example trajectories for lunar and Mars missions are shown.

BODEN, Daryl G., Associate Professor, "Satellite Artificial Intelligence Lab," Proceeding from 1999 ASEE Annual Conference and Exposition. The Spacecraft Artificial Intelligence Laboratory (SAIL) is a joint Navy/NASA/Industry/academia research and development project which uses existing facilities in the Aerospace Engineering Department at the U.S. Naval Academy (USNA). The goals of the project are to test and evaluate automation and machine intelligence techniques for operating space systems. The SAIL project is unique because it uses the UHF Follow-On (UFO) Flight #1 spacecraft as an on-orbit test article, providing the means to qualify artificial intelligence (AI) applications for use in space. The laboratory is also used to support USNA classes and associated laboratories, as well as midshipmen and faculty research projects. This paper describes the SAIL project and how the Aerospace Engineering Department uses the project to support midshipmen education.

MACKNEY, Michael D. A., Associate Professor and Ross, Carl T. F., "Superstructure Effectiveness in the Preliminary Assessment of the Hull Behaviour," Marine Technology, Journal of the Society of Naval Architects and Marine Engineers, Volume 36, Number 1, January 1999.

In a study of hull-superstructure interaction, a parametric investigation was undertaken, which was designed to examine a large number of hull-superstructure arrangements, broadly representative of warship configurations. The study was essentially numerical, based on the finite element method, but was supported by an experimental program used to validate aspects of the modeling. The majority of the numerical work was the analysis of three-dimensional simplified models having either a single superstructure on a standardized hull, or a double superstructure arrangement on an alternative standardized hull. Such models represented simplified structural configurations from which preliminary assessments of the hull-superstructure behavior could be systematically addressed within an initial design sequence.

Superstructure effectiveness is not universally defined or used in the literature. Since stresses are idiosyncratic, effectiveness in this work is defined in terms of overall structural displacement, as the ratio of the maximum displacement of the plain hull to the maximum displacement with superstructures. A variety of cases was considered, including single and double superstructure arrangements of various sizes and in various positions on the hull. Design curves were formed for the different arrangements showing the

variation in the effectiveness. Superstructure effectiveness varies with superstructure length, becoming greater as the superstructure becomes longer. There is a finite limit to the maximum effectiveness which is dependent on the relative cross sectional properties. The position of the superstructure also affects the effectiveness, with the greatest effectiveness occurring at the mid hull position. The change in effectiveness is less when the superstructure is small and changing position than when it is long.

Two superstructures having comparable total length to a single superstructure are less effective than the single superstructure. Three superstructures are more effective than two, but still less than one. As the number of superstructures increases for a given total length, the effectiveness tends towards the single superstructure value. Superstructures, even of modest dimensions, add considerably to the cross-sectional properties and should be considered as part of the hull girder when doing the preliminary design.

MACKNEY, Michael D. A., Associate Professor and Ross, Carl T. F., "Preliminary Ship Design Using One- and Two-Dimensional Models," Marine Technology, Journal of the Society of Naval Architects and Marine Engineers, Volume 36, Number 2, April 1999.

Computational studies of hull-superstructure interaction were carried out using one-, two- and three-dimensional finite element analyses. Simplification of the original three-dimensional cases to one- and two-dimensional ones was undertaken to reduce the data preparation and computer solution times in an extensive parametric study. Both the one- and two-dimensional models were evaluated from numerical and experimental studies of the three-dimensional arrangements of hull and superstructure.

One-dimensional analysis used a simple beam finite element with appropriately changed section properties at stations where super-structure existed. Two-dimensional analysis used a four node, first order quadrilateral isoparametric plane elasticity finite element, with a corresponding increase in the grid domain where the superstructure existed. Changes in the thickness properly reflected deck stiffness. This model was essentially a multi-flanged beam with the shear webs representing the hull and superstructure sides, and the flanges representing the decks.

One-dimensional models consistently and uniformly underestimated the three-dimensional behavior, but were fast to create and run. Two-dimensional models were also consistent in their assessment, and considerably closer in predicting the actual behaviors. These models took longer to create than the one-dimensional, but ran in very much less time than the refined three-dimensional finite element models.

Parametric insights were accomplished quickly and effectively with the simplest model and processor, but two-dimensional analyses achieved closer absolute measure of the displacement behaviors. Although only static analysis with simple loading and support conditions were presented, it is believed that similar benefits would be found for other loadings and support conditions. Other engineering components and structures may benefit from similarly judged simplification using one- and two-dimensional models to reduce the time and cost of preliminary design.

NIEWOEHNER, Robert J., CDR, USN, Assistant Professor, Ricardo Traven and John Hagan "Solving Wing Drop on the F/A-18E/F Super Hornet," 42nd Symposium Proceedings, Society of Experimental Test Pilots, September 1998, 67-84.

The F/A-18E/F recently surpassed 2,000 flights and 3,000 flight hours, 29 months after commencing a three-year Engineering and Manufacturing Development (EMD) test program. One of the many challenges that arose during the flight test program was defining a solution to what became known as "wing drop". Wing drop was an abrupt, uncommanded rolling motion encountered while maneuvering the aircraft. Not to be confused with the wing drop behavior that many aircraft exhibit at high angle of attack (AOA), this particular wing drop phenomena occurred at low AOA and transonic speed conditions in the heart of the operational envelope.

Many aircraft have manifested this type of transonic low AOA wing drop from the F-86 to the NASA F-111 TACT. Unfortunately, predictive design tools have not matured to a level that can guarantee a wing drop free aircraft before first flight. Historically, post design "fixes" in susceptible aircraft have not yielded reliable techniques to alleviate the problem.

This paper reviews the wing drop solutions

that were flight tested on the F/A-18E/F, the techniques used to evaluate the concepts, and summarizes how the solution was integrated into the aircraft while minimizing the impact on the F/A-18E/F test aircraft, the EMD program, and the production F/A-18E/F design.

ROGERS, David F., Professor, "Range," Newsletter of the World Beechcraft Society, May/June 1998, 14-15.

ROGERS, David F., Professor, "Engine Upgrade Performance," Newsletter of the World Beechcraft Society, January/February 1999, 15-17.

Presentations

BODEN, Daryl G., Associate Professor, and Stephen J. Hoffman, "Orbit Selection and Astrodynamics," American Astronautical Society Conference on Human Space Mission Analysis and Design, Houston, Texas, 18 February 1999.

BODEN, Daryl G., Associate Professor, "Satellite Artificial Intelligence Lab," ASEE Annual Conference and Exposition, Charlotte, North Caroline, 22 June 1999.

KARPOUZIAN, Gabriel N., Professor, "Aeroelastic Instabilities and their Control," The Raouf Ali Raouf Memorial Lecture, USNA, 23 February 1999.

NIEWOEHNER, Robert J., CDR, USN, Assistant Professor, Ricardo Traven and John Hagan "Solving Wing Drop on the F/A-18 E/F Super Hornet," Society of Experimental Test Pilots Symposium, Beverly Hills, California, 28 September 1998. (Won best paper of 25 presentations.)

ROGERS, David F., Professor, "Flight Testing with an A-36," American Bonanza Society Meeting, Salisbury, North Carolina, 30 October 1998.

Electrical Engineering

Colonel James F. Kendrick, USAF
Chair

Research and scholarly activity are fundamental to the vitality and viability of any discipline. This is particularly applicable to electrical engineering, which is broadly based and rapidly expanding. Research helps both faculty and midshipmen keep abreast of advancing technology and ultimately improves the effectiveness of the academic environment by encouraging a modern and relevant curriculum.

Funding for our research comes from the Naval Research Laboratory (NRL), the Naval Surface Warfare Center (NSWC), the National Aeronautics and Space Administration (NASA), the Johns Hopkins University Applied Physics Laboratory (JHU/APL), the Korean Agency for Defense Development, and from within the Naval Academy. Research topics supported during the past year included high performance fiber optic communications, wireless communication of distributed shipboard sensors, dynamic path planning and scheduling among a field of moving obstacles, satellite oscillator frequency determination, noninvasive probing of high performance microwave circuits, JAVA applet applications, non-linear array beamforming, noninvasive helicopter gearbox fault detection, adaptive error correction coding, and very low elevation antenna effects. This faculty research contributes directly to the fleet's operational capabilities, and provides relevant topics which benefit the professional as well as the academic development of our midshipmen.

Sponsored Research

Simulation in High-Speed Fiber Optic Communication Systems

Researcher: Assistant Professor Brian Jenkins
Sponsor: Naval Research Laboratory (NRL), Irl Duling, III

High performance fiber optic communication is essential to meet the increasing bandwidth demands of modern telecommunication and computing systems. The design of fiber optic links which operate at data rates above 10 Gb/s is complicated by both linear and nonlinear phenomena. Hence, such links often employ solitons and require high-speed sources, detectors and modulators as well as amplification, filtering, and

dispersion management to insure the accurate transmission of data. Building such a link without numerical simulation can be difficult and expensive. In this project, we use a commercially available simulation package to model various broadband optical communication systems. Recent research has emphasized the use of dispersion management in fiber links using solitons at data rates of 10-20 Gb/s. We simulate links at the much higher data rate of 100 Gb/s. Such data rates require high-speed sources such as the sigma laser developed at NRL. Numerical models are used to optimize the design of the laser as well as the design of the link. In a practical system application, such a link might be used in the physical backbone of a packet switched optical network, where simulation can assess the viability of other technical innovations (wavelength conversion, optical clock recovery, packetization and demultiplexing techniques) on network architecture. The initial focus of the simulations was on repeaterless communication using adiabatic soliton propagation, with a single 10 Gb/s wavelength channel transmitted over a distance of 300 km. The number of wavelength channels was increased to eight, with total throughput of 80 Gb/s. In laboratory experiments, four wavelength channels were transmitted error-free with a bit-error rate below 10^{-9}. We are now continuing simulations which include optical amplification and data rates of 100 Gb/s.

A Distributed Sensor System with Wireless Communication Network

Researcher: Professor Antal A. Sarkady
Sponsor: Naval Surface Warfare Center, Carderock Division (NSWCCD)
Philadelphia, PA, Code 825, Henry Whitesel

Advanced damage control systems are being developed and evaluated at the Naval Surface Warfare Center, Carderock Division, Philadelphia, PA. A large number of distributed shipboard sensors with spread spectrum type transmitters and receivers are interconnected to form a large wireless communication network with display terminals at strategic locations on a surface ship. This wireless communication system is in the evaluation phase and I am providing guidance and help to overcome some of the signal to noise ratio problems experienced when electromagnetic waves are propagating inside closed steel compartments and obscured by shipboard fire.

Autonomous Path Planning and Scheduling

Researcher: Associate Professor Kelly A. Korzeniowski
Sponsor: Johns Hopkins University Applied Physics Laboratory (JHU/APL)

Research continued, under an Office of Naval Research contract at the Johns Hopkins Applied Physics Laboratory, to develop a hierarchical system for dynamic path planning and scheduling among a field of moving obstacles. This type of planning capability is directly applicable to many autonomous navigation scenarios, such as movement on a manufacturing floor, navigation of surface/subsurface ships, or coordination of air traffic. This was accomplished by developing a space/time domain representation and specifying motion control for the agent in that domain. In this space/time domain representation, time requirements can be imposed upon the goal(s) and therefore scheduling can also be accomplished. This algorithm was successfully run as part of a simulated planning environment. In terms of real-time system performance, the algorithm makes path planning tractable.

Determining Oscillator Frequency in Space.

Researcher: Assistant Professor Christopher T. Field
Sponsor: NASA/Goddard Space Flight Center

GLAS is a laser ranging system scheduled to be launched in 2001 to measure the surface topography of the polar ice sheets. The distance between the satellite in a polar orbit about 600 km above the earth's surface and the surface will be measured with an accuracy smaller than 10 cm. The distance is determined by measuring the time required for a short pulse of light to travel from the satellite to the surface and back.

The round trip travel time is measured counting the number of cycles of an on-board oscillator required for the trip. The frequency of the oscillator must be known to better than one part in 10^9 over the 5 year mission life. I have been researching how to use a simple quartz oscillator and the on-board GPS receiver to perform the time measurement. This has required finding a way to bound the oscillator frequency variations from an average frequency measured with the GPS receiver. This work has been performed at Goddard Space Flight Center in consultation with the National Institutes of Standards and Technology in Boulder, CO.

Advanced Packaging Applications

Researcher: Assistant Professor Deborah M. Mechtel
Sponsor: Johns Hopkins University Applied Physics Laboratory (JHU/APL)

A noninvasive, laser-based instrument was used to probe multichip module (MCM) structures fabricated with poled polyimide interlayer dielectrics and thin film metallizations on silicon carriers. The electro-optic interaction between the poled dielectric and the laser beam allows the strength of the internal fields within the MCM to be determined as a function of position. In this work, electric field detection results were obtained for different polyimides with circuit elements characteristic of MCM-D structures. Electrical, mechanical, and optical properties of the electro-optic dielectric layers for various polyimides were compared along with details of the associated poling and processing operations.

The laser-based instrument responds to a change in the index of refraction of MCM dielectric layers caused by the poled material's electro-optic response to electrical signals in the MCM circuit. We have shown that polyimide, appropriately doped and made electro-optic upon poling, may be probed noninvasively. Our current work built on these results by comparing different polyimides and their efficacy for poling and processing done in normal MCM-D-type construction.

Wide bandwidth applications have driven the demand for optical waveguide components for processing and transmitting information. Polymers are attractive materials for waveguide use in both the chip-to-chip and chip-to-board interconnects within MCM-D structures because of their electrical and optical properties and ease of processing. A new technique for simultaneously implementing polyimide as both a dielectric layer and an optical waveguide in the same MCM-D structure has been demonstrated. This technique, using poled polymers, would permit electrical and optical interlayers to be made simultaneously from the same dielectric polymer. The thermal, mechanical and electrical properties of the polyimide along with the index of refraction were studied for this optical waveguides application.

Some polymers, such as polyimide, may be doped and poled to change their index of refraction. Our study has concentrated on selectively changing the doping and poling process to optimize the index of refraction for waveguide applications while monitoring the effect on the electrical properties of the polyimide when employed as a dielectric layer. The optical layer was prepared using two different approaches. In the first appoach, a change in index between the poled and unpoled regions of a doped optical layer was used to form the waveguide. The second approach used the

index change between undoped and doped polyimide. We studied the result of selectively changing the doping and poling levels on the index of refraction and the electrical, thermal and mechanical properties for the two waveguide approaches. The effect of the processing changes on the material's efficacy as a dielectric material was also investigated.

JAVA Applet Tutorials and Quizzes

Researcher: Associate Professor David Harding
Sponsor: USNA sabbatical for one semester

The spring semester of the academic year 1999 was spent learning the JAVA programming language and beginning to develop Applets to be used as self-graded quizzes and tutorials. Thus far, a quiz Applet has been written which will be used in the Electrical Engineering core next fall. Applet programs can reside on a network server and be simultaneously accessed by multiple students using their WEB Browsers. The use of the Scientific Notebook software as a vehicle for quizzes and tutorials will also be investigated. This effort will continue over the summer of 1999.

Bearing Ambiguity Solution By Nonlinear Array Beamforming

Researcher: Commander Wooyoung Hong, KN
Associate Professor, Korean Naval Academy
Sponsor: Agency for Defense Development, Korea

A nonlinear beamforming method is described to solve bearing ambiguity of a towed line array sonar. The method estimates a towed array shaped by a Kalman filter with heading sensor information and performs array signal processing of the nonlinear array distorted by towing ship motion to form left and right bearing beams based on the adaptively estimated array sensor location. The bearing ambiguity resolution performance was investigated in terms of towing ship maneuvering pattern of cycle and amplitude. Computer simulation results recommend preferred towing ship patterns to gain high bearing ambiguity resolution in the boundary of Kalman filter tracking.

Independent Research

Wireless System Innovation and Design

Researcher: Commander Thaddeus B. Welch, III, USN, Assistant Professor

I am working with Dr. Rodger Ziemer {University of Colorado at Colorado Springs} and Dr. Mike Walker {United States Air Force Academy} on a variety of wireless/cellular design and analysis projects. This includes, but is not limited to, the bit error probability determination for a differentially coherent direct-sequence spread-spectrum multicarrier modulation system operating in a double spread channel and the effects on the spaced-time correlation function of highly directive antenna arrays being designed for use in mobile radio applications. These and other projects are progressing very well. Success and publication of each result is expected.

Motor Speed Control Using DAC Techniques

Researcher: Professor Tian S. Lim

This paper describes a motor speed control and measurement project in which a transistor circuit is used to control and measure the speed of a dc motor. An 8051 microcontroller assembly language program is designed to output digital bytes which, when input to a DAC (digital to analog converter), are converted to analog voltages. These are applied to the base of a transistor circuit to vary and control the collector current and hence the speed of a dc motor connected in the collector circuit.

Research Course Projects and Trident Scholar Projects

Non-Invasive Detection of CH-46 Aft Gearbox Faults

Researcher: Midshipman 1/C Bryan D. Rex, USN, Trident Scholar
Faculty Advisors: Professor Antal A. Sarkady and Associate Professor Kelly A Korzeniowski

Currently, the U.S. Navy performs routine intrusive maintenance on CH-46 helicopter gearboxes in order to diagnose and correct possible fault conditions which could eventually lead to gearbox failure. This type of preventative maintenance is costly, and it decreases mission readiness by temporarily grounding usable helicopters. Non-invasive detection of these fault conditions would save time and prove cost-effective in both manpower and materials. This research deals with the development a non-invasive fault detector through a combination of digital signal processing and artificial neural network technology. The detector would classify incipient faults based on real-time vibration data taken from the gearbox itself.

Development and Implementation of an Adaptive Error Correction Coding Scheme for a Full Duplex Communications Channel

Researcher: Midshipman 1/C John Waterston, USN, Trident Scholar
Faculty Advisors: Assistant Professsor Ellen C. Wooten and Associate Professor William E. Bennett

This research investigates, via simulation, the bit error probability (BEP) associated with a variable redundancy coding scheme operating in a wireless communications environment. Within a slowly varying (flat fading) Rayleigh channel, adaptive algorithms provide increased throughput over fixed coding implementations. From a family of BCH codes of the same block length (n=63), a code with appropriate redundancy is chosen depending on the receiver's estimation of the current conditions experienced in this channel. Two different decision techniques are compared. The first method statistically evaluates the receiver's input and calculates the signal to noise ratio (Eb/No), while the second method observes the number of corrected errors in recently decoded blocks. With this information, the adaptive system decides to modify the correction ability of the code, and then transmits this decision to the encoder over a low bandwidth feedback channel. The correction ability can be changed on a block by block basis. This algorithm is implemented in software and, therefore, can be optimized for many real world communications systems.

Very Low Antenna Measurements

Researcher: Midshipman 2/C Ray Foran, USN
Faculty Advisor: Commander Thaddeus B. Welch, III, USN, Assistant Professor
Sponsor: Armed Forces Communication Electronics Association (AFCEA) gift fund

Research to measure the effects of placing an antenna very near to the ground. This geometry is of concern for tactical forces as well as for civilian cellular, cordless, wireless, and personal communication services system users and designers (3G and 4G alike). One paper has been published and a second has been accepted for publication later this year. Defense Advanced Research Project Agency (DARPA) and Space and Naval Warfare Systems Command (SPAWAR) are very interested in this work.

Publications

FIELD, Christopher T., Assistant Professor and Pam Millar NASA/GSFC, "Laser Remote Sensing System Analysis for Search and Rescue," Applied Optics, 38 (20 April 1999), 2586-2593.

Searches for downed small airplanes currently rely on Emergency Locator Transmitters (ELT) which have proven to be inadequate. In such cases, search and rescue teams resort to visually searching from the ground and/or air for the distressed plane.

This paper develops a general model of a laser remote sensing system for search and rescue using fluorescent dye markers. The dye fluorescence occurs at longer wavelengths than the incident wavelength so that a dye covered target can be distinguished from the unshifted ground return.

While altimeter systems almost always receive a return from a large target such as the ground, search systems need to distinguish between a ground return and a small target return which may or may not be

present. The wavelength shift between pump and target fluorescence is used to distinguish the target from ground return. Search systems must also distinguish the target's return signal from mineral or plant fluorescence.

The main conclusion of this paper is a simple expression for the average laser power required to search at a particular rate given a required ground level energy density. It is also shown with an example system that active probing for lost planes may be practical.

HONG, Wooyoung, CDR, KN, Associate Professor, Korean Naval Academy, " Bearing Ambiguity Solution of Towed Array Sensor System By Nonlinear Array Beamforming," Proceedings of '98 Fall Conference of Korean Acoustic Society, (October 1997), 125-138.

JENKINS, Brian R., Assistant Professor, Michael L. Dennis, Thomas F. Carruthers, Walter I. Kaechele, Jin U. Kang, and Irl N. Duling, III., "Long Span Repeaterless Transmission Using Adiabatic Solitons", Photonics Technology Letters, 11 (April 1999), 478-480.

We demonstrate transmission of 10 Gb/s data over 296 km without inline amplification using adiabatically propagating optical solitons as the data carrier. Adiabatic soliton propagation suppresses the deleterious effects of self-phase modulation and stimulated Brillouin scattering, allowing higher optical powers at the transmitter. The system power budget is also enhanced by the narrowing of the optical bandwidth under adiabatic propagation, allowing improved receiver sensitivity. We show that the technique may ultimately enable repeaterless spans in excess of 500 km.

KORZENIOWSKI, Kelly A, Associate Professor, and Josette L. RICE, Commander, USN, "The Khepera Robot as a Teaching Tool", American Society for Engineering Education, CDROM, Charlotte, June 1999.

The Khepera robot is a small, commercially available, microprocessor driven robotic device that has been used at the United States Naval Academy for pre-college recruiting, college level engineering recruiting, course work and research purposes. It is a convenient platform for investigating each element of an autonomous system; namely data acquisition, signal conditioning and microprocessor control. This paper describes demonstrations used for pre-college recruiting and laboratory experiments used in a microprocessor based digital design course.

The Khepera robot is a versatile teaching tool. The robot itself is an excellent object lesson for a microprocessor based device. At the simplest level, students generate on-line commands that pass through a serial computer interface. The robot responds by moving as directed. Students may also investigate the operation of the proximity sensors by queuing the on-board analog to digital converter for the current state of the sensors. By adding the proper signal conditioning circuitry, other sensors may also be added to the robot. At the design project level, students may automate the robot and write code to generate desired behavior such as autonomous maze navigation.

KORZENIOWSKI, Kelly. A., Associate Professor and C.B. McVey, "Hierarchical System for Automated Path Planning and Scheduling", Proceedings of the SPIE, Mobile Robots XIII and Intelligent Transportation Systems, pp. 204-211, Boston, November 1998.

This paper describes a hierarchical system for dynamic path planning and scheduling among a field of moving obstacles. The solution is directly applicable to many autonomous navigation scenarios, such as movement on a manufacturing floor, navigation of surface/subsurface ships or coordination of air traffic. The overall system is discussed in terms of global/local perception and generative planning/reactive control. The development and implementation of the generative planner portion of the existing system are described in detail. In terms of real-time system performance, the multi-dimensional search problem is made tractable by applying two dependent 2-D techniques in series. First, the shortest distance, obstacle-avoiding path to the goal is calculated, then for that path, the time to the goal is optimized. In this space-time representation of the domain, time requirements can be imposed upon the goal(s) and therefore scheduling can also be accomplished.

MECHTEL, D.M., Assistant Professor, H.K. Charles, and A.S. Francomacaro, "Laser Testing of MCM-D Structures ", Proceedings International Conference and Exhibition on High Density Packaging and MCMs,

Denver, 1999.

Non-invasive techniques for measuring electric field strengths in multichip module substrates can be extremely important in determining ultimate module performance. Certain polymers such as polyimide exhibit an electro-optic response, after appropriate doping and poling, that permits direct measurement of these internal fields with a laser probe. Our work compares different poled polyimides for their efficacy as both an MCM dielectric layer and as an electro-optic material.

MECHTEL, D. M., Assistant Professor, H. K. Charles, and A. S. Francomacaro, "Poled Polymers for MCMs with Integrated Dielectric and Optical Layers", Proceedings of Electronic Components and Technology Conference, San Diego, 1999.

Low dielectric constants and ease of processing make polymers attractive materials for building both optical waveguides and dielectric layers. The change in the index of refraction of certain polymers such as polyimide, after appropriate doping and poling, makes it possible to build an optical waveguide using established polymer processing techniques. Our work uses these results to demonstrate optical waveguide fabrication for applications requiring optical and electrical interlayers on the same thin-film multichip module structure (MCM-D).

MECHTEL, D. M., Assistant Professor, H. K. Charles, and A. S. Francomacaro, "Noninvasive Laser Probing: A Solution for Improving the Testability of Buried MDM-D Circuit Structures", (Accepted for Publication), International Symposium on Microelectronics, Chicago, October 1999.

MECHTEL D.M., Assistant Professor, Assistant Professor C. T. FIELD, and Assistant Professor R. B. JENKINS , "Graphical Analysis and Animation in an Introductory Electrodynamics Course", American Society for Engineering Education, Charlotte, North Carolina, 1999.

Students frequently experience difficulty visualizing complex multidimensional electrodynamics topics, especially those with time variation. The classic stationary illustrations of inherently dynamic concepts can be greatly enhanced via computer animation. Animation significantly improves student comprehension of time dependent functions, and provides a secondary benefit for students by improving computer programming skills.

MECHTEL, D. M., Assistant Professor, H. K. Charles, and A.S. Francomacaro, "Laser-Based Electro-optic Testing of Multichip Module Structures", Microelectronics Reliability, published by Elsevier Science Ltd, Vol. 38, Issue 12, December 1998, pp. 1847 – 1853.

Laser-based electro-optic probing is a proven noninvasive technique for testing high-speed microwave circuits on substrates such as gallium arsenide (GaAs) and indium phosphide (InP). We have extended this technique to probe circuit structures on doped and poled polyimide substrates that are useful in high-density packaging applications such as multichip modules (MCMs). Our results demonstrate the potential to improve the testability of MCMs by probing circuit structures that are buried in the central layers of an MCM. In addition to direct, point-by-point electric field measurements in representative MCM structures, we have investigated the poled polyimide dielectric efficacy both as a dielectric circuit layer and as a suitable electro-optic material.

REX, Bryan D., Midshipman 1/C, Professor Antal A. SARKADY and Associate Professor Kelly A. KORZENIOWSKI, "Non-Invasive Detection of CH-46 Aft Gearbox Faults Using Digital Pattern Recognition and Classification Techniques", Proceedings of the 53rd Meeting of the Society for Machinery Failure Prevention Technology, pp. 301-311, Virginia Beach, April 1999.

Currently, the US Navy performs routine intrusive maintenance on CH-46 helicopter gearboxes in order to diagnose and correct possible fault conditions which could eventually lead to gearbox failure. This type of preventative maintenance is costly, and it decreases mission readiness by temporarily grounding usable helicopters. Non-invasive detection of these fault conditions would save time and prove cost-effective in both manpower and materials. This research deals with

the development of a non-invasive fault detector through a combination of digital signal processing and artificial neural network technology. The detector would classify incipient faults based on real-time vibration data taken from the gearbox itself.

REX, Bryan D., Midn 1/C, "Non-Invasive Detection of CH-46 Aft Gearbox Faults", USNA Trident Report No. 266, U.S. Naval Academy, May 1999.

Currently, the US Navy performs routine intrusive maintenance on CH-46 helicopter gearboxes in order to diagnose and correct possible fault conditions which could eventually lead to gearbox failure. This type of preventative maintenance is costly, and it decreases mission readiness by temporarily grounding usable helicopters. Non-invasive detection of these fault conditions would save time and prove cost-effective in both manpower and materials. This research deals with the development of a non-invasive fault detector through a combination of digital signal processing and artificial neural network technology. The detector would classify incipient faults based on real-time vibration data taken from the gearbox itself.

Banks, E. M.,. Assistant Professor Louiza SELLAMI, and M. E. Zaghloul, "VLSI Implementation of a Neural Type Cell Chaotic Modulator," Proceedings of the 5th International Conference on Control, Automation, Robotics and Vision, pp. 727-731, Singapore, Dec. 8-11, 1998.

This paper presents VLSI circuit implementations of the neural type cell (NTC) chaos generator and a chaotic modulator system using 1.2µ CMOS process. The modulator is constructed by feeding the chaotic signal generated by the NTC into a differential pair and can be operated in a multiplicative or additive way. Pspice simulation results and Spice extractions from the layout are included to demonstrate the operation of these circuits.

Singh, S. K., Assistant Professor Louiza SELLAMI, and R. W. Newcomb, "Functional Neural Network Control of a Robot Camera," Proceedings of the 5th International Conference on Control, Automation, Robotics and Vision, pp. 919-923, Singapore, Dec. 8-11, 1998.

The functional artificial neural network (FANN) is applied to the control of a serial-link robot to obtain good views for a digital video camera mounted on the end-effector. The Puma 560 robot is used as an example to illustrate the practicability of FANN based robot camera control. Since FANNs can learn under supervision, mapping functions to functions rather than just points to points, as with conventional multilayer perceptrons, their VLSI realization enables the execution of the forward pass operation of FANNs at high speeds. Thus FANNs are good candidates for real-time robotics applications. It is shown that this VLSI FANN controlled robot can result in efficient usage of video channel bandwidth while tracking an object.

Panagiotopoulos, D. A., Assistant Professor Louiza SELLAMI, S. K, Singh, and R. W. Newcomb, "The Large Signal Behavior of El Masry's Differentiator," Proceedings of the 2nd IMACS International Conference on Circuits, Systems, and Computers, pp. 293-296, Greece, Oct. 1998.

Analysis of the continuous-time current mode differentiator introduced by El Masry and Gates is performed in this work. It is shown that this circuit differentiates not only under the small signal assumption made by El Masry and Gates but also for large signals. This circuit is studied because of its simplicity in CMOS implementation, its small size, low power consumption, and its applicability to filter design.

WATERSTON, John, Midn 1/C, "Development and Implementation of an Adaptive Error Correction Coding Scheme for a Full Duplex Communications Channel," USNA Trident Report No. 270, U.S. Naval Academy, May 1999.

This research investigates, via simulation, the bit error probability (BEP) associated with a variable redundancy coding scheme operating in a wireless communications environment. Within a slowly varying (flat fading) Rayleigh channel, adaptive algorithms provide increased throughput over fixed coding implementations. From a family of BCH codes of the same block length (n=63), a code with appropriate redundancy is chosen depending on the receiver's

estimation of the current conditions experienced in this channel. Two different decision techniques are compared. The first method statistically evaluates the receiver's input and calculates the signal to noise ratio (Eb/No), while the second method observes the number of corrected errors in recently decoded blocks. With this information, the adaptive system decides to modify the correction ability of the code, and then transmits this decision to the encoder over a low bandwidth feedback channel. The correction ability can be changed on a block by block basis. This algorithm is implemented in software and, therefore, can be optimized for many real world communications systems.

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "An Integrated Approach to Teaching Engineering Courses," *ASEE 98*, 28 June - 1 July 1998, CD-ROM Session 1232 (w/ P.W. de Graaf, C.H.G. Wright, and M.J. Walker).

Many undergraduate engineering students have difficulty understanding the connections between the different courses they are required to take. Too many of them focus on learning just details of a specific course without any consideration of how the concepts fit with those of other courses. The integrated approach to teaching engineering involves a "systems view" to the curriculum. Throughout their course, the students are reminded of where they are in the system.

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Teaching Three-phase Electrical Power Using a Low-voltage Power Supply," *ASEE 98*, 28 June - 1 July 1998, CD-ROM Session 1532 (w/ J.N. Berry).

While computer simulations and modeling techniques have become pervasive throughout most of the engineering curricula, and while the utilization of computers in the classroom and the laboratory represents a major pedagogical improvement, a hardware-based approach to teaching several electrical power distribution and usage topics can also be very effective. A locally designed and manufactured three-phase, low-voltage, variable-frequency power supply is used to teach parts of this Electrical Power Systems course. The three-phase low-voltage system enhances student safety while allowing for student involvement in the learning process. Additional laboratory time also leads to numerous other learning opportunities for the student. This paper discusses the utilization of the three-phase low-voltage power supply as a teaching tool.

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Teaching Real-world DSP Using MATLAB," *ASEE 98*, 28 June - 1 July 1998, CD-ROM Session 1320 (w/ C.H.G. Wright).

Enhancements to MATLAB written by the authors make teaching various real-world DSP concepts much easier and more effective. These enhancements eliminate the need to purchase expensive specialized software programs for this purpose. The particular DSP concept described in this paper is an interactive demonstration showing how quantization of digital filter coefficients, which is inevitable with widely-used fixed-point DSP hardware, adversely affects filter performance.

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Teaching DSP Concepts Using MATLAB and The TMS320C31 DSK," *ICASSP 99*, 15 - 19 March 1999, CD-ROM Paper 1778 (w/ C.H.G. Wright).

A graphically-oriented MATLAB program written by the authors facilitates teaching real-world digital signal processing concepts such as quantization of digital filter coefficients that occur in fixed-point processors, for example the widely used TMS320C5x. While many universities have or plan to buy the inexpensive floating-point TMS320C31 DSKs for pedagogical reasons, this MATLAB program simulates certain fixed-point effects on these floating point devices and eliminates the need to purchase expensive specialized software programs or extra hardware. The program described in this paper provides an interactive graphical user interface which communicates directly with the DSK, and demonstrates in real-time how coefficient quantization adversely affects filter performance, without the need for tedious programming of the TMS320C31.

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Teaching DSP Concepts Using MATLAB and The TMS320c5x," *TI DSPS 98*, 6 - 8 August 1998, Web

Distribution (w/ C.H.G. Wright).

Enhancements to MATLAB written by the authors make teaching various real-world DSP concepts much easier and more effective. These enhancements eliminate the need to purchase expensive specialized software programs for this purpose. The particular DSP concept described in this paper is an interactive demonstration showing how quantization of digital filter coefficients, which is inevitable with widely-used fixed-point DSP hardware, adversely affects filter performance.

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Simulation of Coded MC-DS-CDMA Systems, *RAWCON 98*, 9 - 12 August 1998 (w/ R.E. Ziemer), pp. 189 - 192.

In this paper computer simulations are used to compare the performance improvements associated with convolutional coding with soft Viterbi decoding on a *gaussianized* BPSK-MC-DS-CDMA system and a more easily realized system. Specifically, we show through computer simulations, that the effects of coding on the *gaussianized* system approach the performance of a BPSK system operating in a Gaussian channel. For a multicarrier system that does not achieve Gaussian channel performance, coding can significantly improve the bit error performance; however, the performance does not closely approach the performance of a coded AWGN channel.

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Analysis of MC-DS-CDMA Systems," *MILCOM 98*, 18 - 21 October 1998, CD-ROM Session 22.5(w/R.E.Ziemer).

Kondo and Milstein introduced and analyzed the performance of a system that combined multicarrier modulation (MCM) with direct-sequence spread spectrum (DSSS) in late 1993. Their system and similar systems are called MC-DS-CDMA systems [1]. The dramatic performance improvement of this system (as compared to a single carrier system operating in a flat fading channel) is due, in part, to the use of coherent modulation/demodulation and perfect knowledge of the complex channel gains for each of the independent channels associated with every subcarrier. In this paper we investigate the performance degradation associated with a more easily realized system. Our system employs differentially coherent modulation/demodulation with an equal gain combiner (EGC) at the receiver. We investigate the performance of this system operating in a doubly spread (Doppler and delay spread) channel. In a doubly spread channel, any system which does not account for the rapid variations in channel phase will exhibit an irreducible bit error probability. This phenomenon exists even for the single user case.

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "The Spaced-time Correlation Function and its Effect on the Efficient Simulation of Multicarrier Systems," *VTC*, 17-20 May 1999, CD-ROM Paper 447.
As multicarrier communication systems become more complicated, the utilization of computer simulations to estimate the bit error performance of these systems will increase. Knowledge of the simulated channel's autocorrelation function can allow for the reuse of the complex channel gains. With the reuse of these complex channel gains, the estimate of a multicarrier system's performance can be accomplished in less than half the previously required time.

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Very Near Ground RF Propagation Measurements And Analysis," *MPRG* 99, 2-4 June 1999 (w/ Michael J. Walker, and Ray A. Foran), pp. 1 - 9.

We analyze and measure the effects associated with placing a cordless phone antenna, with three different orientations, very near the ground (3 - 28 cm). A significant decrease in signal strength occurs when a user falls from the sitting position to the prone position. As much as a 12 dB decrease in signal strength can occur. This information, if available to an injured cordless phone user, could allow for a successfully completed 911 call.

Presentations

FIELD, Christopher T., Assistant Professor, "Measuring Oscillator Frequency in the GLAS Instrument," *GLAS Critical Design Review*, March 1999.

JENKINS, R. Brian, Assistant Professor, Michael L. Dennis, Walter I. Kaechele, and Irl N. Duling, III, "Timing Jitter in Adiabatic Soliton Transmission Spans", CLEO'99 Conference on Lasers and Electro-Optics, Baltimore, Maryland, 26 May 1999.

JENKINS, R. Brian, Assistant Professor, "Simulation and Animation in Optical Fiber Communication", American Society for Engineering Education Annual Conference, Seattle, Washington, 29 June 1998.

JENKINS, R. Brian, Assistant Professor, Michael, L. Dennis, Walter I. Kaechele, Thomas F. Carruthers, Jin U. Kang, and Irl N. Duling, III, "Long Unrepeated Transmission at 10 GB/S Using Adiabatic Soliton Propagation", OFC'99 Conference on Optical Fiber Communication, San Diego, California, 24 February 1999.

KORZENIOWSKI, K. A., Associate Professor and C.B. McVey, "Hierarchical System for Automated Path Planning and Scheduling", SPIE, Mobile Robots XIII and Intelligent Transportation Systems, Boston, November 1998.

KORZENIOWSKI, K. A., Associate Professor, and J. L. Rice, Commander, USN, "The Khepera Robot as a Teaching Tool", American Society for Engineering Education, Charlotte, North Carolina, June 1999.

LIM, Tian S., Professor, "Motor Speed Control Using DAC Techniques", 1999 ASEE Annual Conference, Charlotte, North Carolina, Session 2548, June 22, 1999.

MORROW, Michael G., Lieutenant Commander, CEC, USN, "An Embedded DSK Development System for Teaching Real-Time Interfacing", Texas Instruments DSP Educator's Conference, Houston, Texas, 6 August 1998.

WATERSON, John, Midshipman 1/C, Assistant Professor E. Curran Wooten and Associate Professor William Bennett, "Development and Implementation of an Adaptive Error Correction Coding Scheme for a Full Duplex Communications Channel", MPRG Ninth Symposium on Wireless Communications, Virginia Tech, Blacksburg, VA, 10 June 1999.

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Analysis of MC-DS-CDMA Systems," MILCOM 98, 18 - 21 October 1998 (w/ R.E. Ziemer).

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Teaching DSP Concepts Using MATLAB And The TMS320C31 DSK," ICASSP 99, 15 - 19 March 1999 (w/ C.H.G. Wright).

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "The Spaced-time Correlation Function and its Effect on the Efficient Simulation of Multicarrier Systems," VTC, 17-20 May 1999.

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "An Integrated Approach to Teaching Engineering Courses," ASEE 98, 28 June - 1 July 1998 (w/ P.W. de Graaf, C.H.G. Wright, and M.J. Walker).

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Teaching Three-phase Electrical Power Using a Low-voltage Power Supply," ASEE 98, 28 June - 1 July 1998 (w/ J.N. Berry).

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Teaching Real-world DSP Using MATLAB," ASEE 98, 28 June - 1 July 1998 (w/ C.H.G. Wright).

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Teaching DSP Concepts Using MATLAB And The TMS320C5X," TI DSPS *98*, 6 - 8 August 1998 (w/ C.H.G. Wright).

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Simulation of Coded MC-DS-CDMA Systems", RAWCON 98, 9 - 12 August 1998 (w/ R.E. Ziemer).

WELCH, Thaddeus B., CDR, USN, Assistant Professor, "Simulation of Coded MC-DS-CDMA Systems", RAWCON 98, 9 - 12 August 1998 (w/ R.E. Ziemer).

DEPARTMENT OF

Hydromechanics Laboratory

Professor David L. Kriebel, P.E.
Director

The Hydromechanics Laboratory supports midshipmen education, as well as midshipmen, faculty and staff research, in the areas of naval architecture and ocean engineering. The laboratory facilities include a large towing tank (380 ft long, 26 ft wide, and 16 ft deep), a small towing tank (120 ft long, 8 ft wide, and 5 ft deep), a coastal engineering wave basin (52 ft long, 48 ft wide, and 2 ft deep), a circulating water channel, and a stability and ballasting tank. All facilities are linked by a local network to a host computer system which is used to both operate the facilities and to acquire and analyze data.

The laboratory facilities are used on a weekly-basis by midshipmen in the Naval Architecture and Ocean Engineering majors, and are used each semester by midshipmen in the Mechanical Engineering, Electrical Engineering, Systems Engineering, Physics, and Oceanography majors. In addition, the laboratory is used by more than 600 midshipmen each year in EN200, a core engineering course taken by all midshipmen in science and humanities majors. As a result, nearly all midshipmen use the Hydromechanics Laboratory facilities at some point during their four years at the Naval Academy.

In addition to classroom support, the laboratory facilities are used for both fundamental and applied research by midshipmen, faculty and staff supporting other naval laboratories and government agencies. During the past year, research programs conducted by the laboratory have included:

- Characteristics of ocean wave groups (Sponsor: Office of Naval Research)

- Resistance and seakeeping tests of a catamaran research vessel (Sponsor: Band, Lavis & Associates)

- Resistance and seakeeping tests of a trimaran hull form (Sponsor: U.S. Coast Guard)

- Transit stability characteristics of the Mobile Offshore Base (Sponsor: Office of Naval Research and Naval Facilities Engineering Services center)

The Laboratory is operated and maintained by a staff which includes four engineers/naval architects, three engineering technicians, and an office manager/secretary. Supporting laboratory efforts are the shop and model-making facilities in the Technical Support Department. The laboratory is further supported by a Memorandum of Understanding (MOU) with the Naval Station-Annapolis, providing support for diving operations in the laboratory.

The results of laboratory research efforts are reflected in journal articles written by faculty and laboratory staff members and in presentations at technical symposia. The Laboratory is actively represented on two of the technical committees of the International Towing Tank Conference and staff members are active participants in the Society of Naval Architects and Marine Engineers, the American Society of Naval Engineers, the American Towing Tank Conference, and the American Society of Civil Engineers. The diverse interests of these organizations reflects the broad nature of the Hydromechanics Laboratory's activities.

Sponsored Research

Model Testing of a Mobile Offshore Base Module

Researchers: Prof. David L. Kriebel and Louise Wallendorf (Hydromechanics Laboratory)
Sponsors: Office of Naval Research and
Naval Facilities Engineering Services Center

This project involved small-scale physical model testing of one semi-submersible module of the Mobile Offshore Base (MOB), a future-generation floating air base currently being investigated for its technical feasibility. The overall MOB platform considered in this project would be about 5000 feet long, 400 feet wide, with a total height from keel to deck of about 250 feet. The structure would consist of five modules linked end-to-end. Each module would be a semi-submersible floating platform, 1000 feet long and 400 feet wide, with a draft of about 40 feet when transiting across the ocean and a draft of about 100 feet when ballasted down for air take-off and landing operations. If constructed, this structure would be much larger than any semi-submersible platform now in use.

The USNA research effort involved two distinct phases: (1) construction of a scale model of a single module of the MOB platform and (2) testing of this model in the large wave/towing tank located in the Naval Academy Hydromechanics Laboratory. The purpose of these tests was to evaluate the dynamic motions of such a large semi-submersible in heave, pitch, and roll, specifically in the transit condition. The MOB model was built in the TSD shops in Rickover Hall during the summer and fall of 1998. The model was built using a scale ratio of 1-to-70, and was thus more than 14 feet long, almost 6 feet wide, and about 3.5 feet high. Initial testing was performed in January 1999 with the model held stationary in the wave tank, and additional tests were completed in March 1999 with the model towed at various forward speeds. In each set of tests, severe ocean sea states were simulated and the resulting motions of the platform were recorded. Results of these tests are being analyzed during the summer of 1999 and will be presented at the Very Large Floating Structures Conference in September 1999.

Resistance and Seakeeping Tests of a Trimaran Hull Form

Researcher: Nancy Harris, Naval Architect, (Hydromechanics Laboratory)
Sponsor: U. S. Coast Guard Deepwater Project

The USNA Hydromechanics Laboratory conducted hydrodynamic model tests on a concept trimaran hull form to support the U. S. Coast Guard Deepwater Project. The concept was developed by the MIT 13A program to fulfill the requirements cited in the USCG Deepwater Circular of Requirements for the Hamilton 378' replacement. The design was modified and faired by the Hydromechanics Laboratory, and a model with a scale ratio of 1-to-36 was built at the USNA Model Shop. The model was then tested in the 380' Towing Tank in the Hydromechanics Laboratory. The test program consisted of resistance tests in calm water and in waves and seakeeping tests (regular and irregular waves.) The model was tested in 18 different configurations in calm water and in two different configurations in waves. The 18 calm water conditions consisted of two displacements, three longitudinal sidehull positions, and three transverse sidehull positions. The objective of these tests was to validate the trimaran concept and determine the most favorable position of the sidehulls relative to the main hull for resistance and seakeeping in head seas.

Resistance and Seakeeping Tests of a Catamaran Research Vessel

Researcher: Nancy Harris, Naval Architect, (Hydromechanics Laboratory)
Sponsor: Band, Lavis, and Associates

Laboratory model tests were performed for Band, Lavis, and Associates on a catamaran research vessel designed by TGMD, Inc. for the University of Miami. The test program consisted of calm water tests, towed seakeeping tests, and zero-speed lightly restrained seakeeping tests. The model was tested at three different ballast conditions and in four different sea conditions.

The objectives of these tests included the following: (1) determine the EHP characteristics of a catamaran research vessel at various loading conditions and at various speeds to identify the capabilities and limitations of the current design in calm water, and (2) identify the seakeeping capabilities of the vessel in the sea conditions in which the vessel will most likely be operating.

Independent Research

Guidelines for Conducting Model Tests of High Speed Marine Vehicles

Model Tests of High Speed Marine Vehicles
Specialist Committee Report and Recommendations to the 22nd ITTC
Researcher: John Zseleczky, Naval Architect (Hydromechanics Laboratory)

Hydrodynamic model tests of high speed marine vehicles (HSMV's) are subjected to many unique problems that are not encountered in conventional ship model testing. These problems were acknowledged at the 21st International Towing Tank Conference (ITTC) and a committee of specialists was formed to identify specific problems and publish guidelines and recommendations for addressing those problems. The committee was composed of eight members from facilities around the world, each of which had significant experience with the testing of high speed marine vehicles. The facilities represented were:

USNA (USA)
INSEAN (Italy)
University of Southampton (UK)
SSPA (Sweden)
Osaka U. (Japan)
MARIN (Netherlands)
KRISO (Korea)
MARINTEK (Norway)

Four meetings were held and regular email correspondence was conducted over a period of three years. Over this period the committee members worked together to produce a final report that was submitted to the 22nd ITTC. A first step in this undertaking was to conduct a survey of ITTC members so that current trends and practices could be documented. Each committee member took primary responsibility for one type of model testing and, using input from the survey, produced a draft that was revised and agreed upon by other committee members. The categories of model testing that were focused on in the report were: resistance, seakeeping, propulsion, maneuvering, structural loads, and dynamic instability. The codes of practice recommended in the report can be debated in the future and amended as necessary.

Technical Reports

ZSELECZKY, John J., Naval Architect, Co-author, "Model Tests of High Speed Marine Vehicles Specialist Committee Report and Recommendations to the 22nd ITTC," 22nd ITTC, Seoul, Korea, September 1999.

Hydrodynamic model tests of high speed marine vehicles (HSMV's) are subjected to many unique problems that are not encountered in conventional ship model testing. This report presents guidelines and recommendations for conducting HSMV model tests based on input from an international survey and the experience of specialists from around the world. The codes of practice recommended in the report will be debated in the future and amended as necessary.

Presentations

ZSELECZKY, John J., Naval Architect, Chairman, High Speed Vehicles Committee, 25th American Towing Tank Conference, "High Speed Vehicles Committee Report," 25th ATTC, Iowa Institute of Hydraulic Research, Iowa, September 1998.

ZSELECZKY, John J., Naval Architect, General Chairman, 14th Chesapeake Sailing Yacht Symposium (co-sponsored by the Society of Naval Architects and Marine Engineers), "14th CSYS," U.S. Naval Academy, Annapolis, Maryland, January 1999.

DEPARTMENT OF

Mechanical Engineering

Professor Patrick J. Moran
Chair

Research by faculty and midshipmen in the Mechanical Engineering Department reflects the board interests of a diverse and highly qualified group of engineers. Research efforts in the department are promoted by faculty and midshipmen interest in studying new technology and solving problems of interest to the U.S. Navy. This activity not only creates excitement among the research teams, but promotes the study and introduction of new technology in the classroom. Faculty and midshipmen involvement in publication of research and invited presentations reflects credit and recognition for the individuals and the U.S. Naval Academy.

Projects active in this period included internal combustion engines, fracture mechanics, fluid mechanics of pumps, thermal systems design, materials processing and engineering, corrosion, continuum mechanics, vibrations and flow field studies. In summary, the department was involved in 37 projects, of which 17 were sponsored research, 12 were midshipmen projects earning academic credit and 8 were independent projects. Research sponsors included the Office of Naval Research, Naval Surface Warfare Center, U.S. Nuclear Regulatory Commission, Naval Research Laboratory, Colorado State University and the National Renewable Energy Laboratory, the U.S. Department of Energy, National Institute for Standards and Technology, NASA, and the U.S. Naval Academy Research Council. Industrial sponsors included the Ford Research Laboratory and the Great Lakes Composite Consortium. The Department is grateful for the cooperation and support by sponsoring agencies and organizations.

Sponsored Research

Investigation of the Mechanical Properties of Fiber-Steered Composites

Researchers: Associate Professor Oscar Barton, Jr.,
Associate Professor Michael D.A. Mackney (Aerospace Engineering Department),
Associate Professor Sarah Mouring (Naval Architecture, Marine and Ocean Engineering Department)
and Professor Gabriel N. Karpouzian (Aerospace Engineering Department)
Sponsors: Office of Naval Research (ONR)/Great Lakes Composite Consortium (GLCC)

This research investigated the characterization of the mechanical properties of fiber-steered composites. More directly, the effort considered the effect of fiber curvature on the mechanical response of fiber-steered composites. Important properties under consideration included the longitudinal modulus in compression and tension, the transverse modulus in compression and tension, as well as the longitudinal and transverse strengths. Other properties investigated included the inter-laminar shear. Similar information was determined for filled-hole specimens.

Coupon specimens were acquired from fiber-steered panels of varying size. The panels were constructed using an IM7/977-3 composite system in the form of 10.7 mil slit tape stacked either in a 4 or 8 ply unidirectional lay-up. For these tests, the fiber placement occurred along paths with radii varying from 18 in to 45 in. This generated test specimens with 20 in,

30 in and 40 in radii. Specimens tested included a set of baseline coupons with straight fibers.

Temperature Field of a Free Surface Undergoing Evaporation

Researchers: Associate Professor Karen A. Flack, John Saylor and Geoffrey Smith
Sponsor: Naval Research Lab (NRL), Remote Sensing Division

The surface temperature of a body of water undergoing evaporation was measured using infrared imaging techniques, demonstrating for the first time the effect of surfactant monolayers on the spatial structure of this field. Measurements were obtained from a water surface which was covered with a surfactant monolayer and also from a water surface which was nominally free of surfactants. The heat flux for these two cases was also varied by a factor of approximately 10. The presence of a surfactant dramatically increased the characteristic length scale of the temperature field for both heat flux conditions.

Elastic-plastic Fracture Mechanics Technology for Lwr Alloys

Researcher: Professor James A. Joyce
Sponsor: United States Nuclear Regulatory Commission

This research project involves investigations of fracture behavior of metallic alloys used in commercial nuclear power reactors and their components. The goals of the research are to develop the fracture mechanics technology and methodologies necessary for predicting the behavior of the reactor pressure vessel and reactor components containing flaws and to develop methodology to properly access the effects of radiation embrittlement using small scale surveillance specimens. Work involves experimental testing, computational analysis, and NRC and ASTM fracture mechanics code and standards development. Most effort during the 1999-2000 time frame is being dedicated to defining methodologies in the ductile-to-brittle transition regime and has involved testing specimens from Charpy scale to full size 1T C(T), standard fracture mechanics specimens. Special short crack specimens have also been investigated because of their special low-constraint properties.

The Effect of Temperature on the Mechanical Behavior of Advanced Materials

Researchers: Professor Dennis F. Hasson and Dr. Michelle A. Gaudett
Sponsor: Office of Naval Research (ONR)

Naval structural and power systems require high performance engineered materials. Two advanced material systems for structural applications are structural porous metals (SPM's) and lattice block materials (LBM's). The latter is a repeatable structure which consists of repeating internal nodes with an open structure that provides macroporosity. In regards to materials for advanced power systems intermetallics are candidate materials. These materials must retain their integrity when subjected to or after soaking at elevated temperatures in an oxidative atmosphere.

The SPM materials were instrument impact tested. The porosity of the Al 6061 specimens resulted in a material with a density of 16.7 percent of nonporous density, while the Al-12Si specimens had a variation from 17.7 to 23.3 percent. The experimental results

indicated that the compression deformation of aluminumfoam occurs by cell wall buckling and tearing. This information was combined with split Hopkinson pressure bar and fragment simulating projectile tests.

For the LBM study two steel castings were made. The first casting had only a 70 percent fill. The casting was cut up for metallographic study, tensile and impact tests. The casting material met specification values. After an evaluation of the gating and riser system, changes were made. Consequently a second casting was successful.

For the Ti-44Al-11Nb intermetallic material high temperature tensile tests were performed. Extensive metallography, SEM and TEM microscopy have been performed. Analysis to explain the fracture behavior has been completed. Also, the equal channel angular extrusion apparatus for grain refinement has been fabricated.

Damage Assessment in High Temperature Materials

Researchers: Associate Professor Angela L. Moran and
Assistant Research Professor Matthew C. Osborne (Postdoctoral Fellow)
Sponsors: Department of Energy (DOE) and Office of Naval Research (ONR)

Materials for high temperature applications are required for the Department of Energy as well as for the Navy. This project involves analyzing the validity of computer codes developed to predict the properties of ceramic composites. SiC/SiC composites will be experimentally tested to determine mechanical properties, density and uniformity. The test data will be utilized to evaluate and compare the results of analytical codes developed by various academic institutions and research facilities to predict elastic stress states for different composite architectures. Materials have been acquired from commercial sources and fabricated in-house.

Transition Range Fracture Toughness of A514 Weldments and Heat Affected Zone

Researcher: Assistant Professor Richard E. Link
Sponsor: Naval Surface Warfare Center, Carderock Division, Fatigue and Fracture Branch

The fracture toughness behavior of the heat-affected zone of A516 steel weldments was determined in the ductile-brittle transition regions. The effect of weld process on the fracture toughness was characterized. Specific recommendations about the fitness-for-service of structures containing the weldments were provided.

Development of Measurement Techniques for Fracture Toughness Determination

Researcher: Assistant Professor Richard E. Link
Sponsor: Naval Surface Warfare Center, Carderock Division, Fatigue and Fracture Branch

New laboratory procedures and analysis techniques were developed for measuring the fracture toughness of metals under quasi-static and rapid loading conditions. Revisions to the ASTM standards governing the determination of fracture toughness were proposed. Experimental verification of proposed

changes was performed as required to validate the new methods.

CFD Analysis of the Flow Distribution in the Oily Waste Ultrafiltration System

Researcher: Associate Professor Steven Miner
Sponsor: Naval Surface Warfare Center, Carderock Division

CFD is used to analyze the distribution of flow to a bank of five parallel filters in an oily waste ultrafiltration system. The purpose is to determine how uniform the distribution of flow is within the system. Several different combinations of inlet and outlet locations are considered.

High Temperature Copper Alloys for the Automotive Industry

Researcher: Associate Professor Angela L. Moran
Sponsor: Ford Research Lab

Spot welding electrodes deteriorate very rapidly when used for welding of aluminum automotive components. This is due to the formation of a low melting point eutectic phase at the interface of the copper electrode and the aluminum, dissolving away the surface of the electrode. This project involves assessing the weldability of current electrode materials and developing novel electrode compositions which suppress the formation of low melting point phases, thereby increasing electrode life. Advanced manufacturing methods such as laser cladding, ion implantation and spray deposition are being utilized and evaluated.

Correlation of Evaporation and Condensation Heat-transfer Coefficients for Flammable Refrigerants in Brazed-plate Heat Exchangers

Researcher: Assistant Professor Sheila C. Palmer
Sponsors: National Institute of Standards and Technology (NIST)
and Naval Academy Recognition Grant

In an effort to promote the use of natural refrigerants in the United States, refrigeration systems must be designed so that all of the refrigerant is outside of the space being conditioned. This requires that a secondary fluid be used between the flammable refrigerant and the air being conditioned. Information must be obtained on the performance of the intermediate heat exchanger in which the secondary fluid and refrigerant interact in order to aid in system design and refrigerant selection. This study will determine the refrigerant heat transfer coefficients for this intermediate heat exchanger, using data previously obtained in the operation of the water-to-water heat pump.

Optimization of Natural-gas Fueled Spark-ignited Engine Combustion

Researcher: Assistant Professor Paul V. Puzinauskas
Sponsors: National Renewable Energy Laboratory and
Naval Academy Research Council (NARC)

Recent emphasis on air quality has motivated investigating alternatives to gasoline and Diesel fuels for use in automobiles and heavy-duty vehicles. Natural gas is one promising alternative fuel due to its clean burning characteristics and plentiful domestic supply. To date, most efforts in developing natural gas for automotive applications have centered on fuel storage and delivery. The engines themselves are not substantially different from their gasoline-fueled counterparts. This research has focused on optimizing the engine intake and combustion systems for use with natural-gas fuel. Issues related to mixing, ignition and flame propagation are being investigated experimentally and analytically. Possible mixing deficiencies are being isolated by comparing combustion performance of single-point premixed and port-fuel injected fuel-delivery configurations in an otherwise identical engine. Ignition and flame propagation are being evaluated using combustion-chamber mounted fast-response surface thermocouples as flame-arrival indicators. Heat-release calculations based on combustion pressure measurements are being evaluated. Additional diagnostics will include conventional 5-gas and FTIR emission measurements.

Insight from the experimental data will be further extended through use of a two-zone thermodynamic engine-simulation program. This program includes intake and exhaust flow in-cylinder mean-flow and turbulence, heat transfer and combustion sub-models which will be calibrated using the test data. The output of the sub-models will then provide additional detail on engine-modification effects.

Experimental Modal Analysis of Four Composite Deck Panels

Researcher: Associate Professor Colin P. Ratcliffe
Sponsor: Naval Surface Warfare Center, Carderock Division

This project experimentally investigated the vibrational performance of a new design of glass reinforced plastic composite deck panel. Work was conducted at half scale, with each of the four panels being 20 ft by 6 ft. The panels were built into a test frame that was floating on a shock test quarry, near Frostburg, Virginia. The test structure included a number of dummy masses, to simulate the mass and center of gravity of potential in service equipment. The chosen test method was impact excitation, with several fixed reference accelerometers.

This was a field trial. The results were used by NSWC to verify a complex finite element model of the entire structure. Subsequent to this modal survey, the structure was subject to an explosive MIL-S-901 shock test, and the results compared to numerical predictions.

Dynamic Characterization of Urethane Damping

Researcher: Associate Professor Colin P. Ratcliffe
Sponsor: Naval Surface Warfare Center, Carderock Division

During the last few years, the Naval Surface Warfare Center has funded projects concerning the vibrational behavior of underwater cylinders constructed from various composite materials and cross sectional geometries. An interesting finding was that reinforced urethane acts both as a structural material, and as a vibrational damping material. This project continued the process of quantifying the performance of the reinforced urethane material system. Experimental modal analysis was used on a variety of structural configurations in order to characterize the material system.

Automated Procedures for Determining the Exponential Window Required for Transient Testing and Determining Structural Damping

Researcher: Associate Professor Colin P. Ratcliffe
Sponsor: Naval Surface Warfare Center, Carderock Division

This project developed an automatic procedure for determining the optimum exponential window to be applied in a signal processor when measuring transient, decaying signals such as those obtained when vibration testing a structure with impact excitation. During the first part of the window determination procedure, the natural attenuation of a signal is determined. As a result, there is a side benefit to the procedure that the damping of a structure can also be determined. In essence, the log decrement technique of estimating damping is also automated. The theory is developed using a single-degree-of-freedom system. The effect of multi-modal signals, and very low level signals, is also demonstrated with measured signals. In all cases it is shown that the optimization procedure is highly satisfactory. The numerical procedure is computationally inexpensive.

Correcting a Significant and Consistent Error in the Modal Damping Obtained Using Transient Vibration Data

Researcher: Associate Professor Colin P. Ratcliffe
Sponsor: Naval Surface Warfare Center, Carderock Division

This project investigates the experimental vibration technique of impact excitation when used to obtain frequency response functions. It is shown that current practices introduce a consistent error in the derived modal damping estimates. The error can be significant, with levels of damping being wrongly predicted by a factor of three or more. The report identifies the source of the error. It then derives and presents a simple

correction to be applied to the observed modal damping estimates. The procedure is demonstrated by experiment.

Boundary Layer Separation and Transition under Low-pressure Turbine Conditions

Researcher: Assistant Professor Ralph Volino
Sponsors: NASA/ASEE Summer Faculty Fellowship and USNA Recognition Grant

Boundary layer separation, reattachment, and laminar-turbulent transition are under experimental investigation. These phenomena are important in the flow over modern low-pressure turbine airfoils. The flow over the trailing section of the suction side of an airfoil is subject to an adverse pressure gradient, which tends to cause boundary layer separation. Transition often leads to reattachment of the boundary layer. Boundary layer separation causes a degradation of performance, particularly if the boundary layer does not reattach. The interaction between separation and transition is complex and difficult to predict, presenting a limitation to designers. A detailed experimental data base is needed to provide a better understanding of the flow, and a basis for new computational efforts and modeling. Experiments were initiated at the NASA Lewis Research Center under the 1998 NASA/ASEE Summer Faculty Fellowship Program. A test wall was placed in a low speed wind tunnel and configured such that the pressure distribution along the wall matched the pressure distribution along the suction side of a modern low-pressure turbine airfoil. Extensive velocity measurements were acquired using hot-wire anemometry. Various Reynolds numbers and free-stream turbulence levels representative of gas turbine operating conditions were considered. The locations of boundary layer separation, transition, and reattachment have been documented. As expected, the length of the separation region is decreased as the Reynolds number and/or the turbulence level is increased. The data is currently under further analysis. Future measurements are expected to include Reynolds shear stresses, which will provide needed information about turbulent transport.

Intelligent Computer Aided Instruction (ICAI)

Researcher: Professor Chih Wu
Sponsor: Office of Naval Research (ONR)

The Mechanical Engineering Department at the United States Naval Academy is currently evaluating a new teaching method which implements the use of a computer software. Utilizing the thermodynamic based software CyclePad, Intelligent Computer Aided Instruction (ICAI) is incorporated in a basic Engineering Thermodynamics course (EM319) for engineering major students and an advanced Energy Conversion Course (EM443) for mechanical engineering students. The use of the CyclePad software enhances lectures and aids students in visualization and design.

The contents of undergraduate thermodynamics courses was established long before computers existed. Problem assignments appearing in popular textbooks have been developed with an understanding that students will work them by hand. Interesting practical problems which are difficult to solve or which involve parametric studies are usually not assigned because the long calculation would require an unreasonable time investment by the students. CyclePad allows users to

concentrate on the fundamental engineering design principles without being distracted by the tedious computation and wrong input design data. As a consequence, students can do more comprehensive design and cover more material without necessarily devoting more study time to the course.

CyclePad introduces students to the concept of design as an open-ended process involving synthesis, analysis, and choices among design alternatives. It provides a valuable design aid by giving visualization of the schematic combination of a variety of thermodynamic cycles. This visualization allows the students to easily exploit the effects that changing design parameters have on the behaviour of a cycle. The approach of the CyclePad makes the learning of thermodynamic cycle design more exciting and results in more effective training of future designers.

CyclePad has been in use for five semesters now at the U.S. Naval Academy for design homework and projects. The experience has been a positive one. The future version of the software will incorporate modifications suggested by users.

Independent Research

Energy Transport in One Dimensional, Multi-Coupled, Anderson Localizing Systems

Researcher: Assistant Professor John Burkhardt

An investigation into the spatial and time-domain evolution of energy density in a multi-coupled, one-dimensional, disordered system is being conducted. Scaling theory predications have been generated for both localization lengths and rates of diffuse transport. Initial results indicate that localization lengths scale with the system's modal density per unit length while transport times are found to scale as modal density per both localization lengths and rates of diffuse transport. Initial results indicate that localization lengths scale with the system's modal density per unit length while transport times are found to scale as modal density per unit length times the distance traveled. A test of these predications has been conducted through the numerical simulation of cylindrical membranes influenced by a foundation of radially oriented springs of random stiffness. The simulation results have strongly supported the scaling theories but minor inconsistencies exist which continue to be explored.

Characterization of Structural Damage Using Free Decays

Researcher: Assistant Professor John Burkhardt

A non-destructive technique for the identification and characterization of damage in built-up structures is investigated. The technique presumes that the presence of damage in a structure will result in increased internal friction, localized in the region of the damage, which is therefore non-proportional in nature. A power-law decay model for the free decay of non-proportionally damped (damaged) structures is presented. The derived decay model relies on a statistical description of the system's eigen-structure and assumes that a finite number of equally damaged connections are distributed at random locations throughout the structure. The resulting decay model contains two significant parameters; one parameter is proportional to the number of damaged connections while the second parameter is proportional to the intensity of that damage. Consequently, the derived decay model is advanced as the basis of a non-destructive technique for the detection of structural damage and for the estimation of both its

extent and severity. Numerical simulations of non-proportionally damped (damaged) trusses have been performed which support the proposed technique. An experimental effort has been initiated to test the practical aspects of the technique.

Finite Elements Solution of the Radiative Transfer Equation

Researcher: Assistant Professor John Burkhardt

An investigation into the application of the finite element method for solution of the radiative transfer equation has been initiated for the specific purpose of enhancing material characterization using diffuse ultrasonics. The radiative transfer equation, which governs the propagation of wave energy in multiple scattering media, has recently emerged as a powerful tool for materials characterization since its identification with ultrasonic wave propagation in polycrystalline materials. Successful application of the radiative transfer equation for material characterization will, however, require efficient, robust and flexible numerical solutions of this equation. Unfortunately, to date, no practical solution technique for the radiative transfer equation has been demonstrated which is suitable for the complex system models relevant to material characterization. Consequently, an innovative numerical approach based on the finite element method is proposed.

Application of Remote Sensing Concepts and Techniques to the Ultrasonic Evaluation of Materials

Researcher: Assistant Professor John Burkhardt

Numerous challenges face the field of ultrasonic testing because of the increasing demands and expectations placed on these technologies. Particular challenges include the identification of flaws in heterogeneous materials such as ceramic based composites and textured titaniums as well as the seemingly unrelated task of locating small tumors in fibrous breast tissues. Traditional ultrasonics typically have difficulty with these tasks because the flaw or tumor does not have an ultrasonic signature significantly different from the surrounding heterogeneous material. This difficulty arises because the inherent heterogeneity of the background material is not modeled in traditional ultrasonics. Consequently, a study has been initiated to apply concepts from remote sensing, a field which specifically addresses the impact of random system properties on system characterization, to the field of ultrasonics.

Direct Numerical Simulation of Ultrasosnic Wave Propagation In Polycrystal

Researcher: Assistant Professor John Burkhardt

An effort to numerically simulate ultrasonic wave propagation in polycrystals and other heterogeneous materials with high fidelity using the finite element code ABAQUS is currently underway. Numerous

applications of the effort are expected including exploration of energy transport in three-dimensional disordered materials and other novel ultrasonic inspection techniques currently under development.

Characterization of Fatigue Damage in Ceramic Composite Materials

Researcher: Assistant Professor John Burkhardt

An ultrasonic nondestructive evaluation technique for the characterization of fatigue damage is currently under investigation. By exploiting the excess internal friction that often accompanies fatigue damage, theoretical estimates relating reverberant decay characteristics to both damaged volume and damage severity are derived. Comparisons of theory with numerical simulations have been conducted and support the proposed technique. Current efforts center on an experimental confirmation of the technique by evaluating fatigue damage in ceramic composites.

Drag Reduction Turbulators

Researchers: Lieutenant Commander Daniel Ray, CEC, USNR
and Professor Robert Granger

The purpose of this project was to build and test different models with surface turbulence generators of various geometric shapes, depth, and spacing over the surfaces of a sharp leading edge wedge and NACA 0015 aerofoil.

A sharp leading edge wedge was constructed with acrylic and positioned with a sting mount in a circulating water channel. A flow visualization device was attached to the turbulators so that the nature of the flow in the depressions could be seen and recorded. The objective of this phase of the experiment was to identify at least one geometric shape of turbulator (cavity or “dimple”) that would generate a standing vortex within the cavity.

An NACA 0015 aerofoil was constructed of a composite material and was mounted on an aluminum carrier in a 120 foot tow tank. The design turbulators obtained from the results of the sharp edged flat plate experiment were tested as well as other geometrically shaped cavities. The parameters of this study were variable Reynolds number for a fixed angle-of-attack and various spacing and depth of different “dimple” geometries. The goal of this phase of the experiment was to achieve an overall drag reduction for a “dimpled” surface compared to a smooth surface.

Various techniques were developed to coat the NACA wing so that turbulators could be etched into the surface. A unique approach involved using sheet wax, applied to the model with an adhesive, and “dimples” etched into the wax coating.

The results from the visual study showed that a standing vortex can be achieved in a cavity on a smooth surface placed in a circulating water channel. This result suggests that with the correct geometry, separation can be delayed, and a reduction in overall drag on a flat plate or aerofoil could be achieved.

Investigation of Inventory and Local Heat Transfer of R-410A and a Miscible Lubricant for Flow Boiling Within a Micro-fin Tube at High Qualities

Researcher: Lieutenant Commander Daniel Ray, CEC, USNR

For many years, experimentally obtained mean heat transfer coefficients have been presented by various researchers for evaporation of refrigerant/lubricant mixtures inside plain and augmented tubes (Schlager). More recently, attempts have been made to measure local boiling heat transfer coefficients. The large variation found in local micro-fin boiling coefficients as a function of local vapor quality and local lubricant concentration have resulted in the use of local rather than mean boiling heat transfer coefficients in new design methods. Studies have shown that at high qualities, the local boiling heat transfer coefficients dropped off rapidly with increasing lubricant concentration (Nidegger).

Lubricants are used to protect the compressors of air-conditioning and refrigeration equipment from mechanical failure. The lubricant migrates from the compressor to the heat exchangers of the system. The refrigerant/lubricant mixture enters the evaporator at a relatively low concentration of lubricant. However, as the refrigerant evaporates along the length of the evaporator it predominantly leaves behind the lubricant. Consequently, the concentration of the lubricant in the liquid refrigerant increases as the refrigerant evaporates. As a result, the lubricant has an increasing effect on the performance of the evaporator at higher qualities.

The study in progress will determine local flow boiling heat transfer coefficients for refrigerant R-410A mixed with a completely miscible lubricating oil. Primary emphasis will be placed on high quality flow where thermodynamic effects of the refrigerant/lubricant mixture are most acute. An existing flow boiling test facility with a horizontal micro-fin tube test section will be used to complete the study. Sample taps will be used to measure the concentration of lubricant in the liquid near the tube wall for various qualities. The performance of the pure refrigerant will be measured to serve as a baseline for comparison with the refrigerant/lubricant mixture. Statistical means will be used to ensure that the data is accurate and to quantify the performance difference between the pure fluid and the mixture with confidence intervals.

Research Course Projects and Trident Scholar Projects

Improved Methods for Turbine Blade Cooling

Researcher: Midshipman 1/C Nicole Aunapu, USN, Trident Scholar
Advisors: Associate Professor Karen A. Flack and
Assistant Professor Ralph J. Volino

Turbine performance in gas turbine engines is limited by the maximum inlet temperature to the turbine. Material restrictions are generally the cause for this limitation. Even though advanced materials have allowed for higher inlet temperatures, hot spots still occur within the turbine that push the material limits. These hot spots generally occur near regions of recirculating flow and vortices. One such hot spot is found near the endwall of a turbine blade as the footprint of a horseshoe vortexthat is wrapped around the blade within the turbulent boundary layer. The ability to diffuse this vortex by mixing the hot fluid in the vortex with the cooler free stream fluid would improve turbine performance by increasing the

allowable inlet temperature. The object of this research was to test the feasibility of breaking up this horseshoe vortex using the technique of boundary layer blowing. Fluid was injected through the endwall of the turbine blade near the vortex core to "blow" the vortex into the free stream. Endwall jets were able to modify the path of the vortex, reducing its effect on the adjacent suction blade. Additional aerodynamic losses were incurred due to the complicated jet/vortex flow pattern.

An Investigation of Various Manufacturing Techniques of Thin-Walled Composite Tubes

Researcher: Midshipman 1/C Joseph J. Furco, USN
Advisor: Professor Dennis F. Hasson

The intent of the research was to investigate different tube manufacturing techniques and release techniques. Specifically, the manufacturing techniques of: a basic wet lay-up, shrink tape, vacuum bag with bleeder, the Torr tube compactor, and prepregs were explored. Release materials such as FREKOTE vs. PVA mandrel prepping were compared. Release techniques to separate the composite tube and the mandrel were also investigated. These techniques include drill pressing as well as using a come-along to pull the mandrel from its composite tube sleeve.

Thin-walled fiberglass tubes were manufactured and tested. The composite architecture consisted of four layers oriented 0E/90E, 45E/-45E, 45E/-45E, 0E/90E. Burnout tests showed the lowest fiber-resin ratio occurred using a wet lay-up, while the highest ratio was obtained using the Torr tube compactor. Torsion tests were also performed. The maximum torque was observed for the tube manufactured by the shrink tape technique.

Development of a Torsion Laboratory Exercise for EM217

Researcher: Midshipman 1/C Pamela Rawe, USN
Advisor: Assistant Professor Richard E. Link

Hollow specimens of A36 steel and 6061-T6 aluminum were tested on a torsion test machine. The results were compared to standard tensile results. The mechanical properties determined for the tensile and torsion tests were very similar (within 1%) for the aluminum specimens and were only within 36% for the steel specimens. It was determined that the experiments were too complex to be implemented as a lab exercise in EM217.

Copper Electrode Degradation Due to the Resistance Welding of Aluminum

Researcher: Midshipman 1/C James Schroeder, USN, Trident Scholar

Advisor: Associate Professor Angela L. Moran

This Trident research project focused on increasing the life of copper electrodes used in the resistance welding of aluminum work pieces employed in the automotive and aerospace industries. When the copper and aluminum make contact at the interface, there is some undesirable mixing which results in the formation of a copper-aluminum eutectic phase. The welding temperature is high enough to melt the aluminum, but the eutectic phase has a lower melting temperature than either pure copper or pure aluminum. During subsequent welds the eutectic melts away, causing the copper to degrade rapidly and the electrode lifetime to be shortened. As an alternative, electrodes made from copper alloys with very high melting temperature refractory metals, such as molybdenum, niobium, and chromium, have been fabricated. Since the refractory metals are not readily soluble in copper, it was necessary to use unconventional processing techniques to produce electrodes of uniform composition. These techniques included spray forming, rapid solidification, ion implantation, laser cladding, and mechanical alloying. The new processing techniques allow for a higher concentration and a more uniform distribution of the refractory metal, as confirmed by metallurgical analysis involving optical and electron microscopy. The electrodes were tested for homogeneity, conductivity and welding lifetime. Recommendations were provided concerning alloy selection for improved electrode performance.

Fabrication of Ceramic Matrix Composites

Researcher: Midshipman 1/C Marissa Dunlap, USN
Advisors: Associate Professor Angela L. Moran,
Dr. Fred Lauten (Visiting Scientist) and Dr. Matthew Osborne (ONR Post-doctoral Fellow)

Advanced energy applications dictate the need for higher and higher temperature materials. This project involved developing techniques for the fabrication of ceramic matrix composites in the USNA Materials Laboratory. A facility has been established for the production of composites by impregnation and infiltration methods in various sizes and thicknesses. Samples were evaluated in terms of density, uniformity and mechanical properties and the values obtained were compared to those for commercially produced materials.

HMS DeBraak Metallurgical Evaluation

Researcher: Midshipman 1/C Sarah Self, USN
Advisor: Associate Professor Angela L. Moran

The HMS DeBraak is a British ship that sunk off the coast of Delaware in the late 1700's and which is now the subject of an extensive investigation by the Delaware State Museums. As part of a collaborative effort with the Physics Department, this project involved metallurgical analysis of the copper fittings recovered when the ship was raised. The fittings have been evaluated in terms of optical microscopy and electron microscopy to identify their microstructure. This information was compared to historical data on copper components to assess the types of processing utilized in manufacturing.

Failures Analysis - Special Projects

Researchers: Midshipman 1/C K. Kenyon, USN and Midshipman 1/C B. Schulz, USN
Advisor: Associate Professor Angela L. Moran

Failed components from the Academy Sailing Squadron and from aircraft located at Patuxent River were forwarded for evaluation. Mode and cause of failure were identified using non-destructive testing, optical microscopy, electron microscopy and chemical analysis as well as an evaluation of environmental and operating conditions for these components. Recommendations concerning subsequent prevention of future failures were included in the reports provided to each facility.

The Use of Thermal Spraying to Enhance the Bonding Characteristics of a Urethane Coated Propeller

Researcher: Midshipman 1/C Corey A. Poorman, USN, Trident Scholar
Advisors: CAPT Owen G. Thorp, USNR and Professor Patrick J. Moran

In order to reduce the cost and machining time of producing propeller blades, the Naval Surface Warfare Center, NSWC, has developed an alternative production method for propeller blades. The alternative production method consisted of a Nickel-Aluminum-Bronze (NAB) blade, covered by two coats of paint and a urethane coating. After exposure to seawater and impressed current cathodic protection, the bond between the paint and the NAB substrate failed to meet NSWC's minimum required bond strength of 80 lbs/linear inch.

This project attempted to improve the bond between the paint and NAB by developing a surface treatment technique that would produce a strong, lasting bond. The surface treatment technique chosen was thermal spraying, specifically arc wire spraying, which created a rough, porous surface. This type of surface promoted mechanical bonding, as well as enhanced chemical bonding, of the paint to the substrate. In order to produce various surfaces, the thermal spray distance was varied at six inch intervals from six inches to two feet. A 90-degree peel test, SEM analysis with x-ray micro-analysis, and optical metallography were all used to evaluate the characteristics of each coating.

After testing, it was determined that flame sprayed coatings created a surface that produced a mechanical bond, increased chemical bonding, and reduced the effects of cathodic protection.

One Dimensional Compressible Flow in Manifold Runner

Researcher: Midshipman 1/C Matthew Hayden, USN
Advisor: Assistant Professor Paul V. Puzinauskas

A mathematical model of flow in a pipe initially pressurized and then opened to atmosphere at one end was initiated. This model is a first attempt at modeling flow in an intake runner attached to a single cylinder engine. The model includes one-dimensional solution to the continuity and momentum equations assuming the air is an ideal gas flowing in an isentropic process. Significant progress was made in learning finite difference techniques and computer programming, but the model as yet does not yield reasonable results. Work continued in the spring on the project with the intent to form the basis for Midn Hayden's Masters

Thesis, but Mr. Hayden elected to do another project at The Johns Hopkins University.

Non-Destructive Damage Detection in Beams using a Time Domain Method

Researcher: Midshipman 1/C M. J. Hiler, USN
Advisor: Associate Professor Colin P. Ratcliffe

Locating damage in structures is an engineering problem that has been approached in the past by looking at the variation of the natural frequencies with damage, and performing a modal analysis on sample structures. This project took the current frequency domain methods that use a damage index, a broadband vibration data, and extended them into the time domain. It is shown that in a steel beam with a small amount of damage, the location of the damage can be found using the time *vs*. position data as well as the frequency response functions. It was determined that the time domain method is very sensitive, as damage was located at a minimum of 0.5% reduction in thickness due to damage, while earlier tests using the frequency domain located damage at a minimum reduction in thickness of 0.8%.

An Investigation into the Effectiveness of Sports Headgear

Researcher: Midshipman 1/C M. A. Stratton, USN
Advisor: Associate Professor Colin P. Ratcliffe

During the course of the semester, the effectiveness of sports headgear was studied. This process first began with research into the mechanics of a brain injury and the medical implications. Further, a literature search was conducted into the current evaluation methods used to regulate sports headgear. A new test apparatus and method were designed and subsequently constructed. The device is ready to be used in evaluating headgear.

Publications

AUNAPU, Nicole V., Midn 1/C, "Improved Methods for Turbine Blade Cooling", USNA Trident Report No. 260, U.S. Naval Academy, May 1999.

Turbine performance in gas turbine engines is limited by the maximum inlet temperature to the turbine. Material restrictions are generally the cause for this limitation. Even though advanced materials have allowed for higher inlet temperatures, hot spots still occur within the turbine that push the material limits. These hot spots generally occur near regions of recirculating flow and vortices. One such hot spot is found near the endwall of a turbine blade as the footprint of a horseshoe vortex that is wrapped around the blade within the turbulent boundary layer. The ability to diffuse this vortex by mixing the hot fluid in the vortex with the cooler free stream fluid would improve turbine performance by increasing the allowable inlet temperature. The object of this research was to test the feasibility of breaking up this horseshoe vortex using the technique of boundary layer blowing. Fluid was injected through the endwall of the turbine blade near the vortex core to "blow" the vortex into the free stream. Endwall jets were able to modify the path of the vortex, reducing its effect on the adjacent suction blade. Additional aerodynamic losses were incurred due to the complicated jet/vortex flow pattern.

BARTON, O., Jr., Associate Professor and MACKNEY, Michael, Associate Professor, MOURING, Sarah, Associate Professor, and KARPOUZIAN, Gabriel, Professor, "The Longitudinal and Transverse Properties of Fiber-Steered Composites," Proceedings of the ASC Conference, September 27, 1999, Dayton, OH, pp.587 - 596.

In this paper, results are reported for the mechanical properties of test coupons that have been manufactured using steered fibers. The motivation of the research is to assess the effect of fiber curvature on mechanical properties. The properties under investigation include longitudinal tension and compression response, transverse tension and compression response, and both the longitudinal and transverse compressive strengths. To accomplish this effort, twelve composite panels were fabricated using a productions fiber placement machine. Fiber placement is the technology that uses composite materials in the form of tape to be placed in any desired path thus maximizing the utility of the material. The tape, called tows, and can vary in width from 0.125 in to 0.182 in. Each panel is constructed using an IM7/977-3 composite system in the form of 10.7 mil slit tape which is stacked either in a 4 or 8 ply unidirectional lay-up. For these tests, the fiber placement occurred along paths with radii varying from 18 in to 45 in. This generated test specimens with 20 in, 30 in and 40 in radii. Specimens tested included a set of baseline coupons with straight fibers. To adequately assess the effect of fiber curvature on the mechanical properties, groups of specimens were tested with each group consisting of 5 specimens. All test were conducted according to ASTM standards.

BARTON, O., Jr., Associate Professor and Wallace, Jacob B., "Composite Structural Mechanical Using MATLAB," Proceedings of the ASEE, paper No. 2520, Charlotte, NC, June 1999, (CD-ROM).

In this paper MATLAB is adopted as the programming tool used for the analysis of composite materials mechanics. Since the formulation of the mechanical behavior of composite materials involves extensive use of matrices, MATLAB is ideally suited. Morever, graphical interfaces provide an effective means of use. This article considers several topics presented in an elective course offered at the U.S. Naval Academy in composite mechanics, provides the background of these topics, and presents an overview of the MATLAB code that performs the analysis.

BARTON, O., Jr., Associate Professor, "Fundamental Frequency of Tapered Plates by the Method of Eigensensitivity Analysis, Ocean Engineering, Vol. 26, No. 6, June 6, 1999, pp. 565-574.

The fundamental frequency of a rectangular isotropic plate having a linear thickness variation is computed using the method of eigensensitivity analysis. The approach incorporates eigen derivatives to evaluate a Maclaurin series representation of the desired eigenvalue, here the fundamental frequency. Comparison with published results, for various taper ratios, aspect ratios, and support conditions, demonstrate the accuracy and utility of the expression and methodology.

BURKHARDT, J., Assistant Professor and Weaver, R. L. "Transport in Multi-Coupled Anderson Localizing Systems," Chaos, Solitons and Fractals, (in press).

The time-domain behavior of a multi-coupled disorder system is studied by numerical simulation. A two-dimensional mesh with periodic boundary conditions in a short, circumferential direction, and fixed boundary conditions in a long, axial direction, is subjected to a tone-burst load on the central ring. The resulting narrow-band process has an energy density which evolves in space and time. On short time scales it diffuses classically. On long time scales the transport ceases and the profile approaches exponential. Localization lengths and time scales are compared with earlier predictions.

FLACK, K.A. Assistant Professor and VOLINO, R.J., Assistant Professor, "A Series-Parallel Heat Exchanger Experiment," ASEE Journal of Engineering Education, Vol 88, No. 1, pp. 27-30.

An experimental apparatus has been designed to test the use of cross flow heat exchangers in series and parallel configurations. The experiment can be used in a number of ways to demonstrate heat exchanger performance in a laboratory. The apparatus consists of three identical fin-tube type cross flow heat exchangers

mounted on a board which is instrumented with thermocouples, flow meters and a pressure transducer. The apparatus can be set to test the performance of a solo heat exchanger, two or three heat exchangers in series or parallel, or combinations incorporating both series and parallel configurations. The apparatus is relatively simple, inexpensive and versatile. It may be used in a variety of configurations for several types of student laboratories ranging from demonstrations to design projects. This allows the instructor to design and change experiments for a specific course. The use of an apparatus such as this gives students hands on experience with experimental procedures and helps them to gain a physical understanding of heat transfer phenomena.

FLACK, K.A., Assistant Professor, Pruitt, B. and Callari, M.J. "Velocity Measurements in the Flow Around a Rotating End Mill," Proceedings of the ASME Fluids Engineering Division Summer Meeting (CD-ROM), No. FEDSM98-4903, Washington, D.C., June 22-25,1998.

Recent experiments using acoustic emission (AE) signal monitoring to detect end mill and work piece interaction has shown high signal levels prior to material removal. A detectable increase in the AE signal is present for separation distances of 25 - 65 mm. A portion of this premature signal is due to elastic contact of the tool and work piece. In addition, it is hypothesized that the AE sensor is detecting the flow induced noise from the squeeze film similar to that of a slider bearing, between the end mill tooth and the work piece. Categorization of this signal could lead to in-process monitoring of edge detection and provide feedback on tool position with respect to the work piece prior to material removal. In order to better understand this manufacturing problem, the flow around a rotating end mill was investigated using a one-component laser Doppler anemometer system. Measurements of the tangential component of velocity were obtained. Phase and time averaged velocity profiles highlight the differences between the flow around a rotating end mill and the flow in a slider bearing of similar dimensions.

JOYCE, J. A., Professor and LINK, R. E., Assistant Professor, "Fracture Behavior of Surface Crack Plates Subjected to Combined Loading in the Ductile-to Brittle Transition Region," Fatigue and Fracture Mechanics: 29th Vol. ASTM STP 1332, T.L. Panontin and S.D. Sheppard, Eds., American Society for Testing and Materials, pp. 55-81, 1998.

Surface cracked tension specimens of ASTM A533, Grade B steel plate were tested to failure in the ductile-to-brittle transition region. Two different specimen configurations were used: one configuration was loaded in tension except for the natural bending resulting from the presence of the surface crack; the second configuration had an offset test section and was pin-loaded to provide a strong bending component in addition to the tension load. For each configuration, at least seven repeat tests were conducted at each of two temperatures. All specimens failed by cleavage and the critical J-integral, J_c, was obtained using three-dimensional finite element analysis of the specimen. The FEM analysis was validated by comparison with experimental strain gage and displacement measurements taken during the tests. The results were compared with previous fracture toughness measurements on the same plate using 2T SE(B) specimens and surface cracked bend SC(B) specimens. The present results exhibited the expected elevation in fracture toughness and downward shift in the transition temperature compared to the highly constrained, deeply cracked SE(B) specimens. The master curve approach was used to characterize the transition curves for each specimen geometry and the shift in the transition temperature was characterized by the associated reference temperature.

JOYCE, J. A., Professor, "Experimental Justification of Proposed Changes to the Measurement of Kic Using ASTM E399," Journal of Testing and Evaluation, JTEVA, Vol. 26, No. 5, September 1999, pp. 455-462.

During the past five years considerable effort has been devoted to developing a fracture toughness measurement standard that combines the linear elastic stress intensity factor at the onset of crack extension, Kic, and the elastic-plastic fracture toughness measurement quantities, namely, Jic, the J resistance curve (J-R curve), and the corresponding crack tip opening displacement resistance curve (CTOD-R curve). The objective of this effort was to allow the

engineer to start with one specimen geometry, conduct a specified test, develop either with one specimen geometry, conduct a specified test, develop either a KQ or a JQ-R curve, and the after application of the relevant size requirements, obtain a valid fracture toughness result. At present, different specimens are required by E 399 and E 1737 (the combination and replacement of E 813 and E 1152), and if the engineer uses the E 399 specimen geometry and test procedure and subsequently finds that the measured KQ fails the E 399 size requirements, new specimens must be machined and tested according to E 1737 to obtain valid fracture toughness measurements.

This paper describes experimental tests that have been conducted in parallel with the development of the new ASTM Standard E 1820-97, a combined fracture toughness test standard that is intended to address this problem. These experimental results show that the standard J integral specimen, incorporating load line crack mouth opening displacement measurements and side grooves, can be used to obtain Kic as presently defined by ASTM E 399. The use of larger a/W ranges is also supported by these results as long as the basic size requirements of E 399 are met and applied to both the specimen crack length and remaining ligament as well as to the specimen gross thickness.

JOYCE, J. A., Professor, "On the Utilization of High Rate Pre-Cracked Charpy Test Results and the Master Curve to Obtain Accurate Lower Bound Toughness Predictions in the Ductile-to-Brittle Transition," Small Specimen Test Techniques, ASTM STP 1329, American Society for Testing and Materials, 1998, pp. 253 - 273.

Much recent work in the field of elastic-plastic fracture mechanics has been directed to developing a mechanics-based relationship between the onset of cleavage fracture in structural components and that of Charpy specimens. In the case of a commercial nuclear power plant the surveillance specimens are expected to have undergone an irradiation history equivalent to that of the pressure vessel, and hence to have the correct fracture toughness properties. The small size of these specimens, however, makes it difficult to obtain fracture toughness measurements that are transferrable to the much larger and higher constraint pressure vessel.

Application of proposed specimen size requirements to this problem shows that for the typical fracture toughness and strength levels in a nuclear pressure vessel, the pre-cracked Charpy specimen could lose constraint well before the onset of cleavage and the results obtained will then provide a very non-conservative estimate of the conditions required for the onset of cleavage in the vessel. Recent computational work by Koppenhoefer and Dodds has strongly suggested, however, that if the specimen is loaded rapidly, additional constraint might be present which would allow the Charpy results to predict correctly the onset of cleavage in the nuclear pressure vessel. These authors predict that the presence of modest viscoplasticity will increase the deformation level at which constraint is lost and this in turn will allow Charpy size specimens to be adequate predictors of the onset of cleavage fracture in structural size elements.

In this paper pre-cracked Charpy specimens of A515 steel are tested at four different loading rates and five different temperatures in the lower ductile-to-brittle transition. The reference temperature, T is developed and shown to be very dependent on the loading rate and very independent of the temperature at which the data set was measured.

LINK, R.E., Assistant Professor and Graham, S.M., "Dynamic Fracture Initiation Toughness of ASTM A533, Gr. B Steel Plate," Fatigue and Fracture Mechanics: 29th Vol. ASTM STP 1332, T.L. Panontin and S.D. Sheppard, Eds., American Society for Testing and Materials, pp. 17-39, 1998.

The dynamic fracture toughness of an ASTM A533, Grade B steel plate was determined at several temperatures in the ductile-brittle transition region. Crack-tip loading rates ranged from approximately 10^3 to 10^5 MPa%m/s. The fracture toughness was shown to decrease with increased loading rate. The dynamic fracture toughness was compared with results from previous investigations and it was shown that the decrease in toughness due to increased loading rate at the highest test temperature was not as severe as reported in previous investigations. It was also shown that the reference temperature, T_0, was a better index of the fracture toughness vs. temperature relationship than the nil-ductility temperature, RT_{NDT} for this material.

LINK, R.E. Assistant Professor and MINER, S.M.,

Associate Professor "Complementary Usage of Mathematica and I-DEAS in Mechanism Design," submitted to Computers in Education Journal, December 1998, (in press).All mechanical engineering majors at the Naval Academy are required to take a course in Computer Aided Design during their senior year. The underlying philosophy of the course is to use the computer to solve problems that would be impractical to solve by hand. The vehicle used to illustrate this is the design of four bar mechanisms. During the first part of the course the students write programs using *Mathematica* to perform synthesis, position, velocity, acceleration, and force analyses for the complete range of motion of a four bar mechanism. Using *Mathematica* helps the students develop an understanding of the equations being solved, as well as, develop an appreciation for the progression of the solution from synthesis through force analysis. In the second part of the course the students are introduced to the SDRC *I-DEAS* solid modeling software package. Using *I-DEAS* they build physically realistic models of the mechanisms including animation of the complete range of motion. The position, velocity, acceleration, and force analyses are repeated within *I-DEAS* by means of menu picks. The only part of the design process that *I-DEAS* cannot be used for is the synthesis of the mechanism. The use of *Mathematica* enhances the students understanding of the mechanism design process, while the use of *I-DEAS* gives the students an appreciation for the ease with which physically realistic models can be generated using high end solid modeling packages.

MINER, S. M., Associate Professor, "Evaluation of Blade Passage Analysis Using Coarse Grids," Proceedings of U.S.-Japan Seminar on Abnormal Flow Phenomena in Turbomachines", November 1998 (CD-ROM).

This paper presents the results of a study using coarse grids to analyze the flow in the impellers of an axial flow pump and a mixed flow pump. A commercial CFD code (FLOTRAN) is used to solve the 3-D Reynolds Averaged Navier Stokes equations in a rotating cylindrical coordinate system. The standard turbulence model is used. The meshes for this study use 22,000 nodes and 40,000 nodes for the axial flow impeller and 26,000 nodes for the mixed flow impeller. Both models are run on a SPARC station 20. This is in contrast to typical analyses using in excess of 100,000 nodes. The smaller mesh size has advantages in the design environment. Stage design parameters for the axial flow impeller are: rotational speed 870 rpm, flow coefficient, head coefficient, and specific speed 2.97 (8101 US). For the mixed flow impeller the parameters are: rotational speed 890 rpm, flow coefficient, head coefficient, and specific speed 2.01 (5475 US). Evaluation of the models is based on a comparison of circumferentially averaged results to measured data for the same impeller. Comparisons to measured data include axial and tangential velocities, static pressure, and total pressure. A comparison between the coarse and fine meshes for the axial flow impeller is included. Results of this study show that the computational results closely match the shapes and magnitudes of the measured profiles, indicating that coarse CFD models can be used to accurately predict performance.

MINER, S. M., Associate Professor, "Evaluation of Blade Passage Analysis Using Coarse Grids," Proceedings of 3rd ASME/JSME Joint Fluids Engineering Conference, Paper No. FEDSM99-7339, FED-Volume 248, July 1999, (CD-ROM).

This paper presents the results of a study using coarse grids to analyze the flow in the impellers of an axial flow pump and a mixed flow pump. A commercial CFD code (FLOTRAN) is used to solve the 3-D Reynolds Averaged Navier Stokes Equations in a rotating cylindrical coordinate system. The standard turbulence model is used. The meshes for this study use 22,000 nodes and 40,000 nodes for the axial flow impeller, and 26,000 nodes for the mixed flow impeller. Both models are run on a SPARC station 20. This is in contrast to typical analyses using in excess of 100,000 nodes. The smaller mesh size has advantages in the design parameters for the axial flow impeller are: rotational speed 870 rpm, flow coefficient, head coefficient, and specific speed 2.97 (8101 US). For the mixed flow impeller the parameters are: rotational speed 890 rpm, flow coefficient, head coefficient, and specific speed 2.01 (5475 US). Evaluation of the models is based on a comparison of circumferentially averaged results to measured data for the same impeller. Comparisons to measured data include axial and tangential velocities, static pressure, and total pressure. A comparison between the coarse and fine meshes for the axial flow impeller is included. Results of this study show that

the computational results closely match the shapes and magnitudes of the measured profiles, indicating that coarse CFD models can be used to accurately predict performance.

MORAN, A. L., Associate Professor, J. Carsten and G. Cover, "Undergraduate Laboratory - Wear Properties of Materials", Journal of Materials Education, Vol. 20 (3&4), pp. 1-4.

Wear is the damage to a solid surface by the displacement or removal of material by another moving material. Fundamentally, wear is caused by the relative motion of one surface, particle or fluid over another surface and is affected by many different factors, including relative hardness of the surfaces, surface finish, presence of lubricants and surface films, presence of particulate, pressure or load applied, temperature and chemical reactions present. Wear may lead to the degradation and ultimate failure of the materials and components involved in a system such as an engine or propulsor. The three most basic types, adhesive, abrasive, and erosive wear, are defined and exemplified. There are numerous methods of wear testing, many of which are expensive and time consuming. These techniques generally have four parameters - contact velocity, contact area, contact pressure, and entry angle which can be varied to compare materials and lubricants in a theoretical setting or to simulate an actual mechanical situation. The purpose of this experiment was to develop a low cost demonstrator that can be used to introduce engineering students to the concepts of wear. A device was found that can create abrasive or adhesive wear depending on materials. The unmodified device is simple and inexpensive as provided, but results were difficult to quantify. Modifications were made to the basic equipment to control experimental variables and make the experiment quantitative. Also, a process was developed for testing which improves repeatability and precision.

MORAN, A. L., Associate Professor, P. Saxton, and S. Rutledge, "Emmissivity Measurement Comparison", submitted to the Ceramics Bulletin, (in press).

Emissivity measurements generated by two different methods were compared for selected candidate materials. The emission from a material is a direct result of the energy released by the oscillations or transitions of the electrons in that material. The oscillations of the electrons are dependent on the internal energy of the material, which in turn is dependent on its temperature. Radiation emerging from a finite volume of matter is the integrated effect of the local emission throughout the volume. In most solids though, radiation emitted from interior molecules is rapidly absorbed by adjoining molecules. Therefore, radiation that actually escapes the surface of the body originates from the molecules that are within approximately 1 µm from the exposed surface. Due to this effect, radiative emission is viewed as a surface phenomenon for solids. Initial testing occurred at the NASA Lewis Research Center in Cleveland, Ohio as part of a U.S. Naval Academy program to screen thermophotovoltaic (TPV) radiator materials. A Perkin Elmer spectrophotometer was used to measure total hemispherical reflectance at room temperature in air, after which the data was corrected to represent total hemispherical emittance as a function of temperature. Comparative testing was performed to directly measure the normal emissivity (with wavelengths between 2.0 and 2.6 microns) of the same samples in vacuum at elevated temperatures (900-1100EC).

MORAN, A. L., Associate Professor, "Incorporating Design Aspects into Materials Engineering Curriculum", Proceedings of ASEE Regional Meeting, pp. 35-38, Howard University, Washington D.C., Nov 1998.

Each year, 150-200 midshipmen participate in the introductory Materials Science courses and the laboratory exercises that have been developed for those classes at the United States Naval Academy. The curriculum has been predominantly limited to metallic materials although many new materials such as ceramics, superalloys and composites are appropriate for today's discussions. The current experiments and demonstrations provided as part of the materials classes needed to be revised and expanded to incorporate all materials - metals, alloys, polymers, ceramics and composites - as well as to assist the students in understanding the materials selection process in terms of trade-offs between required properties and practical factors such as cost and availability. This effort has been directed at incorporating current technology advances into the curriculum and in providing demonstrations and

laboratories involving new materials. The current curriculum was reviewed and critiqued for currency, accuracy and relevance. For each lab module and demo, existing equipment was refurbished and calibrated and new test data were accumulated. Additionally, newly purchased equipment has been utilized to revamp the labs and demos. New modules and demos have been created for creep testing, wear testing, and mechanical properties of ceramics, polymers and composites and an initial database of results have been developed.

MORAN, Patrick J., Professor and Hak Lul Lee, "Effects of Cooling Rate and Annealing Treatment on Sensitization of Austenitic-ferritic Duplex Stainless Steel," Metals and Materials, Vol. 4, No. 5, (1998), pp. 1085-1091.

Duplex stainless steel has higher corrosion resistance and better mechanical properties than conventional type 300 series stainless steel. The corrosion behavior of duplex stainless steel is strongly dependent on the ratio, shape, size and distribution of austenite and ferrite phase in the microstructure. The relationship between the microstructure and the corrosion behavior of the duplex stainless steel was studied. For this purpose, the duplex stainless steel samples were solution heat treated at 1150C followed by either cooling at various rates (water quenching, air cooling, furnace cooling with door opened and door closed) to 820C and then water quenching to room temperature, or quenching to room temperature and annealing heat treatment at 840C for various lengths of time. A double loop electrochemical potentiodynamic reactivation (EPR) test was carried out to examine the effect of various cooling procedures or annealing treatment on the sensitization of duplex stainless steel. The grain size, shape, and distribution of the two phases were examined under microscope. From the test results, the relationships were discussed among heat treatment, electrochemical properties and microstructure.

MORAN, Patrick J., Professor and Robert P. Frankenthal, "A Corrosionist and a Gentleman: Jerome Kruger" Critical Factors in Localized Corrosion III, Proceedings Volume 98-17, pp. xi-xv, The Electrochemical Society, Inc., 1999.

This biography on the life and career of Professor Jerome Kruger was written on the occasion of a special symposium of the Electrochemical Society, Inc. The symposium, entitled "Critical Factors in Localized Corrosion III - A Symposium in Honor of the 70th Birthday of Jerome Kruger," was held at the 194th Meeting of the Electrochemical Society in Boston, MA, November 1-6, 1998.

MORAN, Patrick J., Professor, David A. Shifler and Jerome Kruger, "Passivity and Breakdown of Passivity of 1018 Carbon Steel In PC-DME-H20 Mixtures", Critical Factors in Localized Corrosion III, Proceedings Volume 98-17, pp. 72-88, The Electrochemical Society, Inc.,1999.

The passivity and breakdown of passivity of 1018 carbon steel in a neutral pH, deaerated ternary component mixtures of propylene carbonate, 1, 2-dimethoxyethane, and water with 0.5 molar lithium hexafluroarsenate supporting electrolyte were examined via several electrochemical and surface methods.

Solvent adsorption is the primary passivating mechanism up to the oxidizing potential of either organic solvent alone. Above the solvent oxidizing potentials, each of the components in this system has a predominant passivating mechanism when examined alone (electropolymerization in DME, salt film formation in PC, and oxide formation in water). This paper looked at the interactions of these mechanisms where passivity does occur as well as conditions where competition among the passivating processes prevent passivation.

MORAN, Patrick J., Professor, D. A. Shifler and Jerome Kruger, "The Influence of Water on Passivity and Breakdown of Fe, Ni, and Ferrous Alloys in Organic Solvent Solutions," Proceedings of the 8th International Symposium on the Passivity of Metals and Semiconductors, (in press).

The influence of additions of water to neutral dipolar, aprotic solutions of either LiCl04 or LiAsF6 in propylene carbonate (PC) and/or dimethoxyethane (DME) on the passivity and breakdown of Fe, 1018 carbon steel, Ni, Ni-200, and 304 stainless steel was studied. Traces of water in PC have a detrimental effect on the passivity of Fe and carbon steel but expand the passive range of stainless steel by promoting oxide film formation. In DME/LiCl04 small concentrations of water do not increase the breakdown potential above the DME oxidation potential, DMEox, for Fe and carbon steel but do expand the passive region above DMEox for stainless steel, Ni, and Ni200 by the formation of a protective salt film. In dry DME/LiAsF6, iron and

carbon steel breakdown occurs 200-450 mV above DMEoxthrough the formation of an electropolymerized film. Small water additions increase the passive range of this electropolymerized film.

MORAN, Patrick J., Professor, ENS Brandon W. Davis, USN, and Paul M. Natishan, "Metastable Pitting Behavior of Single Crystal Surfaces of Pure Aluminum,"Critical Factors in Localized Corrosion III," Proceedings Volume 98-17, pp. 215-222, The Electrochemical Society, Inc., 1999.

This communication reports on the metastable pitting behavior of aluminum single crystals. Aluminum single crystals (99.999% pure) with orientations of (100), (110), and (111) were evaluated with electrochemical measurements in 0.6 M NaCl solutions. The potential was stepped in 10 mV increments from the open circuit potential and the current was recorded for 10 minutes at each potential. The number of metastable events and peak currents were record for each potential step. All samples were evaluated subsequent to testing utilizing scanning electron microscopy. (111) crystal surfaces exhibited the highest number of metastable pitting events as a function of potential for potentials below the pitting potential. The (100) exhibited a lower number of events as a function of potential relative to the (111) but exhibited more metastable pitting events than the (110). (111) baseline current densities increased more so than the others as a function of potential. The (100) baseline current densities increased less so than the (111) but more so than those of the (110) surface. The data clearly indicated that the (111) surface has the lowest pitting potential, followed by the (100), followed by the (110) with the highest pitting potential. An estimate of the pitting potential for each crystal surface yielded -0.735 V vs SCE for (111), -0.729 V vs SCE for (100), and -0.708 V vs SCE for (111). The approximately equal values of peak pit current densities over baseline (for approximately equal baseline current densities) in the potential range of -0.755 V vs SCE to -0.735 V vs SCE suggested that the size of the largest metastable pits were about the same for all three surfaces. The resultant faces within the pits of all the orientations tested were always of the (100) orientation.

PALMER, S.C., Assistant Professor, and S.V. Shelton, "Sensitivity Analysis of Absorption Cycle Fluid Thermodynamic Properties," Journal of Energy Resources Technology, Vol. 121, pp. 137-142, June 1999.

Absorption heat pumps are often bypassed in building space conditioning applications because their operating ranges and performance are not competitive with alternative equipment. The desire for broader cycle operating ranges and improved performance may be satisfied by new cycle configurations and by new working fluids. In this study, the effect of working fluids on performance improvement is explored. The performance of two cycles is studied using three fluid property sources for ammonia/water, i.e., curve-fit experimental data, an ideal solution model, and the Peng-Robinson equation of state model. The models require only minimal fundamental thermodynamic property data for the two pure components. This allows investigation into the influence of each fundamental property on cycle performance, providing insight into desirable properties for new absorption fluid pairs. Variations of fundamental fluid properties are used as input to the models, showing that the volatilities of the refrigerant and absorbent have the greatest effect on cycle performance.

POORMAN, Corey, Midn 1/C, "The Use of Thermal Spraying to Enhance the Bonding Characteristics of a Urethane Coated Propeller", USNA Trident Report No. 265, U.S. Naval Academy, May 1999.

In order to reduce the cost and machining time of producing propeller blades, the Naval Surface Warfare Center, NSWC, has developed an alternative production method for propeller blades. The alternative production method consisted of a Nickel-Aluminum-Bronze (NAB) blade, covered by two coats of paint and a urethane coating. After exposure to seawater and impressed current cathodic protection, the bond between the paint and the NAB substrate failed to meet NSWC's minimum required bond strength of 80 lbs/linear inch.

This project attempted to improve the bond between the paint and NAB by developing a surface treatment technique that would produce a strong, lasting bond. The surface treatment technique chosen was thermal spraying, specifically arc wire spraying, which created a rough, porous surface. This type of surface promoted mechanical bonding, as well as enhanced chemical bonding, of the paint to the substrate. In order to produce various surfaces, the

thermal spray distance was varied at six inch intervals from six inches to two feet. A 90-degree peel test, SEM analysis with x-ray micro-analysis, and optical metallography were all used to evaluate the characteristics of each coating.

After testing, it was determined that flame sprayed coatings created a surface that produced a mechanical bond, increased chemical bonding, and reduced the effects of cathodic protection.

SCHROEDER, James A., Midn 1/C, "Copper Electrode Degradation Due to the Resistance Welding of Aluminum", USNA Trident Report No. 267, U.S. Naval Academy, May 1999.

This research project focused on increasing the life of copper electrodes used in the resistance welding of aluminum work pieces employed in the automotive and aerospace industries. When the copper and aluminum make contact at the interface, there is some undesirable mixing resulting in the formation of a copper-aluminum eutectic phase. The welding temperature is high enough to melt the aluminum, but the eutectic phase has a lower melting temperature than either pure copper or pure aluminum. During subsequent welds the eutectic melts away, causing the copper to degrade rapidly and the electrode lifetime to be shortened. As an alternative, electrodes made from copper alloys with very high melting temperature refractory metals, such as molybdenum, niobium, and chromium, have been fabricated. Since the refractory metals are not readily soluble in copper, it was necessary to use unconventional processing techniques to produce electrodes of uniform composition. These techniques included spray forming, rapid solidification, ion implantation, laser cladding, and mechanical alloying. The new processing techniques allow for a higher concentration and more uniform distribution of the refractory metal, as confirmed by metallurgical analysis involving optical and electron microscopy. The electrodes were tested for homogeneity, conductivity and welding lifetime. Recommendations were made concerning alloy selection for improved electrode performance.

WU, Chih, Professor, "Recent Advances in Finite Time Thermodynamics," by Nova Science Publ. Inc., New York, 1999, ISBN 1-56072-664-4.

Finite time thermodynamics is one of the newest and most challenging areas in thermodynamics. The objective of this book is to provide results from current research, which continues at an impressive rate. This book deals with fundamental and applied research of finite time thermodynamics. It illustrates how the gap between thermodynamics, heat transfer, and fluid mechanics is bridged.

WU, Chih, Professor, "Optimal Collector Temperature for Solar Driven Heat Pump Systems," Energy Conversion and Management, v.39, n.½, pp. 143-147, 1998.

The optimal characteristic of a solar-driven heat pump system consisting of a solar collector and a three-heat-reservoir heat pump is performed. The overall COP (coefficient of performance) of the system is adopted to be the objective function of the study. The optimum operating temperature of the solar collector at the system's maximum possible COP or at the system's maximum possible heating load are found. The results provide a theoretical basis for designing a real solar-driven heat pump system.

WU, Chih, Professor, "Influence of Internal Heat Leak on the Performance of Refrigerators," Energy Conversion and Management, v.39, n.½, pp. 45-50, 1998.

The influence of an internal heat leak on the optimal performance of a refrigerator is examined in this paper. This is done by adding a heat leak term into an endoreversible refrigerator. The relationship between optimal heating load and coefficient of performance for a steady state irreversible refrigerator is derived. The performance characteristics of the irreversible refrigerator are found to be deeply affected by the rate of heat leak. This model allows a more reasonable prediction of the performance of an actual refrigerator.

WU, Chih, Professor, "Optimization of Specific Rate of Heat Pumping in Combined Heat Pump Cycles," Energy Conversion and Management, v.39, n.½, pp. 113-116, 1998.

The optimization problem of a combined heat pump cycle made of two endoreversible Carnot heat pump cycles in series without intermediate reservoirs is investigated using finite-time thermodynamics. The fundamental relationship between heating quantity and coefficient of performance of the combined cycle is

derived. Relations are also derived between the specific rate of heat pumping, the average rate of heat pumping per unit of total heat transfer surface area and the COP for reciprocating and stable flow models of combined cycles. The results obtained from this paper may be extended to an endoreversible, combined heat pump cycle formed by more than two endoreversible Carnot heat pump cycles.

WU, Chih, Professor, "Cooling Load Versus COP Characteristics for an Irreversible Air Refrigeration Cycle," Energy Conversion and Management, v.39, n.½, pp. 117-125, 1998.

The effect of heat resistance on the performance of an air refrigeration cycle is analyzed with a finite time heat transfer analysis. The present work extends the recent studies on refrigerator performance by incorporating nonisentropic compression and expansion. Relationships between cooling load and pressure ratio and between COP and pressure ratio for the air refrigerator in which the irreversibilities of heat resistance losses in the hot- and cold-side heat exchangers and nonisentropic losses in the compression and expansion processes are derived. The results show that there exists a maximum value of COP and that the cooling load has a parabolic dependence on COP, unlike the monotonically decreasing behaviour in the case of an endoreversible air refrigerator.

WU, Chih, Professor, "Intelligent Computer Aided Optimization on Specific Power of an OTEC Rankine Power Plant," Applied Thermal Engineering, v.18, n.5, pp. 295-300, 1998.

Specific power of a heat engine is chosen to be the objective function in the design of an OTEC Rankine power plant. An intelligent computer aided instruction computer software, CyclePad, with refrigerant-12 as the working fluid operating between a warm ocean water heat source and a cold ocean water sink is used in the design process. Through manipulation of the boiler pressure and condenser pressure, the specific power of the OTEC is calculated and an upper bound is determined. This bound can direct the design of current and future OTEC heat engines to provide beneficial applications in industry.

WU, Chih, Professor, "Optimal Expansion of a Heated Working Fluid With Phenomenological Heat Transfer," Energy Conversion and Management, v.39, n.3/4, pp. 149-156, 1998.

The optimal motion of a piston fitted with a cylinder containing an ideal gas is examined. The gas is heated at a given rate f(t) and coupled to a heat bath. The optimal path which maximizes the expansion work is obtained. Several applications of the optimal path are also given.

WU, Chih, Professor, "Efficiency of an Atkinson Engine at Maximum Power Density," Energy Conversion and Management, v.39, n.3/4, pp. 337-342, 1998.

The power density is maximized for an Atkinson cycle in this paper. The results showed that the efficiency at maximum power density is always greater that that at maximumpower, and the design parameters at maximum power density lead to smaller and more efficiency Atkinson engines with larger pressure ratios.

WU, Chih, Professor, "Optimization of Steady Flow Heat Pumps," Energy Conversion and Management, v.39, n.5/6, pp. 445-454, 1998.

The finite time thermodynamic performance of steady flow Carnot and Brayton heat pump cycles has been studied for both finite and infinite thermal capacitance rates of heat reservoirs. The fundamental optimal relations of the two cycles are obtained. A comparison of the performance characteristics of the two cycles for the same boundary conditions is shown. The effects of finite thermal capacitance rates of the working fluid and heat reservoirs and of the internal irreversibilities of the cycles on cycle performance are analyzed. Optimal matching between the temperatures of the working fluid and heat reservoirs is discussed.

WU, Chih, Professor, "Using Articulate Virtual Laboratories in Teaching Energy Conversion at the U.S. Naval Academy," Journal of Educational Technology Systems, v.26, n.2, pp. 127-136, 1998.

The Mechanical Engineering Department at the U.S. Naval Academy is currently evaluating a new teaching method which implements the use of a computer software. Utilizing the thermodynamic based software CyclePad, Intelligent Computer Aided Instruction is incorporated in an advanced energy conversion course for Mechanical Engineering students. The use of the CyclePad software enhances lectures and aided students in visualization and design.

WU, Chih, Professor, "Effect of Heat Transfer Law on Finite Time Exergeoeconomic Performance of a Carnot Heat Pump Cycle," Energy Conversion and Management, v.39, n.7, pp. 579-588, 1998.

The operation of a Carnot heat pump is viewed as a production process with energy as its output. The short run economic optimization of the endoreversible heat pump is performed in this paper. The profit of the heat pump is taken as the optimization objective function. Using the method of finite time exergoeconomic analysis, which emphasizes the compromise optimization between economics and the utilization factor of energy for finite time thermodynamic cycles, this paper derives the relationship between optimal profit and COP of an endoreversible Carnot heat pump based on a relatively general heat transfer law. The COP bound at the maximum profit is also obtained. The results obtained involve those for three common heat transfer laws.

WU, Chih, Professor, "Heat Transfer Effects on the Network Output and Efficiency Characteristic for an Air-standard Otto Cycle," Energy Conversion and Management, v.39, n.7, pp. 643-648, 1998.

Finite-time thermodynamic analysis of an air standard Otto cycle is performed in this paper. The relationship between net work output and efficiency of the cycle is derived. The maximum network output and the corresponding efficiency bound of the cycle with heat transfer considerations are also found. Detailed examples are given. The results obtained herein provides a guide to the performance evaluation and improvement for practical Otto engines.

WU, Chih, Professor, "Optimum Performance of Reversible Stirling Engine With Imperfect Regeneration," Energy Conversion and Management, v.39, n.8, pp. 727-732, 1998.

An optimal performance analysis is performed for a Stirling engine with heat transfer and imperfect regeneration irreversibilities. The relationship between the net power output and thermal efficiency of the engine is derived. Detailed numerical examples are given. The results obtained in this paper provide guidance to performance evaluation and design improvement for Stirling engines.

WU, Chih, Professor, "Performance and Optimization Criteria for Forward and Reverse Quantum Stirling Cycles," Energy Conversion and Management, v.39, n.8, pp. 733-740, 1998.

The optimal performance for forward and reverse quantum Stirling cycles is studied in this paper. The finite time thermodynamic performance bound and optimization criteria for these cycles are derived. The optimal relationships between the performance parameters for quantum Stirling engines, refrigerators and heat pumps are obtained.

WU, Chih, Professor, "Multi-objective Optimum Design Method for a Radial Axial Flow Turbine with Optimum Criteria of Blade Twist at Outlet of Blades," International Journal of Power and Energy Systems, v.18, n.1, pp. 16-20, 1998.

This paper gives a multi-objective optimum design method for a radial-axial flow turbine stage which is subject to various engineering construction constraint. Five parameters ($á_1$, $â_2$, μ, u_1 and m) at the mean radius and the criteria of blade twist at the outlet of the blades are considered. These constraints and criteria are taken as design variables, and both the internal efficiency of the design condition and the total weight are taken as the objective functions. The model presented is a nonlinear multi-objective programming problem with two objective functions, twenty nine constrained functions and six variables. The optimization statement for a variety of types of twisted blades is also provided. The results show the method to be valid and effective.

WU, Chih, Professor, "Optimum Design of Centrifugal Compressor Stages," International Journal of Power and Energy Systems, v.18, n.1, pp. 12-15, 1998.

The design of an axial flow compressor stage at subsonic Mach numbers has been formulated as a nonlinear multi-objective mathematical programming problem with the objective of minimizing the aerodynamic losses and the weight of the stage, while maximizing the compressor stall margin . Aerodynamic as well as mechanical constraints are considered in the optimization. The Prediction model of estimating the performance characteristics, such as efficiency, weight and stall margin of the compressor stage is presented. The present design optimization procedure can be applied also to a multistage compressor .

WU, Chih, Professor, "Analysis of MODM for Marine

Steam Turbine Stages," International Journal of Power and Energy Systems, v.18, n.2, pp. 96-101, 1998.

The advantages of using a multi-objective decision making (MODM) method in the design optimization of a marine steam turbine stage and/or stage group is discussed in this paper. Two computer models capable of optimizing significant design variables of the turbine are described. Also discussed is the criteria for selection of the decision making variables and the objective functions, the assumptions made for the constraints within which the solution is searched and the optimization procedure. Cascade losses are predicted by three different methods. The computer programs developed for this analysis were run successfully on a microcomputer. Analytical results of MODM for a turbine stage and a stage group is provided and an analysis of the influence of the number of stages on the efficiency of a steam turbine is given. The calculations show the method to be effective.

WU, Chih, Professor, "Intelligent Computer Aided Design on Optimization of Specific Power Output of a Finite Time Rankine Cycle Using CyclePad," Journal of computer Application in Engineering Education, v.6, n.1, pp. 9-13, 1998.

The specific output of a shipboard nuclear propulsion system is analyzed. The plant consists of a Rankine cycle coupled to coolant from a nuclear reactor and ocean water by heat transfer. The specific power is optimized by using thermodynamic software called CyclePad and computer graphics.

WU, Chih, Professor, "Optimum Performance Parameters for a Quantum Carnot Heat Pump With Spin ½," Energy Conversion and Management, v.39, n.11, pp. 1161-1167, 1998.

The purpose of this paper is to study the optimal performance for an endoreversible Carnot heat pump with a working fluid system consisting of many spin ½ fermi. The relationship between the optimal heating load and the coefficient of performance (COP) for the quantum Carnot heat pump is derived. The optimum parameters are obtained at a maximum heating load point and at a maximum ecological function point, respectively.

WU, Chih, Professor, "Intelligent Computer Aided Analysis of a Rankine/Rankine Combined Cycle," International Journal of Energy, Environment and Economics, v.7, n.2, pp. 239-244, 1998.

Performance of a Rankine/Rankine combined cycle is analyzed. The traditional cycle analysis is a long and tedious process. This paper describes the use of an intelligent computer software to obtain the analysis of the combined cycle quickly and accurately.

WU, Chih, Professor, "Performance of Chemical Engine with Mass Leak," Journal of Physics, D: Applied Physics, v.31, n.13, pp. 1595-1600, 1998.

The performance of an isothermal chemical engine with finite rate mass transfer and a mass leak is analyzed in this paper. The relations between the optimal power and the efficiency, the maximum power output and the corresponding efficiency and the maximum efficiency and the corresponding power output are derived on the basis of linear mass transfer law using the analogous method of finite-time thermodynamics for a heat engine.

WU, Chih, Professor, "Finite-time Power Limit for Solar Radiant Ericsson Engines in Space Applications," Applied Thermal Engineering, v.18, n.12, pp.1347-1358, 1998.

The power output and thermal efficiency of a finite-time optimized solar-radiant Ericsson heat engine is studied. The thermodynamic model adopted is a regenerative gas Ericsson cycle coupled to a heat source and heat sink by radiant heat transfer. Both the heat source and the heat sink have infinitive heat capacity rates. Mathematical expressions for optimum power and the efficiency at optimum power are obtained for the cycle based on higher and lower temperature bounds. The results of this theoretical work provided a base line criteria for use in the performance evaluation and design of such engines as well as use in performance comparisons with existing terrestrial solar power plants.

WU, Chih, Professor, "Finite Thermal Reservoirs Effects on Power Optimized Continuous Endoreversible Carnot Heat Engine Cycles," International Journal of Power and Energy Systems, v.18, n.2, pp.147-154, 1998.

Studies of continuous Carnot cycles with finite thermal reservoirs in the past have considered neither the Second Law constraints of the cycle, nor the interdependence between the power cycle operating temperatures and the initial and final reservoir temperatures themselves. In this work, it is shown that,

when these are considered, the upper and lower power optimized operating cycle temperatures can be semi-decoupled from each other. They remain coupled only through an expression for $\hat{a}_{opt}$ stemming from the Second Law constraint formulation.

WU, Chih, Professor, "Intelligent Computer Aided Instruction of a Heat Pump," Computers in Education Journal, v.8, n.3, pp. 36-42, 1998.

The Rankine vapor cycle plays a very important role in heat pumps. It is an integral part in teaching courses of engineering thermodynamics. The vapor heat pump cycle analysis is long and tedious. It is very necessary to obtain the cycle performance quickly and accurately in the classroom. This paper describes the use of intelligent computer aided software in teaching vapor heat pumps. Historical evolution and several differently arranged vapor heat pumps are demonstrated. Objectives for improvements, constraints, and consequently design, which cannot be easily accomplished the conventional way, are emphasized. Using the software increases student interest and homework problem solving ability.

WU, Chih, Professor, "Intelligent Computer Aided Design of Geothermal Plants," Renewable Energy, v.16, n.4, pp. 2713-2717, 1998.

This paper describes the use of an intelligent computer aided software in design and possible refinements of geothermal plants. The traditional geothermal cycle design is long and tedious. Obtaining accurate cycle performance quickly is necessary in the design process. Objectives for improvements, which cannot be easily accomplished using the conventional methods are emphasized. Utilizing the software increases engineers interest and design ability in geothermal plants.

WU, Chih, Professor, "Performance Characteristics of Fluid Power Converters," Journal of the Institute of Energy, v.71, n.486, pp. 209-215, 1998.

The endoreversible thermodynamic theory of heat engines is extended to fluid power converters. This paper also develops an analogy among the fluid flow power converters, endoreversible heat engines, endoreversible isothermal chemical engines, classical reversible heat engines, and ideal motor powered by an electrical battery. The results can be applied to the performance analyses and optimization for many steady-flow shaft-powered components.

WU, Chih, Professor, "Progress in Finite Time Thermodynamics," Progress in Physics, v.18, n.4, pp. 395-422, 1998.

The historical literature in finite time thermodynamics (FTT) is surveyed. The state of the art and the future development of FTT are also discussed.

WU, Chih, Professor, "Performance Characteristics of Fluid Power Converters," Journal of the Institute of Energy, v.71, n.486, pp. 209-215, 1998.

The endoreversible thermodynamic theory of heat engines is extended to fluid flow power converters. The useful power can be extracted from the piston and cylinder apparatus. The correlation between power output and efficiency is derived based on a linear flow resistance relationship. The influences of the piston-cylinder friction and nonlinear flow resistance relationships on the performance of the converter are also analyzed in this paper. Performance optimization is undertaken based on the overall size constraints. This paper also develops an analogy among the fluid flow power converters, endoreversible heat engines, endoreversible isothermal chemical engines, classical reversible heat engines, and ideal motor powered by an electrical battery. The results can be applied to the performance analyses and optimization for many steady-flow shaft-powered components.

WU, Chih, Professor, "Intelligent Computer Aided Sensitivity Analysis of a Multi-stage Brayton/Rankine Combined Cycle," Energy Conversion and Management, v.40, n.2, pp. 215-232, 1999.

In the design and operation of a power system, significant resources must be utilized in order to maximize the system thermal efficiency. Sensitivity analysis of a multi-stage Brayton/Rankine combined cycle is performed in this paper. Traditional cycle sensitivity analysis is long and tedious process. This paper describes the use of an intelligent computer software to obtain the sensitivity analysis of the combined cycle quickly and accurately.

WU, Chih, Professor, "Performance Analysis for Endoreversible Closed Regenerated Brayton Heat Pump Cycles," Energy Conversion and Management, v.40, n.4, pp. 393-406, 1999.

Finite-time thermodynamic performance of isentropic closed regenerated Brayton heat pump cycles coupled to constant and variable temperature heat reservoirs has been analyzed in this paper. The relationship between heating load and pressure ratio, between COP and the heat resistance losses in the heat exchangers, between the working fluid and the high, and low temperature heat reservoirs and the regenerator are determined. A numerical example is also given.

WU, Chih, Professor, "Effect of Heat Transfer Law on the Performance of a Generalized Irreversible Carnot Engine," Journal of Physics D: Applied Physics, v.32, pp. 99-105, 1999.

In a classical endoreversible Carnot engine model, irreversibility in the form of heat resistance between the reversible Carnot cycle and its heat reservoirs is taken into account. This paper presents a generalized reversible Carnot engine model that incorporates several internal irreversibilities such as heat leak, friction, turbulence, etc. These added irreversibilities are characterized by a constant parameter and a constant coefficient. The relationship between optimal power output and efficiency is derived based on a generalized heat transfer law. The effect of heat leakage, internal irreversibilities and heat transfer law on the optimal performance of the generalized irreversible heat engine are investigated.

WU, Chih, Professor, "Optimum Performance of an Irreversible Stirling Crycooler," International Journal of Ambient Energy, v.20, n.1, pp. 39-44, 1999.

An irreversible simplified model for a Stirling crycooler is presented in this paper. This model takes into account the finite rate heat transfer, finite time evolution of the cycle's regenerative process and the friction irreversibility. The maximum cooling load and the corresponding coefficient of performance at the maximum cooling load are derived. The effects of the regenerative time, finite rate heat transfer and friction on the optimal COP at the maximum cooling load are found. A numerical example demonstrates the relationship between the cooling load and the COP.

WU, Chih, Professor, "Performance Analysis for a Real Closed Regenerated Brayton Cycle via Methods of Finite Time Thermodynamics," International Journal of Ambient Energy, v.20, n.2, pp. 95-104, 1999.

Performance analysis of a real power cycle has been performed using finite time thermodynamics. The analytical formula about the relationships between power output and pressure ratio, and between efficiency and pressure ratio of a real closed regenerated Brayton cycle coupled to variable temperature hear reservoirs are derived.

WU, Chih, Professor, "Intelligent Computer Aided Optimization of Power and Energy Systems," Proceedings of the Institution of Mechanical Engineers, Part A, Journal of Power and Energy, v.213, n.A1, pp. 1-6, 1999.

CyclePad, an intelligent computer aided instruction (ICAI) software package is described. It can be used for design, analysis and improvement of power and energy systems. Performance and sensitivity analysis of a Brayton cycle are discussed in order to illustrate its capabilities.

WU, Chih, Professor, "Transient Flow Analysis on the Regenerator Tube of a Magnetic Heat Pump," International Journal of Power and Energy Systems, v.19, n.1, pp. 38-47, 1999.

This paper presents a numerical study of the transient flow phenomena in the regenerator tube of a magnetic heat pump. The problem is solved using the Navier-Stokes equations with a body force term in the momentum equation. The results show that a 40 K temperature span can be reached in 10 minutes of charge time through the use of a 7-T magnetic field. Using the second approach, temperature stratification in the regenerator fluid column is clearly indicated through temperature contours. The regenerator efficiency and energy delivery rates when heating load and cooling load are applied are also calculated.

WU, Chih, Professor, "Performance Characteristics of an Endoreversible Stirling Refrigerator," International Journal of Power and Energy Systems, v.19, n.1, pp. 79-82, 1999.

An endoreversible Stirling refrigerator is modeled in this paper. The performance characteristic relationships among working fluid temperatures, COP (coefficient of performance) and cooling load of the endoreversible refrigerator are derived in this paper. These equations provide a basis for practicing engineers to design a new refrigerator.

WU, Chih, Professor, "Teaching Rankine Cycle by Using an Intelligent Computer Aided Instruction Software," The International Journal of Mechanical Engineering Education, (in press).

This paper describes the use of an ICAI (intelligent computer aided instruction) software in teaching thermodynamics at the U.S. Naval Academy. Historical evolution and several different arranged Rankine cycles can be demonstrated quickly in classroom. Objectives for improvements, constraints, and consequently design, which can not be easily accomplished via conventional teaching, are emphasized. ICAI evokes the intellectual curiosity of students and increases their interests and design abilities in thermodynamics.

WU, Chih, Professor, "Finite Time Thermodynamic Performance of a Dual Cycle," International Journal of Energy Research, (in press).

Finite-time thermodynamic analysis of an air-standard internal combustion Dual cycle is performed in this paper. The relationship between the net work output and efficiency of the cycle is derived. The maximum net work output and the corresponding efficiency limit of the cycle with heat transfer considerations are found. Detailed numerical examples are given. The results obtained herein provide a guide to the performance evaluation and improvement for practical internal combustion engines.

WU, Chih, Professor, "Effect of Heat Resistance on the Performance of Closed Gas Turbine Regenerative Cycles," International Journal of Power and Energy Systems, (in press.)

The effect of heat resistance on the performance of a closed gas turbine regenerative cycle is examined. The analysis focuses on the heat resistances associated with the hot and cold side heat exchangers as well as with the regenerator of the cycle. The relationships among power output, thermal efficiency and compressor pressure ratio are derived by considering the irreversibilities of heat resistance losses in the three heat exchangers and non-isentropic power losses in compressor and turbine. The results indicate that the power output of the cycle is strongly dependent on the effectivenesses of the three heat exchangers. It is concluded that there exists some optimal temperature matching among the working fluid of the cycle and the working fluid of the surrounding heat reservoirs for maximum power production.

WU, Chih, Professor, "Intelligent Computer Aided Design, Analysis, Optimization and Improvement of Thermodynamic Systems", pp. 437-444, Thermodynamic Optimization of Complex Energy Systems (Book editors: A. Bejan and E. Mamut), Kluwer Academic Publishers, Netherland, 1999.

An artificial intelligence technique based software for computer aided design, analysis, optimization and improvement of thermodynamic systems is described. This paper describes the implementation of the software into the engineering curriculum at the U.S. Naval Academy. It is concluded that intelligent computer aided instruction teaching and design is not only in the future of education, but will also be an effective design tool for engineering students.

Technical Reports

MORAN, A. L., Associate Professor, Midshipman Catherine Westover, USN, and Midshipman Britton Smith, USN, "Ceramic Matrix Composites Evaluation", USNA Engineering and Weapons Report EW-05-98, June 1998.

An overview of the current literature concerning composites and composites testing was done to determine the advantages and problems associated with mechanical testing of high temperature composites, with an emphasis on Ceramic Matrix Composites (CMC). The literature indicated that mechanical testing of ceramic composites is difficult and costly due to the brittle nature of the materials, their anisotropic properties and the time-consuming fabrication and machining processes. It would be advantageous to

define a simple, cost-effective screening test to assess mechanical strength. A simple 3- point bend test was utilized in conjunction with Archimedes density measurements and scanning electron microscopy to determine the effect of fiber architecture, CMC structure, and specimen orientation on specimen strength. It was found that an increased amount of fiber pullout and running of the cracks indicated and caused a higher fracture stress. Additionally, the methods used for obtaining densities and fracture stress were evaluated and determined to be inconsistent in determining component properties.

MORAN, A. L., Associate Professor and Midshipman Justin Carsten, USN, USNA Engineering and Weapons Report EW-06-98, "Wear Properties of Materials", June 1998

Wear is the damage to a solid surface by the displacement or removal of material by another moving material. There are numerous methods of wear testing, many of which are expensive and time consuming. These techniques generally have four parameters - contact velocity, contact area, contact pressure, and entry angle which can be varied to compare materials and lubricants in a theoretical setting or to simulate an actual mechanical situation. The purpose of this experiment was to develop a low cost demonstrator that can be used to introduce engineering students to the concepts of wear. A device was found that can create abrasive or adhesive wear depending on materials. The unmodified device is simple and inexpensive as provided, but results were difficult to quantify. Modifications were made to the basic equipment to control experimental variables and make the experiment quantitative. Also, a process was developed for testing which improves repeatability and precision.

MORAN, A. L., Associate Professor and Midshipman Sarah Self, USN, "Copper Processing in the Late 1700's: HMS DeBraak Reveals History", Engineering and Weapons Report EW-15-98, December 1998.

The Delaware State Museums, De Braak Hull Committee, contacted the U.S. Naval Academy as a research institute to help in the conservation of the De Braak's hull, a British vessel which sunk off the Delaware shore in the late 1700's. In conjunction with an effort involving compositional analysis performed by the USNA Physics Department, the Mechanical Engineering Department's Materials Lab performed optical and electron microscopy in an effort to determine the processing methods utilized to form the ship's fittings.

RATCLIFFE, C. P., Associate Professor, "Correcting a Significant and Consistent Error in the Modal Damping Obtained Using Transient Vibration Data," USNA Engineering and Weapons Report EW-2-98, 1998.

This report investigates the experimental vibration technique of impact excitation when used to obtain frequency response functions. It is shown that current practices introduce a consistent error in the derived modal damping estimates. The error can be significant, with levels of damping being wrongly predicted by a factor of three or more. The report identifies the source of the error. It then derives and presents a simple correction to be applied to the observed modal damping estimates. The procedure is demonstrated by experiment.

RATCLIFFE, C. P., Associate Professor and Crane, R. M., "Mechanical Vibration Testing Results of Acoustic Test Panels,", NSWCCD-65-TR-1998/20, December 1998.

This report describes the mechanical vibration testing of two graphite reinforced composite plates. The plates were tested in a free-free boundary condition up to a frequency of approximately 6 kHz. The plates were designed to assess two different damping treatments. They consisted of a 1.37 inch thick carbon epoxy structural section with a 0.13 inch thick region on one side for each treatment. One plate used a conventional constrained layer design, while the other used a thin free layer of fiber reinforced urethane. The results showed that while the constrain layer damped plate has a higher energy dissipation potential, it also has a reduced stiffness. There is also some localized modal behavior, which suggests it may also be reduced in strength.

RATCLIFFE, C. P., Associate Professor, Crane, C. P., Capone, D., and Koudela, K.. "Standardized Procedure for Experimental Vibration," NSWCCD-65-TR-1998/21.

The experimental determination of structural or material damping as a function of frequency can be a complicated task. The observed values can apparently change between experiments. This report includes a

proposed standardized test procedure which aims to reduce these variations in modal damping. The standard focuses on four main area where variations in test procedures can introduce differences: a) preparation and support of the structure; b) selection, preparation and use of transducers and equipment; c) setting up the analyzer; and d) data analysis and reduction.

RATCLIFFE, C. P., Associate Professor and Crane, R. M., "A Comparison of the Dynamic Performance of Two Full-Scale Cylindrical Structures," NSWCCD-65-TR-1998/22.

This report present the results of modal testing of two composite cylinders with metallic end joints. Both the cylinder and the end joints were designed as part of an effort to provide a submersible system which has low acoustic signature. The cylinder design was previously tested without end joints. In addition, the composite joint design was previously tested but only in a one dimensional form. This effort experimentally determines the modal response and damping performance of a full-scale submersible section which could be retrofitted into an existing underwater vehicle. In addition to the damping of the cylinder system, the transmissibility was also measured. The modal technique used provided data of high quality. The custic performance of the new configuration resulted in improvements in both transmissibility and damping over an existing submersible system, Orion.

Presentations

BARTON, Oscar, Jr., Associate Professor, "Approximate Methods for Composite Structural Mechanics," Army Materials Lab, Aberdeen Proving Ground, Aberdeen, MD, January 1999.

BARTON, Oscar, Jr., Associate Professor, "Computer Methods in Composite Mechanics," Howard University Graduate Student Seminar, Washington, DC, March 1999.

BURKHARDT, John, Assistant Professor, "Structural Damage Identification Using Free Decays," 136th Meeting of the Acoustical Society of America, Norfolk, VA, October 1998.

BURKHARDT, John, Assistant Professor, "Characterization of Complex Systems from Inverse Radiative Transfer Measurements," 137th Meeting of the Acoustical Society of America, Berlin, Germany, March 1999.

BURKHARDT, John, Assistant Professor, "Diffuse Wave Mechanics: Theory and Application," University of Maryland, College Park, MD, May 1999.

FLACK, Karen, A., Associate Professor, Pruitt, B., Callari, M. J., "Velocity Measurements in the Flow Around a Rotating End Mill,," ASME Fluids Engineering Division Summer Meeting, Washington, DC, June 22-25, 1998.

FLACK, Karen, A., Associate Professor, Saylor, J. R., Smith, G. B., "Surface Temperature and Subsurface Velocity Near a Free Surface," 51st Annual Meeting American Physical Society Fluid Dynamics Division, Philadelphia, PA, November 22-24, 1998.

JOYCE, James A., Professor, "Application of Master Curve Technology to Biaxial and Shallow Crack Fracture Data for A533B Steels," 19th International Symposium on Effects of Radiation on Materials, ASTM E10, Seattle, WA, June 10-13, 1998.

JOYCE, James A., Professor, "Development of Consistent Size Criteria for ASTM Combined Fracture Mechanics Standards, 30th National Symposium on Fatigue and Fracture, ASTM E08, St. Louis, MO, June 22-25, 1998.

JOYCE, James A., Professor, "Evaluation of the Proposed ASTM Normalization Method Using ASTM Round Robin Data and Other Data," ASTM E08.08.02 Task Group Meeting, ASTM Committee Week, Seattle, WA, May 17-19, 1999.

LINK, Richard E., Assistant Professor, "Guidelines for Measuring the Fracture Toughness of Shallow Cracks - Proposed Appendix for ASTM E1820," presented at Task Group E08.08.02, 1998 ASTM Fall Committee Week, Norfolk, VA, November 3, 1998.

MINER, Steven M., Associate Professor, "Evaluation of Blade Passage Analysis Using Coarse Grids," presented at the U.S.-Japan Seminar on Abnormal Flow Phenomena in Turbomachines, Osaka, Japan, November 1998.

MINER, Steven M., Associate Professor, "Evaluation of Blade Passage Analysis Using Coarse Grids," presented at the 3rd ASME/JSME Joint Fluids Engineering Conference, San Francisco, CA, July 1999.

MINER, Steven M., Associate Professor, "Complementary Usage of Mathematica and IDEAS in Mechanism Design," presented at the ASEE Annual Conference, Charlotte, NC, June 1999.

MORAN, Angela L., Associate Professor, "Incorporating Design Aspects into Materials Engineering Curriculum," ASEE Regional Meeting, Howard University, Washington, DC, November 1998.

MORAN, Patrick J., Professor, David A. Shifler and Jerome Druger, "Passivity and Breakdown of Passivity of 1018 Carbon Steel in PC-DME-H20 Mixtures," 194th Meeting of the Electrochemical Society, Boston, MA, November 1998.

MORAN, Patrick J., Professor, D. A. Shifler and J. Kruger, "The Influence of Water on Passivity and Breakdown of Fe, Ni, and Ferrous Alloys in Organic Solvent Solutions, 8th International Symposium on the Passivity of Metals and Semiconductors, Jasper Alberta, Canada, May 1999.

MORAN, Patrick J., Professor, "A Brief Review of Past Work Plus Recent Work on Urethane Coated Propellor Technology," 1999 Jerome Kruger Award presentation, NACE International Meeting, Washington, DC, June 17, 1999.

MORAN, Patrick J., Professor, Ensign Brandon W. Davis, USN, and Paul M. Natishan, "Metastable Pitting Behavior of Single Crystal Surfaces of Pure Aluminum," 194th Meeting of the Electrochemical Society, Boston, MA, November 1999.

PALMER, Sheila, C., Assistant Professor, "Research Interests," Meeting with University Maryland, Thermal Sciences Faculty, College Park, MD, May 14, 1999.

PUZINAUSKAS, Paulius V., Assistant Professor, "Engine Combustion Analysis Demonstration, Advanced Engine Technology Conference," Superflow Corporation, Colorado Springs, CO, December 14-15, 1998.

RATCLIFFE, Colin, Associate Professor, "Locating Damage in Beams Using Experimental Broadband Vibration Data,' VibroAcoustic Characterization of Advanced Materials and Structures, International Mechanical Engineering Conference and Exposition, American Society of Mechanical Engineers, Anaheim, CA, November 1998.

RATCLIFFE, Colin, Associate Professor, "Low-Cost, Large-Scale Composite Manufacturing for Naval Structures," International Conference on On-Line Sensing and Control for Liquid Molding of Composite Structures, ONR and advanced Materials Intelligent Processing Center (AMIPC) University of Delaware, Annapolis, MD, April 14-15, 1999.

VOLINO, Ralph J., Assistant Professor, Flack, Karen A., Associate Professor, and Niewoehner, R. J., "Presentation of Research Capabilities and Interests in Fluid Mechanics and Heat Transfer at the U.S. Naval Academy," Aerodynamics Competency Branch, NAVAIR, Patuxent River, MD, December 3, 1998.

VOLINO, Ralph J., Assistant Professor, "Boundary Layer Separation and Transition Under Low-Pressure Turbine Conditions," Seminar for the Laboratory for Computational Physics, NRL, Washington, DC, April 12, 1999.

VOLINO, Ralph J., Assistant Professor, "Research Interests and USNA Facilities," presented to the Mechanical Engineering Department at the University of Maryland, as one of several presentations by USNA and University of Maryland Mechanical Engineering faculty, College Park, MD, May 14, 1999.

WU, Chih, Professor, "Intelligent Computer Aided Design, Analysis, Optimization and Improvement of Thermodynamic Systems," pp. 99-107, Proceedings of NATO Advanced Study Summer Institute of Thermodynamics and the Optimization of Complex Energy Systems, Neptun, Constantza, Romania, July 13-14, 1998.

WU, Chih, Professor, "Intelligent Computer Aided Design of Geothermal Plants," pp. 2713-2717, Part IV, Proceedings of World Renewable Engress V. Florence, Italy, September 20-25, 1998.

WU, Chih, Professor, "Intelligent Computer Aided Design, Analysis, Optimization and Improvement of Combined Cycles," pp. 63-66, AES Volume 38, Proceedings of the ASME Advanced Energy Systems Division, International Mechanical Engineering Congress and Exposition, Anaheim, CA, November 15-20, 1998.

DEPARTMENT OF

Naval Architecture, Ocean and Marine Engineering

Professor Bruce C. Nehrling
Chair

All three departmental disciplines in the Naval Architecture, Ocean and Marine Engineering Department were active in scholarly research and professional development during the 1998-99 Academic Year. As faculty members and midshipmen undertook both funded and unfunded research activities, significant use was made of the outstanding experimental, computational, and library facilities available to this department. The department supported two Trident Scholars and eighteen independent

research projects during this academic year.

The department's faculty continues to participate actively in professional meetings and conferences, both nationally and internationally. They published in professional journals and other technical publications and presented research results at national and international symposia. An energized and current academic environment for both core and major courses is but one outcome of this department's broad and significant involvement in research.

The broad spectrum of research themes reflects the varied specialties of the department's three technical areas of concentration.

• Naval Architecture topics included the study and experimental testing of compressive loads on composite panels - including ultimate strength and failure characteristics, the durability of marine composites, the ultimate strength of stiffened steel panels under combined loads, and the conceptual design of a human powered hydrofoil. Experimental predictions of propeller performance and experiments involving the powering and seakeeping characteristics of trimaran hull forms were conducted in the Hydromechanics Laboratory.

• Ocean Engineering topics included the study of wave groups, modeling of extreme waves - both in random seas and against coastal structures, experimental testing of floating structures, and developing wind and flood loading factors for fixed structures. In materials and structures, research projects dealt with the effect of defects on the ultimate strength of composite panels, the analysis of adhesively bonded composite joints, the flaw criticality of GRP sandwich panels, fiber steering techniques for lightweight composite structures, retrofitting reinforced concrete beams with composite skins, and structural adhesives in ship construction. Other projects involved thermal protection of divers during deep diving operations, experiments on the resistive breathing effort associated with underwater breathing apparatus, safety and engineering aspects of ship navigation channel design and maintenance, and the analysis of toxins in near shore sediments.

• Marine Engineering topics included propeller cavitation noise, advanced ideas for nuclear propulsion plants, simulated reactor performance, power sources for unmanned undersea vehicles, reduction of emissions from marine power plants, combustion of shipboard solid wastes, heat pipe design, and the continued study of thermophotovoltaic direct energy conversion systems. Other research included the study of radiation effects on DRAM devices, photon and neutron responses of various LiF thermoluminescent detectors, hazardous waste remediation, reliability-centered maintenance procedures, and neural network applications to econometric problems.

Research funding was made available from many sources including department operating funds, the Trident Scholar Program, and contracts and grants from the Office of Naval Research; the Dahlgren, Panama City, and Carderock offices of the Naval Surface Warfare Center; the Naval Sea Systems Command; the Naval Dosimetry Center; the National Science Foundation; the U.S. Army Corps of Engineers and the Institute for Water Resources; the American Society of Civil Engineers; the Department of Energy and the Knowles Atomic Power Laboratory; the Naval Research Laboratory; the Naval Facilities Engineering Services Center; the Applied Physics Laboratory; the American Bureau of Shipping; 3M; and the Society of Naval Architects and Marine Engineering.

Sponsored Research

The Analysis of Cavitation Noise from a Propeller

Researcher: Associate Professor Martin R. Cerza
Sponsors: Naval Surface Warfare Center, Carderock Division (NSWCCD) and Office of Naval Research (ONR)

The purpose of this investigation is to resolve the sound spectra emanating from two different sound sources during the cavitation of a ship's propeller. The first source is the growth and collapse of vapor bubbles on the propeller surface. The second source is the entrainment of air bubbles into the propeller flow field and consequent oscillation due to the turbulent eddies present. The program is to establish mathematically the difference in sound spectra, and then confirm experimentally with the aid of a water column made to cavitate. The results will then be compared to propulsor data taken from various NSWC sea tests.

Evaluation and Design of Heat Pipes for High Temperature Applications

Researchers: Associate Professor Martin R. Cerza and Professor Keith W. Lindler
Sponsor: Department of Energy (DOE)

The United States Naval Academy is tasked with the design and fabrication of a flat heat pipe to demonstrate the feasibility of its use as an emitter for a thermophotovoltaic (TPV) energy converter. The USNA team designed, constructed and tested a flat heat pipe. Preliminary results show that it does have promise as an emitter for TPV applications. Its feasibility for TPV cell cooling is also being investigated.

Wave Groups and Wave Breaking in Random Seas

Researcher: Professor Thomas H. Dawson
Sponsor: Office of Naval Research (ONR)

Wave groups in random deep-water waves are being studied experimentally using the Naval Academy's 380 foot wave/towing tank. Results to date have been compared with theoretical work that accounts for nonlinear effects on crest amplitudes. Recent work has been concerned with investigation of wave-group statistics derived from Markov theory for wave runs. Most recent work has been concerned with the effects of breaking waves on group statistics. The work is continuing under ONR sponsorship.

The Design and Construction of a High Temperature Photon Emitter for a Thermophotovoltaic Generator

Researchers: Associate Professor Mark J. Harper (PI) and Professor Keith W. Lindler
Sponsor: Department of Energy (via Knolls Atomic Power Laboratory (KAPL))

The United States Naval Academy was tasked with the design and fabrication of a combustor/emitter which is compatible with a DOE furnished thermophotovoltaic (TPV) power module.

The USNA team (Professors Harper and Lindler, as well as several previous Trident Scholars) designed and constructed an emitter module that was attached to the T-58 gas turbine and tested in August 1998. The results demonstrated that the theoretical model adequately predicted the thermal profile of the high temperature photon emitter. Data also supports using a similar gas-to-gas heat exchanger as the source of photons for use in TPV direct energy conversion schemes.

Characterization and Remediation of Thorium Contaminated Soils at Sites Within Kirtland Air Force Base

Researchers: Professor Martin E. Nelson (PI) and Associate Professor Mark J. Harper
Sponsor: Naval Research Laboratory (NRL)

Eight sites at Kirtland Air Force Base (KAFB) have been intentionally contaminated with Th-232 compounds in order to provide realistic training scenarios for Defense Department personnel. In response to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), KAFB has initiated an Installation Remediation Program (IRP) for complete environmental restoration. Before remediation can commence it is necessary to fully characterize the contaminated soil, with particular emphasis on geophysical analysis and relationships between soil grain size and radionuclear content. Following this analysis various remediation methods will be proposed.

Characterization of the Interservice Nuclear Weapons School (INWS) Site at Kirtland Air Force Base (KAFB)

Researchers: Professor Martin E Nelson, Associate Professor Mark J. Harper and R. August (NRL)
Sponsor: Naval Research Laboratory (NRL)

This project involves performing site characterization at four sites formerly utilized by the Interservice Nuclear Weapons School (INWS). The sites were contaminated with thorium, in order to provide training to DoD personnel who would then be available to respond to a potential nuclear emergency. The project involves performing geophysical and chemical tests, as well as soil sample collection and analysis at the four sites. Following sample collection, radionuclide analysis was performed by gamma spectroscopy. In addition, the collected soil samples were sieved in order to determine if there is a higher concentration of the contaminant in a given particle size. A chemical analysis was also performed in order to determine if various non-radioactive contaminants are present, and hence if a mixed waste problem exists at the sites. The project will continue through the upcoming intersessional period in order to develop recommendations to Kirtland AFB personnel concerning potential future remediation actions that may be required to properly restore the sites. A final report was issued in November 1998.

Two presentations have been given at technical conferences on the results obtained by the project. The first conference presentation, which was entitled "Characterization of Thorium in Soil at the INWS" was presented to the 1998 annual Health Physics Society meeting in July, 1998 in Minneapolis, Minnesota. The second presentation, which was entitled "Environmental Remediation Research" was presented at the 1998 Symposium on Radiation Measurements and Applications in May, 1998 in Ann Arbor, Michigan. A journal article entitled "Mixed Waste Characterization in Soil," was published in 1999 in Nuclear Instruments and Methods in Physics Research (Section A).

Advanced Concepts for Naval Nuclear Propulsion Plants

Researcher: Associate Professor Mark J. Harper
Sponsor: Knolls Atomic Power Laboratory (KAPL)

Various designs of thermophotovoltaic direct energy conversion devices were evaluated and tested. Some innovative energy conversion methodologies using heat pipes for transport of heat were studied. Research continues on an advanced energy delivery system that is capable of supplying power for submersibles of various sizes, from small unmanned vehicles to full-size submarines. Particular attention is paid to integration of advanced propulsion schemes with the vision outlined by the Joint Chiefs of Staff ("Joint Vision 2010") and the Department of the Navy ("Forward...From the Sea) documents, as well as other high level guidance from the Defense Department, including that specified in the Defense Science Board's special task force, "The Future of the Submarine."

Development of Load Factors for Combined Wind and Flood Events

Researchers: Professor David L. Kriebel and Professor Gregory J. White
Sponsor: American Society of Civil Engineers (ASCE)

In this project, load factors for coastal wind and flood loading on buildings are derived for inclusion in the American Society of Civil Engineers (ASCE) Standard ASCE-7-98 "Minimum Design Loads for Buildings and Other Structures," a peer-reviewed set of building standards that can be incorporated into local, state, and national building codes. The design of both residential and commercial buildings is increasingly based on a load and resistance factor design (LRFD) format in which each type of load on the building, *e.g.*, dead load, live load, wind load, etc., is multiplied by a unique partial safety factor to account for the statistical variability and uncertainty in the load. This is in contrast to the more traditional working stress design approach in which a single factor, termed a factor of safety, is applied to the sum of all loads acting on the building. At present, the ASCE building standards do not account for flood loads, nor do they account for the simultaneous occurrence of extreme wind and flood loads. This project involves three major phases: (1) the development of a national database on simultaneous wind and flood events for hurricanes in coastal regions, (2) the development of a database on simultaneous wind and flood loadings on buildings in coastal regions, and (3) the development of load factors to account for the statistical variability in extreme wind and flood loads.

Model Testing of a Mobile Offshore Base Module

Researchers: Professor David L. Kriebel and Louise Wallendorf (Hydromechanics Laboratory)
Sponsors: Office of Naval Research (ONR) and Naval Facilities Engineering Services Center

This project involved small-scale physical model testing of one semi-submersible module of the Mobile Offshore Base (MOB), a future-generation floating air base currently being investigated for its technical feasibility. The overall MOB platform considered in this project would be about 5000 feet long, 400 feet wide, with a total height from keel to deck of about 250 feet. The structure would consist of five modules linked end-to-end. Each module would be a semi-submersible floating platform, 1000 feet long and 400 feet wide, with a draft of about 40 feet when transiting across the ocean and a draft of about 100 feet when ballasted down for air take-off and landing operations. If constructed, this structure would be much larger than

any semi-submersible platform now in use.

The USNA research effort involved two distinct phases: (1) construction of a scale model of a single module of the MOB platform and (2) testing of this model in the large wave/towing tank located in the Naval Academy Hydromechanics Laboratory. The purpose of these tests was to evaluate the dynamic motions of such a large semi-submersible in heave, pitch, and roll, specifically in the transit condition. The MOB model was built in the Technical Support Division (TSD) shops in Rickover Hall during the summer and fall of 1998. The model was built using a scale ratio of 1-to-70, and was thus more than 14 feet long, almost 6 feet wide, and about 3.5 feet high. Initial testing was performed in January 1999 with the model held stationary in the wave tank, and additional tests were completed in March 1999 with the model towed at various forward speeds. In each set of tests, severe ocean sea states were simulated and the resulting motions of the platform were recorded. Results of these tests are being analyzed during the summer of 1999 and will be presented at the Very Large Floating Structures Conference in September 1999.

Durability of Marine Composites

Researcher: Assistant Professor Paul H. Miller
Sponsors: American Bureau of Shipping, TPI, Maricomp (materials only)

This project is part of the investigator's doctoral research and focuses on the fatigue durability of fiberglass (e-glass/polyester) marine composites. These materials have been commonly used to construct hulls, decks and superstructures of small craft for the last three decades. Recently the Navy and others have constructed larger craft with these materials but concerns exist whether the methods developed to predict fatigue effects are accurate.

To validate these methods this project looks at standard coupon test results and compares them with proposed panel test methods. The comparisons include both physical and numerical (finite element analysis) methods. Long-term exposure to the marine environment moisture effects are also tested and simulated. Additionally, the coupon and panel results are compared to full-size vessel tests. Results during the January 1999 - June 1999 period include transferring the materials and models from the University of California at Berkeley to the Naval Academy, correlation of the USNA test equipment, continued moisture exposure, design and construction of the compression and panel test jigs, testing of coupons, development of the finite element models and preparation for the on-the-water tests. Additional time was spent incorporating the findings into the draft dissertation. The project will continue through the summer on a Naval Academy Research Council (NARC) grant and will conclude in the fall.

Flaw Criticality in Glass Reinforced Plastic (GRP) Sandwich Panels

Researcher: Associate Professor Sarah E. Mouring
Sponsor: Naval Surface Warfare Center, Carderock Division (NSWCCD)

A study to quantify the defects of glass reinforced plastic (GRP) panels was performed. In the past, these effects have not been quantified adequately in Navy ships. The use of composites in Navy ship design is expected to expand in the future. Therefore, this study will be beneficial to the Navy's interest. For this study, the Ship Structures Laboratory at the U.S. Naval Academy was utilized to conduct the testing. Forty-two panels were tested under in-plane compressive forces using the Panel Test Fixture. Five panels were baseline panels and the other ones had structural defects such as disbonding of core and skin or impact

damage. The panels were sandwich construction with balsa or foam cores with dimensions of 3 feet by 4 feet. Testing was completed by Winter 1999. Strength and stiffness data were collected which will allow a comparison between the baseline values and the values of the panels with defects.

Behavior of Composite Joints Adhesively Bonded Using an Innovative Joining Method

Researcher: Associate Professor Sarah E. Mouring
Sponsor: National Science Foundation (NSF)

Adhesive structural joints are typically formed by applying a bead of adhesive to one surface of a structural part or panel and placing a second structural part or panel onto the adhesive bead, compressing it to cover all or most of the joint surface. The joint is then usually secured by clamping until the adhesive has cured; this curing process can take many hours, often overnight. Structural adhesive tape (similar to double-sided carpet tape) is also used to make structural joints, however it is usually of much lower strength than the adhesive joint described above. Adhesive tape also can be used to secure a joint while a liquid adhesive cures. The proposed method is a different combination of liquid adhesive/adhesive tape technology, involving the use of adhesive tape to temporarily secure and to create a channel between structural parts to be joined. The liquid adhesive is then pumped into the channel to form a permanent bond. This allows multi-part structures to be "tacked" together quickly, checked for accuracy, and then permanently bonded later by injecting the adhesive. The method eliminates adhesive drips and spills, provides a more consistent bond-line, and uses less adhesive (typically an expensive commodity). It also significantly reduces the amount of labor involved in bonding the parts. This research is to develop and evaluate this new joining method.

The research plan involves both experimental and analytical research. As part of the development and evaluation of the proposed joining method, analytical procedures are being developed to model several different joint configurations. These models are being used to optimize joint designs. Experimental tests are being preformed to validate the analytical models. In the final year of the grant, analytical and experimental research will be performed on the current joining method used in Civil Engineering, and compared to the results of the proposed method. Also, guidelines on testing joints bonded using the new method will be suggested.

Fiber Steering for Lightweight Affordable Composite Structures

Researchers: Associate Professor Sarah E. Mouring (Naval Architecture, Ocean and Marine Engineering Department), Associate Prof Oscar Barton (Mechanical Engineering Department), Professor Gabriel N. Karpouzian (Aerospace Engineering Department), and Associate Professor Michael Mackney (Aerospace Engineering Department)
Sponsor: Office of Naval Research (ONR)

The objective of the program was to develop an integrated design for manufacturing/fiber steering

capability for fiber placement that will achieve optimum structural efficiency while producing affordable primary aircraft structure. In the Summer of 1998, technical support was provided for several aspects of mechanical behavior and testing of composite structures containing non-unidirectional fibers. The research effort was organized into two main focus groups; theoretical methods and experimental methods. The theoretical study included performing a literature survey, investigating current models, and investigating current failure models. The experimental study included an assessment of proposed experimental methodology, coupon specimen testing, and investigating empirically-based modeling. Testing will be complete by the Summer of 1999. At this time, two technical papers on the results of the research are being prepared.

A Thermal Capacitor for Breath Heating in a Deep Diving System

Researcher: Professor M. L. Nuckols
Sponsor: Naval Surface Warfare Center, Dahlgren Division (NSWCDD)

The goal of this research project is to develop a passive heat capacitor mechanism inside the heat exchanger of a helmet used in saturation diving systems which will allow divers to reach a safe refuge in their personnel transfer capsule (*i.e.*, diving bell) in the event of a heating system failure. Under normal deep diving operations, divers receive a heliox breathing mixture from their personnel transfer capsule. During the gas delivery process, the breathing gas loses a significant amount of heat. In order to prevent life-threatening, cold-induced asthma which would result by breathing cold, dense helium-rich mixtures, the gas must be rewarmed to at least 60°F prior to being inhaled by the diver. A thermal capacitor is being designed and tested to satisfy this gas warming function as a backup in the event of failure of the existing gas heating systems. While several options exist for the design, a phase change material looks most promising. Major consideration is being given to design this backup capability without sacrificing the performance of the existing primary gas heating system.

Reliability Centered Maintenance

Researcher: Associate Professor Kenneth L. Tuttle
Sponsor: Naval Sea Systems Command, Surface Ship Maintenance Office (NAVSEA 915)

The Maintenance Engineering Laboratory portion of the Diesel Engine-Room Laboratory was upgraded to MCAS, Machinery Condition Assessment System, from the DEMA, Diesel Engine Monitoring and Analysis System several years ago and is currently being upgraded to ICAS, the Integrated Condition

Assessment System. Upgrading to ICAS will bring the Naval Academy Maintenance Engineering Laboratory up to the level of Diesel Engine Monitoring and Analysis found in the fleet. The ICAS components and hardware include a computer that has been placed in the budget and ICAS software that will be added as an upgrade when the computer upgrade arrives. The system has an OPTO22 electronic data acquisition devices for slow speed A/D conversion at 1Hz and an IDAX100 high speed data logger and an A/D converter operating at 50kHz for vibrations and cylinder firing pressures analyses. Recent upgrades allow operation of the DEMA System on the GM 3-71 Diesel Engine/Generator Set using a Personal Computer. The IDAX 100 computer which controls data acquisition, monitors alarm conditions, makes log sheets, maintains trend analyses and offers some expert system capability has a unique operating system. The new PC Interface has made a dramatic improvement in the quality of the instruction being given the midshipmen in modern maintenance concepts. The diesel engine has been modified to allow measurement of cylinder firing pressures. Also, a probe to allow vibrations analysis on the engine and nearby equipment has been added to the basic DEMA System.

Environmental Text

Researcher: Associate Professor Kenneth L. Tuttle
Sponsor: Society of Naval Architects and Marine Engineers (SNAME)

The Environmental Panel of SNAME, in a joint effort with the Environmental Engineering Committee of American Society of Naval Engineers (ASNE), is writing a reference text: The Principles of Environmental Design and Operation of Ships.. Planning for the text has progressed and three additional members have been appointed to the Environmental Committee. The text will be a comprehensive review of the environmental problems recognized to exist aboard ships as well as the technology available to treat those environmental problems and the regulations pertaining to marine pollution. The effort was extended to include participation by the ASNE Environmental Division to help plan the text, to increase the pool of authors and to increase the justification for such a text.

Impacts of Navigation Trends on Channel Usage and Design

Researchers: Assistant Professor Jennifer K. Waters,
Professor David L. Kriebel and Associate Professor Robert H. Mayer
Sponsor: U.S. Army Corps of Engineers Institute for Water Resources (IWR)

The goal of this ongoing research study is to improve the design and maintenance of navigation channels in order to achieve economic efficiency, reliability, and safety of shipping operations. Specifically, the study aims to investigate how changes occurring in the international shipping industry may impact the Army Corps of Engineers' design and maintenance of its channels. The study is also concerned with how navigation trends on channel usage may contribute to safety, piloting, and maintenance problems.

A critical element in the work unit is an updated review of both domestic and international practices for the design and maintenance of navigation channels. Existing design practices used within the Corps of Engineers are summarized in the Engineer Manual (EM) 1110-2-1613 published in 1983. Given the rapidly changing vessel characteristics of the international shipping fleet, an update of the Corps' design practices may be warranted to ensure U.S. competitiveness in the international shipping industry into the next century. A key first-step in updating these practices is to complete an extensive review of current and future vessel design trends in conjunction with advances in navigation channel design during the past 15 years in both the U.S. and abroad.

Another critical element of the work unit is an investigation into how channels are actually being maintained and utilized, after the design process has been completed. This part of the study must incorporate an analysis of channel accident data, with specifics of vessel navigation and dredging operations. This effort is important since it is well-recognized that navigation channels are not necessarily maintained or utilized as they were originally designed.

This research effort is at approximately its midpoint, with about half of the associated interim tasks completed or near completion.

Marine GRP Sandwich Panel In-Plane and Out-of-Plane Testing

Researcher: Professor Gregory J. White
Sponsor: Johns Hopkins University Applied Physics Laboratory (JHU/APL)

This project continued work begun in 1997 on the strength of various configurations of composite panels under inplane and lateral loads. During the period of this report, ten 4-ft and two 6-ft panels were tested to destruction. The 4-ft panel tests included five balsa-cored panels and two foam-cored panels tested under inplane loads only. Three of the 4-ft panels were tested, first under lateral pressures up to 16 psi and then under a constant lateral pressure of 5 psi with inplane load applied until destruction. The two 6-ft panel tests were balsa-cored panels under inplane loads only.

The strain records from up to 21 installed gages and deflection measurements from 7 locations were recorded along with the applied load. Analysis of the data with plotted results were provided along with the data files. Each test report included still photographs and in some cases digital video photography.

Effect of Mechanical and Manufacturing Defects on the Ultimate Strength Marine Composite Panels

Researchers: Professor Gregory J. White and Associate Professor Sarah E. Mouring
Sponsor: Naval Surface Warfare Center, Carderock Division (Code 6552)

During the period of the report, fifteen 3' x 4' composite sandwich panels with embedded defects (9 with skin-to-core disbonds, 6 with impact damage) were tested in the USNA Ship Structures Laboratory grillage test fixture to determine the effects of defects on panel structural integrity under compressive end loading. This work is in support of ongoing efforts by the Survivability, Structures, & Materials Directorate, Structures and Composites Department, Marine Composites Branch, Mechanics Section of the Naval Surface Warfare Center, Carderock Division.

Transport and Transformation of Navy Relevant Toxic Pollutants in Nearshore Marine Sediments

Researchers: R. Mehta, M. Misra, and J. Seiber (University of Nevada - Reno)
and Assistant Professor Jennifer K. Waters
Sponsor: Office of Naval Research (ONR)

The harbor areas used by Naval operations are considered to be extreme environments because of the dynamics of flow, resuspension of sediments and the extreme solution chemistry imposed by salt water. Interplay of these conditions control the co-adsorption of organic and inorganic pollutants onto the sediments. The resultant inorganic and organometallic compounds and the microencapsulation of sediment/metal/organic create a perpetual problem for remediation and natural attenuation of toxic pollutants.

In order to develop an effective in-situ or ex-situ strategy, it is necessary to understand the mechanisms of adsorption, speciation and transformation of pollutants in the harbor environments. In addition, the sediment resuspension, transport and dispersal of pollutants also need to be investigated. A fundamental study of these processes will provide insight into natural attenuation, remediation, monitoring, and risk assessment of the marine sediments. On the basis of this information, a cost-effective and compliance-based remediation strategy can be developed.

It is proposed to study the co-adsorption/desorption of heavy metals (Cu, Zn, Cr, Cd, Pb and Hg) onto sediments in the presence and absence of organic compounds (PAH and PCB's), in both stagnant and stirred conditions simulating the sediment environment. The growth kinetics and dispersive transport of microencapsulated metal-organic-sediment products will be studied in the water column under dynamic conditions.

The proposed objective will be achieved by conducting a series of six sequential tasks: 1)perform microenvironmental characterization of the three real sediments procured from the three broad naval contamination areas (dredged remediation site), leaking underground storage site and in-situ remediation site which will help establish base-line conditions of the physical, chemical and biological parameters of each of these environments; 2) perform flocculation, deposition and resuspension studies; 3) understand adsorption/desorption mechanisms of heavy metals in a simulated base-line sediment environment; 4) understand binding mechanisms of organic pollutants in a simulated base-line sediment environment; 5) develop partitioning mechanisms of Navy relevant pollutants in a simulated base-line sediment environment, and 6) develop dynamic metal partitioning and transport models and verify the predictions by performing experiments in a settling column. The research will involve analytical techniques, modeling and computational work.

Independent Research

Pollution from Ship Stack Emissions

Researcher: Associate Professor Kenneth L. Tuttle

The purpose of this research is to determine whether stack emissions from ships can be effectively reduced by modifications to the combustion process or by adding end-of-pipe devices and whether the exhaust emissions should be regulated either nationally or internationally. Written input has been submitted to the Environmental Protection Agency (EPA) in an attempt to convince the United States not to regulate ship exhaust emissions, and especially not Navy ships, as they burn low sulfur fuel already and most have engines that produce low oxides of nitrogen. Results of this research have been presented to SNAME, the Society of Naval Architects and Marine Engineers. One paper is included in a book titled, "Ship Design and Operation in Harmony with the Environment," a SNAME Publication. A second paper has been published in the Proceedings of the Maritime Environmental Symposium '95 by the American Society of Naval Engineers, ASNE. A paper was presented at the 1998 SNAME Annual Conference that will be published in its Transactions. This paper is the result of a joint effort that has been developed between SNAME and ASNE.

Combustion of Shipboard Solid Wastes

Researcher: Associate Professor Kenneth L. Tuttle

This area of research is one in which the author has unique expertise and experience. He was appointed to the Naval Studies Board of the National Research Council to study the disposal of solid wastes from ships because of his expertise in the combustion of solid waste fuels. The National Research Council is the principle operating agency of the National Academy of Sciences and the National Academy of Engineering. This research has been investigating the possibility of incineration to destroy shipboard trash rather than dumping at sea. There is world-wide support for burning to destroy shipboard combustible wastes. Most of the combustible solid wastes generated on Navy ships is on ships having incinerators that are being used. The questions are how to use the incinerators effectively and how to improve incinerator design to make it compatible with shipboard use as well as emissions regulations. The author has published data on the emissions from the combustion of solid waste fuels. The data are based on a statistically designed, fractional factorial experiment that includes seven independent variables and seven dependent variables. The experiment includes both unsteady state experiments as well as steady state experiments. A paper was presented to and published in the Proceedings of the 13th International Conference on Solid Waste Technology and Management. A second paper was presented to the 14th Conference in 1998 and also submitted to the Journal of Solid Wastes. The author has several prior publications on the subject of solid fuels, combustion and gasification of solid fuels and combustion generated emissions.

Research Course Projects and Trident Scholar Projects

Extreme Wave Modeling in a Background Random Sea

Researcher: Midn 1/C Maria V. Alsina, USN
Advisor: Professor David L. Kriebel

The goal of this project was to develop a technique for generating extreme or "rogue" waves in the midst of a random sea in a laboratory wave/towing tank. In the past, large waves have been generated in wave/towing tanks with the so-called "transient wave" generation technique in which various wave components, each with a defined amplitude and frequency, are produced by the wavemaker with a specified phase shift such that these waves all arrive at the same time at some location in the tank, thus forming a single large wave. This is unrealistic, however, as the large wave appears by itself and is not preceded or followed by other waves at the measurement location.

In order to obtain a more realistic simulation, this project sought to insert an extreme or rogue wave into a background random sea. This was accomplished by splitting a wave spectrum containing a finite amount of energy into two parts: (a) one part of the spectrum is used to create a background random sea by assigning a random phase to each wave component in the spectrum and (b) the second part of the spectrum (containing the remaining wave energy not accounted for in the random sea) is used to generate a focused transient wave by assigning specific phases to each wave component so that a large wave coalesces at a specific place and time in the tank.

Using this procedure, a total of 39 tests were carried out in the 120-foot wave/towing tank in the Naval Academy Hydromechanics Laboratory in which the wave energy, wave spectra, percentages of energy in either the random and extreme transient waves were varied. Data analysis indicated one surprising and unexpected result: that an extreme wave, whose height is more than two times the significant wave height of the random sea, can be generated with only ten to twenty percent of the wave energy being used to create an extreme wave while the other eighty to ninety percent of the wave energy goes into the random background sea. This suggests that only a small portion of an open-ocean wave spectrum may be responsible for very large rogue or freak waves.

Power Sources for Unmanned Undersea Vehicles (UUVs)

Researcher: Midn 1/C Jason D. Everson, USN
Advisor: Associate Professor Mark J. Harper

The ultimate purpose of the research project was to determine the practicality of powering an unmanned undersea vehicle (UUV) with a nuclear source. The first part of the project was spent researching the different types of unmanned undersea vehicles currently being used in industry and in the Navy. A basic mission profile was established by researching the possible missions UUVs could be used for. Once a basic mission profile was established, different power sources were then examined and compared for optimal efficiency. There were several different power sources studied that could be used to power an autonomous undersea vehicle for an extended period of time. The three main sources studied were rechargeable batteries, fuel cells, and radioisotope thermoelectric generators. The nuclear sources were examined extensively because

they had the greatest possibility of powering a UUV for an extended amount of time before refueling was required. Since power supplies are one of the many limiting factors in the use of UUVs, finding a source that could be used for an extended amount of time would greatly increase the practicality of using UUVs for a variety of different missions.

Use of Radioisotope Thermal Generators (RTGs) as Power Sources for Unmanned Undersea Vehicles (UUVs)

Researcher: Midn 1/C Jonathan J. Kim, USN
Advisor: Associate Professor Mark J. Harper

This independent research project searched for an optimal isotope that might serve as a thermal power source in future unmanned undersea vehicles (UUVs). Ideally such a candidate would exist naturally as a stable element and be capable of neutron activation using existing light water, thermal fission reactors of the sort found in naval applications. Additionally, the activated isotope would have a relatively short half life (for political and environmental reasons) and provide sufficient thermal output to generate the electricity required by typical UUV mission profiles. The project screened isotopes for optimal ones and, using multi-group nuclear reactor neutron diffusion codes, determined the feasibility of using such isotopes for adjuvant submersible vehicle, specifically UUV, power applications. The optimal isotope was determined to be Thulium-169, which activates to Thulium-170 and emits an average of 0.3 MeV per disintegration (beta, 99.87%), with a half-life of 128 days. The result of Thulium-170 decay is stable Ytterbium.

Effect of Armored Structures on Extreme Breaker Heights

Researcher: Midn 1/C Tyler Sewell, USN
Advisor: Professor David L. Kriebel

The purpose of this research project was to validate the Army Corps of Engineers' design guidance regarding selecting the maximum breaking wave height incident on coastal structures. The Army Corps of Engineers' Shore Protection Manual (1984) recommends using a design curve derived by Dr. Richard Weggel in 1972. This curve is used to determine the largest wave that can directly break on a structure in the active beach region. In an effort to evaluate Dr. Weggel's design curve, this project includes (a) an evaluation of the theoretical analysis used to create the design curve, and (b) a series of experiments conducted to test the accuracy of this design curve for determining incident breaking height.

Design, Construction, and Analysis of a Flat Heat Pipe

Researcher: Midn 1/C Britt W. Boughey, USN, Trident Scholar
Faculty Advisors: Professor Keith W. Lindler and Associate Professor Martin R. Cerza
Sponsor: Department of Energy (DOE)

Thermophotovoltaic (TPV) energy conversion utilizes photons from a thermal radiator to convert photonic

energy to electrical energy. Due to the nature of the system, the thermal radiator must emit uniform radiation and therefore maintain a uniform temperature profile in order to achieve maximum efficiency. Heat pipe technology can effectively meet the demand for an isothermal emitter as it utilizes near isobaric phase changes to transfer heat at a uniform temperature. In this project, heat pipes were explored for use in TPV energy conversion systems. A flat heat pipe offers many advantages over the conventional cylindrical design. These include increased surface area to volume ratio in order to maximize power density, as well as the ability to stack or layer the system with photovoltaic (PV) cells on both sides of the flat heat pipe to utilize available energy. Not only do flat heat pipes present unique engineering demands inherent in their operation to counteract pressure differences across their vessel walls, but they are also difficult to construct. To date, only limited analyses of their thermal characteristics have been done for use in performance predictions. Therefore, it is necessary to conduct analyses to enable consideration of heat pipes for implementation into TPV systems. This report details the design and construction of a flat heat pipe analysed both in symmetric and asymmetric heating conditions, involving a low temperature version of future emitter designs due to safety considerations. Water was used as a working fluid instead of the liquid metal required to achieve the temperatures of a functional emitter. Despite this difference in working fluid, the data presented is valuable to both TPV and heat pipe research.

Ductility of Reinforced Concrete Beams Externally Retrofitted with Carbon Fiber Reinforced Polymer Composites

Researcher: Midn 1/C D. Kevin Simmons, USN, Trident Scholar
Faculty Advisors: Associate Professor Sarah E. Mouring
and Associate Professor Oscar Barton (Mechanical Engineering Department)

This study investigated the effect of externally bonded carbon fiber reinforced plastic (CFRP) laminates on the ductility of reinforced concrete beams. Reinforced concrete structures deteriorate over time due to environmental aging, fatigue, excessive loading, chemical attack, and other factors. Strengthening and rehabilitating these concrete structures by externally bonding carbon laminates is one of many economical engineering solutions. Eight rectangular beams with varying internal steel reinforcement were retrofitted with CFRP strips on the tension faces and tested under four-point bending. The beams were instrumented to monitor strains, deflection, and curvature over the entire spectrum of loading, and to determine the structural response of the beams. A computer-based method using strain compatibility and force equilibrium was developed to provide theoretical load-deflection and moment-curvature curves, and a basis for determining ductility and beam failure modes. An existing analytical model using the discrete yield and ultimate values of the load-deflection and moment-curvature curves was modified to an energy-based model and used to predict the ductility of the beams. Numerical results indicated an increase in strength, a decrease in ductility, and validated the analytical model. Ultimately, this study will aid in the development of design guidelines governing the use of CFRP.

Structural Adhesives in Ship Construction

Researcher: Midn 1/C Micah D. Maxwell, USN
Faculty Advisor: Associate Professor Sarah E. Mouring
Sponsor: 3M

Current metal ship, work boat, and yacht construction for above deck cabins typically involves the use of rivets followed by application of a sealant. This construction method is common, but involves the labor intensive process of both tapping holes in panels and structural members for the rivets (typically an 8-10 hour process for a single 10' x 12' panel in commercial construction) followed by the application of a sealant. In addition, it is well known that rivets act as stress concentrators. When welds are used to supplement this process, they provide a potential weakness in the overall ship design for corrosion to begin. Structural adhesives have been successfully employed in other industries (such as aerospace) to replace this two step process. This typically results in major savings of construction costs with no loss or even enhanced performance characteristics.

The key factors in adoption of this method for ship construction (starting with secondary structure such as cabins) will be: (1) investigation of the appropriate American Bureau of Shipping (ABS) and US Coast Guard (USCG) regulations and typical design requirements on structural performance that apply to these kind of bond lines, (2) confirmation of the performance under typical marine conditions and (3) evaluation of the construction method using various adhesives, structural bonding tapes, and surface preparation techniques common in the industry. (Aluminum construction is of primary interest with current adhesives.) Confirming performance under emergency conditions (such as fire) as deemed by ABS, USCG, and various Marine insurers is also a desired result.

The investigation by the U.S. Naval Academy covered items 1 and 2, and provided insight as to what is needed for item 3. The 3M Company provided materials and preliminary information on construction methods and potential tests to the investigator, and actively participated as a partner.

Investigation of Neutron Response of the Copper-doped Lithium Fluoride Thermoluminiscent Detector

Researcher: Midn 1/C Aaron R. Kline, USN
Faculty Advisor: Professor Martin E. Nelson
Sponsor: Naval Dosimetry Center (NDC) and Naval Environmental Health

In the near future, the U.S. Navy will replace their present TLD, the Mg-doped version, with the new Cu-doped TLD. The Cu-doped TLD is more sensitive to both neutron and gamma radiation and therefore will meet the new National Voluntary Laboratory Accreditation Program (NVLAP) standards. This research project focused on characterizing the TLD's response to neutrons through the use of experiments performed at the National Institute of Standards and Technology (NIST) and the Naval Academy. A model was also created using the Monte Carlo N-Particle (MCNP) transport code to reduce the need for future experimentation.

During this past summer, irradiations of both the Cu-doped TLD and the Mg-doped TLD were performed using the bare and moderated Cf source and the thermal column at NIST. The TLDs were also irradiated at USNA using the Pu-Be source and the 14 MeV neutron generator. From these experiments, a plot of Free Field in Air Response vs Neutron Energy was created for

both the Cu-doped and the Mg-doped TLDs.

A MCNP model was created to represent the 14 MeV generator room at the Naval Academy. One of the outputs to this model is the heating value. It is defined as the energy deposited by incident neutrons and products produced by any nuclear reaction per unit mass per incident particle. A heating value ratio was created which represented the ratio of the chip1 heating value to the chip 4 heating value (MCNP R1/R4). This ratio was compared with the ratio of the chip1 dose to the chip 4 dose (experimental R1/R4). The experimental R1/R4 value of .0812 was within 11% of the value for the R1/R4 heating value ratio, .0727.

Powering Experiments in Deep and Shallow Water: A Comparison Between the USCGC Hamilton Class and a Trimaran with Varying Side Hull Positions

Researcher: Midn 1/C Michael J. Olmstead, USN
Faculty Advisor: Professor Bruce C. Nehrling

The inability of the naval architect to mathematically solve many problems relating to hull performance has led to extensive model testing. This testing has resulted in a vast database for monohulls. The same thing cannot be said for the trimaran. The performance of this hull form is not well documented when compared to the monohull. Currently, trimarans are most often used on fast ferries and sailboats. Recently the idea of making a trimaran combatant has been considered. Unfortunately there is no real database for the trimaran, making it more difficult for the naval architect to design trimarans. This lack of a database was the driving force for the experiments conducted in this research study.

The lack of data for the trimaran leaves the options for a test matrix wide open. Among the variables available for testing are side hull position, draft, displacement, and water depth. This test program varies longitudinal side hull position and water depth. There were three variations in the position of the side hulls. The depth of water was varied from deep to a depth-to-draft ratio of two. Measurements were taken for velocity, drag, heave, and pitch. For purposes of comparison a model of the USCGC *Hamilton* class was also tested at each of the depths for the same variables.

The data was analyzed on the model level to determine which of the three side hull positions gave the best results over the greatest range of both water depth and velocity. The data for the trimaran configuration which gave the best results was then expanded to a ship scale which gave it the same draft as the *Hamilton*. The expanded data was used to predict the EHP, trim, rise and sinkage, and heave for a full-scale ship.

Model Trimaran Seakeeping Tests in Regular and Irregular Head Seas at Varying Sidehull Transverse Positions

Researcher: Midn 1/C Patrick R. Cantwell, USN
Faculty Advisor: Professor Bruce C. Nehrling

In cooperation with the U.S. Coast Guard, the Naval Academy Hydromechanics Laboratory conducted a test program involving a 1:36 scale model trimaran with movable side hulls. Tests were conducted in calm water resistance at nine side hull locations and in regular and irregular, long crested, head seas at two longitudinal side hull positions. The project reported here expanded the seakeeping study by testing the same trimaran model in regular and irregular, long crested, head seas at two transverse side hull positions. Tests were conducted in the 380 foot towing tank at the Naval Academy. Resistance, pitch, heave, bow accelerations, center of gravity accelerations, and water surface elevation were all measured. Experimental procedures and data analysis were the same as for the earlier test program. Results from this testing correlated very well to those from the earlier test program. The outboard and inboard side hull positions produced similar non-dimensional seakeeping responses. This test program showed that with regard to seakeeping performance,

transverse placement of the side hulls makes little difference.

A Model Test Comparison Between a Trimaran and a Monohull in Regular and Irregular Waves

Researcher: Midn 1/C Michael J. Olmstead, USN
Faculty Advisor: Professor Bruce C. Nehrling

Predicting ship motions in calm water is no easy task. Naval architects have struggled with this problem since ships were first being built. Today naval architects can buy computer programs to predict their ship's motion or they can look at the characteristics of similar ships. Unfortunately, ships do not run in the calm water provided by a towing tank. To compensate for this, the naval architect has built wave-makers that attempt to model the seaways which the ship will be in. This has been going on for quite some time with monohulls and there are now computer programs which try to predict the motions the ship will experience in waves. This is not the case for trimarans. This new hull form is not as easily modeled into a computer program. There are wave interference patterns with the side hulls which can not yet be modeled or predicted. Their effect on the ship is still unknown. There is the added buoyancy which can be provided at any position longitudinally, transversely, or vertically. Furthermore, unlike the monohull there is no vast database of trimarans to compare with a new trimaran design.

It is this lack of knowledge which caused the need for this testing. The testing was a quest to not only find out how the trimaran performed in waves, but more importantly to find out how it compared to a similar monohull. Naval architects are by nature conservative and not apt to change their designs. The trimaran is quite a drastic change. Te naval architect is asked to take three inherently unstable hulls and combine them into one. Why, asks the naval architect? These results help to answer that question. As time goes on and more becomes known about this new hull form then the answer to the question why will hopefully become clearer. More importantly the answer to the question why not, may also become clear. It is much more efficient to do model tests on a new hull form than it is to build a full scale ship and realize that it is not a good design.

Use of Tart Computer Program for Reactor Analysis

Researcher: Midn 1/C Daniel L. Gorman, USN
Faculty Advisor: Professor Martin E. Nelson

This research project involved applying the TART computer code to problems in reactor analysis. TART is a Monte Carlo radiation transport code, which uses 566 discrete groups to evaluate neutron cross sections. The project involved first applying TART to a neutron point source surrounded by a spherical moderator. The fluence calculated by TART was then compared with that calculated by one group diffusion theory. For this case, agreement was obtained which gave the same trends, but differed in magnitude by 37%. Second, TART was applied to predicting criticality for a reactor, which is of similar design to that used in the *USS Savannah*. Use was made of special TART interface options, which allowed the input file to be constructed in a relatively easy manner. The criticality problem was found to run extremely fast on its PC-based platform and produced the expected results.

Optimization of the Photon Response for a LiF TLD

Researchers: ENS Robert C. Carnell, USN and Midn 2/C Travis W. Haire, USN
Faculty Advisor: Professor Martin E. Nelson
Sponsor: Naval Dosimetry Center (NDC)

In this project filter materials and thicknesses in the United States Navy TLD card holder were optimized in order to maximize discrimination between incident photon energies and hence give an improved dosimetric response. First, a model was created to calculate the energy deposited within the TLD for five different photon beams. These calculations were correlated to within 20% of experimental data. Second, an improved model was developed by employing the Monte Carlo N-Particle-4B (MCNP-4B) radiation transport program. This model accounted for the exact photon spectrum as well as relevant parts of the experimental set-up. With this improvement, the previous experimental data was correlated to within 9% except for one of the beams. Third, predictions were made about the expected response of other photon beams that would be available at an experimental facility at Brooks Air Force Base in Texas. Fourth, new experimental data were collected at this facility and compared with the model predictions. Strong agreement was obtained between this new experimental data and the model predictions.

The research was presented to the 1998 Health Physics Society at the July, 1998 annual meeting in Minneapolis, Minnesota. The presentation was given by ENS Robert Carnell, USN and was entitled "Optimization of Photon response for a LiF TLD." Also, the research has been submitted to Health Physics for publication as a journal article titled "Improvement in Low Energy Photon Response for a LiF TLD."

The photon response of this TLD will be continued in the 1999 intersessional period by Midshipman 1/C Travis Haire, who will perform an internship at the Naval Dosimetry Center in Bethesda, Maryland. An EN495 independent study project is planned with Mr. Haire for the fall semester, 1999.

Development of a Semi-empirical Model for Single Upset Events in Modern Dram Devices Induced by Radiation

Researcher: Midn 2/C Justin A. Sarlese, USN (Trident Scholar for the Class of 2000)
Faculty Advisor: Professor Martin E. Nelson

Exposure of computer dynamic random access memory (DRAM) devices to protons, neutrons, and pions has been found to result in Single Event Upsets (SEU). This phenomenon could be used for the development of newer, cheaper, smaller, and lighter neutron detection devices. The goal of this project was to develop a database which compared several DRAM characteristics and other physical factors for modern commercially available devices, and to develop a semiempirical model to predict the magnitude and cause of SEUs within DRAM chips. This model would then be used to predict the expected SEU rates for DRAM chips made radiosensitive by the addition of an activator material.

This project would be very helpful for the computer industry to understand the radiation sensitivity of its DRAMs. It could also be very useful for the Department of Defense for the detection of fissile material and for the development of aircraft computer systems which would have lower susceptibility to radiation when based on the use of commercially available DRAMs.

Work on this project will proceed in the 1999-2000 academic year as part of a Trident Scholar research

project.

S & P 500 Future Volatility Forecasts with Neural Networks

Researchers: Midn 1/C Jason S. Moore, USN and Midn 1/C Ivajlo D. Nikolov, USN
Faculty Advisors: Professor Martin E. Nelson,
Assistant Professor Suzanne McCoskey (Economics Department),
and LT. George Doney, USN, (Weapons and Systems Engineering Department)

In order to evaluate risk and the practicality of hedging with index options, future market volatility needs to be accurately estimated. A study has been performed in which the future volatility of the S & P 500 was forecasted using neural network models. The study focused primarily on predicting the S & P 500 volatility for one month time periods using historical market data during the 1988-1998 time period. Using traditional econometric methods, only stationary variables were used as inputs into the neural network models. Additionally, the effect of data time lags was investigated. The neural network tested many input variables including historical market volatility, expected market volatility (VIX), T-bond price volatility, crude oil price volatility, and associated time derivatives for their importance in predicting future market volatility. The most successful neural network models were found to have high correlation coefficients in forecasting market volatility.

Characterization of Resistive Breathing Effort of an Underwater Breathing Apparatus

Researchers: Midn 1/C Benjamin J. Cipperley, USN
Faculty Advisor: Professor M. L. Nuckols
Sponsor: Naval Surface Warfare Center, Coastal Systems Station, Panama City, FL

Resistive breathing effort is defined as the work required to inhale and exhale using an underwater breathing apparatus. It is calculated as the work output per unit volume. This project concerns the development and building of a machine (to be maintained at the United States Naval Academy) to measure resistive breathing effort.

Resistive breathing effort is a specification that is becoming of greater concern in the military and civilian diving worlds. With the huge technological leaps in rebreather development, early obstacles such as weight, breathing gas, depth limitations, and materials are becoming obsolete. Resistive breathing effort however, is surfacing as one of the primary concerns in any new breathing apparatus. With extended lengths of time underwater, up to 24 hours including decompression time for some, the resistive breathing effort becomes a great concern. If a diver is exhausted, and cannot continue to exert enough energy to continue to breathe at a normal rate, he enters a very dangerous situation. Unfortunately, most commercial rebreather companies do not have the means to test their apparatus for a resistive effort.

Test results will be produced on two major rigs that are in use today. The first will be a commercially available U.S. Divers Aquarius regulator. This is more of a test of the feasibility of a breathing machine at the U.S. Naval Academy. This type of device is very difficult to measure and therefore is a valuable test for the breathing machine. The other rig is the Halcyon, which was generously donated to the Naval Academy this semester. This rig is used in deep exploration cave diving and has extended bottom time capability. Unfortunately, the rig has not been tested for resistive

breathing effort. With the success of the machine to measure accurate resistive breathing effort the Naval Academy will have a permanent installation with which to measure resistive breathing effort and develop methods for using this with midshipmen design projects and faculty research.

An Analysis of U.S. Coast Guard Accident Data

Researcher: Midn 1/C Mary Lou Godfrey, USN
Faculty Advisor: Assistant Professor Jennifer K. Waters
Sponsor: U.S. Army Corps of Engineers Institute for Water Resources (IWR)

Marine vessel accident data compiled by the U.S. Coast Guard was extensively analyzed, with particular interest aimed toward those incidents whose cause may have been linked to navigation channel design or maintenance issues. Results from this research effort have been incorporated into several other reports related to this sponsored research program.

Development of Workshop on Deep-Draft Navigation Channel Design

Researchers: Midn 1/C Maria V. Alsina, USN and Midn 1/C Mary Lou Godfrey, USN
Faculty Advisors: Assistant Professor Jennifer K. Waters and Professor David L. Kriebel
Sponsor: U.S. Army Corps of Engineers Institute for Water Resources

The U.S. Army Corps of Engineers (USACE) is responsible for the construction and maintenance of the economically-justified deep-draft navigation channels throughout the U.S. Usually, during the process of designing a channel or designing a major channel modification, many of the technical or "engineering" issues involved in deep-draft navigation channel design and maintenance must be addressed early on in a study. This often means that non-engineers, such as planners and economists are tasked with analyzing many hydrodynamic and other technical and engineering issues of which they have no formal training or background. The Army Corps of Engineers' Institute for Water Resources therefore decided to task the principal investigators at USNA involved in the USACE Deep Draft Navigation Channel Design project with developing a short course especially for planners and economists that addresses many of the technical issues involved in deep draft navigation channel design. The short course presented the relevant technical information involved in the design of a channel on an engineering level that these USACE personnel can understand and appreciate.

The midshipmen involved in this project were responsible for the development and compilation of many of the course notes for the workshop.

Ultimate Strength of Stiffened Steel Panels

Researcher: Midn 1/C David S. Collins, USN
Faculty Advisor: Professor Gregory J. White

The objective of this project is to continue the work of Midshipman Robert Vroman ('95) during his Trident Scholar project. In the conclusions of his project on the ultimate strength of stiffened steel panels under combined loads, Midn. Vroman recommended investigating the effects of modifying the algorithm he

used in order to account for other boundary conditions. He felt that by modifying the algorithm it might be possible to get a better agreement with experimental data over a wider range of loading conditions.

In this project, the algorithm used by Vroman was modified to account for fully restrained conditions on the loaded edges of the panel. A modified computer program was developed to allow the user to select various end conditions depending on the relative magnitudes of the inplane and lateral loads. The results were compared to the experimental data base compiled by Vroman. The modified algorithm provided results consistent with Vroman's for the cases of inplane only loads. The modified algorithm improved the strength prediction in the four cases which included inplane loads and large magnitude lateral loads.

Conceptual Design of a Human Powered Hydrofoil

Researchers: Midn 1/C Daniel D. Tarman, USN and Midn 1/C Keith S. Kulow, USN
Faculty Advisors: Professor Gregory J. White and Assistant Professor Paul H. Miller

The impetus for the race toward faster human-powered watercraft was a competition sponsored by DuPont in 1989. The competition offered a monetary prize for the first craft to reach 20 knots on the water. Although many organizations attempted to achieve this goal, no one succeeded. The allure of the prize is no longer the reason for pursuing this milestone, but rather the novelty and engineering challenge provides the necessary enthusiasm. The goal of this project was to complete a conceptual design of a human-powered hydrofoil, addressing the key engineering hurdles, and to provide the framework for further efforts to actually construct and fly the vessel.

The key elements of the project were the literature search, the analysis of the trade-offs in lifting and powering configurations, and the design of the lifting foils and propeller. The literature search provided information on a variety of configurations for powering and stability. The important physical relationships were described and the analytical tools needed to address the problem were identified. The evaluation of the possible powering and arrangement alternatives led us to choose a design with twin-hulls, single foil on twin struts, with recumbent rider powering an air propeller. A proposed design for the foil was achieved as well as a first cut at the design of the large two-bladed air propeller.

Publications

August, Robert A., Jr., Phillips, Gary W., HARPER, Mark J., Associate Professor, NELSON, Martin E., Professor and Gann, Steven, "Environmental Remediation Research," Proceedings of the Ninth Symposium on Radiation Measurements and Applications, paper no. 1DX3, University of Michigan, Ann Arbor, Michigan, May 11-14, 1998, pp. 10 - 11.

A pilot program was initiated at Kirtland AFB, New Mexico to study new methods of environmental characterization and restoration of sites contaminated with mixed wastes. The initial program studied four sites whose primary contaminant was radioactive thorium. Geophysical, nuclear, and chemical analyses were performed during the initial phase, with the program currently expanding to include biochemical studies. The entire program was conducted on-site to eliminate public health concerns about hazardous waste movement and to provide a more efficient way to take and process characterization samples. The program is especially focused on improving remediation alternatives, and the initial study showed a correlation between radiation content and soil grain size that has spurred an effort to exploit this effect for remediation.

August, Robert A., Jr., Phillips, Gary W., HARPER, Mark J., Associate Professor, NELSON, Martin E.,

Professor, Gann, Stephen, "Mixed Waste Characterization in Soil," Nuclear Instruments and Methods in Physics Research A, 422 (1999) 767-772.

A pilot program has been initiated at Kirtland AFB, New Mexico to study new methods of environmental characterization and restoration of sites contaminated with potential mixed wastes. The initial program studied four sites whose primary radioactive contaminant was thorium. Geophysical, nuclear, and chemical analyses were performed during the initial phase, with the program currently expanding to include biochemical studies. The entire program was conducted on-site to eliminate public health concerns about hazardous waste movement and to provide a more efficient way to collect and process characterization samples. Chemical analyses showed no significant chemical contamination by metals, semi-volatile organic compounds, and total petroleum hydrocarbons by EPA standards and thus indicated that the soil would not have to be treated as mixed waste. Radioactivity analysis showed a ^{232}Th activity that ranged from background levels to over 1000 pCi/gram. Additionally, using dry sieving, a correlation was found between sample radiation content and soil grain size. It is planned to exploit this effect later in the program when site remediation strategies are developed.

August, R. A., NELSON, Martin E., Professor, and HARPER, Mark J., Associate Professor, "Characterization of Thorium in Soil at the Interservice Nuclear Weapons School Sites," Proceedings of the Health Physics Society's 43rd Annual Meeting, Minneapolis, MN, June 1998, Volume 74, no. 6, pp S8-S9.

An assessment has been performed on the radionuclide concentration in soil at four inactive INWS sites which are located within Kirtland AFB in New Mexico. A preliminary radiation survey with an ionization chamber yielded the locations of highest potential contamination. Then samples were collected at 6-inch depth intervals from the surface in order to develop a contamination vs. depth profile. The samples were analyzed both chemically and for radionuclides. The radionuclide analysis was performed on site using a HpGe gamma spectroscopy system and showed the presence of predominantly ^{232}Th. Those samples with the highest radioactivity concentration were then dried and sieved and then separated into individual samples of differing grain sizes for further radionuclide analysis. The results showed a definite activity correlation with grain size with a strong excess activity found in the 250-850 µm range. The thorium depth profiles showed in most cases that the concentration had dropped to background levels by a depth of 2 feet. However, in a few cases this was not the case, and sampling down to 5 feet was required before the levels were at or near background. Finally, a risk analysis was performed in order to assess potential remediation needs by calculating the expected mrem y^{1} based on the collected sample's ^{232}Th pCi g^{-1} and using the EPA risk coefficients. Assuming that the current EPA dose equivalent remediation criterion of 15 mrem y^{-1} in soil is adopted, the analysis indicates that little or none of the soil would need to be removed or treated.

BOUGHEY, Britt W., Midn 1/C, "Design, Construction and Analysis of a Flat Heat Pipe," USNA Trident Report No. 261, U.S. Naval Academy, May 1999.

Thermophotovoltaic (TPV) energy conversion utilizes photons from a thermal radiator to convert photonic energy to electrical energy. Due to the nature of the system, the thermal radiator must emit uniform radiation and therefore maintain a uniform temperature profile in order to achieve maximum efficiency. Heat pipe technology can effectively meet the demand for an isothermal emitter as it utilizes near isobaric phase changes to transfer heat at a uniform temperature. In this project, heat pipes are explored for use in TPV energy conversion systems. A flat heat pipe offers many advantages over the conventional cylindrical design. These include increased surface area to volume ratio in order to maximize power density, as well as the ability to stack or layer the system with photovoltaic (PV) cells on both sides of the flat heat pipe to utilize available energy. Not only do flat heat pipes present unique engineering demands inherent in their operation to counteract pressure differences across their vessel walls, but they are also difficult to construct. To date, only limited analyses of their thermal characteristics have been done for use in performance predictions. Therefore, it is necessary to conduct analyses to enable consideration of heat pipes for implementation into TPV systems. This report details the design and construction of a flat heat pipe analysed both in symmetric and asymmetric heating conditions, involving a low temperature version of future emitter designs due to safety considerations. Water was used as a working fluid

instead of the liquid metal required to achieve the temperatures of a functional emitter. Despite this difference in working fluid, the data presented is valuable to both TPV and heat pipe research.

Buchmann, B., Skourup, J., and KRIEBEL, David L., Professor, "Second-Order Wave Interaction with a Large Structure," Proc. 26th Intl. Conf. On Coastal Engineering, Copenhagen, June 1998, pp. 1613-1624.

Wave diffraction around a large vertical circular bottom-mounted cylinder is considered. Results from a 3D second-order numerical time domain Boundary Element Model, a 3D second-order semi-analytical frequency domain model and experiments are compared and show good agreement over a wide range of wave frequencies and wave steepnesses. In general the agreement between the calculated and experimental results is satisfactory even in some cases where second-order Stokes' wave theory is not *a priori* expected to provide accurate results. The two numerical models have thus been validated against each other and validated against experiments. It is noted that the inclusion of second-order effects is important for the accurate estimation of run-up on a structure

KRIEBEL, David L., Professor, Sollitt, C., and Gerken, W., "Wave Forces on a Vertical Wave Barrier," Proc. 26th Intl. Conf. On Coastal Engineering, Copenhagen, June 1998, pp. 2069-2081.

This paper presents a comparison of measured and predicted wave forces on a vertical wave barrier, defined here as a thin impermeable vertical wall extending from above the water surface down to near mid-depth. Theoretical wave loads were computed using the eigenfunction expansion method. Measured wave loads were obtained from two sets of laboratory experiments, one conducted at the U.S. Naval Academy and the other conducted at Oregon State University in a large wave flume. Results of this study suggest that the eigenfunction theory can predict wave loads to within 10% to 20% accuracy for a wide range of wave conditions, water depths, and wave barrier drafts.

Millett, Marshall.G., NELSON, Martin E., Professor, Pertmer, G., "Weight and Counting Efficiency Optimization in a Moderated Neutron Detector," Nuclear Instruments and Methods in Physics Research (section A), A417, pp. 332-341, November, 1998.

This paper describes a technique in which a polyethylene moderated neutron detector was designed in order to have the optimum combination of maximum counting efficiency and minimum weight. The moderator weight efficiency concepts were developed as the basis for comparisons of different moderators and geometries. The Monte Carlo N-Particle (MCNP) neutron transport code was used to evaluate moderator efficiencies for these different systems. Moderators considered included light water, heavy water, graphite, and polyethylene. The geometries considered included both pancake and cylindrical shapes. The optimized system was then fabricated and experimentally tested against the system in use in the INF treaty between Russia and the United States. The test results confirmed the theoretical predictions on the improved moderator weight efficiency of the optimized detector over the current INF deployed system.

DAWSON, Thomas H., Professor, "Allometric Scaling in Biology," Science, Vol. 281, No. 5378, 751 (1998) and www.sciencemag.

A review of scaling laws in biology, as published earlier by the author (Engineering Design of the Cardiovascular System of Mammals, Prentice-Hall, 1991) is presented and contrasted with assumptions made in a recent paper by others. Emphasis is on the scaling laws for capillary blood vessels in mammals ranging in size from the mouse to the elephant.

Krapivin, Vladimir F., Cherepenin, Vladimir A., Phillips, Gary W., August, Robert A., Pautkin, Andrey Yu., HARPER, Mark J., Associate Professor, and Tsang, Francis Y., "An Application of Modeling Technology to the Study of Radionuclear Pollutants and Heavy Metals Dynamics in the Angara-Yenisey River System," Ecological Modeling, Vol. 111, No. 2/3, pp. 121-134, October 1998.

This paper considers the problem of the origin of the pollution level in the Yenisey river estuary which is located in north central Siberia and empties into the Kara Sea. In the framework of this problem, a joint United States/Russian environmental and hydrophysical expedition to the Angara and Yenisey rivers of Siberia was accomplished in the summer of 1995. Using the results of the pollution measurements taken during this expedition, it becomes possible to

begin the synthesis of the spatial mathematical model for pollution transport in the Angara-Yenisey river system. The model includes blocks describing the flows of pollutants from biogeochemical, hydrophysical and anthropogenic sources. The influence of soil-plant formations are considered. The model is designed for interactive use in the mode of a computer experiment. The results of the model calculations and of the expedition are given.

LINDLER, Keith W., Professor, and HARPER, Mark J., Associate Professor, "Combustor/Emitter Design Tool for a Thermophotovoltaic Energy Converter," Energy Conversion and Management, Vol 39, No. 5/6, pp. 391-398, March/April 1998.

Recently, there has been a renewed interest in thermophotovoltaic (TPV) energy conversion. A TPV device converts radiant energy from a high temperature incandescent emitter directly into electricity by photovoltaic cells. The current research at the U. S. Naval Academy involves the design, construction and demonstration of a prototype TPV converter that uses a hydrocarbon fuel (such as natural gas) as the energy source. Since the photovoltaic cells are designed to convert radiant energy efficiently at a prescribed wavelength, it is important that the temperature of the emitter be nearly constant over its entire surface. The U. S. Naval Academy is developing a small emitter (with a high emissivity) that can be maintained near 1478 K (2200EF). This paper describes the computer spreadsheet model that was written as a tool to be used for the design of the high temperature emitter.

LINDLER, Keith W., Professor, "Use of Multi-Stage Cascades to Improve Performance of Thermoelectric Heat Pumps," Energy Conversion and Management International Journal, Volume 39, No. 10, pp. 1009 - 1014, July 1998.

A thermoelectric heat pump is a miniature solid state device used to pump small amounts of heat. Potential uses range from the cooling of electronic components to dorm size refrigerators. An ongoing study at the U.S. Naval Academy proposes to use a miniature thermoelectric heat pump to maintain a neutron dosimeter at near constant temperatures in order to obtain more accurate readings. Unfortunately, the coefficient of performance of the heat pump decreases rapidly with increasing temperature difference. The current study investigates the potential improvement in heat pump performance that can be obtained by cascading two or more heat pumps in series operation.

MAYER, Robert H., Associate Professor and F. C. Monastero, "Renewable Energy Source for Diego Garcia," Proceedings of Oceans `98 - Engineering for Sustainable Use of the Oceans, IEEE, Nice, France, October 1998.

The U. S. Navy desires to improve the reliability and reduce the cost of providing utility services at NSF Diego Garcia. To achieve these goals, the Navy intends to use a Public/Private Venture (PPV) agreement whereby a private entity will contract to replace and/or upgrade existing utility equipment. The PPV contractor will also be responsible for maintaining and operating such utilities for an anticipated period of 30 years. A Request for Proposals was issued in April 1998 and selection of the PPV contractor is anticipated by September 1998. Although contractors are at liberty to select the utility service method(s), strong encouragement has been given to use a renewable energy resource such as ocean thermal energy.

This paper discusses the infrastructure needs on Diego Garcia, specific environmental issues of concern, and merits of various ocean energy technologies to meet the Navy's utility goals. The history of the competitive process which led to solicitation, receipt and evaluation of industry proposals is reviewed. Results of a student design competition to identify the ocean energy resource which best satisfies the utility needs of NSF Diego Garcia are also presented.

MAYER, Robert H., Associate Professor, "Capstone Design of Coastal Wetlands," Proceedings of the 1998 ASEE Annual Conference, Seattle, WA, June 1998 (CD-ROM).

Natural wetlands are found in many forms throughout the world: as inland salt flats in arid regions; as bogs and tundra in cooler, humid regions; as riparian forests and backwater swamps along rivers and streams. In coastal environs, tidal salt and freshwater marshes and mangrove swamps (mangals) are typical.

Besides habitat provision, wetlands are known to improve water quality, reduce the potential for flooding, and control erosion. Their vibrant

productivity provides for several commercial harvests including fish, shellfish, timbers and tannin, and offers many recreational opportunities such as birdwatching, fishing, and hunting. For better or worse, natural wetlands have also been used for wastewater discharge. Even so, drainage and filling of wetlands, principally for agricultural use, were common practices. Fortunately, increased public awareness of wetland functions and values led to the "no net loss of wetlands" policies of the Bush and Clinton Administrations. Today, engineers will find it useful and often necessary to include wetlands restoration and conservation among project objectives.

Accordingly, instruction in wetlands function awareness and design procedures has been introduced in the ocean engineering curriculum at the U.S. Naval Academy. Also, capstone design projects have been initiated which include wetlands restoration or creation as a desired design objective. This paper provides a brief overview of wetlands design principles and reviews the specific tasking of three recent capstone projects. Coupled with its complementary reference, the paper provides others a convenient means to initiate instruction in this relatively-new coastal design methodology.

NUCKOLS, M.L., Professor, Clarke, J. R., and MARR, W. J., CDR, USN. "Assessment of Oxygen Levels In Alternative Designs Of Semi-Closed Underwater Breathing Apparatus," Intl J. of Life Support and Biosphere Science, accepted for publication April 1999.

A method for predicting the circuit oxygen levels in semi-closed underwater breathing apparatus (UBAs) is presented. Oxygen levels are assessed for traditional circuit designs using sonic metering valves to inject a constant mass flow of fresh make-up gas, as well as two alternative respiration-rate-coupled gas dosage designs using demand injection valves. The impact of variations in diver depth, activity level, gas injection rate, circuit volume and make-up gas composition on these circuit oxygen levels is demonstrated. Respiration-coupled, demand gas delivery systems are shown to have significantly reduced circuit oxygen variations over a wide range of diver activity levels when compared to constant mass flow injection systems. Additionally, the respiration-coupled designs are shown to have potential reduced gas usage at low diver activity levels, resulting in longer mission duration capability, when compared to constant mass injection systems.

Knafelc, M.E., NUCKOLS, M.L., Professor, "Evaluation of a Phase Change Material (PCM) Liner For The Non-Return Valve (NRV) Hot Water Suit," Proceedings of the 1999 Undersea and Hyperbaric Medical Society Annual Scientific Meeting, 26-30 June 1999, Boston, MA.

Saturation diving operations require the use of hot water suits for diver thermal protection. In the event of losing the hot water supply, the diver can rapidly chill and become hypothermic. The thermal stress is compounded when the diver is in a current since the thermal barrier of the quiescent water immediately surrounding the diver is removed. This proof of concept study was designed to determine if incorporating bulk PCM into the hot water suit's liner blunts the thermal stress.

The study was conducted during a saturation dive, Deep Dive 98. The mean skin temperature value was based on regional weighting according to the percentage of body surface area. The formula for mean skin temperature is: $T_{sk} = 0.3$ (chest + upper arm temperatures) + 0.2 (thigh + calf temperatures). Eight male U.S. Navy Saturation divers were used as subjects. Four divers wore the PCM (Octadecane 83) liner; four divers wore the standard (lycra/fleece) liner. The water temperature was 1.1 to 2.2 ^{o}C at a depth of 850 fsw (26.7 ata). The diver positioned himself in the current stream created by the discharge side of the water circulation pump. Temperatures were recorded every 15 seconds and the mean skin temperature was calculated using the above formula.

When maintaining the hot water flow to the diver, the PCM-liner maintained the diver's T_{sk}, which decreased with the standard liner. After securing the hot water, the divers wearing the standard liner experienced a rapid drop in their T_{sk}. The average duration of the exposure was 6.6 minutes before the diver terminated the exposure. In contrast, the divers wearing the PCM-liner experienced a less dramatic decrease in skin temperature and were able to complete the 20-minute exposure.

This pilot study suggests that the bulk PCM-liner under a NRV hot water suit is superior to the standard liner in blunting the thermal heat loss when there's a loss of hot water.

NUCKOLS, M.L., Professor and GRUPE, C.E., Midn 1/C, 16-17 Sept 1997, "The Use of Phase Change Materials To Enhance Diver Thermal Protection," Proc

14th Meeting of the U.S.-Japan Cooperative Program in Natural Resources: Diving Physiology Panel, Panama City, FL, pp. 187-194.

An overview of the design, analysis and testing of a recent development in diving suit technology is presented which incorporates the use of phase change materials inside a thermal liner to provide stored latent heat during cold water diving. This liner provides thermal protection for divers' wetsuits, drysuits, and hot water suits while causing minimal restrictions to diver mobility. The liner, which contains approximately 6 pounds of bulk octadecane or eicosane, has been shown to provide up to 30 minutes of emergency backup heating in the event of an interruption of warm water supply when hot water diving suits are used. Up to 2 ½ hours of supplemental heating are predicted with the liner when used as a supplemental heat source for divers wearing passively-insulated drysuits to prolong acceptable durations in near freezing water. The thermal liner is also being investigated to give an emergency "come home" capability in case of power failure within drysuits supplied with an electrically-heated undergarment. As an added benefit, these liners have been shown to protect divers from thermal "shorts" normally encountered when a diver's suit is compressed by surface contacts or in high water currents.

Moore, D., Mead, P., Natishan, M., Schmidt, L., University of Maryland, Lathan, C., Catholic University of America, and MOURING, Sarah E., Associate Professor, "The ESTEAM Program's Phase I Results: Faculty Views on Engineering Student Team Effectiveness," Women in Engineering Program Advocate Network (WEPAN) Conference Proceedings, Seattle, WA, June 1998 pp. 247 - 252.

Engineering remains a male-dominated environment. How women engineering students and professionals learn and work continues to be perplexing and often bewildering for male counterparts sharing the same engineering classrooms, labs, and teams. While this makes life interesting, it can make the learning and working environments uncomfortable for the *different* thinker. In this paper we introduce the BESTEAMS Partnership. BESTEAMS brings engineering schools together with the aim of transforming professional engineering environments into places which comfortably sustain all types of learners. We report results of ESTEAM Program Phase I: Engineering Faculty Interviews, the Partnership's gap analysis project. The results suggest that faculty encountered in the study have limited awareness of unique circumstances women students in engineering face and could benefit from training targeted to meet the challenges of mixed-gender classrooms and teams.

MOURING, Sarah E., Associate Professor, "Buckling and Postbuckling of Composite Ship Panels Stiffened with Preform Frames," Ocean Engineering Journal, 26 (1999), 793-803.

The U.S. shipbuilding industry recently has started incorporating composite materials into the construction of both military and commercial ships due to the advantages of composite construction. These advantages include the reduction in total life costs, corrosion resistance, high strength- and stiffness-to-weight ratios, and improved stealth. One disadvantage is the higher material costs of composites compared to steel and other conventional materials. Therefore, new higher quality materials with lower costs and new fabrication methods need to be developed before composite materials will be fully accepted for the construction of large ships. A new composite preform framing technology shows promise in the reduction of fabrication costs for large ship construction. There already has been significant cost savings using this framing technology in the construction of small recreational boats and large yachts. This framing technology involves casting a dry glass fiber-reinforced plastic (GRP) fabric into shape in a closed mold with a foam core. One unresolved issue using this framing technology is the orientation of the fiber for the frames. This paper summarizes experimental results of testing of composite panels stiffened with preform frames under in-plane uniaxial compressive loads. Biaxial (0,90), quadaxial (0,90,+45,-45), and triaxial (+45,-45,0) laminates were used in the frames.

MOURING, Sarah E., Associate Professor, "Investigation into a Novel Joining Technique for Composite Marine Applications," American Society for Composites Thirteenth Annual Technical Conference Proceedings, Baltimore, MD, September 1998, 481-488.

An innovative joining technique has been developed as an alternative to current techniques. This method

uses a combination of liquid adhesive and adhesive tape to fabricate joints. The adhesive tape is used to temporarily "tack" structural parts together and to create a channel between the structural parts in which liquid adhesive can be injected at a later time. The resulting bond lines are more consistent than bond lines formed using current bonding methods. Tape thickness determines the bond line thickness while spacing between tape strips determines the bond line width. One advantage of this technique is that it can be used for variety of structural configurations.

Furthermore, quality control is possible not only before the application of liquid adhesive but also after the application of liquid adhesive. This joining technique shows great promise to be a more cost-effective, less labor-intensive technique without reduction in the structural performance. This paper summarizes the development and evaluation of the innovative joining technique using experimental and analytical methods.

MOURING, Sarah E., Associate Professor, "Composites for Naval Surface Ships," Marine Technology Society Journal, 32:2 (1998), 41-46.

The U.S. Navy is incorporating composite materials into the fleet due to the many advantages of composite construction compared to steel and aluminum construction. These advantages include the reduction in life costs, corrosion resistance, high strength- and stiffness-to-weight ratios, ability to tailor, and improved stealth. Of particular interest to the Navy are weight reduction and non-magnetic and damping characteristics associated with composite construction. Increased payload and range and improved ship stability can be achieved with weight reduction while non-magnetic and damping characteristics help reduce magnetic and acoustic signatures. Many challenges still remain including issues related to design and analysis, fabrication, environmental effects, repair/joining, and fire, smoke, and toxicity. This paper includes a review of recent composite naval applications and a discussion on technical challenges associated with composite construction of naval ships.

SIMMONS, D. Kevin, Midn 1/C, MOURING, Sarah E., Associate Professor, and BARTON, Oscar, Associate Professor, "Fiber Reinforced Plastics and the Ductility of Reinforced Concrete Beams," National NSBE Conference Proceedings, Kansas City, MO, March 1999, (National award winner), 1-12.

This paper investigates the effect of externally retrofitted carbon fiber reinforced polymer (CFRP) composites on the ductility of reinforced concrete beams. Reinforced concrete structures deteriorate over time due to environmental aging, fatigue, excessive loading, chemical attack, and other factors. Strengthening and rehabilitating these concrete structures by externally bonding carbon laminates is one of many economical engineering solutions. The research is divided into three approaches: experimental tests of rectangular reinforced concrete beams, analysis of existing numerical models, and the development of a computer-based design methodology. Ultimately, this study will aid in the development of design guidelines governing the use of CFRP.

MOURING, Sarah E., Associate Professor, Schmidt, L., Mead, P., Natishan, M., Moore, D., University of Maryland, and Lathan, C., Catholic University of America, "The ESTEAM Program: Changing the Paradigm on Engineering Student Teams from Forming for Diversity to Training for Diversity," Engineering Foundation Proceedings, Montreal, Canada, July 1998, 118-125.

Effective engineering student team performance is not a spontaneously occurring phenomenon and is further confounded by gender diversity. Not only do good team behaviors often contradict individual achievement-based performance models, but the understanding of what it means to be a good team member is different for men and women. A recent change to university engineering education accreditation requirements is the inclusion of *the ability to function in teams* as a student learning outcome, but training for effective team performance has yet to be systematically addressed in engineering curricula. As a result, female engineering students often encounter difficulty in succeeding in project-based courses, becoming discouraged and frustrated within their engineering programs. This paper describes the Building Engineering Student Team Effectiveness and Management Systems (BESTEAMS) Partnership and its Engineering Student Team Effectiveness and Management (ESTEAM) Program—an engineering project team training gap analysis process—comparing responses from students and faculty and highlighting interesting

trends.

SIMMONS, D. Kevin, Midn 1/C, "The Effect of Externally Retrofitted Carbon Fiber Reinforced Polymer Composites on the Ductility of Reinforced Concrete Beams," USNA Trident Report No. 268, U.S. Naval Academy, May 1999.

The effect of externally bonded carbon fiber reinforced plastic (CFRP) laminates on the ductility of reinforced concrete beams are studied in this report. Eight rectangular beams with varying internal steel reinforcement were retrofitted with CFRP strips on the tension faces and tested under four-point bending. The beams were extensively instrumented to monitor strains, deflection, and curvature over the entire spectrum of loading, and to determine the structural response of the beams. A computer-based method using strain compatibility and force equilibrium was developed to provide theoretical load-deflection and moment-curvature curves, and a basis for determining ductility and beam failure modes. An existing analytical model using the discrete yield and ultimate values of the load deflection and moment-curvature curves was modified to an energy-based model and used to predict the ductility of the beams. Numerical results indicated an increase in strength, a decrease in ductility, and validated the analytical model. Results from this research will aid in the development of design guidelines and codes governing the use of CFRP.

TUTTLE, Kenneth L., Associate Professor, "Computer Models Using Spreadsheets to Study Heat Engine Thermodynamics," Proceedings, Annual Conference American Society for Engineering Education, Seattle, June 28, 1998 (CD-ROM) and pp. 1-7.

Marine Power Systems is the second term of a two term course in thermodynamics at the U.S. Naval Academy. This is an applied thermodynamics course and is taught by the marine engineering faculty. One of the primary objectives of this thermodynamics course is to teach the thermodynamics of heat engines. Marine Power Systems takes the study of heat engine cycles beyond the first step, of how to work the heat engine cycles. The midshipmen at the Naval Academy write computer models of the heat engine cycles to study the thermodynamics of heat engines. The best example of the thermodynamic cycle modeled is the Brayton Cycle. The marine engineering students use a spreadsheet program on their personal computers to model the Air Standard Brayton Cycle and run experiments by varying the independent variables.

TUTTLE, Kenneth L., Associate Professor and Thomas C. Miller. "Marine Diesel and Gas Turbine Engine Emissions," 1998 SNAME Annual Conference Preprints, San Diego, Nov. 11-14, 1998. pp. B-1 - B-14.

Emissions from marine diesel engines as well as marine gas turbine engines continue to be of interest both from the regulatory standpoint and from operations. The primary source of concern is the marine diesel, as gas turbines are currently used almost exclusively by Navy ships. The difference in the emissions from these two type of marine engines is substantial and is likely to be of interest to all who are involved in reducing stack emissions or meeting regulations. There are also differences in the emissions from medium speed diesel engines and from the low speed engines and emissions from those engines are compared. The NOX emissions data from marine diesel engines, both low speed and medium speed, were taken by Lloyd's Register Marine Exhaust Emissions Research Program and the gas turbine data are from U.S. Navy research laboratories. The diesel engine particulate emissions data were taken at Massachusetts Institute of Technology by the author (Miller, 1996).

WATERS, Jennifer K., Assistant Professor, "Environmental Protection Issues in Small Craft Design and Operations," Proceedings of Ocean Community Conference '98, Baltimore, MD, November 1998.

Environmental protection has taken a paramount role in the design of all water-borne craft as more and more concern is placed on water quality issues and the overall health of our oceans and coastal waterways. While recommendations and regulatory guidance for design, construction and operations exist in many references for larger sea-going vessels, very little information is presently available for smaller craft design.

This paper discusses the various environmental pollutants emitted by small vessels and recreational craft and provides an overview of current and future environmental protection issues related to smaller craft

design and operations. Topics include water pollution, air pollution, noise pollution, as well as a discussion of legislative and regulatory bodies governing small craft pollution. Applications of existing federal environmental protection acts are discussed, along with some typical and atypical local regulatory statutes. Future trends in environmental legislation are also discussed.

KRIEBEL, David L.., Professor, Berek, E.P., Chakrabarti S.K., and WATERS, Jennifer K., Assistant Professor, "Wave-Current Loading on a Shallow Water Caisson: An Evaluation of the API Recommended Practice," Journal of Waterway, Port, Coastal & Ocean Engineering, Vol. 125 No. 1, pp. 29-38, Jan/Feb 1999.

Results of laboratory model tests are used to assess the accuracy of the American Petroleum Institute (API) method of predicting wave-current loading on a shallow water production caisson in extreme random waves. Model tests were conducted using a 1-to-20 scale model of a 36-inch diameter caisson in a 50-foot water depth. Tests were conducted with and without in-line currents in extreme random waves, many of which were breaking. The experimental results for wave-current kinematics, wave forces, and overturning moments are compared to predictions based on the API procedure using Stream Function wave theory. Based on analysis of 132 extreme random waves from the test program, it is found that the in-line fluid velocities predicted just below the wave trough level were 6% larger than measured values on average. Predicted in-line wave forces and moments were also somewhat biased and were, on average, 10% and 15% larger than measured values, respectively. Measured wave loads included dynamic amplification of about 10% due to ringing of the structure following the impact of extreme breaking waves. The standard deviation between measured and predicted values were quite large, however, and measured wave loads for a few waves that plunged directly on the caisson model were between 1.5 and 2.2 times larger than the predicted loads.

Miller, M., Nadeau, J., and WHITE, Gregory J., Professor, "Longitudinally Stiffened Panels – A Comparative Analysis of the Compressive Strength of Three Common Construction Methods," Transactions of the Society of Naval Architects and Marine Engineers, Volume 107, 1999 (accepted for publication).

Due to the reduction in labor, material, and weight, intermittent welding is often used in lieu of continuous welding to join longitudinal stiffeners to hull plating. Traditionally, use of this cost reduction technique, common in both ship and barge construction, has not been considered significantly detrimental to the overall strength. Similarly, in barge construction, serrated stiffeners are considered an acceptable alternative to continuously welded stiffeners. After the catastrophic failure of the deck plating of two inland tank barges constructed using intermittently welded serrated stiffeners, the Coast Guard conducted testing on stiffened panels at the U.S. Naval Academy. The ultimate strength of panels constructed using continuously welded stiffeners, intermittently welded stiffeners, and intermittently welded serrated stiffeners was determined and compared. Testing results and analysis of the failures showed that the use of serrated stiffeners introduces a different failure mechanism which can lead to significantly earlier failure.

Roberts, J. C. and WHITE, Gregory J., Professor, "Experimental Results for Bending and Buckling of Rectangular Orthotropic Fiber-Reinforced Plastic Plate Structures," Marine Technology, Society of Naval Architects and Marine Engineers (SNAME), Vol. 36, No. 1, January 1999, pp. 22-28.

Solid unstiffened, sandwich, and hat-stiffened rectangular orthotropic fiber-reinforced plastic (FRP) plates were tested in uniaxial in-plane compression and out-of-plane uniform pressure. The two short edgesof all plates were clamped, whereas the two long edges of the unstiffened and sandwich plates were simply supported and the same edges of the hat-stiffened plate were left free. Unstiffened plates reached global buckling at about 688 kN (155 klb); however, the plates did not collapse up to the machine load limit of 1334kN (300 klb). Sandwich plates never reached the overall elastic buckling load; they collapsed in local buckling by face sheet delamination and core shear failure at loads of about 939 kN (211 klb). Hat-stiffened plates exhibited local buckling of the outer unsupported flanges at a load of about 356 kN (80 klb). All hat-stiffened plates collapsed under uniaxial compression due to a combination of face sheet to stiffener delamination followed by hat-stiffener local buckling at loads of about 939 kN (211 klb). The stresses and deflections due to out-of-plane uniform pressure were compared between the unstiffened, sandwich, and hat-stiffened plates from pressures of 6.895 kPa (1 psi) to 34 kPa (5 psi). With

the plates under uniaxial compression and out-of-plane uniform pressure simultaneously, there was a general decrease in buckling and collapse with an increase in out-of-plane uniform pressure.

Technical Reports

August, Robert A. Jr., HARPER, Mark J., Associate Professor, NELSON, Martin E., Professor, and Gann, Steven, "Environmental Remediation Research,"1998 NRL Review, Naval Research Laboratory 75th Anniversary Review, April 1998, pp.97-99.

All branches of the Armed Forces are conducting environmental restoration programs under the auspices of each service's investigation and remediation program (IRP). These IRPs must follow the protocols and statutory amendments of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which provides a regulatory framework under which to complete environmental restoration activities at all federal (including military) facilities. Unfortunately, compliance at individual sites can often mean multi-year programs costing many millions of dollars. Even then, cleanup can be restricted to little more than moving the hazardous material to an approved storage facility. This is especially true when the contaminant is mixed waste, a combination of chemical and radionuclear hazards. NRL's Radiation Detection Section initiated a pilot program at Kirtland Air Force Base, New Mexico, to study new methods of environmental characterization and remediation of sites contaminated with mixed wastes. The initial program studied four sites contaminated with radioactive thorium. Geophysical, nuclear, and chemical analyses were performed during the initial phase. The program is structured as two parallel research thrusts: characterization methods and remediation alternatives.

DAWSON, Thomas H., Professor, "Maximum Wave Crests in Heavy Seas," USNA Report, EW-16-98, June 1998.

The Longuet-Higgins theory for the maximum crest amplitude expected in a run of ocean waves is examined using data from extensive computer simulations of random linear waves. Results indicate close agreement between theory and data. The application of the theory to wave crests in heavy seas is also discussed within the context of Stokes nonlinearities.

MAYER, Robert H., Associate Professor, Jennifer K. WATERS, Assistant Professor, and David L. KRIEBEL, Professor, "Design & Maintenance of Deep-Draft Navigation Channels - An Overview of Current Practice with an Annotated Bibliography," USNA Technical Report EW-14-98, December 1998.

Given the increasing size and speed of ships in the world fleet and related changes in port and channel usage, the Corps' Institute of Water Resources (IWR) has initiated a study entitled "Impacts of Navigation Trends on Channel Usage and Design." Its principal goal is to improve the design and maintenance of navigation channels in order to sustain effective channel navigation and port operations well into the next century. A critical element of this study will be an assessment of how Corps' deep-draft channel design and maintenance guidance compares with other domestic and international policies and practices. This assessment will serve to identify areas for further research and for recommending changes in Corps' policies and procedures.

Prior to initiating the assessment, the authors were asked to review current practices used domestically and internationally to design and maintain deep-draft navigation channels. Technical publications and the policy guidance of numerous government, professional, and other U.S. and international maritime organizations were identified. A bibliography containing over 200 of the references was gathered and captured in a database that is discussed in Part IV of this report. Contents of the bibliography are reproduced in the Appendix.

Whereas this document, with its annotated bibliography, provides an overview of current deep-draft channel design and maintenance policies world-wide, a follow-on study is underway to compare Corps policy and procedural guidance with the policies and practices of other U.S. and international maritime organizations. A second report that details results of

the assessment will be forthcoming.

WATERS, Jennifer K., Assistant Professor, KRIEBEL, David L., Professor, and MAYER, Robert H., Associate Professor, "Analysis of U.S. Coast Guard Accident Data," USNA Technical Report EW-11-98, Oct 1998, and Interim Report, Institute for Water Resources, U.S. Army Corps of Engineers, Alexandria, VA, January 29, 1999.

This report describes an analysis of U.S. Coast Guard (USCG) accident data performed in support of the Institute for Water Resources (IWR) study entitled, "Impacts of Navigation Trends on Channel Usage and Design." The IWR study is comprised of three interrelated components: (1) a safety performance review, (2) a channel design and maintenance assessment, and (3) a shipping trends analysis. This USCG accident data analysis was performed in order to provide information for the safety performance review component of the IWR study.

USCG accident data files were obtained and analyzed in order to assist in the safety performance review portion of the study, specifically identifying those ports whose incidents may be associated with the design and/or maintenance of their navigation channels. The accident data statistics were therefore interpreted and analyzed with this emphasis in mind.

Data from all domestic ports from 1992 until present are included in the analysis. Discussions of incident types, vessel types and causal factors are included. The incident types of particular interest to this study include allisions, collisions and groundings. The ports are ranked as to the number of these incidents experienced over two different time periods. It was found that the top five ports in both cases were New Orleans, Paducah, Morgan City, Mobile and Galveston. Results of this analysis also indicate some interesting additional statistics. More than 90% of all vessels involved in incidents were U.S.-flag vessels, and more than two-thirds (2/3) of the relevant incidents indicated "human factors" as the primary causal factor. The vessel type most often involved in the relevant incidents were barges (34%), with ships involved in only 12-24% of these incidents. Of the grounding incidents, nearly one-third (1/3) were reported as occurring within a channel.

An additional, limited, but similar analysis including only tank ship and freight ship vessel types was also conducted. Theses vessels were selected for a separate analysis in order to gain a better measure of statistics for deeper draft vessels. As expected, the results from this analysis differed significantly from those including all total vessel types, but still point to New Orleans as the port with the most accidents.

Presentations

AUGUST, Robert A., Jr., Phillips, Gary W., Harper, Mark J., Associate Professor, Nelson, Martin E., Professor, and Gann, Steven, "Environmental Remediation Research," Ninth Symposium on Radiation Measurements and Applications, The University of Michigan, Ann Arbor, Michigan, May 11-14, 1998.

AUGUST, Robert A., Jr., Nelson, Martin E., Professor, Harper, Mark J., Associate Professor, "Characterization of Thorium in Soil at the Interservice Nuclear Weapons School Sites," Health Physics Society's 43rd Annual Meeting, Minneapolis, MN, July 12-14, 1998.

BARTON, Oscar, Jr., Associate Professor, Mouring, Sarah E., Associate Professor, Mackney, Michael, Associate Professor, Karpouzian, Gabriel, Professor, "Composite Capabilities at USNA," GLCC Conference, Columbia, SC,15 July 1998.

BOUGHEY, Britt W., Midn 1/C, "Design and Construction of a Flat Heat Pipe," U.S. Naval Academy Trident Scholar Conference, April 1999.

KLINE, Aaron R., Midn 1/C, Nelson, Martin E., Professor, Cassata, James R., LT, USN, Riel, Gordon K., "Evaluation of the Neutron Response of the Copper-

Doped (LiF) TLD," Health Physics Society Annual Meeting, Philadelphia, Pennsylvania, June, 1999.

KRAPIVIN, V.F., Phillips, G.W., Cherapenin, V.A., AUGUST, R.A., Pautkin, A. Yu., Harper, Mark J., Associate Professor, and Tsang, F. Y., "Application of a Global Model to the Study of Arctic Basin Pollution: Radionuclides, Heavy Metals and Oil Carbohydrates," First International Symposium on Issues in Environmental Pollution, Denver, CO, August 23-26, 1998.

KRIEBEL, David L., Professor, "Wave Forces on a Vertical Wave Barrier," Paper presented at the 26th International Conference on Coastal Engineering, June 24, 1998, Copenhagen, Denmark.

KRIEBEL, David L., Professor, Seminar entitled, "Performance of Vertical Wave Barriers," on Seminar on Vertical Breakwaters," presented to Alaska District U.S. Army Corps of Engineers and to Alaska Department of Transportation and Public Facilities, July 8, 1999, Anchorage, Alaska.

KRIEBEL, David L., Professor, "Development of Load Factors for Combined Wind and Flood Loads," Paper presented to the American Society of Civil Engineers Committee on Minimum Loads for Buildings and Other Structures, July 29, 1999, San Francisco, California.

MARR, William J., CDR, USN, "Using the ST725 Sonar for AUV Feature Based Navigation and Correction," Proceedings of the Autonomous Underwater Vehicles 1998 (AUV-98) Workshop on AUV Navigation, August 1998.

MAYER, Robert H., Associate Professor, "Renewable Energy Source for Diego Garcia," at the 1998 IEEE Conference - Oceans '98, Nice, France, October 98.

MAYER, Robert H., Associate Professor, "Capstone Design of Coastal Wetlands,"at the 1998 ASEE Annual Conference, Seattle, WA, June 98.

MOORE, J. S., and Nelson, Martin E., Professor, "S & P 500 Volatility Forecasts with Neural Networks," 19th International Symposium on Forecasting, Washington, D.C., June, 1999.

MOORE, D., Mead, P., Natishan, M., Schmidt, L., University of Maryland, Lathan, C., Catholic University of America, and Mouring, Sarah E., Associate Professor, "The ESTEAM Program's Phase I Results: Faculty Views on Engineering Student Team Effectiveness," Women in Engineering Program Advocate Network (WEPAN) Conference, Seattle, WA, 16 June 1998.

MOURING, Sarah E., Associate Professor, Schmidt, L, Mead, P., Natishan, M., Moore, D., University of Maryland, and Lathan, C., Catholic University of America, "The ESTEAM Program: Changing the Paradigm on Engineering Student Teams from Forming for Diversity to Training for Diversity," Engineering Foundation Conference, Montreal, CANADA, 20 July 1998.

MOURING, Sarah E., Associate Professor, "Innovative Joining Methods for Composites and Advanced Construction Materials," NSF-CERF Forum, Washington, D.C., 10 November 1998, (invited speaker; one of 19 projects highlighted - chosen from over 2000 research projects).

NUCKOLS, M.L., Professor, "Characterization of Semi-Closed Circuit Underwater Breathing Apparatus," Invited speaker at the National Association of Underwater Instructors Technical Conference, New Orleans, LA., 10 January 99.

NUCKOLS, M.L., Professor, "The Year of the Ocean -- 1998," Keynote speaker at the Navy Ball in Panama City, FL on 16 October 1998.

SIMMONS, D. Kevin, Midn1/C, "Fiber Reinforced Plastics and the Ductility of Reinforced Concrete Beams," National NSBE Conference, Kansas City, MO, 25 March 1999, (National award winner).

SIMMONS, D. Kevin, Midn 1/C, Mouring, Sarah E., Assoc Professor, and Barton, Oscar, Assoc Professor,

"The Effect of Externally Retrofitted Carbon Fiber Reinforced Polymer Composites on the Ductility of Reinforced Concrete Beams," U.S. Naval Academy Trident Scholar Conference, 16 April 1999.

TUTTLE, Kenneth L. Associate Professor, "Computer Models Using Spreadsheets to Study Heat Engine Thermodynamics," Annual Conference American Society for Engineering Education, Seattle, June 30, 1998.

TUTTLE, Kenneth L., Associate Professor, "Combustion Generated Particulate Emissions," Thirteenth International Conference on Solid Waste Technology and Management, Philadelphia, November 3, 1998.

TUTTLE, Kenneth L. Associate Professor, and Miller, Thomas C., "Marine Diesel and Gas Turbine Engine Emissions," SNAME Annual Conference, San Diego, November 13, 1998.

WATERS, Jennifer K., Assistant Professor, "Environmental Protection Issues in Small Craft Design and Operations," Ocean Community Conference '98, Baltimore, Maryland, 19 November 1998.

Weapons and Systems Engineering

Professor Terrence E. Dwan
Chair

Research within the Weapons and Systems Engineering Department continues to provide the faculty with an opportunity to grow professionally and to keep abreast of rapidly advancing systems technology. In addition, every graduating Systems Engineering major participates in research, design, and development projects for the purpose of realizing practical applications of some of the theory which they have studied.

Every faculty member, both civilian and military, either participates in research in areas of interest to the U.S. Navy or supports midshipmen research programs in an advisory capacity. Faculty research areas currently include fuzzy modeling, magnetic bearings, metrology, robotics, ship power systems, and system identification.

This year there was one Trident Scholar in the Systems Engineering Department. The scholars engage in extensive research projects in lieu of several courses. The research topic was the development of a model-based controller for methane combustion.

Strong emphasis continues on the faculty-midshipman relationship during the individual research oriented capstone design course. Each midshipman in assigned both an administrative and a technical advisor. These advisors not only provide support of a technical nature, but also emphasize planning, scheduling, and effective oral and written presentation. Typical examples of midshipmen research projects include development of autonomous carts and boats, automatic target detection, magnetic levitation, and vibration control.

Funding for research continues to be diverse. This year sponsors included the Naval Academy Research Council, the Office of Naval Research, the Naval Research Lab, the Naval Surface Warfare Center, and the National Institute of Standards and Technology.

Sponsored Research

Evaluation of Uncertainty of a Calibration Method for a Four-Terminal Pair Capacitance Standard

Researcher: Assistant Professor Svetlana Avramov-Zamurovic
Sponsor: National Institute of Standards and Technology (NIST)

This project characterizes capacitors at the frequencies up to 10 MHz. The method is based on the work of the Yokogawa-Hewlett-Packard group, as well as Cutkosky and Jones of NBS. Measurements needed to obtain a capacitor's frequency characteristic are the high frequency driving-point impedance measurements via a network analyzer and the capacitance measurements at 1 kHz using the bridge technique. Type A and Type B uncertainties for both the capacitance bridge and the network analyzer need to be developed. In order to verify the characteristics obtained, a computer program was developed that uses detailed equivalent circuitry of the test capacitors to calculate impedance for the entire frequency range.

Type B uncertainty needs to be established for the regression method involved in the capacitor's frequency characteristics prediction.

Hybrid System Theory for Vision-Driven Robotic Systems

Researcher: Assistant Professor Bradley E. Bishop
Sponsor: Naval Academy Research Council (NARC)

The use of computer vision in robotic applications is strongly motivated by the primacy of vision among human senses used for planning and executing manipulation tasks. While a great deal of effort has been devoted to development of exceptionally sophisticated visual processing techniques, surprisingly few researchers have approached the problem from a standpoint of sensing for real-time closed-loop control.

This project is aimed at utilizing the fundamental nature of a digital computer vision system in concert with closed-loop control for improvement of flexibility and performance of robotic systems in dynamic and uncertain environments. The primary tool used in these investigations is to be hybrid system theory (HST), in which various controllers and sensing strategies are implemented at various times in order to optimize the performance of the system based on objectives, world and system state and knowledge of the dynamics of control and vision.

This project is an extension of my work on visual servo using HST. Previous results indicate that careful system analysis must be carried out in order to achieve desired performance, especially when using nonlinear controllers whose properties are primarily local in nature. The goal of the research is to develop fundamental synthesis techniques for suites of visual processing strategies as well as full system synthesis techniques relating hybrid control to hybrid sensing for uncertain and rapidly changing environments. As an initial step, investigations into the fundamental nature of nonlinear hybrid systems are being carried out in order to develop potential synthesis techniques that are applicable to the visually-driven robotics problem..

Supervisors for Adaptive Systems

Researcher: Assistant Professor Kiriakos Kiriakidis
Sponsor: Naval Research Laboratory (NRL)

The goal of this project is to develop efficient methods for the synthesis of intelligent supervisors for adaptive

systems. It will include the application of control theory in novel contexts, such as the verification of discrete-event or hybrid systems. The proposed research will be applicable in the area of micro air vehicles.

Fuzzy Model-Based Control: An LMI Approach

Researcher: Assistant Professor Kiriakos Kiriakidis
Sponsors: Naval Academy Research Council (NARC) and
Office of Naval Research (ONR)

We developed a fuzzy-model-based control synthesis framework for a class of nonlinear systems, whose fuzzy model comprises controllable local models. Within this framework, we formulated and solved the robust stabilization problem for the above class as a convex program with LMI constraints. The resulting controller, linear or nonlinear, achieved its objective despite parametric uncertainty, estimated-state feedback, and control input limitations. Usage of commercial LMI solvers adds ease of computation to these virtues. Fuzzy-model-based control is primarily developed for complexnonlinear plants where conventional modeling is impractical. The method, however, applies equally when the fuzzy model is derived from an existing conventional model and hence poses an alternative nonlinear control design approach with the characteristics summarized previously.

Robust Controller Design for Linear, Time-Varying Systems

Researcher: Assistant Professor Richard T. O'Brien, Jr.
Sponsor: Naval Academy Research Council (NARC)

This research focused on two separate areas: (1) definition of poles for linear, time-varying systems and (2) the design of a linear, time-varying steering controller for an automated vehicle. The abstracts for each area are included below:

(1) A definition of poles is presented for continuous-time, linear, time-varying systems. For a time-varying state equation, a pole set defines a stability preserving variable change relating the original state equation to an upper triangular state equation. This definition is shown to be a generalization of the existing definition of poles for linear, time-varying systems and is consistent with the definition for linear, time-invariant systems. A computation procedure is presented using a QR decomposition of the transition matrix for the state equation. A numerical example is given to illustrate this procedure. (2) The modeling and control of a highway vehicle with a known, variable speed are considered. In particular, a fundamentally new steering control task is introduced that requires the vehicle to change lanes while changing speeds. Linear and nonlinear, time-invariant models of the vehicle's lateral dynamics are generalized to account for the effects of varying speed. A linear, time-varying steering controller is synthesized using an H-infinity design procedure for linear, time-varying systems previously developed by the author. In this procedure, linear, time-varying weighting filters were constructed by linearly interpolating (in time) between linear, time-invariant weighting filters. This procedure allowed for specification of approximate localized-in-time frequency response. Closed loop simulations using the nonlinear, time-varying model are conducted for this maneuver and several additional cases to test the robustness of the controller to parameter variation and external disturbances. These simulations show that the
linear, time-varying controller provides better nominal and robust performance than a linear, time-invariant

controller designed for a constant speed.

Development on Quiet Shipboard Machinery Utilizing Electronic Controls

Researchers: Associate Professor George E. Piper
and Assistant Professor John M. Watkins
Sponsor: Naval Surface Warfare Center (NSWC), Annapolis Detachment

In this work, active noise control techniques were applied to rotary machinery equipped with magnetic bearings. The machinery's rotor, suspended by electromagnetic bearings, was used to project acoustic pressure signals. Robust and adaptive feedback control schemes were used in conjunction with the magnetic bearings to cancel noise. Simulation and experimental results were obtained.

Development of Quiet Shipboard Machinery Utilizing Electronic Controls

Researchers: Assistant Professor John M. Watkins, Associate Professor George E. Piper,
Assistant Professor David Baumann and Glen Bell
Sponsor: Naval Surface Warfare Center (NSWC), Annapolis Detachment

In this work, active noise control techniques were applied to rotary machinery equipped with magnetic bearings. The machinery's rotor, suspended by electromagnetic bearings, was used to project acoustic pressure signals. Robust and adaptive feedback control schemes were used in conjunction with the magnetic bearings to cancel noise. Simulation and experimental results were obtained.

Multiple Aperture Camera System

Researcher: Associate Professor Carl E. Wick
Sponsor: Naval Air Warfare Center (Code 4556)

This study was part of the groundwork needed in the development of an all-around aircraft vision system that is based on a set of fixed infrared cameras (apertures). These fixed cameras provide images to a computer system, which is then able to 'move' the observer point of view within the field covered by the cameras. An experimental platform was built at USNA and some fundamental aspects of image rotation were demonstrated.

Control of an Electrically Reconfigurable Ship

Researcher: Assistant Professor Edwin L. Zivi

Sponsor: Office of Naval Research (ONR)

Future warships will be configured with integrated propulsion and ship service power systems which are highly automated and realize improved survivability, coupled with decreased crew size requirements. These electrically reconfigurable ships require survivable automation which shifts crew intensive functions to advanced machinery and control systems. Robust, reconfigurable power and control systems are essential for the replacement of human senses and muscle during casualty conditions. These systems must be capable of dependable situational assessments and predictable casualty response during major engineering failures and battle damage evolutions.

This research focuses on nonlinear stabilization algorithms for electrical power distribution systems under stress. In particular, these systems exhibit "negative impedance " leading to catastrophic voltage collapse. Voltage collapse occurs when constant power, solid-state conversion equipment increases current demand in response to falling supply voltage. Stabilization requirements are formulated in admittance space and derived for efficient, fault tolerant, distributed, implementation. This is new work.

YP Automation Demonstration

Researcher: Assistant Professor Edwin L. Zivi
Sponsor: Office of Naval Research (ONR)

The Naval Research Advisory Committee has called for robust demonstrations of automation for reduced manning. The Yard Patrol (YP) automation demonstration involves ONR ownership and enhancement of one USNA YP which was scheduled for disposal. Per a letter from ADM Gaffney, Chief of Naval Research, ONR has committed to maintain YP679 as a technology demonstration. USNA has teamed with Florida Atlantic University and Vector Research to perform the automation demonstration under ONR funding of $1.5M. This initial demonstration involves automation of propulsion, propulsion ancillaries, electric plant, and steering. This control system upgrade will demonstrate the feasibility of using self-healing, commercial, component level, intelligent control, for critical shipboard machinery systems. As research ramps up during the summer of 1999, USNA will acquire an organic capability to perform laboratory automation research and directly support YP technology demonstrations. Two systems majors will contribute undergraduate research during academic year ‘00.

Independent Research

Investigation of the MATLAB Graphical User Interface for Control Systems Applications

Researcher: Professor Robert DeMoyer

New with MATLAB 5 is the Graphical User Interface Development Environment, or GUIDE. This tool enables the engineering educator to produce pedagogical software which combines the computing and graphics capability of MATLAB with convenient Graphical User Interfaces. The purpose of this research is to develop ways to adapt GUIDE to relatively complex control system applications.

MATLAB GUI Applications

Researcher: Professor E. Eugene Mitchell

MATLAB 5 introduced a feature called GUIDE for use with GUI's (Graphical User Interface). The new feature allows much easier and faster implementation of Windows-based user interface buttons, plots and solutions to difficult problems. Just a few days work with the MATLAB GUI package generates the equivalent of 10000 lines of C code, code that would take an experienced programmer three or four man-months of work to duplicate.

A root locus GUI was developed that allows a user to add poles and zeros to a transfer function and plot the root locus, to find design points, etc. The program had considerable use in ES308, during the root locus design segment.

A time response GUI was developed for use in ES202 and ES307. This program has been developed into a paper for presentation at the Frontiers in Education Conference.

An optimal control design GUI was developed for use in ES418, Modern Controls. Optimal control is unsolvable by hand and requires an iterative solution. The GUI allows easy parameter changes and solutions.

Robust Global Control of Fan Noise in an Acoustic Duct Using Magnetic Bearings

Researchers: Assistant Professor Richard T. O'Brien, Jr. and Assistant Professor John M. Watkins, Associate Professor George E. Piper and Assistant Professor David C. Baumann

In this research, a novel approach has been developed to reduce fan related noise in an acoustic duct. By installing magnetic bearings on the noise producing machinery, it is possible to locate the anti-noise source with the disturbance noise source. This approach allows for global noise reduction throughout the duct system. Using H-infinity control theory, an active noise controller is designed that attains broadband as well as tonal noise reduction at all points along the duct. H-infinity control designs are particularly robust to uncertainties in the plant model. Finally, simulation results demonstrate the global nature of this novel active noise control approach.

On the Steering of an Articulated Vehicle Using Differential Braking

Researchers: Assistant Professor Richard T. O'Brien, Jr. and Associate Professor George E. Piper

In this research, the use of differential braking to steer the trailer of an articulated vehicle is considered. A dynamic model of the vehicle has been developed and linearized for a constant velocity and zero relative angle

condition. The resulting state space realization is controllable indicating that it is feasible to steer the trailer using differential braking. Open loop simulations show that the differential braking force reduced the relative angle between the tractor and trailer during a lane change maneuver.

In future work, a closed loop differential braking control system will be designed. Furthermore, the avoidance of "jack-knifing" during steering and braking maneuvers will be investigated.

Analysis of Nonlinear Sampled-Data Systems

Researcher: Assistant Professor Daniel J. Stilwell

The primary goal of this research is to develop guidelines and algorithms for the design of nonlinear sampled-data controllers. Since nonlinear controllers are typically designed in continuous-time, methods of discretization are essential elements in the controller design process and a major focus of this research.

Particular attention is focused on the class of nonlinear controllers that are *gain scheduled*. Gain scheduled controllers have a rich historical development dating back at least to the early, post-WWII flight control programs. Present-day applications of gain scheduling are found throughout industry, especially in aerospace control. In fact, almost every military aerospace vehicle contains a gain scheduled controller.

To date, we have shown that continuous-time gain scheduled controllers can be discretized while retaining certain linearization properties of the original continuous-time design. This fact is useful to control engineers in justifying the work required to design continuous-time controllers that satisfy certain linearization properties.

Research Course Projects and Trident Scholar Projects

Model-based Control of Combustion

Researcher: Midshipman 1/C Nicholas G. Osburn, USN, Trident Scholar
Faculty Advisor: Assistant Professor Kiriakos Kiriakidis

This project investigates the use of mathematical modeling to design a closed-loop system for the control of combustion in a methane-fueled burner. Regulation of the air-to-fuel (A/F) ratio for lean or rich combustion, depending on fuel efficiency or power requirements, is pivotal in applications such as internal combustion engines or fossil fuel power plants. The model-based system operates by continuously measuring the quantity of the carbon monoxide within the exhaust flue. Using this measurement, a control algorithm, implementable on a wide range of computing platforms, regulates the flow of fuel to the burner. The basis of the algorithm is a mathematical model of the combustion process that captures its input-output behavior and is obtainable exclusively from measurement data. The proposed design is capable of regulating the A/F ratio within narrower tolerances than existing model-free approaches.

Design Course Projects

Each Systems Engineering major enrolls in ES402, Systems Engineering Design, during senior year. This course is the capstone of the Systems Engineering curriculum. The student is required to propose, design, construct, test, demonstrate and evaluate a system of particular personal or general professional interest.

The ES402 design course requires the combined efforts of the total Systems Engineering Department faculty. Military instructors normally function as project monitors and help with organization, administration, and scheduling of individual projects. Civilian faculty function as technical advisors, and military and civilian technicians supply the hands-on technical help.

The results of academic year 1998-99:

Micro Saboteur
Midshipmen 1/C Aaron Anthonsen,
Andrew C. Grubler and Andrew B. Hall, USN
Advisor: Commander Frederick A. Hoover, USNR

Walking Robot
Midshipmen 1/C Peter T. Aparico,
Gary L. Buxton, Christoper G. Comora.
James R. Compton, John Gallucci, Vijay A. George
Jeremy J. Graczyk, Jason B. Higgins
and George H. Klaus, USN
Advisor: Lieutenant George D. Doney, USN

Autonomous Battleship Control
Midshipmen 1/C Matthew Baldwin
and William D. Price, USN
Advisor: Major Denise A. Mattes, USMC

Automatic Golf Putter
Midshipmen 1/C Matthew Bernhard,
Kevin J. Goodwin and Matthew R. Malinowski, USN
Advisor: Commander Bradford H. Baylor, USN

Follow the Leader
Midshipmen 1/C Brent R. Biniek
and Jason D. Everson, USN
Advisor: Commander John F. McKernan, USN

Firefighting Robot
Midshipmen 1/C Douglas B. Booher,
Sura Bunchongchuitr, Joshua D. Crouse
and Edward F. Ward, USN
Advisor: Lieutenant Commander Kenneth L. McElroy, USN

Autonomous Table Soccer
Midshipmen 1/C Jeremy S. Bowen
and Frank L. Norcross, USN
Advisor: Commander John J. Viniotis, USN

Active Filter and Sound Attenuation for Muffler
Midshipmen 1/C Taryn F. Brady
and Isaac R. Stutts, USN
Advisor: Lieutenant Commander Fredric D. Forney, USN

Maglev Vehicle
Midshipmen 1/C William B. Brooks,
Babatunde A. Ogunwole,
and Micah M. Weller, USN
Advisor: Major William W. Arrasmith, USAF

Systems Ball
Midshipmen 1/C Daniel S. Burr,
Joseph A. Cuba and Jeffrey G. Rogers, USN
Advisor: Lieutenant Commander Scott D. Bohman, USN

Automated Steering Car
Midshipmen 1/C Tony E. Clark
and Robert A. Kirby, USN
Advisor: Commander John J. Viniotis, USN

The Safegun
Midshipman 1/C Christopher M. Colson, USN
Advisor: Lieutenant Commander Brent A. Ditzler, USN

Water Temperature Controller
Midshipmen 1/C Brien J. Croteau and Matthew R. Severson, USN
Advisor: Major Denise A. Mattes, USMC

GPS-Controlled Car
Midshipmen 1/C Jesse A. Davidson and Richard Menichelli, USN
Advisor: Commander Frederick A. Hoover, USNR

Unmanned Automatic Artillery
Midshipmen 1/C Michael J. Doniger and Fadi Sbaiti, USN
Advisor: Lieutenant Commander Brent A. Ditzler, USN

Sumo Wrestler
Midshipmen 1/C Jason A. Edelbertg and Ronald R. Martin, USN
Advisor: Lieutenant Commander Franklin D. Hixenbaugh, USN

Mine Hunter
Midshipmen 1/C Brian J. Ellis and Robert M. Pierce, USN
Advisor: Lieutenant Commander Kenneth L. McElroy, USN

Ticky Mickey
Midshipmen 1/C Alicia N. Evans and Travis W. Kaltenbach, USN
Advisor: Commander Bradley D. Taylor, USN

Bothoven
Midshipmen 1/C Matthew D. Fanning, Robert E. Lingler and Aaron C. Shulski, USN
Advisor: Lieutenant Commander Fredric D. Forney, USN

Magnetic Levitation Train
Midshipmen 1/C Gabriela Fiorilo and Eric D. Shebatka, USN
Advisor: Lieutenant George C. Dyer, USN

Systems Ball
Midshipmen 1/C Cecil A. Fletcher and Jacob L. Purdon, USN
Advisor: Major Denise A. Mattes, USMC

Remote Life Sign Detector
Midshipmen 1/C Adam H. Fox and Jacqueline R. Jackson, USN
Advisor: Commander John F. McKernan, USN

Autonomous Stability Control of Dyanamic Flight Model
Midshipman 1/C Christopher T. Franssen, USN
Advisor: Lieutenant Commander Steven F. Vincent, USNR

Systems Ball
Midshipmen 1/C Gregory P. Garnett, John J. McNamara and Jonathan D. Uyboco, USN
Advisor: Major Denise A. Mattes, USMC

Police Band Laser/Radar Detector/ Jammer
Midshipman 1/C Gregory J. Gebbie, USN
Advisor: Major Thomas L. Langlois, USMC

Computer Controlled Car Security System
Midshipmen 1/C Christopher T. George, Brandon J. Harjer and James M. Maher, USN
Advisor: Commander Frederick A. Hoover, USNR

Shark Wall
Midshipmen 1/C Kerry A. George, Autumn J. Kosinski and Kathleen M. Merkle, USN
Advisor: Lieutenant George C. Dyer, USN

Secure Communications Laser
Midshipman 1/C Thomas A. Guccione, USN
Adviser: Major William W. Arrasmith, USAF

Snype Hunter
Midshipmen 1/C Kyle L. Guilfoyle
and Craig W. Hempeck, USN
Advisor: Commander John J. Viniotis, USN

Remote Car Starter
Midshipman 1/C Jerin T. James, USN
Advisor: Commander Bradford H. Baylor, USN

Sumo Wrestler
Midshipman 1/C Peter A. Jayroe, USN
Advisor: Lieutenant Commander Scott D. Bohman, USN

Digital RF Point-to-Point Communications
Midshipmen 1/C Andrius Kaikaris
and Yassen Mikhailov, USN
Advisor: Lieutenant Commander Fredric D. Forney, USN

Systems Ball
Midshipmen 1/C Jonathan J. Kim
and Catalin Lebidov, USN
Advisor: Lieutenant Commander Kenneth L. McElroy, USN

Autonomous Underwater Vehicle
Midshipmen 1/C Andrew J. Lawler
and Mark G. Minukas, USN
Advisor: Lieutenant Commander Franklin D. Hixenbaugh, USN

Smart Camera System
Midshipman 1/C Rick W. Lentz, USN
Advisor: Major William W. Arrasmith, USAF

Autonomous Underwater Vehicle
Midshipmen 1/C Scott M. Morrill
and Eric D. Pedersen, USN
Advisor: Lieutenant Commander Franklin D. Hixenbaugh, USN

Magnetic Leviatation
Midshipmen 1/C Lawrence D. Nance,
Damian A. Sanders and William E. Spann, USN
Advisor: Commander Bradley D. Taylor, USN

Weather Sensitive House
Midshipman 1/C Jason L. Ofner, USN
Advisor: Lieutenant Commander Brent A. Ditzler, USN

Automated Potato Launcher
Midshipman 1/C Andrew J. Rozek, USN
Advisor: Major Thomas L. Langlois, USMC

Inverse Pendulum
Midshipmen 1/C John M. Smith
and Anthony J. Toriello, USN
Advisor: Lieutenant Commander Steven F. Vincent, USNR

Tireless Farm Hand
Midshipman 1/C Matthew R. Smith, USN
Advisor: Commander Bradford H. Baylor, USN

Rail Gun on Motorized Mount
Midshipmen 1/C David C. Whitmer
and Timothy A. Williams, USN
Advisor: Major Thomas L. Langlois, USMC

PUBLICATIONS

ARRASMITH, William W., Major, USAF, M. Roggemann, and B. Welsh, "Optimal Wavefront Reconstruction for a Coherent Diffracted Field," Applied Optics, 37 (20), 4457-4467 (July 1998).

Phase differences in the far-field of a coherently illuminated object are used to estimate the two-dimensional phase in the measurement plane of an imaging system. A previously derived phase correlation

function is used in a minimum variance phase estimation algorithm to optimally map phase difference measurements to estimates of the phase on a grid of points in the measurement plane. Theoretical and computer simulation comparisons between the minimum variance phase estimator and conventional least squares estimators are made. The minimum variance phase estimator produces a lower aperture-averaged mean-square phase error for all values of a sampling parameter, $\hat{a}$.

ARRASMITH, William W., Major, USAF, "Branch Cut Effects in Optimally Estimating a Coherent Diffracted Field," Proceedings of the OSA Signal Recovery and Synthesis VI Topical Meeting, 99-101, (June 1998).

In optical imaging systems that image coherently illuminated diffuse scattering objects, the complex field in both the object plane and the measurement plane of the object are described by a circularly complex random process with a spatial correlation function for the phase of the field. The spatial phase correlation function can be used to determine weighting coefficients that optimally estimate the 2-D phase in the measurement plane of an imaging system. The spatial phase correlation function is also used to estimate the theoretical aperture-averaged mean-square phase error. This paper modifies the spatial phase correlation function to account for the presence of branch cuts in the 2-D measurement plane phase function. The branch cuts are dominant in coherent imagery and arise from point-zeros in the measurement plane irradiance. If the effects of the branch cuts are not properly modeled, a catastrophic effect on conventional image reconstruction algorithms results.

AVRAMOV-ZAMUROVIC, Svetlana, Assistant Professor, N.M. Oldham, M. Parker, and B. Waltrip, "Low Frequency Characteristics of Thin-Film Multijunction Thermal Voltage Converters", IEEE Transactions on Instrumentation and Measurements, (March 1999).

Low frequency errors of thin-film multijunction thermal voltage converters are estimated using a simple model based on easily measured parameters. The model predictions are verified by measuring the converter's frequency characteristic using a digitally synthesized source.

AVRAMOV-ZAMUROVIC, Svetlana, Assistant Professor, Carl E. WICK, Associate Professor and T. E. DWAN, Professor, "Communications Track for Systems Engineering Majors", Frontiers in Education Conference Proceedings, Tempe, AZ, (November 1998).

The Weapons and Systems Engineering Department at the United States Naval Academy offers an undergraduate degree in Systems Engineering (Controls) to approximately 100 midshipmen annually. Fourth-year students are allowed to specialize by taking a two-course track chosen from several areas of interest. Our communications track is one of these areas of interest. The communications track integrates signal analysis and processing methods, and modern communication systems operation principles through hand-on laboratory experience and computer simulation. The uniqueness of this track is that it is offered to students that do not have traditional electrical engineering background. This paper details our experience in teaching modern communication systems to undergraduate Systems Engineering majors.

AVRAMOV-ZAMUROVIC, Svetlana, Assistant Professor, Carl E. WICK, Associate Professor, and Terrence E. DWAN, Professor, "Communications Track for Systems Engineering Majors," Frontiers in Education Conference Proceedings, Session F4E, CD ISBN 0-7803-4765-X, (November 1998).

This paper details our experiences in teaching modern communications systems to undergraduate Systems Engineering Majors students. We show how the current track of courses is able to integrate signal analysis and processing methods, and modern communication systems operating principles through classroom work, hands-on laboratory experience and simulation.

BISHOP, Bradley E., Assistant Professor and Mark W. Spong, "Control of Redundant Manipulators Using Logic-Based Switching," Proceedings of the 37th IEEE

Conference on Decision and Control, December 1998, pp. 1488-1493.

In this paper we study the control of redundant planar robotic manipulators using a switched (or hybrid) control scheme, focusing on manipulators with a degree of redundancy of one. We emphasize the effectiveness of switched control systems with respect to stabilization and performance enhancement for this class of manipulators. We present a simulation study of logic-based switching control of a 3 DOF planar manipulator under end-effector trajectory tracking and demonstrate the capabilities of this scheme.

BISHOP, Bradley E. Assistant Professor,"Lyapunov Function Normalization for Controlled Switching of Hybrid Systems," Proceedings of the 1999 American Control Conference, June 1999, pp. 2461 - 2465.

In this paper, we consider tools for control of switched nonlinear systems using Lyapunov-function based techniques. We focus our efforts on those switched nonlinear systems that admit a single equilibrium point that is common to all subsystems. We develop techniques by which independent Lyapunov functions can be normalized so that switching surfaces are implicitly generated and switches guarantee some level of system performance, including stability and state convergence.

BISHOP, Bradley E. Assistant Professor and Mark W. Spong, "Vision-Based Control of an Air Hockey Playing Robot," IEEE Control Systems Magazine, (1999) pp. 23 - 32.

Robotic manipulation of rapidly moving objects through the application of visual feedback requires careful analysis of the interaction of sensing and control. Selection of achievable manipulation tasks can be carried out through analysis of the visual data stream when combined with task-specific controllers. Flexibility can be increased in such a system through the use of hybrid control, in which multiple controllers are designed for independent objectives. This article describes vision-based robotic ballistic manipulation using integrated sensing and hybrid control. Experimental results are given for the air hockey example.

BISHOP, Bradley E. Assistant Professor and Mark W. Spong, "Vision-Based Objective Selection for Robust Ballistic Manipulation,", Robust Vision for Vision-Based Control of Motion, IEEE Press, (1999) pp. 203 - 219.

The use of visual measurement for high-speed and high-precision robotic tasks requires careful analysis of the fundamental properties of the sensing paradigms chosen. In this work we analyze the information generated by a state estimator for a target moving object that is to be intercepted by a robotic manipulator. Selection of potential interaction objectives is carried out through analysis of the data stream from the visual system. The underlying sensing problem is designed for a fundamentally unstructured environment under fixed-camera visual measurement. The test domain is chosen to be ballistic manipulation of a sliding object on a low-friction planar surface: the air hockey problem.

BISHOP, Bradley E., Assistant Professor and Mark W.Spong, "Adaptive Calibration and Control of 2-D Monocular Visual Servo Systems," Control Engineering Practice, Volume 7, Number 3, 423-430, (March 1999).

For most visual servo systems, accurate camera/robot calibration is essential for precision tasks such as tracking time-varying end-effector trajectories in the image plane of a remote (fixed) camera. This paper presents details of control-theoretic approaches to the calibration and control of monocular visual servo systems in the case of a planar robot with workspace perpendicular to the optical axis of the imaging system. An on-line adaptive calibration and control scheme is developed along with an associated stability and convergence theorem. A redundancy-based refinement of this scheme is proposed and demonstrated via simulation

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KIRIAKIDIS, Kiriakos, Assistant Professor, Anthony Tzes, Apostolos Grivas, and Pei-Yuan Peng, "Modeling, Plant Uncertainties, Fuzzy Logic Sliding

Control of Gaseous Systems," IEEE Transactions on Control Systems Technology, 7, 42-55 (January 1999).

The active control problem of gaseous processes such as primary air atmospheric-suction and forced-draft supply of air for fuel combustion is addressed in this article. The objective is to regulate gas velocity, at particular locations within the system, so that appropriate volume flow rate is achieved. Using modal expansion and treating the high-order modes as unmodeled dynamics, the governing law of momentum conservation reduces to a finite set of ordinary differential equations. Due to variations of the gas properties with operating conditions, there exists parametric uncertainty in the obtained reduced-order model. Moreover, inclusion of the fan characteristic and actuator dynamics introduces additional uncertainty and nonlinearity in the model.

To avoid relying on estimation of parameters that vary with operating conditions or on conservative bounds on the uncertainty, the proposed controller has variable structure with adaptive switched gain. A fuzzy-logic-based inference engine realizes the adaptive law that tunes the switched gain to the smallest value that verifies the sliding condition. In effect, this novel design reduces the tendency and magnitude of chattering, a drawback of conventional sliding control. The fuzzy logic sliding controller is tested on a prototype air-handling unit.

KIRIAKIDIS, Kiriakos, Assistant Professor, "Fuzzy Model-based Control of Complex Plants," IEEE Transactions on Fuzzy Systems, 517-529. (November 1998).

In the field of fuzzy modeling, the Takagi-Sugeno fuzzy model has been used to accurately approximate the dynamics of complex plants. This paper addresses two control design problems associated with state-space realizations of such fuzzy models. First, we treat the stability robustness of fuzzy-model-based controllers against modeling uncertainty. Next, we develop observer-based control schemes and further investigate the behavior of estimated-state feedback. In both cases, we provide sufficient conditions that guarantee stability of the closed loop. The results are demonstrated on the fuzzy model of a gas furnace process.

KIRIAKIDIS, Kiriakos, Assistant Professor, Apostolos Grivas, and Anthony Tzes, "Quadratic Stability Analysis of the Takagi-Sugeno Fuzzy Model," Fuzzy Sets and Systems, 98, 517-529 (August 1998).

The nonlinear dynamic Takagi-Sugeno fuzzy model with offset terms is analyzed as a perturbed linear system. A sufficient criterion for the robust stability of this nominal system against nonlinear perturbations guarantees quadratic stability of the fuzzy model. The criterion accepts a convex programming formulation of reduced computational cost compared to the common Lyapunov matrix approach. Parametric robust control techniques suggest synthesis tools for stabilization of the fuzzy system. Application examples on fuzzy models of nonlinear plants advocate the efficiency of the method. The examples demonstrate reduced conservatism compared to norm-based criteria.

KIRIAKIDIS, Kiriakos, Assistant Professor, “Control Synthesis for a Class of Uncertain Nonlinear Systems,” Proceedings of the American Control Conference, San Diego, CA, (June 1999), pp. 4073 - 4074.

The paper investigates the synthesis of nonlinear control systems with performance and stability robustness in the presence of parametric uncertainty. The proposed technique searches for a positive definite (p.d.) function that simultaneously satisfies design criteria stemming from the above requirements and recasts the general problem in the form of two Nonlinear Matrix Inequalities (NLMIs). Using non-conventional models, such as fuzzy approximates or global linearizations, the method provides constant-matrix or piecewise quadratic solutions.

KIRIAKIDIS, Kiriakos, Assistant Professor, “A New Tool for Analysis and Design of Robust Fuzzy Systems,” Proceedings of the 18th International Conference of the North American Fuzzy Information Society, New York, NY, (June 1999), pp. 436 - 437.

Modeling and control methods that use the

Takagi-Sugeno (T-S) fuzzy system structure have received wide acceptance in the area of fuzzy logic control. This is mainly due to the ability of such methods to assess important properties of the closed-loop system such as stability and performance. These methods use Nonlinear Matrix Inequalities (NLMIs) to formulate the problem. Because of the quasi-linear structure of the T-S fuzzy system, this approach leads to a simpler and easier to solve problem that involves Linear Matrix Inequalities (LMIs). The T-S and NLMIs formalism serves also as a vehicle for the investigation of more complex system properties-notably robustness. Recent results have shown how to obtain quadratic Lyapunov functions that prove robust stability against sector-bounded uncertainty. These results, however, are conservative, *i.e.*, they apply to T-S fuzzy models whose local linear systems form a tight convex hull. To reduce conservatism, we propose a piecewise quadratic rather than a constant-matrix quadratic Lyapunov function. As a result, the region of the state space where robustness is assessable will increase and so will the numerical complexity of the problem. Rather than the computationally efficient LMI-based optimization, the solution will now involve Bilinear Matrix Inequalities (BMIs). The advantage of the BMI alternative lies in its ability to provide a solution where the LMI approach fails but without the computational burden of the NLMI approach.

KIRIAKIDIS, Kiriakos, Assistant Professor, “An LMI Approach to the Control of a Class of Nonlinear Systems,” Proceedings of the 37th IEEE Conference on Decision and Control, Tampa, FL, 1470-1475, (December 1998).

This paper considers the control of the class of nonlinear systems that can be represented by the convex hull of a collection of local linear approximates. Use of such quasi-linear modeling reduces the problem of the robust stabilization of the class with static state or dynamic output feedback, against modeling error and parametric uncertainty, to a Linear Matrix Inequality (LMI) problem.

KIRIAKIDIS, Kiriakos, Assistant Professor and WATKINS, John M., Assistant Professor, “Adaptive Control of Time-Varying Systems Based on Parameter Set Estimation,” Proceedings of the 37th IEEE Conference on Decision and Control, Tampa, FL, (December 1998) 4002-4007.

Adaptive control of time-varying plants, in the presence of unmodeled dynamics and bounded disturbances, via parameter set estimation is proposed. The set estimator uses normalization and maps the uniformly bounded equation error on parametric error, which characterizes the modeled part of the plant. Based on the information from the set estimator, a switching control criterion selects the parametric vector froma set of nominal model parameters and tunes in the adaptive controller. At the same time, through stabilization against the parametric error, the policy renders the closed-loop modeled dynamics robust with respect to the equation error mechanisms. O’BRIEN Jr., Richard T., Assistant Professor and Pablo A. Iglesias, "Pole/Zero Cancellations in Time-Varying Systems," International Journal of Control, 71(1), 103-130, (September 1998), pp. 337 - 340.

Poles and zeros are defined for continuous-time, linear, time-varying systems. A pole set for a time-varying state equation defines a stability-preserving variable change relating the original state equation to a time-varying, diagonal state equation. A zero is a function of time corresponding to an exponential input whose transmission to the output is blocked within the system. These definitions are shown to be generalizations of the definitions of poles and zeros in the time-invariant case. Using these definitions, it is shown that the relationship between the loss of controllability and/or observability in cascade systems and pole/zero cancellations is analogous to the relationship in the time-invariant case.

O’BRIEN Jr., Richard T., Assistant Professor and Pablo A. Iglesias, "Closed Loop Cancellations in H-infinity Control of Time-Varying Systems,” International Journal of Control, 71(1), 163-189, (September 1998).

The pole/zero cancellation phenomenon is examined in the closed loop system resulting from the solution of

the $\Hf$ control problem for time-varying systems. The unobservable and uncontrollable states are identified in the realization of the closed loop system associated with the general $\Hf$ control problem. Then these results are used in conjunction with previous results obtained by the authors on the pole/zero cancellation phenomenon in time-varying systems to identify pole/zero cancellations in two specific types of H-infinity control problems. These results generalize the work of Sefton and Glover for time-invariant systems.

O'BRIEN Jr., Richard T., Assistant Professor and Pablo A. Iglesias, "Time-Varying Steering Control for an Autonomous Highway Vehicle," Proceedings of 1998 American Control Conference, 1998, pp. 26 - 30.

An automated steering controller design is presented for a fundamentally new driving maneuver. The task for the controller is to steer the vehicle through a series of lane change maneuvers while following a desired velocity trajectory. A linear, time-varying steering controller is synthesized using a design procedure based on the solution of a H-infinity optimal control problem. This controller is compared to several time-invariant steering controllers and it is shown that the time-varying controller provides performance that a time-variant controller can not.

O'BRIEN Jr., Richard T., Assistant Professor, "Time-Varying H-infinity Steering Control," Proceedings of 1998 Summer Computer Simulation Conference, 179-184, (July 1998).

This paper addresses the design of a steering controller for an automated vehicle. A new class of tasks is considered where the vehicle is traveling at a known time-varying speed. Specifically, the task of the controller is to steer the vehicle through an *accelerate and pass* maneuver requiring the vehicle to move into an adjacent lane while accelerating, then return to the original lane while decelerating. The time-varying speed admits the use of a time-varying model of the vehicle's lateral dynamics. A steering controller is synthesized using $\Hf$ design procedure for linear, time-varying systems recently developed by the author. The procedure incorporates the performance objectives in the design using a generalized frequency domain technique. A series of simulation modules has been created to facilitate and standardize the design process. Results of numerical simulation are presented to illustrate the design process and the performance of the steering controller.

O'BRIEN Jr., Richard T., Assistant Professor and Pablo A. Iglesias, "Robust Controller Design for Time-Varying Systems," Proceedings of 1998 Conference on Decision and Control, 1998, pp. 3813 - 3818.

This paper examines the design of controllers for linear, time-varying systems. In particular, a design procedure is presented that incorporates performance and robustness objectives into existing optimal control methods. Using a frequency domain description of a time-varying system, a correlation is established between the transmission of power across frequencies and the time-variation of a system. The design procedure is developed using this description and the solution of the analogue to the H-infinity optimal control problem for time-varying systems. In particular, design guidelines are derived for several basic performance and robustness objectives. These guidelines reflect the time dependence of the frequency response of a time-varying system while retaining the frequency domain intuition of the time-invariant case. This procedure is analogous to the loop shaping design procedure of McFarlane and Glover for time-invariant systems.

O'BRIEN Jr., Richard T., Assistant Professor, "Analysis and Control of Finite Time-Variation Systems," Proceedings of the American Control Conference, 1786-1790, (June 1999).

In this paper, a new type of linear, time-varying, state space model is considered that admits a useful frequency response and a tractable solution to the controller synthesis problem. These objectives are achieved by defining a finite time-variation model, assuming one exists, where the coefficient matrices varying with time on a finite interval and were constant outside this finite interval. Using this type of model, the concepts of poles and frequency response of a finite

time-variation model are investigated. A pole set for a finite time-variation model is simply the set of frozen-time poles at each instant. Furthermore, for a certain class of a finite time-variation models, the frequency response can be related to the frequency response of the frozen-time plant at each instant. This type of model captures the relevant time-variation information on a finite horizon and requires only a finite amount of data to specify the plant. As a result, it was shown that the H-infinity robust stabilization problem can be solved on a finite horizon. This result simplifies the controller synthesis problem greatly.

O'BRIEN, Jr., Richard T., Assistant Professor and Pablo A. Iglesias, "Pole/Zero Cancellations in Time-Varying Systems," Proceedings of 1998 Conference on Mathematical Theory of Networks and Systems, (October 1998), pp. 723 - 728.

Definitions of poles and zeros for continuous time, linear, time-varying systems are presented. For a time-varying state equation, a pole set defines a stability preserving variable change relating the original state equation to a time-varying, diagonal state equation where the diagonal elements are the poles. A zero is a function of time corresponding to an exponential input whose transmission to the output is blocked with in the system. These definitions are shown to be generalizations of the definitions of poles and zeros in the time-invariant case. Using these definitions, it is shown that the relationship between the loss of controllability and/or observability in cascade systems and pole/zero cancellations is analogous to the relationship in the time-invariant case.

O'BRIEN, Richard T., Assistant Professor and George E. PIPER, Associate Professor, "On the Steering of an Articulated Vehicle Using Differential Braking," Proceedings of the 1999 Annual Conference On Information Sciences And Systems, Baltimore, MD, (1999).

In this paper, the use of differential braking to steer the trailer of an articulated vehicle is investigated. A dynamic model of the vehicle is developed and linearized for a constant velocity and zero relative angle condition. Open loop simulations are presented to show that steering control using differential braking force is feasible and effective.

PIPER, George E., Associate Professor,, John M. WATKINS, Assistant Professor, David Brumann, Assistant Professor and Glen Bell, "Modeling of a Magnetic Bearing Pump," Classified Proceedings of the Naval Symposium on Electric Machines, Annapolis, MD, (1998).

ABSTRACT-CLASSIFIED

PIPER, George E., Associate Professor,, John M. WATKINS, Assistant Professor, David Brumann, Assistant Professor and Glen Bell, "Adaptive Feedback Control in a Magnetic Bearing Pump System," Classified Proceedings of the Naval Symposium on Electric Machines, Annapolis, MD, (1998).

ABSTRACT-CLASSIFIED

BAUMANN, David, Assistant Professor, George E. PIPER, Associate Professor, John M. WATKINS,, Assistant Professor, and Glen Bell, "Implementation of Adaptive Control on a Magnetic Bearing Pump System," Classified Proceedings of the Naval Symposium on Electric Machines, Annapolis, MD, (1998).

ABSTRACT-CLASSIFIED

PIPER, George E., Associate Professor, John M. WATKINS, Assistant Professor, Richard T. O'BRIEN, Jr., Assistant Professor, and David BAUMANN, Assistant Professor, "Global Control of Fan Noise Using Magnetic Bearings," IEEE Transactions on Control Systems Technology, (September 1998).

In this paper, a novel approach is presented to reduce fan related noise in an acoustic duct. By using magnetic bearings as an noise control actuator, it is possible to co-locate the anti-noise source with the disturbance noise source. This approach allows for global noise reduction through out the duct system. Using H-infinity control theory, an active noise

controller is designed that attains broadband as well as tonal noise reduction at all points along the duct. H-infinity control designs are particularly robust to uncertainties in the plant model. Finally, simulation results demonstrate the global nature of this novel active noise control approach.

PIPER, George E., Associate Professor and John M. WATKINS, Assistant Professor, "System Identification of the Sound Field in a Fluid-Filled Pipe," Proceedings of the 1998 Summer Computer Simulation Conference, 197-201, Reno, NV, (July 1998).

In this paper, modeling of the sound field within a fluid-filled pipe is investigated. One of the answers sought is the minimal model order for system identification that best captures the relevant characteristics of the acoustic path. In this study we develop a infinite order theoretical model of the sound field of an open-ended fluid-filled pipe. The pole-zero configuration of this model is then analyzed to determine the minimal order model that accurately models the sound field. Finally, system identification schemes are performed on data generated by the theoretical model to produce IR models. The results of the system identification models are compared to the theoretical model and the results are discussed.

PIPER, George E., Associate Professor, Terrence E. DWAN, Professor, Carl E. WICK, Associate Professor, and E. Eugene MITCHELL, Professor, "Environmental Systems Engineering Course," Proceedings of the 1998 Summer Computer Simulation Conference, 449-454, Reno, NV, (1998).

A new course and track in the Systems Engineering major at the United States Naval Academy presents the design and analysis of environmental systems from a systems engineering approach. Several engineering topics and our approach to them are addressed in the course including: ecological dynamics, transport phenomena, meteorological, atmospheric and solar processes. The two particular areas of study in the new course to be discussed in this paper are: the analysis and simulation of thermal transport phenomenon and the simulation, measurement and analysis of ecological data. The systems engineer's role in the study of all of these environmental topics is emphasized throughout the course.

PIPER, George E., Associate Professor, Terrence E. DWAN, Professor, E. Eugene MITCHELL, Professor and Carl E. WICK, Associate Professor, "Teaching Environmental Systems Engineering," Proceedings of the 1998 ASEE Annual Conference, CD-ROM, Seattle, WA, (June 1998).

The Systems Engineering Department at the U. S. Naval Academy has introduced a track in Environmental Systems Engineering. The track consists of a sequence of two courses. The first course is taught within the Systems Engineering Department. This course addresses areas where systems engineers impact environmental issues. The course concentrates on environmental hardware, sensors, data handling, and modeling. For the second course in the track, students choose from two traditional environmental courses in the Ocean Engineering Department at the Naval Academy. One course centers on marine pollution: its causes, effects and remediation. The other course centers on ocean resources: their identification, recovery and utilization. This paper presents an overview of the Environmental Systems Engineering track and focuses on the Systems Engineering Department's environmental course. It discusses the course philosophy, content, and labs.

WATKINS, John M., Assistant Professor, George E. PIPER, Associate Professor, Richard T. O'BRIEN, Jr., Assistant Professor, and David C. Baumann, Assistant Professor, "The Use of Magnetic Bearing for Global Control of Fan Noise," Proceedings of the American Control Conference, CD ROM, June 1999.

In this paper, a novel approach is presented to reduce fan related noise in an acoustic duct. By installing magnetic bearings on the noise producing machinery, it is possible to collocate the anti-noise source with the disturbance noise source. This approach allows for global noise reduction through out the duct system.

STILWELL, Daniel J., Assistant Professor and Wilson

J. Rugh, “Stability and L2 Gain Properties of LPV Systems,” Proceedings of the 1999 American Control Conference, San Diego, CA, (June 1999) pp. 2262 - 2266.

Stability and L2 gain properties of linear parameter-varying systems are obtained under assumed bounds on either the maximum or average value of the parameter rate.

STILWELL, Daniel J., Assistant Professor and Wilson J. Rugh,"Interpolation Methods for Gain Scheduling," Proceedings of the IEEE Conference on Decision and Control, Tampa, FL, pp. 3003-3008, (December, 1998).

Synthesis of gain scheduled controllers often requires that a parameter-varying controller degenerated from a finite set of linear time-invariant controllers. We propose interpolation methods for this task with the property that stability of the linearized closed-loop system is preserved for each fixed value of the scheduling parameter. In addition, slow-variation arguments are presented that establish stability of the nonlinear closed-loop system with gain scheduled controller.

STILWELL, Daniel J., Assistant Professor and Douglas A. Lawrence, "Sampled-Data Implementation of a Gain Scheduled Controller," Proceedings of the Conference on Information and Systems Sciences, Baltimore, MD, (March, 1999), pp. 717 - 722.

A continuous-time gain-scheduled controller must be transformed to a corresponding discrete-time controller for sampled-data implementation. We show that certain linearization properties of a continuous-time gain scheduled controller are inherited by its sampled-data implementation. We also show that a similar relationship exists for multi-rate gain scheduled controllers arising in flight control applications.

WATKINS, John M., Assistant Professor and Stewart, Major Devilbiss, “An Input Synthesis Procedure for Parameter Set Estimation of Unstable System,” Proceedings of the 33rd Annual Conference on Information Sciences and Systems, Baltimore, MD, (March 1999).

System identification of unstable systems is a very challenging problem. While feedback can be applied to stabilize the system during the identification process, the addition of feedback poses additional problems. First, finding a stabilizing feedback gain when a model of the plant dynamics does not exist may be very difficult. Second, even if a feedback gain can be found that stabilizes the system, it is well known that “identifiability" can be lost due to static gain feedback. In this paper, an input synthesis procedure for parameter set estimation of unstable systems is presented. While feedback is inherent in this strategy, identifiability is preserved due to the time-varying nature of the feedback gain matrix.

PIPER, George, Associate Professor and WATKINS, John M., Assistant Professor, “System Identification of the Sound Field in a Fluid-Filled Pipe,” Proceedings of the 1998 Summer Computer Simulation Conference, Reno, NV, (July 1998).

In this paper modeling of the sound field within a fluid filled pipe is investigated. One of the answers sought is the minimal model order for system identification that best captures the relevant characteristics of the acoustic path. In this study we develop a infinite order theoretical model of the sound field of an open-ended fluid filled pipe. The pole-zero configuration of this model is then analyzed to determine the minimal order model that accurately models the sound field. Finally, system identification schemes are performed on data generated by the theoretical model to produce IIR models. The results of the system identification models are compared to the theoretical model and the results are discussed.

WICK, Carl E., Associate Professor and George E. PIPER, Associate Professor,"Using the ADSP-21061 SHARC EZ-KIT in Undergraduate DSP Oriented Courses", Proceedings of the 1998 FIE Conference, Phoenix, AZ, (1998), CD-ROM.

In this paper we discuss the use of Analog Devices ADSP-21061 SHARC EZ-KIT evaluation board as a

teaching tool. We have developed a Windows-95 "front-end" program to accompany the evaluation board that ties Analog Devices' C programming package with some additional editing, downloading, uploading and graphing tools. The complete package provides much improved access to program development tools and to the processor for program operation, debugging and data extraction. With this set of programs, we believe that this processor and evaluation board can now become an effective tool for exploring the use of digital processors for signal processing and for control applications by students who have little computer science background. In this paper we present an example laboratory exercise using these tools.

WICK, Carl E., Associate Professor and George E. PIPER, Associate Professor, “Using the ADSP-21061 SHARC EZ-KIT in Undergraduate DSP Oriented Courses,” Frontiers in Education Conference Proceedings, Session F2D, CD ISBN 0-7803-4765-X, (November 1998).

In this paper we discuss the use of Analog Devices ADSP-21061 SHARC EZ-KIT evaluation board as a teaching tool. We have developed a Windows-95 ‘Front End’ program to accompany the evaluation board that ties Analog Devices’ C programming package with some additional editing, downloading , uploading and graphing tools. With this set of tools we believe that the processor and evaluation board can become an effective tool for exploring digital signal processors at the undergraduate level. We supply an example laboratory exercise to illustrate the use of the evaluation board and program.

WICK, Carl E., Associate Professor, “Introducing Embedded Computer Systems to Undergraduate Engineering Students; Experiences using RISC Microcomputers in a Simulation Oriented Course,” Proceedings of the International Conference on Simulation and Multimedia in Engineering Education, San Francisco, CA, (January 1999), 136-141.

This paper describes the use of a locally built programming and simulation package to teach embedded digital processors to undergraduate Systems Engineering Majors. The development of the simulator is discussed as well as its operation in the classroom and in the laboratory.

ZIVI, Edwin L., Assistant Professor and Timothy J. McCoy, "Control of a Shipboard Integrated Power System," Proceedings of the Thirty-third Annual Conference on Information Sciences and Systems, (March 1999).

The control requirements for the next generation of Integrated Power Systems (IPS) are discussed within the context of present naval machinery monitoring and control state-of-the-art. After a brief review of modern naval propulsion systems, key requirements for next generation systems are identified. Derived control system requirements are then compared to existing capabilities and shortfalls are identified. A shipboard automation strategy is suggested which builds on current technology and ongoing innovations in fault tolerant distributed control for mission critical systems. Complementary aspects of stabilizing control, analytic redundancy, component level intelligent control, and neural nets are described. The end objective is the development of dependable, survivable, cost-effective, mission critical control systems based on commercially available control technology.

TECHNICAL REPORTS

STILWELL, Daniel J., Assistant Professor and Wilson J. Rugh, "Analysis of Stability and L2 Gain Properties of LPV Systems," Johns Hopkins University Department of Electrical and Computer Engineering Technical Report, JHU/ECE TR 98-05, 1998.

Stability and L2 gain properties of linear parameter-varying systems are obtained under assumed bounds on either the maximum or average value of the parameter rate.

Bell, Glen, George E. PIPER, Associate Professor, John M. WATKINS, Assistant Professor, and David BAUMANN, Assistant Professor, "Using Magnetic Bearings for Broadband Noise Attenuation," Naval Surface Warfare Center Technical Report NSWCCD-C-TM-84-98/14, (1999).

ABSTRACT-CLASSIFIED

PRESENTATIONS

ARRASMITH, William W., Major, USAF, "Branch Cut Effects in Optimally Estimating a Coherent Diffracted Field," OSA Signal Recovery and Synthesis VI Topical Meeting, Kona, Hawaii, June 1998.

AVRAMOV-ZAMUROVIC, Svetlana, Assistant Professor, K. Andrew, N. M. Oldham, B. Waltrip, "The Sensitivity of a Method to Predict Capacitor's Frequency Characteristic," IEEE Instrumentation and Measurement Technology Conference, Venice, Italy, May 1999.

K. Andrew, AVRAMOV-ZAMUROVIC, Svetlana, Assistant Professor, B. Waltrip, N. M. Oldham, "Uncertainty Analysis for Four Terminal-Pair Capacitance and Dissipation Factor Characterization at 1 MHZ and 10 MHZ," IEEE Instrumentation and Measurement Technology Conference, Venice, Italy, May 1999.

AVRAMOV-ZAMUROVIC, Svetlana, Assistant Professor, Carl E. Wick, Associate Professor and Terrence E. Dwan, Professor, "Communications Track for Systems Engineering Majors," Frontiers in Education Conference, Tempe, AZ, November 1998.

A. Koffman, AVRAMOV-ZAMUROVIC, Svetlana, S. B. Waltrip and N. M. Oldham, "On Uncertainty of Capacitance Measurements," National Conference of Standards Laboratories Workshop and Symposium, Albuquerque, NM, July 1998.

BISHOP, Bradley E., Assistant Professor and Mark W Spong, "Control of Redundant Manipulators Using Logic-Based Switching," 37th IEEE Conference on Decision and Control, Tampa, FL, December 1998.

BISHOP, Bradley E., Assistant Professor, "Lyapunov Function Normalization for Controlled Switching of Hybrid Systems," 1999 American Control Conference, San Diego, CA, June 1999.

DWAN, Terrence E., Professor, "Environmental Systems Engineering Course," 1998 Summer Computer Simulation Conference, Reno, NV, July 1998.

DWAN, Terrence E., Professor, "Teaching Environmental Systems Engineering," ASEE Annual Conference, Seattle, WA, June 1998.

KIRIAKIDIS, Kiriakos, Assistant Professor, "Control Synthesis for a Class of Uncertain Nonlinear Systems," The American Control Conference, San Diego, CA, June 1999.

KIRIAKIDIS, Kiriakos, Assistant Professor, "A New Tool for Analysis and Design of Robust Fuzzy Systems," The 18th International Conference of the North American Fuzzy Information Society, New York, NY, June 1999.

KIRIAKIDIS, Kiriakos, Assistant Professor, "An LMI Approach to the Control of a Class of Nonlinear Systems," The 37th IEEE Conference on Decision and Control, Tampa, FL, December 1998.

O'BRIEN, Jr., Richard T., Assistant Professor, "Time-

Varying Steering Control for an Autonomous Highway Vehicle," American Control Conference, Philadelphia, PA, June 1998.

O'BRIEN, Jr., Richard T., Assistant Professor, "Time-Varying H-infinity Steering Control," Summer Computer Simulation Conference, Reno, NV, July 1998.

O'BRIEN, Jr., Richard T., Assistant Professor, "Robust Controller Design for Time-Varying Systems," Conference on Decision and Control, Tampa, FL, December 1998.

O'BRIEN, Jr., Richard T., Assistant Professor, "On the Steering of an Articulated Vehicle Using Differential Braking," 33rd Conference on Information Science and Systems, Baltimore , MD, March 1999.

O'BRIEN, Jr., Richard T., Assistant Professor, "Analysis and Control of Finite Time-Variation Systems," American Control Conference, San Diego, CA, June 1999.

O'BRIEN, Richard T., Assistant Professor and George E. Piper, Associate Professor, "On the Steering of an Articulated Vehicle Using Differential Braking," The 1999 Annual Conference on Information Sciences and Systems, Baltimore, MD, March 1999.

PIPER, George E., Associate Professor and Terrence E. Dwan, Professor, "Teaching Environmental Systems Engineering," The 1998 ASEE Annual Conference, Seattle, WA, June 1998.

PIPER, George E., Associate Professor and Terrence E. Dwan, Professor, "Environmental Systems Engineering Course," The 1998 Summer Computer Simulation Conference, Reno, NV, July 1998.

PIPER, George E., Associate Professor and John M. Watkins, Assistant Professor, "System Identification of the Sound Field in a Fluid-Filled Pipe," The 1998 Summer Computer Simulation Conference, Reno, NV, July 1998.

PIPER, George E., Associate Professor, "Modeling of a Magnetic Bearing Pump," Classified Session of the Naval Symposium on Electric Machines, Annapolis, MD, October 1998.

PIPER, George E., Associate Professor, "Active Noise Control," USNA Sigma Xi Meeting, Annapolis, MD, October 1998.

STILWELL, Daniel J., Assistant Professor, "Stability and L2 Gain Properties of LPV Systems," 1999 American Control Conference, San Diego, CA, June, 1999.

STILWELL, Daniel J., Assistant Professor, "Interpolation Methods for Gain Scheduling," 1998 IEEE Conference on Decision and Control, Tampa, FL, December 1998.

STILWELL, Daniel J., Assistant Professor, "Sampled-data Implementation of a Gain Scheduled Controller," 1999 Conference on Information and Systems Sciences, Baltimore, MD, March 1999.

STILWELL, Daniel J., Assistant Professor, "Interpolation Methods for the Synthesis of Gain Scheduled Controllers," Johns Hopkins University Applied Physics Laboratory, Laurel, MD, October 1998.

STILWELL, Daniel J., Assistant Professor, "Interpolation Methods for the Synthesis of Gain Scheduled Controllers," Electrical and Computer Engineering Department, Johns Hopkins University, Baltimore, MD, September 1998.

WATKINS, John M., Assistant Professor, "An Input Synthesis Procedure for Parameter Set Estimation of Unstable System," 33rd Annual Conference on Information Sciences and Systems, Baltimore, MD, March 1999.

WATKINS, John M., Assistant Professor, "Adaptive Control of Time-Varying Systems Based on Parameter Set Estimation," IEEE Conference on Decision and Control, Tampa, FL, December 1998.

WATKINS, John M., Assistant Professor, "Adaptive

Feedback Control in a Magnetic Bearing Pump System," Naval Symposium on Electric Machines, Annapolis, MD, October 1998.

WICK, Carl E., Associate Professor, and George E. Piper, Associate Professor, "Using the ADSP-21061 SHARC EZ-KIT in Undergraduate DSP Oriented Courses," 1998 Frontiers in Education Conference, Session F2D, Tempe, AZ, November 1998.

WICK, Carl E., Associate Professor and George E. Piper, Associate Professor, "Using the ADSP-21061 SHARC EZ-KIT," USNA Systems Engineering Seminar, Annapolis, MD, November 1998.

WICK, Carl E., Associate Professor, and George E. Piper, Associate Professor,"Using the ADSP-21061 SHARC EZ-KIT in Undergraduate DSP Oriented Courses," The 1998 FIE Conference, Phoenix, AZ, November 1998.

WICK, Carl E., Associate Professor, "Introducing Embedded Computer Systems to Undergraduate Engineering Students; Experiences Using RISC Microcomputers in a Simulation Oriented Course," 1999 Western International Multi-Conference on Simulation and Multimedia in Engineering Education San Francisco, CA, January 1999.

ZIVI, Edwin L., Assistant Professor,"Control of a Shipboard Integrated Power System," Thirty-third Annual Conference on Information Sciences and Systems, March 1999.

ZIVI, Edwin L., Assistant Professor, "Automation Strategies for Shipboard Power Systems," Third Annual Inter-Agency Energy Systems Analysis Consortium Conference, April 1999.

DEPARTMENT OF

COL Robert B. Blose Jr., USMC
Director

Economics

Professor J. Eric Fredland
Chair

Members of the Economics Department faculty were engaged in research on a broad range of topics in 1998-1999. Associate Professor Karen Thierfelder, who was again the departmental nominee for the USNA Research Excellence Award, continued to develop and apply computable general equilibrium models to international trade flows. Working with several different teams of researchers, she published three papers, made four conference presentations, and continued work on a half dozen projects in various stages of completion. Assistant Professor Suzanne McCoskey, working with two members of the Engineering faculty, developed a course in the application of neural networks to economics. Two papers resulting from this course were presented by the midshipmen at a professional conference on forecasting. Professor McCoskey, who won a prestigious Fulbright Scholarship to South Africa to begin in the winter of 2000, published one applied econometrics paper and presented another. The latter was given at the Allied Social Sciences Associations meetings, the highest profile forum for presenting economic research. In addition to her applied econometric work, she has been doing research on women's contributions to the 19th century literature in economics. She presented a conference paper as a result of this work. Other faculty have also been productive, although less prolific. Professors Bowman and Little have continued their work on diverse military manpower topics. Professor Goodman collaborated with Professor Little on some of that work and also was engaged in several projects relating to her role as the Director of Teaching and Learning. Assistant Professor Getter published one paper and made several presentations. He will be on leave in 1999-2000 on the research staff at Freddie Mac, working on issues of credit availability. Professor Kendry served for a third year as the William Crowe Professor. The Frederick L. Sawyer Prize, awarded to the best senior research paper by a graduating economics major, was won by Midshipman 1/C David P. Perry for his paper "A Time Series Model: Testing for Global Stock Market Interdependence" written under the direction of Assistant Professor McCoskey. It is the second straight year that a student of Dr. McCoskey has won.

SPONSORED RESEARCH

The Career Progression of Minority Naval Officers

Researchers: Professor William R. Bowman and Stephen L. Mehay (Naval Postgraduate School)
Sponsor: U.S. Dept of Navy, Bureau of Personnel

Little, if any, research exists on the performance of naval officers, let alone on minorities within the military services. However, a consistent outcome observed over time has been the under-representation of minority officers especially at higher ranks. The focus of this research project is directly related to this phenomenon. Using multi-variate regression techniques, the study attempts to determine if the slower career progression of minorities-especially African American male officers-can be explained by differences related to individual performance as opposed to institutional forces related to segregation or even discrimination on the part of the Navy.

While the study addresses Navy-wide career progression of minorities compared with the majority, the emphasis is directed to relative retention-promotion outcomes of Unrestricted Line officers-the warrior communities in the Navy. Little evidence of career progression differences between the majority and racial minorities is found in the submarine and aviation communities, but significant differences are found within the surface community. While minority officers are equally likely to remain on active duty status as their majority counterparts, they fail to promote at comparable rates to LCDR, especially if they are not assigned or otherwise select a combatant ("cru-des") as their ship during their initial three year sea tour as a junior officer. Statistical modeling can neither explain why minorities fail to be assigned to these ships like the racial majority nor can they explain why they are less likely to screen for department head or to be selected to Grade 04 at rates comparable with the racial majority. These findings do not necessarily support institutional racial bias because much of the observed differences are attributed to differences in the technical skills and early job performance between the two racial groups.

Results of the study will be briefed by the author to senior Navy department officials in the Bureau of Personnel and will help form the basis of a body of knowledge that will be used by BUPERS to formulate a major study of minorities in the Armed Services at the turn of the century.

Gender Differences in the Second Paycheck: An Exploration into the Labor Force Status and the Earnings of the Husbands and Wives of Service Members

Researchers: Professor Roger D. Little and Professor Rae Jean B. Goodman
Sponsors: Office of Naval Research (ONR) and the Naval Academy Research Council (NARC)

As more women serve in the military, it is not surprising that there are increasing numbers of military families where both spouses are on active duty or where the service member on active duty is female and her husband is civilian. Such a husband may be a 'tied migrant' whose earnings constitute the second paycheck within the family. Using the Heckman correction for selectivity bias, we estimate earnings regressions for both civilian female and male spouses. Several findings include: labor force participation rates (LFPRs) are higher for the spouses of enlisted than officers and higher for males than females; contrary to most individuals, educational levels of the spouses are not a factor in LFPRs; young children reduce LFPRs for both males and females; returns to education are close to zero for both genders; and full-time federal employment is extremely important in determining earnings. The research will continue using a new data set available in the summer of 1999.

A Note on Taxes, Prices, Wages and Welfare in General Equilibrium Models

Researcher: Associate Professor Karen Thierfelder
and Sherman Robinson (International Food Policy Research Institute)
Sponsor: Naval Academy Research Council (NARC)

Changes in real wages are often used to measure welfare changes. There is a problem, however, in interpreting measures of changes in factor returns when analyzing the impact of changes in taxes — such as tariffs and indirect taxes — that operate as wedges in product and factor markets versus direct taxes that do not work through the price system. One must account for both how the tax is collected and where the tax revenue goes. This research sorts out how a shift in tax structure will affect the real wage in a model which isolates the price, wage, revenue, and welfare effects. The work starts from a simple general equilibrium model which accounts for all income and expenditure flows in the economy and includes both traded and domestic goods. An analysis of the impact of changes in indirect taxes and tariffs on prices and wages demonstrates the pitfalls of using real factor returns as a welfare indicator. There is a transfer effect on factor returns arising from any shift between indirect and direct taxes, regardless of any efficiency effects. Next, factor markets are added to the model and used to describe the implications for income distribution. It is found that the transfer effect dampens the magnification effect of a price change on factor returns, but does not reverse the Stolper-Samuelson results. This paper has been published as an International Food Policy Research Institute (IFPRI) Trade and Macroeconomics Division working paper. It has been submitted to the *Journal of Policy Modeling* to be considered for publication. This paper was presented at the Southern Economic Association Meetings, Baltimore, MD, November 1998.

INDEPENDENT RESEARCH

Examination Performance and Incentives

Researchers: Professor Rae Jean B. Goodman and Associate Professor Thomas A. Zak

The fundamental hypothesis is that providing a monetary incentive stimulates student performance on a standardized exam. The data used for the analysis are the performances of first class economics majors on the Major Field Achievement Test for the 1989-1991 period. The experimental setup was to divide the class into separate classrooms matching the academic quality of the two rooms by QPR rank. As students entered the "incentive" room they were given a memorandum which informed them that there were monetary prizes for the top three performers by four QPR groupings. The students in the other room received the same memorandum as they exited the exam. The empirical analysis tests the hypothesis holding ability measures constant; the ability measures include economics QPR, overall QPR, SAT scores, performance in intermediate macroeconomics and microeconomics courses, numbers of economics courses completed, etc. The analysis has not been completed; however, the plan is to complete the research during the intersessional period.

Two Projects on Women's Historic Writing in Economics

Researchers: Assistant Professor Suzanne McCoskey and Susan Gensemer (Syracuse University)

Project 1: **The Mid 19th Century Emergence of Women's Writings on the Intersection of Marital and Economic Status**

Mid-nineteenth century American and British women's written contributions toward understanding and expanding women's economic rights are investigated. Crucial to understanding this work is the marital status of individual women. Both the support of married women's property rights and the debate on the working rights of married women will be considered; thoughts on the latter range from no married women should work to the idea that all labor markets should be open to women regardless of marital status. The writings of well known figures such as Harriet Taylor Mill and Barbara Bodichon will be explored as well as lesser known ones such as Caroline Dall and Jessie Boucherett.

Project 2: **Turn of the Century Women's Writings on Optimum Family Design**

This project explores turn of the century American and British women's written contributions toward developing optimum family design. These women used analytical reasoning and economic language to propose alternative family structures. They considered such issues as efficient division of labor, not only within the family, but across society; appropriate training for future household roles; the perhaps changing household roles over individuals' life cycles. The works of well known figures like Charlotte Perkins Gilman and Helen Dandy Bosanquet are investigated along with those of lesser known ones such as Mona Caird. A report of this project has been accepted for presentation at the Conference for the International Association for Feminist Economics, June 1999.

Testing the Stability of a Production Function with Urbanization as a Shift Factor: An Application of Non-Stationary Panel Data Techniques

Researchers: Assistant Professor Suzanne McCoskey and Chihwa Kao (Syracuse University)

Urban economists have long sought to explain the relationship between urbanization levels and output. This paper revisits this question and tests the long run stability of a production function including urbanization using non-stationary panel data techniques. The results show that a long run relationship between urbanization, output per worker and capital per worker cannot be rejected for either a sample of 30 developing countries or a sample of 22 developed countries. In addition, an estimate of the long run average effects of urbanization and capital on GDP is made. These results offer new insights and potential for dynamic urban models rather than the simple cross-section approach.

Near-Integration, Dynamic Implicit Cost and Aggregate Discount Window Borrowing

Researchers: Assistant Professor Suzanne McCoskey and Donald Dutkowsky (Syracuse University)

This study puts forth stationarity considerations as a factor behind the observed breakdown between aggregate Discount Window borrowing and the interest rate spread during the post1987 period. Tests with bi-weekly data reject the unit root for adjustment borrowing, but indicate I(l) processes for the spread and other bank variables. Discount Window borrowing under Goodfriend/Dutkowsky dynamic implicit cost formulation can accommodate the contrasting stationarity properties. Structural restrictions are compatible with stationary borrowing and a near integrated spread. Estimates using Fully Modified Generalized Method of Moments uniformly support the model. The estimates exhibit remarkable stability over the 1990s.

Trade Liberalization and Regional Trade Agreements: the Search for Large Numbers

Researchers: Associate Professor Karen Thierfelder
and Sherman Robinson (International Food Policy Research Institute)

The debate over the impact of regional trade agreements (RTAs) on world welfare hinges upon (1) whether they are net trade creating or trade diverting and (2) whether they impede multilateral trade liberalization. Theoretical models are ambiguous on these issues. The authors summarize the insights from the vast body of empirical literature on multi-country CGE models which analyze RTAs. The empirical models overwhelmingly show that aggregate trade creation dominates trade diversion. Indeed, in many cases, there is no absolute aggregate trade diversion from an RTA. The models also indicate that welfare for all members — both current and potential — increases when RTAs expand. There are even bigger welfare gains when models incorporate aspects of "new trade theory" such as increasing returns, imperfect competition, technology transfers, trade externalities, and dynamic effects such as links between trade liberalization, total factor productivity growth, and capital stock accumulation. The researchers broaden the search for large numbers by suggesting an additional gain from RTAs. It is conjectured that increases in intra-sectoral trade arise from the fact that an RTA provides an expanded secure market, and permits firms to pursue economies of fine specialization. This Smithian specialization in production is another source of efficiency gains.

This paper has been published as an International Food Policy Research Institute (IFPRI) Trade and Macroeconomics Division working paper. It is being prepared for submission to the *International Trade Journal*.

The paper was presented at the International Agricultural Trade Research Consortium Meetings, St. Petersburg, Florida, December 1998, it will be presented at the Second International GTAP Conference, Copenhagen Denmark, June 20-22, 1999.

The Trade-Wage Debate: Making Room for Labor Economists in General Equilibrium Trade Theory

Researcher: Associate Professor Karen Thierfelder

and Sherman Robinson (International Food Policy Research Institute)

The Heckscher-Ohlin-Sameulson (HOS) model in international trade theory provides a powerful general-equilibrium paradigm for analyzing the impact of changes in trade on factor returns. In the HOS model, factor returns are determined solely by commodity prices, which are determined on large world markets. Changes in factor supplies affect the structure of production and trade, but not relative factor returns. In this framework, there is little room for labor economists who focus on partial-equilibrium analysis of supply and demand in factor markets. The purpose of this research is to extend the HOS model to include "nontraded" goods, distinguishing them theoretically from "nontradable" goods. The resulting 1-2-2-3 model applies to one country with two production activities using two factors of production but consuming a third imported good. It is shown that the HOS model is a special case of the 1-2-2-3 model when imports and domestic goods are perfect substitutes. In the 1-2-2-3 model, the magnification effects in the Stolper-Samuelson and Rybczynski Theorems are greatly qualified and changes in relative wages depend on changes not only in world prices, but also in factor endowments and in the balance of trade. Empirical sensitivity analysis indicates that wages are more sensitive to changes in factor supplies than to changes in prices or the trade balance.

This article is being prepared for submission to the *Review of International Economics*.

Farm Policy Reforms and Harmonization in the NAFTA

Researchers: Associate Professor Karen Thierfelder and Mary Burfisher (U.S. Department of Agriculture)
and Sherman Robinson (International Food Policy Research Institute)

NAFTA was negotiated in an environment of domestic agricultural support. Mexico guaranteed the price of corn and beans while the U.S. had price supports for grains and oilseeds. Recently, the policy environment has changed. In 1996, the U.S. adopted the Federal Agricultural Improvement and Reform (FAIR) Act, which eliminates price supports. Under the new U.S. program, farmers receive a direct income transfer which is not linked to production decisions. Also in 1996, Mexico announced additional farm programs to improve overall efficiency and competitiveness in agriculture. Most of the programs under the new Alianza para el Campo (Alliance for the Country side) relate to infrastructure and extension-type assistance, and are designed to improve agricultural productivity. Each country's domestic changes will affect trade and therefore production decisions in the partner country; furthermore the transmission linkages are stronger when trade barriers are eliminated. Canada has maintained its domestic farm support instruments, but has reduced the level of support substantially. This paper analyzes the interaction between trade and domestic policy reforms. By strengthening market signals, policy reforms increase farm producers' responsiveness to changing prices due to NAFTA, leading to potentially greater specialization and trade, and larger welfare gains than under the former support programs. New farm programs will also result in more trade creation and less trade diversion due to NAFTA than would have occurred under former programs. NAFTA and farm program reforms together will result in substantial structural change in the region's agriculture.

This paper has been published as a chapter in *Regional Trade Agreements and U.S. Agriculture*, Mary E. Burfisher and Elizabeth A. Jones (eds), Economic Research Service, AER no 771. This paper was presented at the Allied Social Science Meetings,

New York City, New York, January 1999.

Estimating the Marginal Cost of Public Funds in Developing Countries

Researchers: Associate Professor Karen Thierfelder, Shantayanan Devarajan and Sethaput Suthiwart-Narueput (The World Bank)

In evaluating a particular public expenditure, one needs to know the marginal cost of public funds-the sum of the marginal dollar raised from the private sector and the "marginal excess burden," or the change in the total welfare cost of taxation caused by increasing tax revenue by the dollar. This project seeks to derive heuristic guidelines for estimating the marginal cost of funds (MCF) in developing countries by, first, explicitly calculating MCF's in Bangladesh, Cameroon, and Indonesia using computable general equilibrium (CGE) models and, second, comparing model-based estimates with those obtained from simple rules-of thumb.

This research is in its final stages; it will be submitted to the *Journal of Public Economics* soon.

NAFTA Farm Policy Reforms and Adjustments to External Shocks

Researchers: Associate Professor Karen Thierfelder, Mary E. Burfisher (USDA) and Sherman Robinson (International Food Policy Research Institute)

Recently, the U. S., Canada, and Mexico have reduced production distortions in agriculture. These domestic reforms have been made in a more integrated regional economy — the U.S., Canada and Mexico are removing bilateral tariffs and other impediments to trade as agreed under the North American Free Trade Agreement (NAFTA). In this environment of greater regional integration and domestic policy reform, NAFTA agriculture must also adjust to important changes in the world economy. This paper analyzes the adjustment of NAFTA members to the current, relatively low world commodity prices. The impacts on Mexico, a commodity importer, can be expected to be different than the impacts on Canada and the U.S., both of which are net exporting countries. Surprisingly, it is found that the welfare effects of lower commodity prices on Mexico and Canada are quite similar, and differ from the welfare effect on the U.S. Some important features of the projects' model, including sectoral factor productivity differences and endogenous farm program expenditures, are drawn upon to explain this finding. By reducing fiscal expenditure, farm program savings allow increased private consumption, leading to second best effects due to distortionary value added and indirect taxes.

This paper will be presented at the Second International GTAP Conference, Copenhagen, Denmark, June 20-21, 1999.

Regional Trade Agreements in Southern Africa

Researchers: Associate Professor Karen Thierfelder, Jeffrey Lewis (The World Bank) and Sherman Robinson (International Food Policy Research Institute)

This project will be directed towards constructing a multi-country model of countries in Southern Africa. The model will be used to evaluate the effects of regional trade agreements and global free trade. This work is in the preliminary stages.

Research Course Projects and Trident Scholar Projects

Regional Consumption Smoothing: An Econometric and Neural Network Investigation of the Life-Cycle Hypothesis

Researchers: Midn 1/C Jason Mendenhall, USN and Midn 1/C Matthew Severson, USN
Faculty Advisor: Assistant Professor Suzanne McCoskey

While the engine of mathematical and quantitative techniques continues to drive the testing of economic theory, econometricians find themselves in an endless search for just the right tools that can help provide insight to an ever more complex economic environment. Recent advancements have highlighted the potential of non-parametric analysis to assist in this effort. Nowhere are these methods more useful than with large, noisy data sets across regions. This paper uses neural network technology along with traditional OLS regression to examine the robustness of life cycle theory and evaluate regional impacts on consumption. This paper has been accepted for presentation at the 19th Symposium on Forecasting : Strategic Forecasting for Government and Business, June 1999.

Regional Variations in Median Household Income: A Neural Network Approach

Researcher: Midn 1/C Jeffrey Chestnut, USN
Faculty Advisor: Assistant Professor Suzanne McCoskey

This paper attacks the question of regional income variations with both traditional econometric modeling and neural network technology. While OLS provides valuable information in the study, the application of neural networks provides a more rich, complete analysis. Because this analysis incorporates both prediction and classification networks, the model is able to appraise the determinants of income as well as measure the effects of each region's peculiarities. The use of neural networks provides superior results and looks to be a promising development in future studies in the field of regional economics. This paper has been accepted for presentation at Computing in Economics and Finance: Fifth International Conference of the Society for Computational Economics, June 1999.

Publications

ANDERSON, David, Lt Colonel, USMC, Assistant Professor, "Using Power and Influence Tactics for Better Results". Marine Corps Gazette. December, 1998, pp. 37 - 38.

FREDLAND, J. Eric, Professor, (with David Boesel, National Library of Education) *College for All?: Is There Too Much Emphasis on Getting a 4-Year College Degree?* (Washington DC: National Library of Education, U.S. Department of Education), January 1999, ISBN LA226 .B64 1999.

Over the years, larger and larger proportions of high school graduates have enrolled in 4-year colleges. Many view college as essential to labor market success, but the movement toward 4-year colleges has its critics. The critics contend that: 1) the "college movement" sweeps many poorly qualified students into college, and hence the average ability of college students has declined; 2) because of declining ability levels, college dropout rates have increased; 3) many dropouts do poorly in the labor market and would have been better advised to pursue other education and training options; 4) dropouts are also burdened by unnecessary debts from college loans; 5) even college graduates do not necessarily do well in the labor market, and thus might have been better advised to pursue other options. This monograph is a synthesis of research examining evidence for these arguments. The criticism most strongly supported by the literature is that non-completers do relatively poorly in the labor market. The review of research thus suggests that high school graduates of modest ability or uncertain motivation who are thinking of enrolling in 4-year colleges would be well advised to consider attending 2-year colleges instead. If they did so, they would probably realize the same earnings and cognitive skill gains at lower cost and with less debt. High school guidance counselors should be more realistic than many are at present in advising lower-achieving or less motivated high school seniors about their post-secondary options. The evidence that the labor market success of college graduates is not good enough to make college a worthwhile investment for many of them is much more equivocal. Returns to college education have fluctuated widely in the past three decades, but the weight of the research suggests that college is a good investment for the average bachelor's degree graduate.

GETTER, Darryl E., Assistant Professor, "Three Ideas for Teaching Money and Banking", Papers and Proceedings of Ninth Annual Teaching Conference, February 19-21, 1998, Robert Morris Teaching College, pp. 41 - 47.

Money and banking, given today's rapidly changing financial environment, can be a very interesting course. However, it seems that there is a large amount of material to cover, and the course may become a bit overwhelming for students. Furthermore, an attempt to cover everything may not leave enough time at the end of the semester to cover the more interesting policy questions which ultimately affect financial markets and institutions. This paper offers three suggestions regarding course content that will make a money and banking course much more digestible for students while still providing a strong background and understanding of the workings of the financial system.

GOODMAN, Rae Jean B., Professor, and Hubbard, Kirsten A. "Beginning a Peer Tutorial Program at USNA," *National Tutoring Association Conference Proceedings '98*, pages 96-108.

This paper examines the steps taken to institute a peer tutorial program at USNA, as well as a brief review of the program's results in its first semester. The steps taken to generate support for and implement peer tutoring at USNA included educating the academic chain of command, finding departments willing to participate in an experimental program (Chemistry Department at USNA), selecting qualified tutors, providing the necessary training and supervision of the tutors, and evaluating the program from many aspects: student performance, attendance, faculty evaluation,

etc. Given that the Naval Academy had no history of formalized peer tutoring programs, and that the seventeen midshipman tutor volunteers had no prior experience with being trained peer tutors, it is pleasing to see that the tutors (1) received excellent evaluations by students, and (2) elicited positive student grade changes over the course of the semester.

LITTLE, Roger D., Professor, review of Making the Corps in *Armed Forces and Society* Vol. 25, No. 1, Fall 1998, pp. 166 - 171.

McCOSKEY, Suzanne K., Assistant Professor, (with Thomas Selden) "Health Care Expenditures and GDP: Panel Data Unit Root Test Results", *Journal of Health Economics,* Vol 17, No. 3, 1998, pp. 369 - 376.

THIERFELDER, Karen, Associate Professor (with Sherman Robinson, International Food Policy Research Institute), *A Note on Taxes, Prices and Welfare in General Equilibrium Models*, International Food Policy Research Institute, Trade and Macroeconomics Division Discussion Paper No. 39., 1999.

THIERFELDER, Karen, Associate Professor (with Sherman Robinson, International Food Policy Research Institute), *Trade Liberalization and Regional Integration: The Search for Large Numbers,* International Food Policy Research Institute, Trade and Macroeconomics Division Discussion Paper No. 34., 1999.

THIERFELDER, Karen, Associate Professor (with Mary E. Burfisher, U.S. Department of Agriculture, and Sherman Robinson, International Food Policy Research Institute), "Farm Policy Reforms and Harmonization in the NAFTA," in Mary E. Burfisher and Elizabeth A. Jones (eds.) *Regional Trade Agreements and U.S. Agriculture*, Economic Research Service, AER No. 771. Washington D.C.: U.S. Department of Agriculture, 1999.

Presentations

BOWMAN, William R., Professor, "Promotion, Performance and Productivity of Junior Managers: A Case Study of the U.S. Navy," Annual International Atlantic Association of Economics Conference, Vienna, Austria, 15 March 1999.

CHESNUT, Jeffrey H., Ensign, USN, "Regional Variations in Median Household Income: A Neural Network Approach," 5th International Conference of the Society for Computational Economics, Boston, June 1999.

GETTER, Darryl E., Assistant Professor, "Demographics and Stock Ownership Patterns," Securities and Exchange Commission, Washington, DC, 8 February 1999.

GETTER, Darryl E., Assistant Professor, "Contributing to the Delinquency of Borrowers," Freddie Mac, June 1999.

GETTER, Darryl E., Assistant Professor, "Variation in Credit Constraints By Race and Other Demographic Characteristics," Annual Mid-Year Meeting of the American Real Estate and Urban Economics Association, Washington DC, June 1999.

GOODMAN, Rae Jean B., Professor, and LITTLE, Roger D., Professor, "Enculturation, Career Expectations, and Commissioning Source," Western Economic Association International, Lake Tahoe, Nevada, 29 June, 1998.

GOODMAN, Rae Jean B., Professor, "Gender Differences in the Second Paycheck: An Exploration into the Labor Force Status and Earnings of the Husbands and Wives of Service Members," Economics

Department Seminar, Davidson College, March 1999.

GOODMAN, Rae Jean B., Professor, and HUBBARD, Kirsten A., "The First Year: Results of a New Peer Tutoring Program," National Tutoring Association, Orlando, Florida, 5 May, 1999.

KENDRY, Adrian P., Crowe Professor, "The Beggars' Banquet? Globalization, the Asian Crisis and the Role of International Organizations" Graduate Business School Lecture, The Gloucestershire (UK) Business School, Cheltenham and Gloucester College of Higher Education, March 1999.

KENDRY, Adrian P., Crowe Professor, "NATO and the Balkan Dilemma: A European Perspective," Key Note Address, Phi Kappa Phi Banquet, U.S. Naval Academy, April 1999.

McCOSKEY, Suzanne K., Assistant Professor, "How Does Your Output Grow?" Allied Social Sciences Associations meetings (Chinese Economic Assn in North America session) New York, January 1999.

McCOSKEY, Suzanne K., Assistant Professor, "Turn of the Century Women's Writing on Optimum Family Design," Conference for the International Association for Feminist Economics, June 1999.

MENDENHALL, Jason A., Ensign, USN and Ensign Matthew R. SEVERSON, Ensign, USN, "Regional Consumption Smoothing: An Econometric and Neural network Investigation of the Life-Cycle Hypothesis," 19th Symposium on Forecasting: Strategic Forecasting for Government and Business, Washington DC, June 1999.

MOORE, Jason S., Ensign, USN, and Ivajlo D. Nikolov, "S&P Volatility Forecasts with Neural Networks,"19th Symposium on Forecasting: Strategic Forecasting for Government and Business, Washington DC, June 1999.

THIERFELDER, Karen, Associate Professor and Sherman Robinson, "A Note on Taxes, Prices, and Welfare in General Equilibrium Models," presented at the Southern Economic Association Meetings, Baltimore, MD, November 1998.

THIERFELDER, Karen, Associate Professor and Sherman Robinson, " Trade Liberalization and Regional Integration: The Search for Large Numbers," presented at the International Agricultural Trade Research Consortium, St. Petersburg, Florida, December 1998.

THIERFELDER, Karen, Associate Professor and Sherman Robinson, " Trade Liberalization and Regional Integration: The Search for Large Numbers," to be presented at the Second International GTAP Conference, Copenhagen Denmark, June 1999.

THIERFELDER, Karen, Associate Professor, Mary E. Burfisher and Sherman Robinson, "NAFTA Farm Policy Reforms and Adjustments to External Shocks," to be presented at the Second International GTAP Conference, Copenhagen Denmark, June 1999.

ZAK, Thomas A., Associate Professor, "*Qui Tam* Law Suits and the Effect on Defense Contractor Reputation," Western Economic Association International Conference, Lake Tahoe, July 1998.

DEPARTMENT OF

English

Professor Timothy D. O'Brien
Chairman

As the following pages show, the English faculty are engaged in a wide range of scholarly, critical, and creative activities. During this past year they have published several books, written and spoken on pedagogical subjects, completed and published novels and poems, and published numerous articles, reviews, and reference work entries.

The Naval Academy Research Council (NARC) supported the research of ten English faculty, who pursued topics ranging from "the environment and art," the Japanese novelist Natsume Soseki, the anthropological approaches to Old English literature, Korean War literature, and the influence of Christian spiritualists on Victorian literature. All but three of the NARC supported projects have been completed and scheduled for publication. The range and success of independent research projects are equally impressive. This research has produced publications and presentations in first-rate venues on such literary figures as Shakespeare, Eliot, Chaucer, and Hemingway; and on such subjects as dance, game-theory in literature, and the African-American literary heritage. Four officers, moreover, pursued their Masters degrees in English or Liberal Studies as part of the Academy's "grow-your-own" program. One of these officers, LCDR Mark Larabee, won the award at the prestigious College English Association Conference in April for the best conference paper by a graduate student.

Though nearly every member of the department – professors and officers of every rank and Visiting Assistant Professors as well – were involved in productive scholarly and/or creative activities, several of those publications and activities deserve mention in this introduction: Assistant Professor Anne Ellis' performance of the lead role in *The Rainmaker* and her direction of *Barefoot in the Park* both for the Colonial Players of Annapolis; Associate Professor Anne Marie Drew's book, *Letters from Annapolis: Midshipmen Writing Home, 1848-1969*; Associate Professor Herbert Gilliland's book (coauthored with Robert Shenk), *Admiral Dan Gallery: The Life and Wit of a Navy Original*; Professor John Hill's book, *Reconstructing Heroic Values*; and Professor Phil Jason's critical anthology (coauthored with W.D. Ehrhart), *Retrieving Bones: Stories and Poems of the Korean War*. Along with these four books, members of the department delivered twenty-three presentations, published and/or had accepted for publication fourteen refereed articles, and placed over a dozen reviews or reference articles, as well as over twenty poems.

Such research and creative activity enriches the education of midshipmen in a number of ways: it leads to the creation of challenging upper level seminar courses in which midshipmen pursue research of their own; it gives authority to the supervision of such independent research courses as are described in the following pages; and, perhaps most importantly, it ensures that midshipmen are taught by lively, up-to-date professors whose instruction in reading critically and writing persuasively is grounded in practice and proven success.

Sponsored Research

At the Bottom of *The Waste Land*: Essays on the Footnotes

Researcher: Associate Professor Allyson Booth
Sponsor: Naval Academy Research Council (NARC)

This project investigates the interconnections between T. S. Eliot's *The Waste Land* (1922) and its numerous source materials. It relates directly to the teaching of modernism and should eventually constitute part of the available literature on the subject of teaching *The Waste Land* – a poem in which an extremely small detail frequently provides a window onto a surprisingly large field of vision. Eliot's complicated and intimidating poem is too often billed as absurdly inaccessible. By becoming more familiar with the poem's source materials, the researcher will become more adept at situating it in a cultural context that was still reeling from World War I and more skillful at communicating that context to the students.

Imagining a World of Communities: The American Festival Project

Researcher: Assistant Professor Anne M. Ellis
Sponsor: Naval Academy Research Council (NARC)

This is a book-length study of *The American Festival Project*, a coalition of community-based artists who use art as activism in a struggle for social justice and cultural equity in urban and rural communities throughout the United States. Much of the research is drawn from personal experience with the American Festival Project over the last eight years, including a NARC-funded trip to New Orleans for the *Ec(h)o Arts/Environmental Justices Festival*. Questionnaires, project histories, and archival material are being made available through Project Director Michael Hunt, and personal interviews are ongoing.

Down by the Riverside: The Ec(h)o Arts Festival

Researcher: Assistant Professor Anne M. Ellis
Sponsor: Naval Academy Research Council (NARC)

An article documenting the 1998 *Ec(h)o Arts [Environmental Justice] Festival* sponsored by Junebug Productions in New Orleans, Louisiana. The festival was designed to raise awareness of practices of ecological racism endangering working-class communities in Louisiana. The article, which is under submission for publication, examines the various ways in which "the environment" influenced the physical and ritual space of performance for festival artists as well as for audiences.

Passing the Flame: Michael Harper's Role in the Legacy of Modern African American Poetry

Researcher: Professor Fred M. Fetrow
Sponsor: Naval Academy Research Council (NARC)

The project, begun with seed money from NARC in AY 1996-97, continues. Study of Harper's poetry and the historical sources for it led to a closer look at the poems by contemporary African American poets about Frederick Douglass and his legacy. An investigation of these works in conjunction with a reading (or re-reading) of some of Douglass's seminal works reveals a curious manifestation of the abolitionist's influence–his style seems to surface in the poems dedicated to him, almost as if the modern poets either subconsciously or deliberately adopted Douglass's imagery to enhance his legacy in their versions of that legacy. In other works, what was to be a close analysis of cultural influence has become a literary analysis of contrasting genres as well.

Can We Just Read Soseki?

Researcher: Professor Bruce E. Fleming
Sponsor: Naval Academy Research Council (NARC)

This 10,000 word essay considers the difficulties for Westerners in reacting to the words of the Japanese modernist master Natsume Soseki. It starts with the observation that Soseki is the single most influential and written-about Japanese author of the twentieth century inside Japan, and yet he is virtually unknown in the West. Why is this so? Is there anything we in the West can or should do about this state of affairs? The article begins with a brief overview of the problem and some of the intrinsic difficulties involved with reacting to words from another culture, especially if those are read in translation. Most contemporary discussions of this problem take as their point of departure the work of Michael Foucault and Foucault's disciple, the Palestinian-American professor Edward Said. The essay explains why Foucault and Said's vocabulary is not appropriate for considering the relationship between Japanese culture and the West: the Foucault/Said paradigm works best and was developed to explain the relationship between the West and politically much less powerful cultures, so that reading or writing from the point of view of the more powerful entity is always seen as an exercise of political muscle. Japan, the world's second-largest economy, is hardly in the position of the economically and culturally-disparaged Third World, nor is its culture in the position of uncomfortable also-ran of the Muslim world. There are, however, undeniable difficulties for Westerners in approaching the novels of Soseki, most glaringly the problem Westerners have in understanding the motivation of Soseki's heroes. The article goes through Soseki's principle works one by one, suggesting the reaction a Western reader is most likely to have, contrasting it with the reading that Japanese commentators have identified as that most likely to be adopted by a Japanese reader, and suggesting the cause of the divergence. The reader may fill in the motivation (the impulse of commentators), or simply leave the space blank. This essay suggests the interest of doing the latter; it suggests that Western readings divergent from the Japanese may in fact be of interest in their own right: Soseki's novels seem to Westerners precise exercises in unmotivated behavior, almost nihilistic rather that well defined, their heroes acting for no visible reason.

Master's Mate John C. Lawrence: A Journal

Researcher: Associate Professor C. Herbert Gilliland
Sponsor: Naval Academy Research Council (NARC)

This project to complete an edition of the journal kept by Master's Mate John C. Lawrence aboard the sloop-of-war *USS Yorktown* during an 1844-45 cruise with the African Squadron continues from the previous summer. The journal gives a vivid eyewitness account of U.S. Navy operations aimed at suppressing the transatlantic slave trade in the 1940s. The project involves not merely textual editing, but the incorporation of a considerable mass of amplifying material gathered from other sources.

Anthropological Approaches to Old English Literature

Researcher: Professor John M. Hill
Sponsor: Naval Academy Research Council (NARC)

This project on anthropological approaches to all manner of Old English literature involved soliciting a comprehensive gathering of original essays, composing an introductory and orienting overview of the anthropological and literary issues involved, and completing an essay to join those solicited from other scholars. Nationally renowned scholars in Anglo-Saxon studies were approached for essays on the following topics: evidence of totemism in the Germanic avunculate, especially involving matrilineal kinship organization; the psychological use of oral story in Old English narrative; the cultural transformation of heroic story into Christian apologetics; the nature and ethical and thematic status of the feud in *Beowulf*; and the politicized nature of seemingly traditional heroic story poems such as *Widsith*. The essays are finished and the collection is now in the final stages of publication as a special issue of *Philological Quarterly*, guest edited and introduced by Professor Hill.

Stories and Poems of the Korean War

Researcher: Professor Philip K. Jason
Sponsor: Naval Academy Research Council (NARC)

The project recovers a neglected and forgotten body of creative literature that reflects the imaginatively fashioned experiences of those who participated in, witnessed, and studied the Korean War. The selection and examination of these representations provides an understanding of the impact of that war on American culture, as well as the ways in which American culture shaped understandings of the war. The specific goal of the project is to develop an anthology of Korean War literature with appropriate contextualizing and critical apparatus. The problem is neglect and cultural amnesia. There is less acknowledgment, exploration, and understanding of the Korean War than any modern American historical event of similar magnitude. The phrase "forgotten war" is already a handy label, and there is a "forgotten" literature that needs to be made available and reassessed in order to correct the notion that there was little or no literary record of consequence. A "rough cut" of the surveyed literature has narrowed the range of possibilities to

about twelve stories and fifty poems.

Resolution and Discernment in Victorian Literature

Researcher: Associate Professor Eileen Tess Johnston
Sponsor: Naval Academy Research Council (NARC)

As they moved away from the focus on epistemology, perception, and creativity characteristic of the previous generation of Romantic writers, Victorian authors began to address with increasing awareness and sophistication questions of discernment, ethics, and the will. Such major works as Alfred, Lord Tennyson's *Idylls of the King*, Robert Browning's dramatic monologues, and the novels of Charles Dickens, Charlotte Bronte, and George Eliot address crises in characters' lives that require them to make major changes in their human relationships, their work, their religious and civic allegiances, and their standards and styles of living. These are the kinds of choices that, although sometimes fraught with moral implications, are often, at least on the surface, morally neutral, albeit complex. In addressing issues of discernment and resolution, these authors have recourse to a shared set of terms, ideals, images, and patterns of actions. These common features are rooted in the literature of various Christian spiritualities, including those of the eighteenth century Methodists and Pietists, of Quakers, and of Jesuit writers in the Roman Catholic tradition, especially Ignatius of Loyola, whose *Spiritual Exercises* are the most important Christian treatment of the process of forming resolutions and of the discernment of spirits. Part of Professor Johnston's research involved seeking for missing links between the *Spiritual Exercises* of Ignatius Loyola and the complex treatment of resolution and discernment by the major Victorian authors. Pursuing leads suggested by scholar Louis Martz in *The Poetry of Meditation*, which demonstrates the wide dissemination of Ignatian ideas in England in the seventeenth century and their influence on a number of British poets, Johnston began to identify some of the missing links. Her research also involved careful study of the letters and biographies of several Victorian writers, particularly George Eliot and Robert Browning, and close analysis of various poems and novels.

The British Music Trade in the Late Eighteenth-Century

Researcher: Associate Professor Nancy A. Mace
Sponsors: National Endowment for the Humanities and the Bibliographical Society of America

Although music publishing is important in the history of eighteenth-century theater, music, literature, and the print trade, scholars have virtually ignored this area. Beginning with a collection of thirty lawsuits in the Public Record Office, London, which are hitherto unknown to scholars, the researcher is studying the music trade in the late eighteenth century – the relationship between book - and music - sellers, their conflicts over copyright, and their business practices. This project began seven summers ago. A database of music sellers and others named in the suits has been developed, providing new information about the music sellers and about the publishing history of the compositions they published, which will substantially help musicologists and music librarians in dating these works. The first of two books on the subject–dealing specifically with music copyright–is almost completed. Another book will examine the business practices, clients, and finances of late eighteenth-century music sellers. In addition, several articles have appeared and are in progress on various elements of the music trade.

Hemingway's Puzzling Pursuit Race

Researcher: Professor Charles J. Nolan, Jr.
Sponsor: Naval Academy Research Council (NARC)

In "A Pursuit Race," which Hemingway published in *Men Without Women* (1927) and which Archibald MacLeish believed "missed fire," Hemingway presents another of those characters whom life defeats. From the symbolic opening paragraphs to the story's final lines, Hemingway portrays for us an aggressively hostile world. The flashback, which occupies much of the story, conveys this theme effectively. Campbell's messy room and his supine posture, for example, suggest the disorder of his life and his emotional deadness. The initial contrast between Campbell and his boss, Turner, is later modified so that readers can see that Turner is a fellow-sufferer. He is different from Campbell, however, in that he has learned how to live in the world instead of having been beaten by it; in the story's terms, his nickname ("Sliding Billy") suggests his ability to adapt to life's terrors. His attempt to help Campbell beat his drug and alcohol addiction – Campbell's response to an actively hostile universe – changes our view of both men so that ultimately we feel sympathy for Campbell's plight. The final paragraph of the story suggests that, because Turner has suffered similar pain, he has learned a new set of values – a frequent Hemingway theme. The article growing out of this research has been accepted for publication by *Studies in Short Fiction*.

Hemingway's "Out of Season": The Importance of Close Reading

Researcher: Professor Charles J. Nolan, Jr.
Sponsor: Naval Academy Research Council (NARC)

A close reading of "Out of Season," the first story Hemingway wrote after the loss of his early manuscripts, makes clear his basic talent as it reveals essential aspects of his artistry. The problems of gender relationships, the theory of omission, the incommunicability at the heart of human interaction, the use of symbolic landscape, the choice of just the right word – these and other elements of Hemingway's craft manifest themselves fully if we look, line by line, at this remarkable story. This article is currently in circulation.

Independent Research

The She-Gallants

Researcher: Lieutenant Commander Cara D. Akerley, USN

This is a critical edition of *The She-Gallants*, a play by George Granville, first produced in London in 1696. Various editions of the play are being collated and the variations in text noted. A detailed introduction to the play and the time period is included with the work. This edition is a dissertation for the University of Maryland.

The Road to Sainte-Victoire

Researcher: Professor Nancy Arbuthnot

This is a series of poems based on the artwork by Cezanne and other French Impressionists and post-Impressionists and the researcher's personal experiences in the villages and countryside of southern France which provide the background settings for many of the art works. The title poem concerns the mountain, Montagne Ste-Victoire, painted so often, from many different perspectives, by Cezanne: it intertwines a description and analysis of Cezanne's path, his career, to the mountain, with observations on the contemporary landscape as viewed by the writer. The manuscript is now complete and has been submitted to a number of university presses.

The "Sweet Pressure" of Play as Survival in *Billy Phelan's Greatest Game*

Researcher: Professor Neil Berman

Billy Phelan's Greatest Game is a complex and dynamic account of the play attitude in sports and games on levels both literal and metaphoric, and while Billy is not the accomplished athlete his father was in mastering a single sport, he is a consummate player proficient at many sports and games which shape and give meaning to his daily life and, in the largest context, to William Kennedy's Albany. The interest in the importance of play, sport, and games is announced in one of the epigraphic quotations which introduce the novel: "The great archetypal activities of human society are all permeated with play from the start." Taken from Johan Huizinga's seminal book on the play element in human culture, the quotation announces both the author's interest in and the importance of Billy's sporting and gaming activities. Eventually, we come to understand that the play attitude informs all the important human intercourse in the novel, even those activities not typically associated with sports and games, and, finally, that the title of the novel refers to a meta-game, that Billy Phelan's survival depends upon his complete involvement in the sporting spirit and his personal identification with the play attitude beyond the literal sports and games which form his livelihood. Put another way, Billy's greatest game is one he does not even realize he is playing, but which his full adoption of the play attitude has prepared him to accept and which, ultimately, makes possible his survival.

'He Do the Police in Different Voices': *Our Mutual Friend* and *The Waste Land*

Researcher: Associate Professor Allyson Booth

In an early draft of *The Waste Land* (1922), T. S. Eliot grouped the first two sections of the poem ("The Burial of the Dear" and "A Game of Chess") under a single title quoting a character from Charles Dickens's *Our Mutual Friend* (1864-65): "He Do the Police in Different Voices." This article traces the complicated reverberations of both Betty Higden's voice in *The Waste Land's* manuscript and of her eventual absence from its final published version, arguing that her presence in the poem's organizational structure would have suggested a closure more complete than anything that made it into the final draft.

Performing Appalachia: Roadside Theater

Researcher: Assistant Professor Anne M. Ellis

This is a book-length history of Roadside Theater of central Appalachia, a community-based theater which has used art and performance to develop cultural awareness and political activism in the Appalachian region. This is a continuation of research Professor Ellis has been pursuing for more than eight years. The work, which is still in progress, has been solicited by University of Tennessee Press's Appalachian Studies line.

Lizzie, *The Rainmaker*

Researcher: Assistant Professor Anne M. Ellis

Professor Ellis' performance of the lead role in N. Richard Nash's play *The Rainmaker* for Colonial Player's 50th Anniversary Season. Developing the performance included completing a successful audition process, a three-month rehearsal process, and five weeks of public performances. The rehearsal process included historical research and performance research, application of previous training in Method acting and general theatrical production, and significant individual creativity. This production was reviewed by the *Annapolis Capital*, the *Baltimore Sun*, the *Washington Post*, and *The New Bay Times*. Performances ran from 4 September to 3 October 1998.

Director, *Barefoot in the Park*

Researcher: Assistant Professor Anne M. Ellis

Professor Ellis served as the director for Neil Simon's *Barefoot in the Park* for the Colonial Player's 50th Anniversary Season. The project included responsibility for auditioning, three months of rehearsal (blocking, actor coaching, technical coordination), and guidance through five weeks of performance. Preparation for the rehearsal process included: in-depth script analysis; research into performance history; design of floorplan and blocking; consultation with designers for lighting, sound, set decoration, set construction, and costuming; scheduling and coordination of the rehearsal time; and consultation with publicity (including one radio interview with WBJC and a television interview on *Capital Profiles* for Jones Cable's public access television channel). Rehearsals ran from early November through January. Performances ran from 22 January to 20 February 1999. The production was reviewed by the *Annapolis Capital*, the *Baltimore Sun*, and *The New Bay Times*.

Economic Transformations in the *Canterbury Tales*

Researcher: Lieutenant Colonel Kent Esbenshade, USA

This draft of a dissertation is about half completed; the research is nearly completed. The work deals with Geoffrey Chaucer's use and transformation of medieval economic paradigms in selected tales from the *Canterbury Tales*.

Re-igniting the Flame: Michael S. Harper's Role in the Continuum of Modern African American Poetry

Researcher: Professor Fred M. Fetrow

Professor Fetrow has renewed his research effort on this project by attempting to establish dialogues with Harper and two younger poets, Cornelius Eady and Elizabeth Alexander. With Harper's assistance, Fetrow hopes to continue the project with inclusion of the younger poets and continuation of filling in the background of Harper's relationships with his elder predecessors.

Full of Passion and Intensity

Researcher: Professor Bruce E. Fleming

This article, currently undergoing final editorial revision for *The Chronicle of Higher Education*, is a reaction to an article by Camille Paglia in the *New York Times* on Judy Garland. After praising Garland's intensity, Paglia asks rhetorically where we will get another Garland: her point is that we won't. Our society, under the influence of its postmodern professors, has instilled a "shallow irony" in the young and has condemned itself to colorless public entertainers. The essay takes Paglia's reasoning as typical of many pessimistic commentators who sense a waning of intensity in current life, and considers the reasons why we should be suspicious of this sort of thinking. Most egregious of these is the fact that it presumes a Golden Age, a presumption as much the result of human nature as of any correlation with reality. The more fundamental problem with Paglia's reasoning, however, is that Paglia is castigating contemporary society for being insufficiently Romantic: in fact, we have become a society of Romantics, with the rhetoric of self-realization the very lingua franca of the advertizing world. Everyone wants to be famous in our world; everyone wants to express him- or herself. The only problem is that not everyone can do so in the Romantic sense of true individualism: logistics and logic make it impossible for everyone to be a rebel at the same time, and in fact we show only our conformity by buying one brand of a product rather than another, the way in which we are told we nowadays express our individuality. Thus though the essay contests the particular reasoning of Paglia's argument, it concedes that the true expression of individuality, such as Paglia finds in Garland, is more difficult than ever. Still, just as Garland was an exception, so an exception to the rule is possible today.

Sex, Art, and Audience

Researcher: Professor Bruce E. Fleming

Sex, Art, and Audience is a collection of 3,000-5,000 word essays on a series of dance and theater performances over a ten-year period, virtually all of which have previously appeared as individual essays in dance periodicals that include *Ballet Review*, *Dance View*, *Dance International*, and *New Dance Review*. The whole is greater than the sum of its parts; the essays are divided into five main sections in order to make a series of inter-related theoretical points. The collection considers first of all the relationship between the artwork, the piece of patterned movement on the stage, and the audience: how do we react to the bodies on the stage? What is the relation of everyday movement to that pattern of movement we call choreography? The first essay in the collection considers a midshipmen parade on Worden Field at the U.S. Naval Academy, comparing it to a dance with military themes by the Modernist master George Balanchine. How are they the same? How different? Other topics covered in the book include the intrinsic textlessness of dance and the difficulties of speaking of dance history, given that dance is transmitted almost universally without the aid of written or visual reproductions or sign system, body to body. The book appears in the same series of Peter Lang Publishing that has published the last three of Professor Fleming's scholarly books, *New Series in Aesthetics*.

Midshipmen Literature

Researcher: Associate Professor C. Herbert Gilliland

Forthcoming in the *Encyclopedia of American Literature of the Sea and the Great Lakes*, this article notes that from 1851 until the creation of Naval ROTC in 1925, the U. S. Naval Academy was the only source of U. S. Navy midshipmen, and it remains the primary source today. The article surveys all novels known to have Naval Academy midshipmen as protagonists, many of which are set at the Academy. Dozens of such novels have been published from 1885 to date.

Alfred the Great: Eleven Hundred Years After

Researcher: Professor John M. Hill

A joint proposal for a National Endowment for the Humanities Summer Seminar for College Teachers by Professor Hill and Professor Richard Abels of the U.S. Naval Academy History Department, this project proposes a six-week seminar on Anglo-Saxon material culture and secular myth during the ninth and tenth centuries, centered on the Alfredian period.

William Faulkner and the Plantation Novel

Researcher: Associate Professor Mary D. Howland

In 1936, two novels of life in the American South were published. The first novel, Margaret Mitchell's *Gone with the Wind*, portrays a romantic South that never existed, a South that the novel itself helped to create in the mythic imagination of this country. It is America's best-selling novel. When MGM released the film version of the novel in 1939, the myth of a magnolia-scented and Edenic antebellum South was further embedded in the cultural consciousness. The other novel published in 1936, William Faulkner's *Absalom, Absalom!*, arguably his greatest novel, presents a far different South, where a violent man from the hills of what would become West Virginia wrests a plantation, which he names Sutpens's Hundred, out of good Mississippi bottom land. Thomas Sutpen's slaves are not loyal retainers like Scarlett's beloved Mammy, but rather twenty Africans from Haiti who are half or completely naked and who speak no English. And far from being the paternal white man in the Big House, Sutpen works right along with his slaves. The one "faithful retainer" in Faulkner's novel is the housemaid Clytie, who is in reality the unacknowledged daughter of Sutpen and an unnamed slave. If Mitchell's antebellum Tara embodies a paradise on Earth, Faulkner's Sutpen's Hundred in the plantation from Hell. There is nothing noble or chivalric about Thomas Sutpen. Although he is brave and strong, he is a cruel man and certainly never a gentleman. At the very heart of Faulkner's novel is the dilemma of miscegenation which caused Sutpen to first abandon and then forever refuse to acknowledge his eldest son, Charles Bon, after he fonds out that his son's mother may have had African-American blood.

An Encyclopedia of American War Literature

Researcher: Professor Philip K. Jason

This project aims at providing concise information on a wide range of literary texts that respond to the American experience of war. The researcher and his co-editor (Mark Graves of Michigan State University) have complied a master list of authors, works, and topics for which entries have been sought through postings in professional journals and electronic forums. The editors have also selected several associated editors as subject matter experts in key areas such as Civil War literature, Revolutionary War literature, and so forth. The project, under contract to Greenwood Press, is now in the late stages of development. About 80% of the projected materials have been received, and most of these have been edited and revised. This 180,000-word, one-volume reference work will provide authoritative commentary on over 300 authors and topics and perhaps 1,000 works.

An Encyclopedia of Sea Literature

Researcher: Professor Robert D. Madison

The ENCYCLOPEDIA OF AMERICAN LITERATURE OF THE SEA AND GREAT LAKES, ed. Jill Gedmark (Greenwood, forthcoming) is a one-volume reference work covering the American

maritime literature in English from the earliest discovery narratives to present-day writings. Particular attention has also been paid to the literature of native peoples and to drama on maritime subjects. Eleven current or former members of the USNA English Department contributed articles ranging from slavery narratives to modern poetry: Nancy Protho Arbuthnot, Matthew D. Childs, Jonathan Eller, Fred M Fetrow, C. Herbert Gilliand, John F. Hussey, R. D. Madison (also a board member), Laurence W. Mazzeno, Joseph Navratil, Robert Shenk, and Charles F. Warner. John B. Hattendorf of the Naval War College was also a contributor.

Performance Aspects of Shakespeare's *The Tempest*

Researcher: Professor Robert D. Madison

In an effort to recover performance practice in *The Tempest*, the investigator scored the entire play with contemporaneous music for authentic renaissance instruments, and then edited an acting version of the play which incorporated aspects of early theater adapted to modern production by midshipmen. Research consultation was conducted at the Folger Library and at the Lute Society of America summer seminar, as well as at USNA. Literary topics included metrics and textual analysis, while non-literary aspects included the exploration of historical costume, stage architecture, seamanship, and arms and armor. Offshoots from this study have already included the HE 506 *Tempest* seminar offered in the Fall of 1998 and the *Tempest* paper "A Thousand Furlongs: Sea and Stage in *The Tempest*" at the College English Association national conference, 1-3 April 1999.

English Renaissance Town and Country Plays

Researcher: Professor Robert D. Madison

Following work on Shakespeare's *The Tempest*, the researcher has begun an examination of *The Merry Wives of Windsor* and other renaissance plays which represent bourgeois England, focusing on pre-Jacobean (Italianate) staging and performance. The genre is important because it may represent a much more practical application of Renaissance philosophy in more realistic settings and characterizations than is present in the great tragedies, in festive comedies, or in "humors" plays.

Hand in the Matter: the Hand, Identity, Gender and Authorship in Malory's *The Book of Sir Launcelot and Queen Guinevere*

Researcher: Professor Timothy D. O'Brien

This research project investigates Malory's use of the hand as symbol in *The Book of Sir Launcelot and Queen Guinevere*. The frequent appearances of hand imagery in this area of Malory's *Works* is too astonishing to be ignored. Discussions of the body in the Arthurian canon help us to understand generally the meaning of the hand in Malory's fictions. However, that approach does not account for the

almost compulsive repetition of images of the hand. The first aim of this study is to document that repetition and establish its rate of occurrence in Malory as different from that in the sources. The next goal is to interpret the modification of the sources as it relates to Malory's delineation of knightly "wholeness" and the way the knightly "wholeness" is defined over and against female attempts to prove themselves by their "hands." Finally, the study demonstrates how the symbol of the hand as instrument of writing turns upon Malory's function as author. A paper on this project will be read at the South Eastern Medieval Association Conference
in October 1999. By that time a longer version will have been submitted for publication.

Seductive Violence and Three Chaucerian Women

Researcher: Professor Timothy D. O'Brien

This study investigates Chaucer's depiction of three women in *The Canterbury Tales*: the Wife of Bath, the wife in the "Shipman's Tale," and the Prioress. The common element in these portraits, this study posits, is the females' depiction of themselves as objects of male violence and thus of desire. This study explores the cultural basis of this connection between violence and desire. The Latin schoolbooks studied by boys, the saints' lives authored largely by men, and romances all position women as objects of violence, particularly of rape. When grammar and devotional study is fixed in the minds of students by the very principle of memorable violence, the result is inevitably an association of male achievement through language with violence to females. These three female characters present themselves as if they knew what books the men were brought up studying and what images have made those males feel empowered. A paper on this research has been delivered at the Texas Medieval Association Conference in Austin. A thirty-page article on the
research has been submitted for publication.

"Sike" and "Sikernesse" in the *Merchant's Tale* and *Troilus and Criseyde*

Researcher: Professor Timothy D. O'Brien

This project explores what seems to be a secondary but nevertheless significant theme that Chaucer explores in two rather different works. The theme identifies a desire for certainty, "sikerness," with sickness, "sikeness." It first emerges as punning and thus as a kind of idle play. However, because Chaucer's life, at least insofar as we can tell, is a record of adaptability to changing circumstances and because the theme appears in both an earlier work, *The Troilus*, and a late one, "The Merchant's Tale," it does appear to be an enduring concern. Initial exploration of secondary literature is halfway complete. An initial draft of a paper on the subject will begin shortly.

A History of Presidents Hill in Annapolis

Researcher: Professor Michael P. Parker

The area of Annapolis now known as Presidents Hill lies between West Street, Taylor Avenue, and the old Baltimore, Washington & Annapolis Railroad right-of-way. It consists of four streets: Munroe Court, Madison Place, Hill Street, and Jefferson Place. The neighborhood was first developed by the Brewer family in the early 1890s as a fashionable suburb of Annapolis; the crash of 1893, however, sent real estate prices plummeting, and the remainder of the lots were developed on a less pretentious scale. In the early 1900s Presidents Hill was the home of many small businessmen and craftsmen, including some who went on to become significant forces in the Annapolis commercial community. Two mayors of Annapolis lived in Presidents Hill; another, former Mayor Alfred A. Hopkins, has close family links to the community. The neighborhood began to change dramatically in the 1960s as the traditional family and social networks that held it together were eroded; the availability of Title 8 low-income housing moneys led to a marked increase in rental property in the neighborhood. In 1984 Presidents Hill was included in the Annapolis National Register Historic District, and it has become increasingly subject to gentrification over the last decade. This history will trace the chronicle of Presidents Hill from its founding up to the present day, relying on interviews with long-time residents, newspaper accounts, and property records. A building-by-building survey of the community architectural and historic landmarks will complement the narrative.

An Edition of the Poems of Edmund Waller

Researcher: Professor Michael P. Parker

Although one of the most accomplished and influential poets of the seventeenth century, Edmund Waller has remained largely neglected by modern critics. This neglect is due primarily to the lack of a reliable standard edition of his works. The most recent edition, that of George Thorne Drury, was published over one hundred years ago, in 1892, and it fails to meet the exacting standards of editorial practice established by W. W. Greg, Fredson Bowers, and Thomas Tanner in the twentieth century. Several scholars have begun new editions of Waller over the past seventy-five years, but none has been brought to completion. Most recently, Philip R. Wikelund of Indiana University labored over an edition from 1954 until his death in 1989. The researcher, in collaboration with Professor Timothy Raylor of Carleton College, has taken over Wikelund's work. The first stage of the project has entailed producing a census of Waller editions and manuscripts as well as a complete bibliography of secondary works on Waller. The second stage is to reexamine Wikelund's theory of the Waller copy-text: his choice of the 1664 edition does not conform to contemporary editorial practice. This project is large in scale and will take a number of years to get off the ground, but the result will be a major contribution to modern scholarship on the seventeenth century.

Songs in the Night
Ceremonies of the Horseman

Researcher: Professor John C. Wooten

The researcher continues to work on two novels. A recent sabbatical was spent revising the first and completing the second. The second is currently under revision with the assistance of Upton Brady, of Brady Literary Management. Once these revisions are complete, Professor Wooten will resume work on a new novel in what is a projected trilogy.

Research Course Projects and Trident Scholar Projects

The Growth and Decline of Children's Literature

Researcher: Midn 1/C Kielly A. Brannan, USN
Faculty Advisor: Associate Professor Eileen Tess Johnston

This paper begins with a study of the development of literature for children, focusing on its content, form, and style. This examination includes an analysis not only of the literature itself, but also an investigation of its ways of shaping children's behavior and facilitating the growth of character. The instructional use of children's literature within specific time periods is also considered, relative to the content of that literature and its intended child audience. A brief review of the emergence and development of literary criticism addressing children's literature also contributes to this examination. The intent behind this analysis is to identify and discuss the changes over time in the actual literature for the child, including the implications of modern alterations to classic tales.

Studies in Latin Language and Literature

Researcher: Midn 1/C Deryk Petersen, USN
Faculty Advisor: Associate Professor Nancy A. Mace

The primary goal of this independent study was for the midshipman to continue his review of the Latin language begun in the fall of 1997. The advisor and the midshipman met each week to examine particular elements of Latin grammar and read representative Latin readings that introduced the midshipman to ancient Roman culture, history, myth and art. In preparation for his final project, Mr. Petersen also read materials on the theory of translation, the Roman poet Ovid, and the history of his epic, the *Metamorphoses*. Over the last few weeks of the semester, he translated selected passages from Ovid's epic with the help of his advisor. His final essay examined closely translations of these sections done by John Dryden and Jonathan Swift in the seventeenth and eighteenth centuries. It explores the differences between the translations and

their original and considers the reasons why each translator chose to shape his version of the original as he did. This study demonstrates that translations are usually shaped by the translator's interpretation of the original work and that the same text can elicit widely differing English versions. It reveals the need for literary critics to be familiar with a work in the original language in order to understand the nature of versions done in other languages.

Studies in "Yard" Legends Through the Lens of Urban and Campus Folklore

Researcher: Midn 2/C Edd Hendee, USN
Faculty Advisor: Assistant Professor Anne Ellis

The goal of this course was to gain a unique insight into the Naval Academy folk narrative through a background in Urban and Campus folklore. In *The Vanishing Hitchhiker*, Jan Brunvald defines the folk narrative as, "stories that most people have heard as true accounts of real-life experiences, and few except scholars recognize as an authentic and characteristic part of our contemporary folklore." Even more so than other campuses, the environment at the Naval Academy fosters such narratives and even perpetuates them through force. Through the exploration of both the environment and the perpetuated legends, Professor Ellis and Mr. Hendee interviewed midshipmen, graduates, long-term faculty, and civilian workers. In addition, they conducted research in the Naval Academy Special Collections and Archives.

Publications

BOOTH, Allyson, Associate Professor, "Sir Ernest Shackleton, Easter Sunday, and the Unquiet Dead in T.S. Eliot's *Waste Land*." *Yeats Eliot Review*, forthcoming in 1999.

DREW, Anne Marie, Associate Professor, *Letters from Annapolis: The Midshipmen Write Home: 1848-1969*. Naval Institute Press, 1998.

This volume contains selected letters from 13 different midshipmen. An introduction, biographies, and a glossary are also included with many photos. The original letters are housed in Special Collections at the Nimitz Library.

FLEMING, Bruce E., Professor, "Skirting the Precipice: Truth and Audience in Literature." *The Antioch Review*, 56 (Summer 1998), 334-57.

The article begins with an overview of the relationship between literature (or art in general) and the world outside it in the works of Plato, Aristotle, Sir Phillip Sidney, and contemporary thinkers. Professor Fleming suggests that earlier divisions of writing into the neat categories of fiction and non-fiction are simplistic, even when they are applied to separate parts of the same work. He proposes that all written works are to a degree non-fictional, as for example even in a novel the sky is blue, and up, and people walk with their legs along the ground: this is an accurate representation of reality. The biggest problem for philosophers has been the "invention" of proper-name entities, called characters, who never really existed. Fleming suggests that these are not so much inventions as exploitations of what he calls the gray areas of knowledge: we do not know for sure that a woman named Mary Smith did not exist in 1850 London with these characteristics, so we accept a novel about her. We do not, however,

accept a novel about the nineteenth-century British monarch named Margaret, because the name Victoria is part of our public store of facts. All fiction plays on the gray areas of our world-views, but it must do so correctly. When it does not, we can identify what we call "bloopers," things we call simply incorrect: people did not wear bikinis in 1850, for example. As facts come to or disappear from public consciousness, the boundaries of the gray areas change, as they do already over geographical areas: what can pass for acceptable fiction about Washington, D.C. for a Japanese audience is not what can do so for a local one. Facts remain facts, even though the distinction between the true and the plausible is fluid.

FLEMING, Bruce E., Professor, "Something for Everyone to Dislike." *Ballet Review*, 26 (Fall 1998), 75-80.

The review explores the implications of re-vamping the nineteenth century dance classic "Swan Lake," traditionally performed with female swans; a contemporary version by the British choreographer Matthew Bourne casts it with male swans. Fleming puts this new version in the context of contemporary color- or gender-blind theatrical casting to analyze the successes and failures of Bourne's concept. He finds numerous difficulties in changing the gender of only one element of the plot and leaving many others unchanged. Difficulties of other sorts arise from plot elements that seem insufficiently thought-out, and the audience the piece is aiming at seems an ill-defined one.

FLEMING, Bruce E., Professor, "Body Piercing." *Dance View* 15 (Summer 1998): 37-9.

The title refers to the American philosopher Charles S. Pierce, whose essays in semiotics were re-discovered by American academics in the 1970s and 1980s. His work attempts to show the many different paths by which the signs with which we communicate take on meaning with respect to each other and with respect to the objective world. The essay analyzes three dance performances from the point of view of semiotics.

FLEMING, Bruce E., Professor, "Blurring Boundaries." *Dance View* 15 (Fall 1998): 28-30.

The article analyzes a performance of abstract puppetry through the lens of the aesthetic theories of the eighteenth century German playwright Gottfried Ephraim Lessing. The performance is a puppetry program performed in a masked off aquarium, where the "puppets" are rags tied to invisible sticks manipulated through the water to the music of Berlioz's Romantic program music "Sinfonie Fantastique." Fleming argues that the attempt to blur boundaries in this way is a Romantic gesture, though one more in keeping with the late Romanticism of Walter Pater or Charles Baudelaire than of the early Romanticism of Berlioz. The attempt to blur boundaries of genres must be deemed a failure, at least if analyzed through the neo-Classical lens of Lessing.

FLEMING, Bruce E., Professor, "Why Are We Entranced by Trashy Movies." *The Chronicle of Higher Education* 7 August 1998: B9.

This essay, which appeared in the "Opinion" section of *The Chronicle*, is an attempt to explain the metaphysical interest of "action" movies, those that include strong-men such as Arnold Schwarzenegger or Steven Segal. Fleming suggests that they show how strong our fantasies of individual control are, since everyone in such movies is at the behest of the hero. In addition, they show a disdain for the means we have developed for caring for ourselves: the hero constantly puts himself at risk, as if taunting the "bad guys" and daring the world to punish him for his risk-taking. The material world plays a large role in such films, which appear to be celebrations of technology and control over it. In the final analysis, however, they are more about the destruction of that technology; Fleming suggests that this shows our societal hatred of the so-complex objects that determine our lives. The position of the hero with respect to the technology that surrounds him and that he so contemptuously masters is that of someone before a religious leap of faith. The identification of audience members with the hero is extreme, so that finally what may be most striking about such escapist fantasies is precisely the contrast between the reality of the many strip malls in which such films play and the world they allow entrance to for a brief hour and a half.

FLEMING, Bruce E., Professor, "Fluff." *Dance View* 16 (Winter 1999): 45-7.

Fleming analyzes a performance by the Australian Ballet of a full-length work based on the Viennese operetta "The Merry Widow" and a program by the modern dance choreographer David Parsons to arrive at a definition of "light" dance, or "fluff." Fluff resolutely refuses to delve beneath the surface of emotions, and works within a narrowly-defined range of possibilities. Such insubstantiality takes one form in the all-too predictable goings-on of the story derived from Lehar, and another in the too-diluted work of Parsons, which spins out its premises for too long and ends seeming thin.

FLEMING, Bruce E., Professor, "Between the Movements." *Dance View* 16 (Winter 1999): 25-7.

An analysis of a program by the modern dance repertory group "White Oak Dance Project," whose director is the ballet dancer Mikhail Baryshnikov, suggesting parallels between the program and Virginia Woolf's final novel, *Between the Acts*. Woolf contrasts the personal interactions between audience members at a country pageant with the acts on the stage to make a point about the relationship between structure and incidents in our lives. In the same way, the most headlined piece on the program, "Heartbeat: mb," whose "music" is the amplified sound of Baryshnikov's own heart, makes a point about the relation between the personal and that which is sufficiently structured to be worth putting on the stage. Quite by accident, too, a number of incidents that occurred at the particular performance under analysis contributed to make this point: a disturbance in the street, the sound of an audience member's wheezy breathing. Fleming distinguishes between the sense in which we all bring our subjective reactions to performances and the way in which some mediocre pieces require our re-writing the piece using our own content. He ends by noting that great art is that which can dispense with all these unpredictable connections to the world outside, making situations where enough of this context is on the stage (or in the book) to make the experience predictable. Yet the most satisfying evenings in the theater are frequently those in which the subjective response of the viewer determines the experience.

FLEMING, Bruce E., Professor, "White Tie and Tales." *Dance View* 16 (Spring 1999): 46-8.

An analysis of the role of costumes in dance pieces, focusing on the Paul Taylor classic "Cloven Kingdom" and on Peter Martins's "Stabat Mater" to music by Pergolesi. The Taylor piece has four men dressed in white tie and tails, joined with women in long skirts and wearing oddly-shaped mirror-headdresses. The essay suggests that "Cloven Kingdom" is really about the white tie. Introduced in the program through an epigraph by Spinoza ("Man is a social animal"), the piece is clearly about the anti-social forces just under the surface in human beings: when left to themselves, the men jump about as if afflicted with St. Vitus's dance, do odd gymnastics, and then return to their "civilized" selves, all wearing full boiled-shirtfront dress. The women, in their sections, seem to experience the need to round their arms into monkey-like upside-down lyres. The mirror balls that all but cover their heads serve as the female equivalent of the men's white ties. Without the men's costumes, the essay suggests, we would not be able to see the contrast the piece underlines between civilization and its discontents.

GILLILAND, C. Herbert, Associate Professor, and Robert Shenk, *Admiral Dan Gallery: The Life and Wit of a Navy Original*. Annapolis: Naval Institute Press, 1999.

Though not a legendary World War II hero like Nimitz, Gallery is well known for his dramatic capture of U-505 on the high seas, the first such taking of an enemy vessel since the War of 1812, and for his controversial support after the war of the need for carriers. He also was known for his success as a writer, both while in the navy and after, and the best of his writings make up a significant part of this book. Excerpts from magazine articles, short stories, and letters are introduced with biographical commentary.

HILL, John M., Professor, "Interactions of Thought and Language in old English Poetry [Book Review]." *Modern Philology* 96.1 (August 1998): 61-5.

HILL, John M., Professor, "Pride and Prodigies [Book Review]." *Modern Philology* 96.1 (August 1998): 58-61.

HILL, John M., Professor, "Anthropological Approaches to Old English Poetry." *Philological*

Quarterly (Winter 1999).

A special issue of *Philological Quarterly*, guest edited and introduced by Professor Hill.

HILL, John M., Professor, *Reconstructing Heroic Values*. Gainesville: Florida UP, 1999.

Outside of *Beowulf*, the poems and stories we call "heroic" seem survivals from an earlier period. For generations of readers they have seemed to celebrate ancient Germanic loyalties and values within the context of an aristocratic, warrior world. These loyalties and values concern a warrior's relationship to kin as well as to lord, the duty of revenge, and such personal qualities as courage and reciprocal generosity (services for gifts, gifts for gifts). While aspects of these loyalties and values appear in the story of Cynewulf and Cyneheard, "The Battle of Brunanburh," "The Battle of Maldon," and a few short pieces or fragments such as "The Five Burroughs Poem," "The Fight at Finnsburg," and "Waldhere," mainly they are not archaic or ancient aspects of ethical life (as many scholars claim). Rather, they have been reformed to serve the politics of late ninth and tenth-century state formation – particularly the formation of West Saxon kingship and hegemony, led by the immediate male ancestors and descendants of the House of Alfred. What we celebrate as – in virtually every Old English handbook and Reader, and in virtually every survey anthology of English Literature I – the ostensibly traditional ethos of these poems and stories is really the reflection of late, West Saxon political ideals. Those ideals insist on the primacy on lordship over, but not always against, kinship; on the then greater primacy of kingship as nearly sacrosanct, mythologically justified, genealogically legitimated and ecclesiastically blest; and on retainership as correspondingly absolute – a reflection of what supreme lordship and kinship demand. Using the much more complicated *Beowulf* as illuminating counterpoint, *Reconstructing Heroic Values* works out the development in the heroic literature of these new ideals.

JASON, Philip K., Professor, and W.D. Ehrhart, *Retrieving Bones: Stories and Poems of the Korean War*. New Brunswick: Rutgers UP, 1999.

JASON, Philip K., Professor, and John Wilson, eds., *Masterplots II: Poetry Series Supplement*. Vols. 7-9. Pasadena: Salem Press, 1998.

These three new volumes in the widely-used *Masterplots II* reference series contain discussions of 376 poems from the eight to the late twentieth century. The supplement expands the original series in two primary ways: first, by including discussions of well-known older poems that were not in the original series, and, second, by extending coverage to more twentieth-century poetry — thereby allowing more discussions of work by African American, Hispanic, Asian American, and American Indian writers. Each essay has three sections: an overview of content, an analysis of forms and devices, and a discussion of themes and meanings. A glossary of terms and several indexes make this an extremely user-friendly reference.

JASON, Philip K., Professor, and Allan B. Lefcowitz, *Creative Writer's Handbook*. 3rd edition. Upper Saddle River: Prentice Hall, 1999.

This latest edition of the highly successful guide for creative writers weaves together theory, practical advice, and instructive examples for the writing of fiction, poetry, and plays. New materials amplify the discussions of writerly attitudes, free verse, and screen writing. A new chapter on creative nonfiction involves student writers in the preparation of personal essays. The "Tools and Resources" section has been updated, and the number and range of illustrative works has been increased.

JASON, Philip K., Professor, "South Florida Chopper Pilot." *WordWrights* Fall-Winter 1998: 18.

JASON, Philip K., Professor, "Suicide Mission." *WordWrights* Fall-Winter 1998: 18.

JASON, Philip K., Professor, "Waiting for Spring." *WordWrights* Fall-Winter 1998: 18.

JASON, Philip K., Professor, "St. Thomas Blues." *WordWrights* Fall-Winter 1998: 18.

JASON, Philip K., Professor, "Interest." *Tampa Review* 13 (Spring-Summer 1999): 43.

JASON, Philip K., Professor, "Linda Pastan's *Carnival Evening: New and Selected Poems*." *Magill's Literary Annual 1999*. Pasadena: Salem Press, 1999.

An essay on and review of Pastan's work.

JASON, Philip K., Professor, *Novels of the Korean War*. http://www.illyria.com/korea 1999.

An Internet publication with an associated page on short fiction.

MADISON, Robert D., Professor, "An Interview with Ronn McFarlane." *Lute News: The Lute Society Magazine* 48 (1998): 22.

A member of the well-known Baltimore Consort, Ronn McFarlane is also a world-famous soloist and composer
who has expanded traditional media for distributing classical music, both from the renaissance and newly composed for ancient instruments.

MADISON, Robert D., Professor, "Review of Robotti and Vescovi's *The USS ESSEX and the Birth of the American Navy*." *Foreword*, April 1999.

Robotti and Vescovi's book is almost local-color in its emphasis of the Salem origins of one of America's most famous frigates, but their work transcends both local and academic history in making the full career of ESSEX and her people available to the general reader.

O'BRIEN, Timothy D., Professor, "Fire and Blood: 'Queynte' Imaginings in Diana's Temple." *Chaucer Review*. 33.2 (1998):157-67.

This article examines the episode in "The Knight's Tale" in which the narrating Knight focuses on Emily's prayer to Diana. At issue is the degree to which we interpret Chaucer's treatment of the narrating Knight and particularly his use of the controversial term "queynte" as ironic. In order to come to some solution to this problem the article surveys the scholarly controversy over the meaning of that term and carefully examines the contextual cues within the "Diana's temple episode" itself. The article also outlines a theoretical basis for reading "queynte" as a pun. The piece concludes that Chaucer is exposing the Knight's unawareness of his ideology and that Chaucer is as sympathetically as possible displaying the subjugation of Emily's body to the male culture.

Presentations

ARBUTHNOT, Nancy, Professor, "An American Artist in World War II: Jason Schoener in the Marshall Islands," exhibit on Schoener's WWII art, Marjuro, The Republic of the Marshall Islands, 10 May 1999.

BERGMANN, Harriet F., Professor, "The Society to Encourage Studies at Home," U.S. Naval Academy's Women's History Month Celebration, Annapolis, Maryland, 1 March 1999.

DREW, Anne Marie, Associate Professor, "Becoming a Virgin: The Love Life of Elizabeth I," Maryland Humanities Council Speakers Bureau, 21 March 1999.

Lecture offered to a wide range of audiences, from the daughters of the British Empire to the Catonsville Senior Citizens.

DREW, Anne Marie, Associate Professor, "Discovering *Letters From Annapolis*," Author's Luncheon, Washington College, Chestertown, Maryland, 6 March 1999.

DREW, Anne Marie, Associate Professor, "The Academy Through its Letters," U.S. Naval Academy Alumni Association Monthly Meeting, Annapolis, Maryland, 30 March 1999.

ELLIS, Anne M., Assistant Professor, "History of Religious Drama," St. Martins in the Field, Severna Park, Maryland, May 1999.

ELLIS, Anne M., Assistant Professor, "*Barefoot in the Park*," WBJC, Baltimore, Maryland, 22 January 1999.

A radio interview with WBJC regarding Professor Ellis's production of *Barefoot in the Park* for Colonial Players in Annapolis.

ELLIS, Anne M., Assistant Professor, "*Barefoot in the Park*," *Capital Profiles*.

An interview for Jones Cable's public access television channel, covering Professor Ellis's production of *Barefoot in the Park* as well as other professional activities and the 50th anniversary at Colonial Players.

ELLIS, Anne M., Assistant Professor, "KC/ACTF Adjudication," Kennedy Center for the Performing Arts, Washington, D.C., 16 April 1999.

A critical, creative, and pedagogical response to the cast and director of American University's production of *Camelot* as part of the Kennedy Center/American College Theater Festival.

FLEMING, Bruce E., Professor, "The Zen of Action Movies," Honors Colloquium, University of Alabama at Huntsville, 11 November 1998.

HILL, John M., Professor, "Violence and the Making of Wiglaf," Medieval Conference, Toronto, Canada, 11 October 1998.

HOWLAND, Mary D., Associate Professor, "Letting Go of the Past," Al-Anon, Kensington, Maryland, 10 October 1998.

LARABEE, Mark D., Lieutenant Commander, USN, "'A Funny Piece of Water': The Altered Seascape of Joseph Conrad's Gulf of Siam," College English Association Conference, Philadelphia, Pennsylvania, 2 April 1999.

MACE, Nancy A., Associate Professor, "Charles Dibdin and the Music Sellers in 1784: Testing the Length of Copyright," Modern Language Association Convention, San Francisco, California, 28 December 1998.

MACE, Nancy A., Associate Professor, "New Information on the Final Years of Longman & Broderip: Music Seller Finances in the Late Eighteenth Century," East-Central American Society for Eighteenth-Century Studies Conference, Salisbury State University, Salisbury, Maryland, 9 October 1998.

MADISON, Robert D., Professor, "A Thousand Furlongs: Sea and Stage in Shakespeare's *Tempest*," College English Association Conference, Philadelphia, Pennsylvania, 2 April 1999.

MADISON, Robert D., Professor, "Submission and Restoration in *The Wept of Wish-ton-Wish*," American Literature Association Conference, Baltimore, Maryland, 28 May 1999.

NOLAN, Charles, J. Jr., Professor, Chair of Panel on "Techno-Literacy, Placement and Curriculum: Lessons from the Two-Year College," Conference on College Composition and Communication, Atlanta, Georgia, 25 March 1999.

NOLAN, Charles, J. Jr., Professor, Chair of Panel on "Going Against the Grain," College English Association Conference, Philadelphia, Pennsylvania, 2 April 1999.

O'BRIEN, Timothy D., Professor, "Seductive Violence and Three Chaucerian Women," Conference of the Texas Medieval Association, San Antonio, Texas, 17 September 1998.

PARKER, Michael P., Professor, "Ghostlier Demarcations, Keener Sounds: The U.S. Navy and the Sutton Apparition Case," American Culture Association Convention, San Diego, California, 1 April 1999.

PARKER, Michael P., Professor, "Using the Academy to Teach the Research Paper," Educating Our Nation's

Leaders: A Conference for the Federal Service Academies, West Point, New York, 9 April 1999.

PARKER, Michael P., Professor, "Whose England? The Controversy over Jones's Restoration of Pauls and the Meaning of British History," International Conference on Seventeenth-Century Studies, Durham, England, 26 July 1999.

PORTOLANO, Marlana, Visiting Assistant Professor, "George Campbell's *Philosophy of Rhetoric*," Catholic University graduate seminar in History of Rhetoric, 18 March 1999.

REES, Elizabeth, Visiting Assistant Professor, "Teacher Training in the Use of Poetry in the Elementary School Classroom," Piney Branch Elementary School, Takoma Park, Maryland, 22 March 1999; Damascus High School English Department, Damascus, Maryland, 16 November 1998; Eleanor Roosevelt Senior High School, Laurel, Maryland, 13 May 1999.

DEPARTMENT OF

History

Professor Robert Artigiani
Chair

Members of the History faculty were actively involved in research during academic year 1998-1999, and their labors produced many and varied fruits. Naval Academy Research Council (NARC) grants supported twelve different research efforts in remarkably diverse areas. Some work was in comparative cultures, for example, how competing societies (Russian and Chechen) recorded the same experience or how hearing and deaf cultures interacted in nineteenth century France. Historians studied Etruscan record keeping, traced the rise of the English nation, and evaluated American code breakers in China. They also helped clarify and expand current knowledge of the American past. How the early Republic was democratized, how the Civil War tore apart venerable institutions like the USNA and sparked economic developments in Southern cities, and how FDR maneuvered defense budgets were all examined in detail. Meanwhile, faculty with more far-flung interests studied topics from early Christian art to AIDs in Zimbabwe. External sources such as the Mellon Trust and the National Endowment for the Humanities contributed to funding travel to archives in three cases. A wide range of research projects was undertaken independently, of course. These involved two different kinds of gender studies, one on English aristocrats and one on Virginia colonists, the creation of a reader on foreign encounters with Western civilization, and several works in naval history.

Faculty involved and supported midshipmen in various sorts of research projects, too. There were ten Honors students and a Trident Scholar, whose projects ranged from slave culture in Annapolis to the management of nuclear weapons in the North Atlantic. A study of jazz saxophonist John Coltrane was begun, and midshipmen undertook independent study courses with significant research components, as well. One of the latter included a course that drew faculty from both Mathematics and History to test the value of cellular automata models of military conflict.

Two book-length monographs were published by university presses during academic year 1998-1999. One, the story of the Anglo-Saxon King *Alfred The Great*, has been nicely reviewed and is already going into a paperback edition. The other, *Gentlemen and Freeholders*, has been nominated by Johns Hopkins Press for virtually every major award in American history writing. An edited volume on how the Russians interpreted their past also appeared. Faculty published seven articles in professional journals and books, ranging from applications of information theory to culture through in-depth studies of Persian and Russian historiography to Chinese code breakers. There were also nearly ten short articles published in various encyclopedias, which will serve as references to future generations of scholars. The list of presentations is too long to detail, but it includes foreign venues from Sardinia to Japan, various government schools and agencies, Finally, five reviews were published in various professional journals.

Sponsored Research

The Formation of the English Nation, c. 650-939

Researcher: Professor Richard P. Abels
Sponsor: Naval Academy Research Council (NARC)

Between the seventh and the early tenth century, 'England' emerged, both as a concept and a political entity. This project explores how the political and social world described by Bede, with its numerous small tribal kingdoms, evolved into the consolidated English kingdom of the tenth century.

Recent historians of Middle Saxon England have tended to concentrate upon establishing the basic chronologies of kingship. Archaeologists, on the other hand, tend to ignore names and dates in favor of reconstructing the material past. Over the last decade our understanding of Anglo-Saxon settlement, village and urban life, and commerce has been dramatically changed by discoveries of archaeologists. Recent excavations at London, for instance, have forced historians to reconsider received ideas about he history of that city. What this project attempts to do is bridge the two disciplines. The goal is a deeper understanding of the changing nature of early medieval governance and politics, and a firmer understanding of the meaning of 'nationhood.' This is a long term, ongoing project.

Art and the Christian Intelligence According to John Scotus Eriugena

Researcher: Associate Professor David F. Appleby
Sponsor: Naval Academy Research Council (NARC)

This study set out to investigate the ideas about the role of the liberal arts in the process of individual Christian conversion and salvation in the thought of John Scotus Eriugena (ca.810-ca.877). The intention was that Eriugena would form the subject of one chapter in a monograph on Carolingian views of the place of the liberal arts in the process of Christian restoration. In Carolingian Francia Eriugena is important as one of the only thinkers who knew Greek and was familiar with parts of the Greek patristic tradition and some late antique neo-platonic philosophical sources. His image of the human person and of Man's condition after the Fall were deeply informed by a Hellenic anthropology that focused more on the intellect than the will, and a conception of human restoration that emphasized an anagogical means of ascent and deification. Eriugena attempted to reconcile the will-based anthropology and theology of descent that were dominant in the early medieval West with the Hellenic ideas that so intrigued him. The questions that seemed most pressing included the following: first, what role do the senses of sight and hearing play in the acquisition of knowledge by human beings? Second, how does Eriugena picture the faculties of the human mind? Third, which faculties do the liberal arts influence, and how do they exercise this influence?

Etruscan Record Keeping

Researcher: Professor Phyllis Culham
Sponsor: Naval Academy Research Council (NARC)

The investigator has been engaged in a long-term project on roman literacy and numeracy. Her publications to date on that topic have already excited much international comment and discussion. They call into question standard narratives of roman history by insisting that Romans failed to keep systematic records from which historians in Rome could work and that many of the so-called records which circulated in various forms were actually spurious. The investigator gradually came to realize that explanations for Roman counting and recording practices which seem inefficient or even corruption-prone to us were to be found in the older Etruscan culture which influenced Rome so deeply. The investigator is prepared to conclude that religious associations inherited from the Etruscans underlie the remarkable Roman cultural conservatism which continued to prefer durable text-bearing objects over easier to read and store papyri. This supports her published theory that religious connotations of many texts and objects limited their circulation in Roman society. The investigator even concludes that some of the most influential authors of imperial-era Rome preserve traces of Etruscan religious prototypes in their narrative form.

Arsenals of the Confederacy: Richmond & Atlanta, 1860-1865

Researcher: Professor Mary A. Decredico
Sponsor: Naval Academy Research Council (NARC)

This research project examines the impact of the Civil War on the people and cities of Richmond and Atlanta. Because of the wartime mobilization, these cities were transformed into major sectors of industrial and military significance. Were it not for the contributions of Richmond and Atlanta to the war effort, the Confederacy would not have survived four long years of war.

The Democratization of American Society and the Virginia Electoral System, 1760-1820

Researcher: Associate Professor John G. Kolp
Sponsors: Naval Academy Research Council (NARC),
Mellon Fellowship, and Virginia Historical Society

There is a continuing debate among historians over the role played by the American Revolution in the democratization of American society. Most scholars do not see the Revolution as a catalyst for democracy but rather see a conservative movement aimed only at preserving traditional English liberties which colonists believed were being nullified by the British Government. In the last few years, however, several historians have challenged this conservative interpretation and claim, to the contrary, that the American Revolution was as revolutionary and radical as any modern event of its kind. The project

investigates the origins of American democratic ideals and practices by examining the responses of local political institutions to the constitutional and social upheavals of the American Revolution. Specifically, it looks at voting patterns and voting behavior within the communities of Virginia from 1760 to 1820. The project builds upon extensive previous research into local electoral politics in Virginia, 1725 to 1775.

FDR and American Rearmament, 1933-1939

Researcher: Professor Robert W. Love, Jr.
Sponsor: Naval Academy Research Council (NARC)

This project is a continuation of work done in 1997; it attempts to understand how, between 1933 and 1939, Present Franklin D. Roosevelt devised his annual military and naval budgets and his methods of negotiating with various congressional committees over Navy Department and War Department authorization and appropriation measures.

Militarism and Politics in Latin America

Researcher: Professor Daniel M. Masterson
Sponsor: Naval Academy Research Council (NARC)

The researcher's project was the revision of his book, *Militarism and Politics in Latin America: Peru from Sanchez Cerro to Sendero Luminoso,* published in 1991 by Greenwood Press. Research and writing of a new chapter for this book encompassing the years of the critical presidential administrations (1990 to the present) of Alberto Fujimore is completed and submitted with the original text to Scholarly Resources Publishers under a new title, *The Military and Society in Contemporary Peru.* Completing further internal revisions of the original text, making bibliographical updates, and completing a new index are additional goals to continue working on.

A second project will undertake further revisions to a proposed Spanish edition of the book which will hopefully be published in Lima by the Catholic University of Peru.

AIDS in Zimbabwe: the Making of a Stigmatized Disease

Researcher: Associate Professor Samuel H. Nelson
Sponsor: Naval Academy Research Council (NARC)

The AIDS stigma in Africa remains one of the most troubling obstacles in the promotion of effective disease-prevention strategies because the nature of the stigma has not been fully understood. This project explores the making of the AIDS stigma in Zimbabwe by focusing on the ways ideas about AIDS have been created and propagated in society, and how these ideas

have shaped attitudes and behaviors. By examining how people have acquired negative connotations about AIDS, and how these ideas have been acquired by people, this study seeks to make a significant contribution to an on-going ethical and health problem in Africa.

Discovering the Signs: Social Images of the Deaf Community in Nineteenth Century France

Researcher: Professor Anne T. Quartararo
Sponsor: Naval Academy Research Council (NARC)

This research project is a historical study of the social and cultural forces that created the Deaf community in nineteenth century France. The researcher is focusing on the emergence of a Deaf identity during a period of intense social change in western society. In the first part of the study, the researcher examines the ideology of the revolutionary period and how it affected the creation of a Deaf community in the late 1790s. The researcher is studying the concept of how language and culture coalesced in the late eighteenth century in a way that led to the formation of an early Deaf community. In the second part of the project, the researcher is studying the emergence of Deaf community associations, initiatives for Deaf education and the role of leading activists to improve the condition of Deaf people. In the third part of the study, the researcher is looking at the uses of language and the exclusion of sign language from schools that educated the Deaf in the late nineteenth century. The researcher has analyzed, at least in part, the role of Deaf-run congresses and Deaf associations in the formation of Deaf culture. Most recently, the researcher has been compiling information about the period 1789 to 1815. She has delivered a major paper on the topic at the American Historical Association's annual meeting in Washington, D.C. in January 1999 and has submitted the material for publication. The researcher has also proposed a conference paper for Western society for French History (October 1999) dealing with medical ideas of the early nineteenth century that affected the French Deaf community. As Powrie V. Doctor Chair of Deaf Studies at Gallaudet University in the spring semester of 1999, the researcher was able to share some of her preliminary research conclusions with the Gallaudet University community.

Re-translation of Tolstoy's *Hadji Murad*

Researcher: Associate Professor Thomas Sanders
Sponsor: Naval Academy Research Council (NARC)

This project involves a re-translation of Leo Tolstoy's *Hadji Murad* a wonderful, posthumously published work that centers on the Russian-Chechen wars of the nineteenth century. Associate Professor Ernest Tucker is translating a Turkic, mountain epic about the main Chechen leader, which will be paired in comparative text with the researcher's translation.

Franklin Buchanan, Confederate Admiral

Researcher: Professor Craig L. Symonds
Sponsor: Naval Academy Research Council (NARC)

Franklin Buchanan is distinguished in American naval history for three accomplishments: He was the founding superintendent of the Naval Academy in 1845; he commanded the CSS *Virginia* (formerly the *Merrimack*) on her maiden voyage which resulted in the destruction of the USS *Congress* and USS *Cumberland*, and in which action he was wounded; and he commanded the CSS T*ennessee* in the Battle of Mobile Bay when Farragut "damned the torpedoes." In addition, he was Matthew C. Perry's second in command on the voyage that opened Japan in 1852-53. Despite this remarkable career, no modern biography has ever been written of his life. The 1st book to deal with his life was published in 1929 and is what is sometimes known as a "boy's book" – an adventure tale subtitled: "Fearless Man of Action." The purpose of this project is to work toward a full-length scholarly biography of Buchanan that will fill a significant gap in the literature of both the American navy and the Civil War.

Chinese Codebreakers During WWII: Military Intelligence and Military Cooperation

Researcher: Assistant Professor Maochun Yu
Sponsor: Naval Academy Research Council (NARC)

This project deals with Chinese success in breaking Japanese military codes during WWII and the military and political intrigues among the allies surrounding this Chinese effort. While the Chinese achieved remarkable results in code-breaking, the overall accomplishment did not assume any meaningful strategic value as did the Ultra and Magic efforts. The importance of signal intelligence as vital to the growth of KMT's intelligence empire became apparent and it didn't take time for the Chinese government to recognize its value. Yet in the absence of a modern, mechanized and consolidated military and industrial might that could deal the enemy a decisive and fatal blow, any excellent intelligence system would lose its relevance and usefulness. In today's world, we often forget that what ultimately wins a war is not intelligence operations alone, however good they may be. This supplementary role of intelligence is often ignored by empire builders who thereby lay the foundation for their own demise.

Independent Research

Constructing George Wyndham: Narratives of Aristocratic Masculinity in Fin-de-Siecle England

Researcher: Associate Professor Nancy W. Ellenberger

This project uses methodologies and findings from psychology, gender studies, and literary criticism to examine the inner world of an important politician and member of the aristocratic landed elite in the Edwardian period. It argues that George Wyndham's strengths and weaknesses as a politician, as well as some parts of his political ideology, are best understood in the context of his generation's shifting debates over manliness, debates which were expressed not just in gender but also in class terms. The Wyndham material casts light on the "catastrophic imagination" that characterized some members of Britain's aristocratic elite before WWI, as this class attempted to adapt to an increasingly democratic society based on meritocracy and new forms of wealth and status.

Henry Braid Wilson

Researcher: Associate Professor William R. Roberts

This is a 600-word article about Admiral Henry Braid Wilson and the contributions he made to professional military education while superintendent of the United States Naval Academy from July 1921 to February 1925. Wilson wrote the first official statement of the mission of the Naval Academy, codified the ascending system of privileges, or "rates," used by midshipmen to this day, and introduced the first leadership course taught at the Naval Academy.

Research for this essay was conducted during the summer of 1998, using the annual reports of the superintendent, minutes of the meetings of the Board of Visitors, and Admiral Wilson's scrapbooks. The first two sources are part of the United States Naval Academy Archives, while the United States Naval Academy Museum houses Wilson's scrapbooks in its collections. This article has been accepted for publication and will appear next year in a dictionary on professional military education edited by William Simon.

World and Western Civilization Reader

Researchers: Associate Professor Thomas Sanders
and Associate Professor Samuel Nelson

This project is a reader for World and Western Civilization courses. It incorporates primary source materials treating encounters between Westerners and non-Western civilizations and between Western elites and challengers to the Western authority structure.

War in the Caucasus, 1830-1860: The View From the Chechen Side

Researcher: Associate Professor Ernest Tucker

During the first half of the nineteenth century, Imam Shamil, a Chechen tribal leader in the northern Caucasus mountains, successfully challenged the Russian occupation of his homeland for over twenty years by conducting guerilla war according to the principles of *jihad* (Islamic holy war). He was the most successful leader ever to oppose Russian imperial expansion into the Caucasus and Central Asia during the 18th and 19th centuries, and he became a national hero not only to the Chechens, but to other Caucasian and central Asian Muslim peoples in their long confrontation with the Russian Empire.

Shamil developed a reputation in Russia not unlike that of Chief Sitting Bull in the late 19th century United States, as one of the few opponents to check, even if only for a time, the juggernaut of Russian military might. In the Muslim world, he also became famous for administering his domains according to Islamic law and serving as a paragon of Islamic propriety to hisfollowers. Although he was ultimately defeated by the superior technology and resources of Russian forces, his memory has lived on in the hearts of his countrymen, whose 1993-1996 struggle with the Russians took great inspiration from his story. An annotated English translation is underway of the Bariqat as-Suyuf., an Arabic chronicle written in the 1879s by Muhammad Tahir al-Qarakhi, an Islamic cleric who had been a close associate of Shamil and later fled to the Ottoman Empire. It appears to be one of the very few firsthand accounts of Shamil's campaigns from the Chechen side.

In the summer of 1997, research was completed on the background of Shamil and the Caucasus, and the bibliographical picture was filled in through research on Russian and Arabic sources at the Library of Congress. Translation work is continuing through the academic year with anticipated completion by Spring 2000.

Gender, Property, and Voting Rights in Colonial Virginia

Researcher: Associate Professor John G. Kolp

Historians have long recognized that despite the absence of legal privilege, women were central to political life in colonial America including helping candidate husbands treat and entertain voters, receiving attention from candidates during campaigns, and advising husbands on which way to vote. Yet their role as owners and conveyors of property could have had an even greater impact on local politics. Because only adult males who owned 100 acres of unimproved or 25 acres of improved land could vote in eighteenth-century Virginia, the property men received from mothers, sisters, and especially wives could have been crucial in male enfranchisement. The extent to which women's property contributed to the enfranchisement of men has never been fully explored.

This project sought to explore this question and to complete the research and writing of a chapter-length paper on women's property and men's voting rights. Material collected on female property transfer by project co-author, Terri Snyder, was merged with a large data base on voter participation and behavior collected as part of several earlier projects. In addition to exploring the many ways women, as political outsiders, contributed to the political culture of local communities, the quantitative analysis demonstrated that nearly one-fifth of the male electorate owed some if not all of their political rights to women.

This project will appear as a chapter in a book on

early American legal history to be published in Fall, 1999, University of North Carolina Press.

Research Course Projects and Trident Scholar Projects

John Coltraine: Spiritual Quest

Researcher: Midn 2/C Dennis Watkins, USN
Faculty Advisor: Professor David P. Peeler

This project examines the ideas, art and life of American jazz musician John Coltraine. The project will culminate in an Honors Thesis, to be presented to the History Department faculty during academic year 1999-2000.

Coltraine was one of the most original jazz artists of the twentieth century. He pioneered new motifs in his art, helping to propel jazz away from big-band swing and toward the improvisational solos that characterized this music of the later twentieth century. Coltraine's development mirrored any number of larger historical movements of the century: he was part of the black migration from the rural South to the urban North, and he was a World War II veteran whose post-war studies were in part funded by the GI Bill. But the principal focus of this study will be on a relatively narrow part of Coltraine's career: Thatmoment in 1957 when he experienced what he called a "spiritual awakening." The project will examine the nature of that awakening, considering both its biographical and intellectual dimensions, and the project will also explore the awakening's influence on Coltraine's music.

During 1998-1999, the researcher has read the major secondary works on Coltraine, as well as the artist's major published statements. A set of recordings has also been assembled and examined. During the fall of 1999 this material will be analyzed, and the subsequent honors thesis completed.

Africanisms in the Urban Chesapeake

Researcher: Midn 1/C Michael R. Thompson, USN
Faculty Advisor: Associate Professor John G. Kolp

This History Honors Thesis noted the recent archeological discovery in Annapolis, MD., of a West African religious artifact known as a Nukisi bundle and asked the question: What does this suggest about both the survival of Africanisms and the type of African-American culture that was possible or probable in the late 18th century urban Chesapeake? Although direct evidence of cultural practices among Annapolis' slave and free black populations is limited, this project used more extensive evidence from other port cities, detailed material from rural plantations, known West African social, cultural, and religious practices, data on slave ship arrivals, and actual demographic data on Annapolis to suggest that a number of specific African practices could have indeed survived and flourished within a dominant Anglo-American culture.

The Alanbrooke Diaries

Researcher: Midn 1/C Frank Monterisi, USN
Faculty Advisor: Professor Robert W. Love, Jr.

Britain's field-marshal Viscount Alanbrooke in one way or another participated in or was involved with almost every major Allied campaign of the Second World War. In 1939-1940, he served in France, commanding II Corps of the British Expeditionary Force up to the Dunkirk evacuation; thereafter, until November 1941, he was Home Isles Commander, responsible for defending Britain against a German invasion. One month before Pearl Harbor, Churchill appointed General Brooke as Chief of the Imperial General Staff, the key post in Britain's wartime higher command and an appointment Brooke held until the Japanese surrender in 1945. As CIGS, he directed British Army operations against the American and Soviet allies, to fashion British and Allied grand strategy during the second stage of the conflict.

Each evening throughout the war Alanbrooke entered is reflections on the days events in a diary, long held to be one of the key documents for understanding Allied wartime strategy and military diplomacy. Edited by the English historian Sir Arthur Bryant, Lord Alanbrooke's diary was published in two volumes in 1957-1959; these volumes since then have served as one of the principal primary sources for student of the Second World War-era high command. However, the original, handwritten diaries recently became available to scholars and one of the first to examine them, Professor Gerhard Weinberg, contended in his highly-regarded work, A World At Arms: A Global History of World War II that "the text (of the diaries) has been seriously tampered with, and until a reliable edition is published, one must consult the original." If wholly accurate , this extraordinary charge by one of the most learned historians of the war throws into doubt a great many of the major studies and interpretations, including , indeed, a recent biography of Alanbrooke by David Fraser, of the major figures and key decisions taken by the Allied higher command in the Second World War.

Just how "unreliable" are the Bryant editions of the Alanbrooke diaries and, secondarily, how might editorial changes have influenced historians' accounts are the two questions this project addressed. Every entry in the original diary, now held at the Liddell Hart Centre in Kings College in London was compared with the edited, or Bryant version, and every change, alteration, addition, and omission was noted. The volume of editorial changes and omitted passages was significant, but their real importance to the utility and reliability of the Bryant volumes is another, far more complex and ambiguous matter. At the very least, this research demonstrated that Weinberg was surely correct at least insofar as Bryant's version depicted Alanbrooke as a somewhat different general than the diaries suggest. On major questions of policy, however, the differences between the original and the published documents appear to involve shadings, intensity, and nuance. These are clearly important, and unfortunate, but this conclusion means that the questions posed by Weinberg's assertion cannot be answered easily. Nonetheless, this work leaves no doubt that most recent, major studies of the British high command rely entirely too much on Bryant's editions.

The Multi-Lateral Force: America's Nuclear Solution for NATO (1960 - 1965)

Researcher: Midn 1/C James Solomon, USN, Trident Scholar
Faculty Advisor: Professor Robert W. Love, Jr.

The Multi-Lateral Force (MLF) proposal was advanced by the Eisenhower, Kennedy, and Johnson administrations from 1960 to 1965 as a means to prevent the proliferation of nuclear weapons among the NATO allies, provide the non-nuclear allies with a sense of participation in nuclear strategy, and bring existing European nuclear forces under an allied command structure. In short, MLF provided for the establishment of a nuclear-armed fleet of two dozen submarines and cruisers manned and commanded by mixed crews drawn from all of the NATO powers. Although MLF was the major NATO nuclear armsproposal of two American presidencies, without exception Cold War historians have ignored the scheme, the attending diplomacy, and its effect on Allied and East-West relations.

This study constituted the first account of the history of the MLF grounded in archival sources, which included the records of the State and Defense departments and the British Foreign Office, Cabinet, and Ministry of Defence. The study concluded, not surprisingly, that the proposal failed in the end because the scheme was overly complex and failed to meet the needs of the European allies.

The British, for instance, saw the MLF as somewhat unreal inasmuch as they had little faith that any particular configuration of nuclear forces would alter the outcome of a nuclear exchange with the Soviets. On the other hand, London recognized proliferation to be a problem, supposed on occasion that the American scheme might solve it, but mostly leaned toward other alternatives, none of which survived for long. Uppermost in the sights of both Tory and Labour governments was the need to maintain the "special relationship" with Washington. The French, who were erecting their own national nuclear deterrence, opposed any project that smacked of Anglo-American domination.

The research suggested, however, that the saga of the MLF demonstrated one of the reasons that NATO won the Cold War. It was an efficient alliance. By contrast to the Warsaw Pact, the dominant power did not impose solutions on its partners. Rigorous, informed discussion dispensed with imperfect plans, and the MLF was one of them. In sum, the abandonment of the MLF in 1965 showed not the weakness and divisions of the alliance, but one source of its strength and staying power.

Publications

ABELS, Richard P. , *Alfred the Great: War, Kingship and Culture in Anglo-Saxon England*. London and New York: Longman, 1998.

ABELS, Richard P., Five articles for M. Lapidge, J. Blair, S.D. Keynes, and D. Scragg, eds., *Basil Blackwell Encyclopedia of Anglo-Saxon England*. Oxford: Basil Blackwell, 1999 pp. 47 - 48; pp. 234; pp. 235- 236; pp. 330 - 331; and pp. 456 - 457.

ABELS, Richard P., Review of Cassandra Potts, *Monastic Revival and Regional Identity in Early Normandy* (Rochester, NY: Boydell and Brewer, 1997) in *Albion* 30(1998), 660-62.

APPLEBY, David F., "The Priority of Sight According

to Peter the Venerable," *Mediaeval Studies* 60 (1998), 123-157.

The study focuses on the ideas about the spiritual implications of ordinary eyesight in the writings of Peter the Venerable, abbot (1122-1156) of the great Benedictine monastery of Cluny in Burgundy. The abbot's observation and the communicant who sees the physical bread and wine of the Eucharist is moved to a more profound experience of the sacrament furnishes the starting point of a review of all the abbot's references to eyes and sight, but also the human body and senses. Clearly, since orthodox Christian belief precludes crude body soul dualism, the question here is not whether Peter the Venerable was hostile to man's physical and sensory self. Instead, the question is the extent to which he integrated the body and senses into the process of Christian conversion and salvation: does the believer ascend to God by somehow transcending his/her physical and sensory self, or does the process of ascent involve the body and senses in some positive way? Peter the Venerable was torn between two perspectives, one traditional and ascetic, the other modern (for the twelfth century) and more at ease with the whole human person. At times, he referred to the body as little more than the soul's prison and emphasized the rational mind as the locus of Man's likeness to God. At other times, especially in the case of sight, he admitted that the senses may be enlisted in the process turning toward God, and in this respect his thought reflects one of the important developments of the period.

APPLEBY, David F., Five short entries and one long entry for D.R. Woolf, ed., *A Global Encyclopedia of Historical Writing* 2 vols. (New York & London: Garland, 1998): "Asser", "Ecclesiastical History", "Guibert of Nogent", "Hugh of Fleury", "Otto of Freising", "Jean-Baptiste de la Curne de Sainte-Palaye".

APPLEBY, David F., Review of Janet L. Nelson, *The Frankish World, 750-900* (London, 1996), for *The International History Review* 20 (September 1998), 638-640.

ARTIGIANI, P. R., "Social Information: The Person is the Message" in Wolfgang Kirchner, ed., *Quest for a Unified Theory Of Information*. Gordon and Breach Scientific Publishers, 1999.

Shannon's concepts are extended to human social systems by showing that social information measures the reductions in uncertainties individuals have about the systemic effects of each other's behavior. Since systemic effects are what individual actions "mean", reductions in systemic uncertainties about the collective environment are also measured. Social information is symbolically stored in Values, Ethics, and Morals (VEMs), which encourage individuals to act predictably and replicate the improbable behaviors characterizing particular societies. When individuals internalize meaning, their personal identities communicate societal priorities to future generations. (This is a reprint of an earlier *BioSystems* publication)

KOLP, John G. *Gentlemen and Freeholders: Electoral Politics in Colonial Virginia*. Baltimore: Johns Hopkins University Press, 1998.

This book explores the role of elections in the public culture of culture of Virginia during the half-century prior to the American Revolution. Using a two-pronged attack, it examines both the gentry elite who ran for office as well as the hundreds of small freeholders in each county who elected these gentlemen to the provincial legislative assembly, the House of burgesses. Part I investigates the entire set of legal, procedural, demographic, and behavioral parameters within which these elections occurred. This comprehensive and comparative section explores the development of franchise law and campaign customs, the growth and development of county electorates, voter turnout and behavior, and the broad trends in electoral competition over time and among constituencies. Part II exposes the actual workings of this varied political culture through detailed case studies of four local political communities.

MCBRIDE, William M., Harvard *Business History Review* 72 (1998):631-33 on Paul A.C. Koistinen,

Pursuing Peace: The Political Economy of American Warfare, 1920-1939 (University of Kansas Press, 1998)

MCBRIDE, William M., "Cone, Hutchinson Ingham," in *American National Biography*, eds. John A. Garraty and Mark C. Carnes, 24 vols. (New York: Oxford University Press, 1999) vol. 5, 324-25.

MCBRIDE, William M., "Taylor, David Watson," in *American National Biography*, eds. John A. Garraty and Mark C. Carnes, 24 Vols. (New York: Oxford University Press, 1999), vol. 21 362-63.

MCBRIDE, William M., "Turner, Richmond Kelly," in *American National Biography*, eds. John A. Garraty and Mark C. Carnes, 24 vols. (New York: Oxford University Press, 1999), vol 22, 32-33.

QUARTARARO, Anne T., "Susan Plann: A Silent Minority: Deaf Education in Spain, 1550-1835," book review in *Das Zeichen*, n. 47 (März, 1999), 165-167.

QUARTARARO, Anne T., "A Silent Minority: Deaf Education in Spain," book review in *Journal of Social History*, 32 (Spring 1999), 705-707.

Both reviews examine the work of Susan Plann, a linguist at the University of California, Los Angeles who has produced a study of Deaf education in Spain between the sixteenth and early nineteenth centuries. Her study is based on numerous archival sources and tries to explain the tensions between the use of signed language and articulated speech in the education of deaf youth. Her study analyzes the philosophical basis for educating deaf children in the centuries before the spread of universal schooling for hearing children. Though these book reviews deal with the same publication, the reviewer would like to stress that each review was written independently from the other; hence, the reviews do not contain the same language and emphasize different parts of the text. *Das Zeichen* asked for the review of Plann's book after a review had been submitted to *Journal of Social History*. The researcher did not consult the previous review when writing for *Das Zeichen.*

SANDERS, Thomas, *Historiography of Imperial Russia: The Profession and Writing of History in a Multinational State*. Armonk, New York: M. E. Sharpe, 1999.

This book is the culmination of several years' of conceptualization, organization, and exhortation, bringing together in one volume the work of an international group of scholars on Russian historiography broadly defined. It represents the first new work in the field in several decades and, as such, promises to be a seminal volume, basic to the graduate preparation of all students in relevant post-Soviet fields. In addition to a section on the background and evolution of historical writing in tsarist Russia up to the Stalinist purges, it includes sections on individual practitioners of both Russian and Ukrainian history. This substantial component on individual Ukrainian historians supplements a sections on non-Russian historical visions and is one of the most significant contributions of the volume. Finally, the concluding thought pieces by two of the most eminent scholars in the field-Marc Raeff and Manfred Hildermeier-help lay out signposts for the next generation of research. Two noteworthy features of the volume are 1) that most of the articles in it are new and were commissioned by the editor specifically for this work and 2) the global caliber of the contributors (German, Canadian, Russian, Ukrainian, and American). Indicative of the quality and timeliness of the enterprise is the fact that the publisher prepared a paperback edition at the same time that the hardback was being printed.

SANDERS, Thomas, "A Most Narrow Present," in *Historiography of Imperial Russia: The Profession and Writing of History in a Multinational State*, Armonk, New York: M.E. Sharpe, 1999: 3-13.

This article is a substantive introduction to the author's edited volume. While deeply informed by the scholarly contributions to the volume itself, the article represents a unique synthetic interpretation of the evolution of Russian and non-Russian historical

practice and writing up to 1930. In particular, it identifies three broad transitions: from chronicle to national narratives based on sources but also literary in inspiration (Romantic), from amateur, noble and literary forms of history to professional historical research and writing on the German model, and finally the inchoate and, as it transpired, abortive evolution to multifactoral, non-Positivist (a la *Annales*) historical research. These main swales of change and maturation are presented as not completely "progressive" in nature, and they are tied to the later emergence from its subterranean status of a "Russian" historiographical tradition within Soviet historical practice. In general, the article provides a flexible framework in which untrained readers can place the articles and information that follows. At the same time the article represents an interpretation of Russian historical practice and tradition that differs from and is more critical than the standard story and yet is highly optimistic about the strength, richness, and durability of this tradition.

SOLOMON, James B., Midn 1/C, "The Multi-Lateral Force: America's Nuclear Solution for NATO (1960 - 1965)", USNA Trident Report No. 269, U.S. Naval Academy, May 1999.

The Multi-Lateral Force (MLF) proposal was advanced by the Eisenhower, Kennedy, and Johnson administrations from 1960 to 1965 as a means to prevent the proliferation of nuclear weapons among the NATO allies, provide the non-nuclear allies with a sense of participation in nuclear strategy, and bring existing European nuclear forces under an allied command structure. In short, MLF provided for the establishment of a nuclear-armed fleet of two dozen submarines and cruisers manned and commanded by mixed crews drawn from all of the NATO powers. Although MLF was the major NATO nuclear armsproposal of two American presidencies, without exception Cold War historians have ignored the scheme, the attending diplomacy, and its effect on Allied and East-West relations.

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TUCKER, Ernest S., "1739: History, Self, and Other in Afsharid Iran and Mughal India," *Iranian Studies* 31:2 (Spring, 1998).

Article based on a conference paper comparing protrayal of the ideal subordinate in Afsharid and Mughal sources.

TUCKER, Ernest s., "Charles Melville (ed.), *Safavid Persia," Iranian Studies* 31:1 (Winter, 1998), 128-132.

YU, Maochun,"Chinese Codebreakers, 1927-1945," in the journal, *Intelligence and National Security*, vol.14, issue 1, Spring 1999.

Presentations

ARTIGIANI, Robert, Professor "The Emergence of Social Information,"International Conference of Sociology Montreal Canada, 20-23 July 1998.

ARTIGIANI, Robert, Professor "Technology and Meaning," Evolution theory at the Millenium, Calgari, Sardinia, 24-29 November 1998.

QUARTARARO, Anne T., Professor "Creating a Deaf Community in Revolutionary France, 1789-1799," American Historical Association, Washington, D.C., 8-10 January 1999.

TUCKER, Ernest S., Associate Professor, "The Safavid Nostalgia of the Ottomans: 1720-1750," Third International Roundtable on Safavid Iran, Edinburgh, Scotland, UK, August, 1998.

Language Studies

Professor Sharon Dahlgren Voros
Chair

During the 1998-1999 academic year, the Language Studies Department continued to conduct important research in a wide variety of fields and foreign languages. Faculty members produced a total of 3 sponsored research projects, 18 Independent Research Projects, 15 publications, including 2 books, 8 articles, one reprint, and 4 reviews, and 28 presentations at professional societies, both national and international, including Canada, Italy and Spain.

Of particular note this year are two books. Associate Professor María Castro de Moux, promoted this year to full professor and the department's nominee for the Research Excellence Award, published her work on Puerto Rican Poetry, titled La negritud de Luis Palés Matos (The Black Poetry of Luis Palés Matos). She emphasizes Palés's search for Puerto Rican ethnicity in its African roots as a means of establishing an Afrohispanic cultural identity. Associate Professor Marianne Bosshard published her book Chantal Chawaf (Chawaf is a contemporary woman writer from France). Her contribution marks the first time in book form that a comprehensive study and interpretation of Chawaf's literary production has been undertaken. Professor Bosshard also published a review of Chawaf's latest novel.

Among the highlights of various other publications, Associate Professor Castro de Moux published two articles, one on Luis Palés Matos and one on the myth of Prometheus in the seventeenth-century dramatist, Pedro Calderón de la Barca. Associate Professor Clementine Fujimura published a book chapter on the issue of ideal and real culture in American society, including an analysis of military culture within the US. Professor Elsa Gilmore published an article on the Chilean playwright, Marco Antonio de la Parra and a review of a book on Chilean theater. Associate Professor Elizabeth Knutson published one article on reading research in the foreign language classroom and one review of a pronunciation CD-Rom tutor for French. Assistant Professor Chie Paik published an article on her pedagogical research involving the "Self-Concept Scale" for students of Japanese. Professor and Chair Sharon Voros published a bio-bibliographical study of a sixteenth-century Spanish dramatist, Lope de Rueda, and a book chapter on the seventeenth century woman dramatist, Leonor de la Cueva y Silva. This wide range of scholarly expertise provides a rich learning environment for midshipmen studying the culture, literature, history and language of other nations. Our students ultimately are the beneficiaries of faculty research when they take classes from active, productive scholars.

In the field of language acquisition, the Annapolis Interactive Video Project continued to create interactive video lessons for Spanish and establish plans to develop lessons for all languages taught in the department. Associate Professor William Fletcher continued his pioneering development of organizational infrastructures for net-based instruction delivery of multimedia lesson materials to midshipmen in the laboratory, classrooms, and Bancroft Hall. These delivery systems provide access to world-wide authentic foreign-language material for instruction at all levels of proficiency. Associate Professor María Castro de Moux, with the assistance of Visiting Assistant Professor Leonard Sekelick, completed a series of video lessons for first-year Spanish. Dr. Sekelick also assisted Professor Elsa M. Gilmore, coordinator of second-year Spanish, who has continued to refine lessons in Intermediate Spanish with the latest technology-supported computerized programs in digitized video, now fully integrated into course syllabi. Professor Rivera-LaScala with assistance from Professor John Hutchins (ret.) and Professor Emeritus Guy Riccio (ret.) has revamped video from the Televisión Azteca and placed the video lessons on CD-Rom for computer access. Lieutenant Homero Cruz, exchange officer from the Mexican Navy also assisted in this endeavor. Lessons were planned for intermediate and advanced courses using these native-speed materials and adapting them to classroom concerns for authenticity of language and timeliness of subject matter with real-life situations and conflicts involving Mexican society and politics.

While the Language Studies Department does not offer a major in foreign languages, it has a strong

minors program with 111 minors in all languages, including 5 double minors, among the 1999 graduates. These midshipmen have elected to pursue advanced studies in language, literature, culture, history and area studies. Of these minors thirty-three (33) have taken majors in Division I, ten (10) in Division II, and sixty-eight (68) in Division III, thus providing a depth of experience beyond an education in technological fields for these midshipmen in a concentrated area of the Humanities. Majors then from all three Divisions continue to pursue minors in foreign languages and excel in their knowledge of other cultures beyond the borders of the U.S..

The Language Studies Department also offers immersion programs with the Cox Fund Overseas Summer Programs in six different countries (France, Germany, Japan, Russia, Spain and Mexico), internships at U. S. embassies in France, Germany, and Spain, and summer exchanges with the French Naval Academy in Brest, France, and the German Naval Academy in Flenburg, Germany. These study-abroad programs offer academic courses in the history, culture, literature and language of each nation. Graduates of the Class of 1999 with minors in foreign languages will bring to the Navy and Marine Corps not only valuable linguistic skills but also in-depth knowledge of the regions of the five areas offered: Spanish, French, German, Russian, and Japanese.

SPONSORED RESEARCH

Constructing A New European Identity

Researcher: Professor Eva L. Corredor
Sponsor: Naval Academy Research Council (NARC)

The purpose of this research project was to analyze Andréï Makine's autobiographical novel Le Testament Français which in the year of its publication, 1995, immediately earned the Russian - born author two of France's most prestigious prizes, the Prix Goncourt and the Prix Médicis. It has since been translated into twenty-eight languages.

During the term of the NARC grant, the researcher examined in particular the unique process in which Makine's young narrator acquired a native-like "Frenchness" in the midst of Siberia under the influence of a lonely French grandmother whose culture and refinement enchanted – and in some ways seduced– the boy's imagination and made him into an exile not only in his native Soviet Russia but also in France where he later sought political asylum.

The study examines the narrator's confrontations, on a metaphoric, linguistic, cultural, and psychological level, of, on the one hand, an idealized, only abstractly known French culture, and on the other, the brutal reality of the Soviet Regime. The contrasts between the atrocities committed in twentieth-century Europe and the sensitivity and refinement nurtured by the grandmother and the study of French literature contribute to the narrator's individuation marked by a growing awareness of otherness and perpetual exile.

The results of this NARC-supported research have been discussed at several professional conferences and are intended for publication. The researcher has plans to continue her study of Makine's work in view of a later publication in book form. In Spring 1999, midshipmen enrolled in the researcher's French Literature course, FF422, read and analyzed Le Testament Français with considerable interest for its gripping story but also its highly metaphoric, suggestive prose.

Net-Based Multimedia Instruction Delivery for Language Courses

Researcher: Associate Professor William H. Fletcher
Sponsor: USNA Curriculum Development Project

This project continues developing the software and hardware infrastructure for delivering multimedia lesson materials to language learners in the laboratory, classroom, and Bancroft Hall via the Naval Academy intranet. The researcher has extended support for the various highly compressed digital video and audio codecs supported by RealMedia G2 player and will incorporate that application into a browser-centric pedagogical tool for delivering multimedia lessons, eliciting learner responses, and reporting performance and accountability data via the Net. Instructor creation and editing of presentations and lessons will rely on off-the-shelf HTML and SMIL authoring tools. The long-term goals are to provide a familiar, consistent, flexible, and extensible user interface across all instructional software developed in the department and to establish an easily-mastered instructor front-end for authoring and updating multimedia language lessons.

The researcher will also enable delivering satellite video from the department's 7.2 meter dish via the web. He proposes to replace or supplement analog cassette recording with automated real-time digital encoding. Under this scheme, the dish controller computer will also be programmed to capture and digitally encode broadcasts, then upload them to the webserver for access (restricted to USNA) by midshipmen and faculty from throughout the yard. Valuable clips will be archived for later use, while ephemera will be purged after a certain interval. This video-on-demand strategy finally will permit all interested parties access to high-quality up-to-date foreign-language video when it fits their schedule. It also means that video resources will be stored directly in a format which can be edited and incorporated into multimedia lessons.

The Reliability and Construct Validity of the Six-Factor DOSC-Form H

Researcher: Assistant Professor Chie M. Paik
Sponsor: Naval Academy Research Council (NARC)

The dimensions of Self-Concept (DOSC)-Form H purports to measure academic self-concept of college students. Developed by Michael and associate, the DOSC-Form H stands on a theory of a multi-dimensional construct of academic self-concept. The current DOSC-Form H consists of five subscales representing the five hypothesized factors of academic self-concept. In this study a sixth factor was added to the current five-factor DOSC-Form H. The twofold purpose of the present investigation was: (1) to examine the reliability and construct validity of the six-factor DOSC-Form H as administered to a sample of 350 midshipmen at the United States Naval Academy, and (2) to compare scores on the DOSC-Form H by the subjects' years at the Academy, academic major, and gender. The reliability tests indicated satisfactory reliability for each of the six subscales of the DOSC-Form H. The confirmatory factor analyses yielded the best fit to an oblique six-factor model, supporting multi-dimensionality of the DOSC-Form H. Comparisons of scores by the subjects' demographic variables revealed a significant difference in scores on the Academic Interest and Satisfaction (AIAS) subscale between gender and across academic majors.

Independent Research

Maryse Condé: Désirada ou la non désirée

Researcher: Associate Professor Marianne Bosshard

In summer of 1998, the researcher wrote a paper on Maryse Condé's novel, Désirada (published in fall of 1997) which was presented at the "Colloque International sur la Littérature Française Contemporaine des Années 1990," held at Dalhousie University, Halifax, Nova Scotia, Canada, in September of 1998. In this paper, the researcher analyzed one aspect of this novel in the context of the socio-political history of a Guadeloupian island by the same name which served the author as partial background for her novel. This summer, the researcher plans on doing further research on this topic in order to write an article which will be submitted to the CIEF literary journal "Etudes francophones."

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Alchemy and Emblems in Calderon de la Barca

Researcher: Associate Professor Maria E. Castro de Moux

This researcher is continuing her study of the meaning and function of alchemical symbols and images in 17th-century Spanish playwrite Pedro Calderon de la Barca's theological and mythological plays. Her study draws from art, history, theology, philosophy and 17th-century science.

Ethics, Law, and Justice

Researcher: Professor Eva L. Corredor

Over the last two years, the researcher has been studying the ethics that have dictated some of the major philosophies and critical theories of the twentieth century. She has confronted the sociocritical theories of György Lukács with the deconstructive practices of Jacques Derrida. She expanded this interest with a view toward the possible illegality of laws as it has been perceived by philosophers such as Plato, Aristotle, Montaigne and Montesquieu and more specifically by twentieth-century philosophers such as Walter Benjamin, Emmanuel Levinas and Jacques Derrida. More recently, the researcher has been analyzing classical and modern interpretations of Justice and the place Justice occupies in the postmodern world. Some results of this research have been presented at professional conferences. The researcher hopes to pursue her study and ultimately publish the results in book form.

The Culture of Street Children in Urban Russia: An Ethnographic Study

Researcher: Associate Professor Clementine K. Fujimura

The purpose of this project is to study the culture and daily lives of Moscow's street children in the wake of social turmoil in order to promote the protection of marginalized children and their families. This project is designed so as to gain insight into the complexity of the relationship between Russia's marginalized children and Russian society. Questions to be answered include: How might orphans and street children be spared as victims of human rights violations? What cultural and social factors cause children to take to the streets? How does the culture of street children continue to develop? What social networks are in place to aid these children? What are the immediate and long term needs of these children so that they may be ensured a better quality life in society? The investigation of these questions will contribute to ongoing sociological and anthropological research being conducted world wide on the subject of street children as well as on Russian society in general.

Portraits of Russian Orphans in the United States: A Look at the Lives of Adoptive Families

Researcher: Associate Professor Clementine K. Fujimura

Along with recent social, political and economic developments in Russia has come a new crisis: that of unwanted children. As a recent study by this researcher points out: "Once hailed under the Soviet regime as the future of modern society and the responsibility of all adults, thousands of children have since been labeled as unwanted beggars (nishchie)" (Childhood 343). Indeed, many children, both orphaned and adopted have been forced to survive as marginalized. Even orphans now living as members of American families are coping with their often stigmatized status as adopted children. However loved these children are by their families, their issues are unlike children living with their birth parents. Within the U.S., they will always be seen as different. In Russia, they are regarded as inferior, stemming from "bad blood".

How do the families and children cope with such stereotypes? How do these American families redefine themselves as kinship units in a society which still questions the adaptability and success of Russian adopted children? How do children who for many years saw themselves as existing outside the family reconceptualize themselves as newly adopted "Americans"? Such questions, as they are embedded in the context of Russian orphanhood, Russian society and American society, are the subjects for this paper. Not only does this paper explore the process of self-definition of families of Russian adopted children, but furthermore, it addresses social issues faced by both Russian orphans and adopted children alike. It is hoped that via this paper, marginalized children will be seen as a valuable focus for further social scientific research.

Euromosaic and France's Endangered Languages

Researcher: Associate Professor Audrey Gaquin

This ongoing study addresses current French language policy with respect to France's non-immigrant

languages in view of the recommendations of the Euromosaic report recently issued by the Office of Official Publications of the European Community. The Euromosaic report gives the results of exhaustive research carried out by sociolinguists Peter Nelde, Miquel Strabell and Glyn Williams among the more than fifty non-immigrant minority cultures of the European Union. The report evaluates minority language production and reproduction among these groups, and predicts the probability of survival of each language based on eight criteria which include government policy and institutional support. This article studies the current situation of France's seven linguistic minorities as described by Euromosaic and in recent minority periodicals and makes proposals for increasing the chances of survival of these languages, most of which are considered seriously endangered by the Euromosaic researchers.

Tradition and Innovation in France's Minority Language Theater

Researcher : Associate Professor Audrey Gaquin

This project is a series of articles exploring the ways that France's minority language theaters communicate across linguistic and cultural barriers. The first article, currently in preparation, is a general introduction to minority language theater in France, based on interviews with Claude Alranq, Goulc'han Kervella and Joseph Fenninger conducted in summer 1997, as well as studies of the minority theater heritage by Alranq, Gwennole Le Menn, Georges Hérelle, and Jocelyne Fritsch, and the examination of scripts and videos of some recent productions. The second article is a study of verbal and non-verbal signs in the Alsatian Théâtre de la Chimère's production Le Retour d'Ubu. Future articles concerning Claude Alranq's production of Vaudeville d'Oc and Goulc'han Kervella's Avanturiou Yann Konan are planned.

Marco Antonio de la Parra and the New Chilean Theatre

Researcher: Professor Elsa M. Gilmore

This researcher is continuing her long-term project on the work of this well-known and prolific Chilean dramatist. During l998-1999 her article The Dead Father: Ekphrasis and History" appeared in the Fall issue of Gestos.

Hegel's Aesthetics: An Artistic Consecration in view of Edward Mörike's Poem `On a Lamp'

Researcher: Professor Sylvain Guarda

In evaluating Hegel's statements on aesthetics, the essay charts Hegel's attempts to formulate a form of art that would reconcile the individual with the divine. Not only does Hegel - in his speculative method similar to modern deconstructionists - integrate Kant's and Schiller's ideas into a synergetic system that

centers on man as mirror image of God, but he also threads his artistic views into a concept of community. The study then defines Hegel's lectures on aesthetics as a political document and invalidates claims made by philosophers such as Kierkegaard, Heidegger and Sartre against Hegel's system. An article based on this research is forthcoming in Monatshefte.

Gottfried Benn's Metaphysical Quest for Mother-Hope: An Animistic Inner Birth

Researcher: Professor Sylvain Guarda

No other 20th century writer reflects as magically and painfully the violent socio-political quakes and the artistic traditions of the society between 1910 and 1950 as Gottfried Benn. Through close analysis of Benn's prose and poetry, the study attempts both to retrace the poet's flights into the archaic dawn of mankind and to explain his unique iconography that often takes on a transfigured life in his verses. The results of this research will be published in the 2000 spring issue of Seminar: A Journal of German Studies.

Strategy Use in Foreign Language Writing

Researcher: Associate Professor Elizabeth Knutson

This project is a qualitative research study of strategy use in foreign language writing. The subjects are six students enrolled in introductory through advanced French courses at USNA. This year the research included devising a writing rubric to evaluate the quality of student writing samples, administering questionnaires, conducting think aloud interviews with students, reviewing the tape recordings of the interviews, and analyzing and writing up the data. Results of the research were presented in a paper at the Northeast Conference on the Teaching of Foreign Languages in April 1999. Issues discussed included the pressure and importance of message (focus on content rather than form), tolerance for approximate meaning, awareness of surface errors, vocabulary versus grammar, the role of the student's native language in composition, and the relationship between ease of writing and knowledge of topic.

Fostering Student-to-Student Classroom Interaction in the Foreign Language

Researcher: Associate Professor Elizabeth Knutson

This research focuses on the issue of students' foreign language interaction with other students in a whole group situation, *i.e.*, in class discussions, in oral reports given for the whole class, or in any activity which involves the entire class of students simultaneously. The researcher attempts to determine why students fail to listen to one another, and how student-to-student communication in the foreign language can be made to really "count" in language and literature courses. This research involves data

collected from actual classroom experiences. Results will be presented at the annual convention of the American Council on the Teaching of Foreign Languages.

The Development and Construct Validation Study of a Japanese Version of a Six-Factor Academic Self-Concept Scale for College Students

Researcher: Assistant Professor Chie M. Paik

For a sample of 158 college students enrolled in a highly competitive private college in Tokyo, Japan, the psychometric results arising from the development and validation of a Japanese version of an existing college level form of a standardized academic self-concept scale in English were presented. Confirmatory maximum likelihood factor analyses indicated that among several alternative first-order and higher-order factor models the one for which six oblique first-order factors were hypothesized yielded overall indexes revealing the closest degree of fit. It was concluded that the Japanese version demonstrated what could be considered satisfactory levels of reliability and homogeneity for all six five-factor subscales as well as moderate discriminant validity. Confirmatory factor analyses further provided a promising evidence for the construct validity of the scale as the best goodness-of-fit indexes were afforded to an oblique six-factor model among several alternative models.

Academic Self-Concept of Japanese Female Private High School Students

Researcher: Assistant Professor Chie M. Paik

The purpose of this study was to examine a profile of academic self-concept for a sample of 293 students of a private girls-only high school in Japan as measured by the Dimensions of Self-Concept (DOSC)-Form S, Japanese version. The DOSC-Form S, Japanese version yields five scores associated with the five underlying dimensions of academic self-concept: Aspiration (ASP), Anxiety (ANX), Academic Interest and Satisfaction (AIAS), Leadership and Initiative (LAI), and Identification versus Alienation (IA). Past studies involving Japanese college students have reported that Japanese college students display dispositions indicative of low self-concept relative to American counterparts. Little empirical study has been done on the academic self-concept of Japanese high-school students. Japanese high schools constitute a unique subculture within the entire Japanese educational system, characterized by intensive preparation and competition for college entrance examination. This paper employs empirical data analyses to investigate how academic self-concept develops among a group of Japanese high school students enduring the pressure of academic excellence in a competitive school environment.

The Relationship of Classroom Communication Apprehension, Academic Self-Concept,

and Academic Performance of the Japanese Students Enrolled in Graduate Schools in the United States

Researchers: Assistant Professor Chie M. Paik and Instructor Shinobu Anzai

For a sample of 100 Japanese students enrolled in graduate schools in various parts of the United States the purpose of the study was to examine the relationship of communication apprehension, academic self-concept, and academic performance. The past studies on communication apprehension, which involved the U.S. students indicated a negative correlation between communication apprehension and academic performance and self-concept. In the present investigation it was hypothesized: (1) that the Japanese students who participated in this investigation would score higher on classroom communication apprehension scale than U.S. college students, (2) that the Japanese students would score lower in academic self-concept scale than their U.S. counterparts, and (3) that the Japanese students would show lower academic achievement than their U.S. counter parts. The Communication Apprehension Scale (Neer, 1987), the Dimensions of Academic Self-Concept (DOSC) were employed to measure communication apprehension and self-concept, respectively. The paper discussed whether or not the commonly held belief about the relationship of classroom communication apprehension, academic self-concept, and academic performance would apply to the foreign students in the U.S. schools, specifically to the Japanese students in the U.S. graduate schools.

The Effects of Combining Computer-Based Aural and Written Practice in the Learning and Retention of Uses of the Subjunctive in Spanish

Researcher: Professor Gladys M. Rivera-La Scala

The purpose of this project is to test the effectiveness of certain types of instructional materials delivered via computer on the learning and retention of Spanish verb usage and form. With a 1997 summer CDP grant, the author has developed over 30 Lab programs integrating digitized sound and text. These programs have been field tested by midshipmen in Intermediate Spanish II, in the Spring semester of 1998. Using knowledge acquired at a 1998 summer seminar on cognitive strategies, the researcher developed a research design that she is currently using to analyze the data collected over two years on the students' use of these programs to understand the Spanish subjunctive. When this phase of the experiment is completed, the findings will be published as part of an on-going research done on the effects of this type of instructional treatment on second language acquisition. This project was partially funded by a USNA travel grant.

Juan de Mena's Coplas de los siete pecados mortales: Second and Third Continuations: A Critical Edition and Study.

Researcher: Professor Gladys M. Rivera-La Scala

This book-length study includes the first critical edition of the Second and Third Continuations of the Coplas de los siete pecados mortales, left unfinished at Juan de Mena's death, and an intertextual analysis of the main poem and its three continuations. The first chapter contains a comparative study of the four works based on themes, imagery, meter, and rhyme. In the second chapter the author gives detailed, firsthand descriptions of the manuscripts and 16th-century printings used in establishing the base text and discusses the interrelationships that exist between the many versions of the works. A corrected version of the continuations in modern script follows. Editorial, literary, and linguistic notes comprise the next section which ends with a glossary of medieval Spanish terms and one of proper names. Included in this volume is an extensive bibliography of primary and secondary source materials on Spanish and European 15th-century didactic poetry. To be published in Maryland: Studia Humanistica.

Eve's Patrimony: Women's Roles and Gender in Pedro Calderón de la Barca (1600-1681)

Researcher: Professor Sharon Dahlgren Voros

This book-length study examines the feminine presence on the Calderonian stage as a philosophical rejection of Eve's patrimony, the legacy of original sin brought into the world by the first woman according to the Biblical story. While Eve does not appear as a Calderonian dramatic character, she is evoked in his dramatic discourse as in the affirmation by Irene in the comedy Mañanas de abril y mayo, "That sin is nothing new for us today; it is Eve's patrimony" (p. 573). The relationship between notions of gender and theology involve issues of establishing communities of women in dramatic discursive practice. Women characters reject Aristotelian notions of themselves as weak, inferior, or incapable of learning. Although Calderón is not a feminist, he does insist on the notion of free will as he rejects deterministic notions of the human subject. This study will incorporate the researcher's previous work done on seventeenth-century Spanish drama and re-focus issues of women on the stage according to philosophical and legal issues, including Salic Law, that the plays present.

PUBLICATIONS

BOSSHARD, Marianne, Associate Professor, Review of Amour noir, by Dominique Noguez. The French Review 72.1 (October 1998): 161-162.

In this brief literary review, the researcher discussed Dominique Noguez' novel in the light of common exotic clichés often present in the works of "metropolitan" authors who write on topics concerning the French Overseas Departments.

BOSSHARD, Marianne, Associate Professor, Chantal Chawaf. Ed. Michaël Bishop. Amsterdam and Atlanta:

Editions Rodopi B.V., 1999.

This critical analysis of Chantal Chawaf's literary works, from Retable-La Rêverie (1974) to Vers la lumière (1993), is of interest to scholars, graduate students engaged in research in the field of contemporary French women writers, as well as academics who teach particular works of this author. It represents, for the first time in book form, a comprehensive discussion and interpretation that is exclusively focused on various aspects of Chawaf's literary itinerary. An extensive bibliography is included. Though the critical approaches vary according to the topics addressed, the analysis follows the chronological order in which Chawaf's literary texts were published. Her theoretical essays serve as a background for the discussion of the author's thematic and linguistic explorations that distinguish her oeuvre from that of other contemporary French women writers. The five chapters of this volume address Chawaf's literary ethics; her "poétique fusionnelle"; the complexity of maternal symbolism omnipresent throughout her works; her questioning of the essential "Other," linked to a personal quest for identity, as well as Chawaf's utopias and reformulations of certain ancient myths. Since Chawaf's oeuvre not only filters the world through a woman's eyes and life experiences,but also affirms itself in the context of linguistic, sociological, psychoanalytical and philosophical debates of the past quarter of a century, this analysis includes references to well know figures such as Michel Serres, Emmanuel Levinas, Mircea Eliade, Luce Irigaray, Elisabeth Badinter, Jacques Lacan, Gilbert Durand, Jean Bottéro, among others. The goal of this volume is to stimulate further examination and enjoyment of this author's work and to offer interesting insights into a literary universe that continues to evolve, as shown in the publication, in February of 1998, of Chantal Chawaf's novel, Le Manteau noir.

CASTRO DE MOUX, María E., Associate Professor, La negritud de Luis Palés Matos (The Black Poetry of Luis Palés Matos). New Orleans: University Press of the South, 1999.

This is a study of Luis Palés Matos' search for Puerto Rican cultural and political identity through his early works to his Black poetry. It presents an overview of the impact of his early years on his later poetry, especially his Masonic and spiritualistic beliefs. His search encompassed European Vanguardist movements, Marxist theory of art which he abandoned, settling for Taine's theory of the "milieu" as developed by Oswald Spengler. His search for Puerto Rican ethnic roots led him to a poetry supporting an Afrohispanic cultural identity as a basis for an independent nation.

CASTRO DE MOUX, María E., Associate Professor, "History and Myth in Luis Palés Matos' Black Poetry." Cultura 2-4 (1998): 41-45.

This is a study of the use of archetypes in poetry and politics. Governor Luis Muñoz Marín made the farmhand into the symbol of the new Puerto Rico emerging from the 1930's depression. Albizu Campos proposed the Catholic Nationalist as the identity for all Puerto Ricans. Luis Palés Matos created a poetical, mythical "mulatto" symbolizing racial and cultural unity of all Puerto Ricans in an independent nation.

CASTRO DE MOUX, María E., Associate Professor, "Duality in Calderón's La estatua de Prometeo: Astral Myths and Emblems." A Star-Crossed Golden Age. Myth and the Spanish *Comedia*. Ed. Frederick A. de Armas. Lewisburg, Pennsylvania: Bucknell University Press, 1998. 179-196.

The myth of Prometheus, as presented by Calderón de la Barca, is studied through 16th century Emblems by Andrea Alciatus, various Spanish emblem books, and two Golden Age mythological handbooks, Juan Pérez de Moya's Philosophia secreta (Secret Philosophy, 1585) and Fray Baltasar de Vitoria's Teatro de los dioses de la gentilidad (Theater of Pagan Gods,1620, 1623). The article explores duality in human psychology, as well as moral and spiritual development as illustrated by the play's characters. In his play Calderón de la Barca uses Alciatus' Emblem 41 as an allegory of War and Peace (Concord and Discord),

Wisdom and Will.

FUJIMURA, Clementine, Associate Professor, "Official and Unofficial Culture."Diversity in the United States. Ed. Larry L. Naylor. Westport, CT., Bergin & Garvey, 1999.

In American society, there exists a contradiction between real and ideal culture. In this chapter, the author confronts the issue of ideal and real culture, which is crucial to the real understanding of cultural groups and the pursuit of realistic solutions to the problems of diversity. Solutions must address what actually exists, not simply what people want to think exists. It is important that people distinguish between official (ideal) and unofficial(real) cultures if they hope to develop the awareness and understanding necessary to confront the problems of diversity. To be able to propose more realistic solutions to the problems, Americans have to begin where they actually are on these issues, not simply where they think they are. In addition, Fujimura demonstrates that the military cultures of America are very different from every other kind of culture that makes up America. Military groups function according to very different ideas and behaviors than most other Americans, even different from those characterizing the nation-state culture– in essence, making the United States a pluralistic society.

GILMORE, Elsa M., Professor, "Marco Antonio de la Parra's El padre muerto: Ekphrasis and History." Gestos 13.26 (November 1998): 99-108.

This article proposes a possible expansion of ekphrasis (the literary depiction of a visual work of art) to encompass the contrapuntal presentations of visual imagery and linguistic commentary which characterize The Dead Father. Such an approach allows the play's performance to be understood as an evaluation of the European heritage's effects upon Latin American Culture. The play focuses on three institutions and visual media: Christianity, as characterized in traditional iconography; political institutions, as portrayed in journalistic photography; and mass culture, as revealed in the publicity poster. The drama's collage-like structure is explained as resulting from the same ideological premises which first produced that visual art form in Europe and North America. Ultimately, the article draws on Pierre Bourdieu's The Field of Cultural Production to justify the play's tentative, partial, and repetitive approach to its visual images and to the culture which they embody.

GILMORE, Elsa M., Professor, Review of Teatro chileno y modernidad: identidad y crisis social, by Maria de la Luz Hurtado. Latin American Theatre Review 29.2 (June 1999): 180-182.

The reviewer examines the book's fundamental premise: that the modernizing philosophies and social theories of the last four hundred years have been favorably received by Chilean dramatists and propagated through their plays. This initial reaction, however, has been followed by a second level of response, characterized by criticism of the new ideologies. After a thorough analysis of the liberal social projects embodied in Chilean theatre history, Hurtado posits that the liberal capitalist model has been the one most consistently questioned by Chilean dramatists of every generation.

KNUTSON, Elizabeth, Associate Professor, "Reading with a Purpose: Communicative Reading Tasks for the Foreign Language Classroom." Foreign Language Annals 30.1 (1997): 49-57. Reprinted in Northeast Conference on the Teaching of Foreign Languages Newsletter 44 (1998): 39-44, and ERIC Digest, Clearinghouse on Languages and Linguistics. Washington, DC. December 1998. <http://www.cal.org/ericcll>.

Recent reading research has shown that reading comprehension is a function of both text- and reader-based factors. This article focuses on the reader-based factor of purpose, beginning with a review of research which demonstrates that reading texts with a particular purpose or perspective facilitates comprehension and increases reader interest. The article suggests approaches to the teaching of texts which provide

learners with purpose, including student-generated text collections, communicative tasks with reading components, and pre-reading tasks for readings in literature or civilization. Finally, the article argues that the concept of purpose provides a useful organizing principle for the coordination of reading instruction across the foreign language curriculum.

KNUTSON, Elizabeth, Associate Professor. Review of The Rhythm of French: Pronunciation Tutor for English Speakers, by Bernard Rochet. Modern Language Journal 82.3(1998): 434.

This review provides a description and evaluation of a multimedia self-instructional program (CD-Rom) emphasizing pronunciation problems typically experienced by native speakers of English. The tutorial is designed for language lab operation or at-home use by individual students and provides a supplement to communicatively-based French courses from beginning to advanced levels. The content of the fifteen lessons covers rhythm, intonation, syllabification, spelling-to-sound rules, vowels, semi-vowels, consonants, liaison, mute "e", and an overview of dialectal variation, including a unit on Canadian French. The review highlights features of the program which are likely to be of most benefit to students and provides guidance to instructors with respect to its use at various instructional levels.

PAIK, C., Assistant Professor, and Michael, W. (1999). A Construct Validity Investigation of Scores on a Japanese Version of an Academic Self-Concept Scale for Secondary School Students." Educational and Psychological Measurement 59.1 (1999): 98-110.

For a sample of 354 students taken from two highly similar college preparatory, girls-only Catholic high schools in Japan, the twofold purpose of this study was to obtain evidence of the internal consistency reliability and construct validity of scores on each of five dimensions of a Japanese version of an academic self-concept measure titled Dimensions of Self-Concept (DOSC), Form S, Japanese version. Internal consistency estimates of reliability of scores on the five 14-item subscales varied between .71 and .84, with a median value of .77. From each of the five factor subscales, three subtests each comprising four or five items were formed, scored, and intercorrelated (15 subtests in all). Confirmatory maximum-likelihood factor analyses for several alternative factor models indicated that a five-factor oblique model accounted for the greatest proportion of covariance in the matrix of 15 subtests.

Note: Chie Paik was a primary investigator and author of this paper. W. Michael, as an author of the academic self-concept scale, English version, acted as a supervisor and advisor in the process of investigation and write-up.

VOROS, Sharon D., Professor. "Lope de Rueda." Major Spanish Dramatists: A Bio-Critical Guide to the History of the Spanish Theater: 1500 to Today. Ed. Mary Parker. Westport,CT and London: Greenwood Press, 1998. 188-204.

In this article, the researcher presents the biography, dramaturgy of major works, critical response to these works, and selected bibliography of one of Spain's first playwrights, Lope de Rueda (1510? to 1565?). This writer was an influence on Miguel de Cervantes who describes a Rueda performance he saw in Sevilla that instilled in him a love of theater. Lope de Rueda is best know for his comic interludes or *pasos*, short pieces interspersed within larger dramatic works during a performance. These interludes have been understood as the main source of comic theatrical production throughout the Renaissance. Rueda also wrote four comedies adapted from Italian sources, similar in theme to Shakespeare's Twelfth night with mistaken identities generated between fraternal twins (brother and sister). The researcher argues that Rueda's most successful and enduring comedy is Medora in which he adapts the Italian theme to an Hispanic setting, language and culture. Further, this work is the first major play to feature a Gypsy in a principal role. A consummate comedian in his own right, in addition to writing his own scripts, Rueda probably played the role himself or in any case it was

a role for a male actor. The Gypsy provides some of the best examples of gender confusion and cross-dressing which have become standard in the *gracioso* tradition of comedy in Early Modern Spain.

VOROS, Sharon D., Professor, "Leonor de la Cueva Rewrites Lope de Vega: The Subversion of Silence in La firmeza en la ausencia [Firmness in Absence] and La corona merecida [Worthy of the Crown]." Engendering the Early Modern Stage: Women Playwrights in the Spanish Empire. Eds. Amy Williamsen and Valerie Hegstrom. New Orleans: University Press of the South, 1999. 189-209.

In this article, the researcher argues that Leonor de la Cueva y Silva adapted and rewrote Lope de Vega's La corona merecida from the point of view of the female main character. Lope de Vega was a friend of her uncle, Francisco de la Cueva y Silva, the only lawyer to whom Lope ever dedicated a play. In Cueva's play La firmeza en la ausencia as in Lope's work, the female protagonist rejects the monarch's sexual advances, potentially a dangerous position in the days of absolute monarchies. In retaliation the king resorts to the same tactics as King David in his lust for Bathsheba in that he sends the warrior hero, lover and husband of the lady, to war and presumably his death. Unlike the Biblical story, however, the lady is still unwilling to submit and the warrior hero returns triumphant. The king then has no other recourse than to accept the situation and reward the hero and his lady. Cueva's main seduction scene is markedly different from Lope's in that the lady, asleep in her bedchamber, carries on a dream conversation with her absent lover. The king interprets her message as a dialogue with him. She nevertheless continues to reject him even in her oneiric discourse. In Lope, the lady disfigures her body by burning herself with candle wax, thus transforming the female body into a kind of secular saint. Cueva appropriates even similar lines, such as "mi resistencia honrada" [my honorable resistance] and "Callen griegas y romanas" [Keep silent Greek and Roman Women], a phrase referring to Classical model of female resistance to male aggressors. Cueva then read Lope de Vega and skillfully rescripted her play to include her own sites for gender negotiation in feminine discourse.

PRESENTATIONS

BOSSHARD, Marianne, Associate Professor. "Maryse Condé: Désirada ou la non désirée." Colloque International sur la Littérature Française Contemporaine dans les Années 1990. Dalhousie University, Halifax, NS, Can. 23-25 September 1998.

CASTRO DE MOUX, María E., Associate Professor, "Mujer y redención en el auto sacramental Las aventuras del hombre de Lope de Vega" (Woman and Redemption in the Religious Play The Adventures of Man by Lope de Vega). International Congress on Lope de Vega. Università degli Studi di Firenze, Florence, It. 10-13 February 1999.

CASTRO DE MOUX, María E., Associate Professor, "El *anima mundi* y los cuatro elementos: Las apariencias para el auto La vida es sueño de Calderón de la Barca" (The Soul of the World and the Four Elements: Scenery for Calderon de la Barca's Religious Play Life is a Dream). International Association of Hispanists (AIH) 13th Congress. Madrid, Sp. 6-11 July 1998.

CASTRO DE MOUX, María E., Associate Professor, "La leyenda del Conde Partinuplés: Magia y escepticimos en Tirso de Molina y Ana Caro" (The

Legend of Partonopeus de Blois: Magic and Skepticism in Tirso de Molina and Ana Caro). Purdue Annual Conference on Romance Languages, Literatures, and Film. West Lafayette, IN. 15-17 October 1998.

CORREDOR, Eva L., Professor. "Justice Does Not Take (A) Place - La justice n'a pas (de) lieu." International Conference on Philosophy and Literature. Trinity College, Hartford, CT. 11-15 May 1999.

CORREDOR, Eva L., Professor. "The Il/legal Violence of Laws." Congress of the American Comparative Literature Association. Montreal, Can. 9-11 April 1999.

CORREDOR, Eva L., Professor. Organizer and Chair, session of Discussion Group on Hungarian Literature. Theme for 1998: "History in Literature and the Arts: The Case of Hungary." Congress of the Modern Language Association. San Francisco, CA. 27-30 December 1998

FLETCHER, William H., Associate Professor. "Winnowing the Web with KwiCFinder." CALICO. Miami University of Ohio, Oxford, OH. 5-9 June 1999.

FLETCHER, William H., Associate Professor. "Managing Online Multimedia in the Learning Laboratory, Classroom, and Student Room." CALICO. Miami University of Ohio, Oxford, OH. 5-9 June 1999.

FUJIMURA, Clementine, Associate Professor. "Women's Rights and Family Issues." Invited panelist to conference entitled "Social Conditions and Human Rights in Russia's regions," funded by the Kennan Institute and Human Rights Watch. Washington, DC. 13-14 January 1999.

FUJIMURA, Clementine, Associate Professor. "Childhood in Russia: Representation and Reality." A book-signing at Barnes and Nobles. Annapolis, MD. 29 October 1998.

GAQUIN, Audrey P., Associate Professor. "Tradition and Innovation in France's Minority Language Conference Theater." Conference of the American Association of Teachers of French. Montreal, Can. 24 July 1998.

GILMORE, Elsa M., Professor. "Reconsidering U.S. Cuban Theatre." International Congress of the American Association of Teachers of Spanish and Portuguese. Madrid, Sp. August 1998.

GILMORE, Elsa M., Professor. "On the Margins of Marginalization: Rita and Bessie." Latin American Studies Association Conference. Chicago, IL. 24-26 September 1998.

GILMORE, Elsa M., Professor. "The Theatre of Mario Martin." XVII Conference on Spanish in the United States. Florida International University, Coral Gables, FL. 12-16 March 1999.

KNUTSON, Elizabeth M., Associate Professor. "Composing in a Foreign Language." Northeast Conference on the Teaching of Foreign Languages. New York, NY. 9-10 April 1999.

KNUTSON, Elizabeth M., Associate Professor. "L'écriture véhicule: au delà du simple vocabulaire et de la forme grammaticale." American Association of Teachers of French (AATF) Regional Conference. Worcester, MA. 1 May 1999.

KNUTSON, Elizabeth M., Associate Professor. Chair, Session on "Emotion and Language: Implications for Language Learning." Modern Language Association Annual Convention. San Francisco, CA. 27 December 1998.

PAIK, Chie, Assistant Professor, and ANZAI, Shinobu, Instructor. "The Relationship of Classroom Communication Apprehension, Academic Self-Concept, and Academic Performance of the Japanese Students Enrolled in Graduate Schools in the United States." Annual Conference of the New England

Association for Asian Studies. Tufts University, Boston, MA. 24 October 1998.

PRUNER, Ludmila, Associate Professor. "The Russian Orthodox Iconography: Early 12th through 20th Centuries." The National Gallery of Art, Washington, DC. 24 March 1999.

PRUNER, Ludmila, Associate Professor. "The Film Noir and Darizan Omirbaev's Killer." Post-Soviet Cinema: New Films from Russia and Central Asia Conference. Tufts and Harvard Universities, Cambridge, MA. 22-25 April 1999.

PRUNER, Ludmila, Associate Professor. "New Films From Kazakhstan: S. Narymbetov, S. Aprymov and A. Karakulov." The National Gallery of Art, Washington, DC. 8 and 9 May 1999.

SEKELICK, Leonard C., Visiting Assistant Professor of Spanish. "The Brazilian Financial Crisis: Its Impact on the Rest of Latin America." Invitational lecture at The Johns Hopkins' School of Advanced International Studies. Washington, DC. 26 January 1999.

SEKELICK, Leonard C., Visiting Assistant Professor of Spanish. "The Use of Video in Teaching Foreign Languages." Presentation sponsored by the TALL committee of USNA's Language Studies Department. Annapolis, MD. 16 March 1999.

VOROS, Sharon D., Professor. "'Al tribunal de amor apelo:' Leonor de la Cueva and the Language of Law." Third Annual Conference on Early Modern Hispanic Women Writers of Spain and Colonial Latin America. Loyola Marymount University, Los Angeles, CA. 21-24 October 1998.

VOROS, Sharon D., Professor. "The Proverb 'Allá van leyes do quieren reyes' in Leonor de la Cueva y Silva." South Atlantic Modern Language Association [SAMLA], Annual Convention. Atlanta, GA. 4-7 November 1998.

VOROS, Sharon D., Professor. Chair of session, "Performance and Art in Early Modern Spain," Spanish Golden Age Drama Symposium, sponsored by the Association for Hispanic Classical Theater, Inc.. El Paso, Texas. 4 March 1999.

VOROS, Sharon D., Professor. "Leonor de la Cueva y Silva and the Oneiric Tradition of Sibylline Discourse." Bucknell Hispanic Studies Conference. Bucknell University, Lewisburg, PA. 12-13 April 1999.

Political Science

Professor Stephen E. Frantzich
Chairman

Political Science is a complex discipline which focuses on varying geographical regions and a broad spectrum of human behavior. Research in the Political Science Department reflects this variety and vitality while maintaining a focus on contemporary research methodology. Our faculty base their findings on

documentary analysis, empirical data collection, interviewing, and formal experimentation. Recognizing the utility of new tools of inquiry, members of our faculty have drawn upon and contributed to the information highway and the Internet for use both as a research tool and for access to the most up-to-date pedagogical methods. Political Science faculty have been published widely this year in numerous formats and have also been actively sought out for professional presentations and policy-making forums. Furthermore, Political Science encourages independent student research projects in which midshipmen design their own research under the guidance and direction of appropriate faculty.

Departmental faculty this year published seven independently authored or edited books, ten articles, book chapters or technical reports, and numerous book reviews. Among the varied topic areas are explorations into the necessity for the development of early warning systems in humanitarian emergencies, judicial performance, the future of NATO, political decision-making, and civic cynicism. This year departmental faculty received external research funding from sources as diverse as the United States Air Force Academy Institute for National Security Studies, the Dirksen Center, the White House and the International Social Science Council.

The department is fortunate to have hosted Jack Mendelson, the John M. Olin Foundation Distinguished Professor of National Security and drew heavily on ADM William Crowe, next year's Olin Professor. Warwick Boulton, of the Britannia Royal Naval College brought a foreign perspective to our teaching and research on international relations.

A reflection of the quality of our faculty is the large number of prestigious speaking engagements to which they were invited, as well as the various academic conferences which they attended. Most notable invitations included the Lester Pearson Peacekeeping Institute (Canada), Atlantic Treaty Association (Portugal), The Woodrow Wilson Center, and the White House. Members of our faculty traveled widely, both in the United States and abroad. They shared knowledge, taught courses and exchanged ideas, enriching our faculty's understanding of their fields and of the rapidly changing world that they study.

Independent research performed by midshipmen in the department is equally important since independent scholarly research is rare among undergraduates. This year five midshipmen took advantage of the two-semester independent research program. The honors thesis program affords a student the opportunity to participate in advanced research under the close mentorship of a faculty advisor. The culmination of this experience is an honors thesis presented by the student before a faculty panel, where it is critically judged and evaluated. As a result of their efforts, four participating midshipmen graduated with an Honors designation on their diplomas and two others received departmental honors.

A record of ten Class of 2000 midshipmen from the Political Science Department have been awarded advanced education programs, either through the Voluntary Graduate Education Program or as Olmsted Scholars. All of these outstanding midshipmen will go on to receive masters degrees as junior officers.

This year midshipmen activities and achievements once again extended beyond the classroom to participating in and organizing conferences, including the Naval Academy Foreign Affairs Conference (NAFAC), the Model United Nations (MUN), and Model NATO.

The theme for the Thirty-eighth NAFAC was "Keeping Peace." This extraordinary conference included a keynote address by the former President of the American Red Cross, Elizabeth Dole. Students participated in round table sessions exploring prominent issues and had the opportunity to participate in an executive-level conflict simulation. Over 200 students from 97 colleges and universities across the nation and 20 foreign countries attended this extremely successful event. This type of academic and cultural exchange among undergraduate students demonstrates the commitment of the Political Science Department to remaining on the vanguard of undergraduate international political studies.

In its sixth year, the United States Naval Academy's MUN Club has experienced remarkable growth and success. This year midshipmen participated in collegiate-level Model United Nations at Montreal,

Canada (MECMUN) and in Model NATO in Washington, D.C. The club also hosted the Fifth Annual United States Naval Academy Model United Nations (USNAMUN). More than 400 students from high schools as far away as Wisconsin and California participated in the four-day conference, which was completely organized and staffed by 170 midshipmen. Throughout the month of June, the department sponsored 24 workshops for the Naval Academy Summer Seminar. These workshops are designed to mentally challenge promising high school students. Additionally, this program often serves as a useful recruiting tool for teenagers who may be considering applying to the Naval Academy.

An overview of departmental research efforts reveals in-depth activity on the part of all members of the faculty. The knowledge and excitement of research produces invaluable dividends in the classroom, where faculty can use their newfound knowledge to educate and stimulate students. This energy and enthusiasm is reflected in the midshipmen activities and research, and reaches beyond the academy to the wider academic, political, and social world.

Sponsored Research

The Defining Issues Test: Report of Findings from Midshipmen Study of Moral Reasoning

Researchers: Professor Charles L. Cochran and Associate Professor Eloise F. Malone
Sponsor: Office of Institutional Research

Having compiled the DIT findings into an SPSS save file and merging this data with ACE data and findings from the Myers-Briggs personality inventory, Professor Cochran and I developed a time series data base of midshipmen attitudes, behaviors, and temperament. Last January intercessional I implemented a post-test of the DIT and administered a survey that I designed which asked first class midshipmen about "moral development" issues and the impact of core courses, the IDS and other USNA activities had on individual growth in moral reasoning. I coded these findings in an EXCEL file and imported it to SPSS for statistical analysis. Last summer I built the data set and began the data analysis. Over the course of AY1998-1999 I prepared a final report (attached) which will be submitted to the Office of Institutional Research.

The Assured Vulnerability Paradigm: Can it Provide a Useful Basis for Deterrence in the Second Nuclear Age?

Researcher: Associate Professor Willie Curtis
Sponsor: USAF Institute for National Security Studies (INSS)

Funding for this research in the amount of a $2,750.00 grant came from the United States Air Force Institute

for National Security Studies (INSS). The study will examine a number of assumptions and questions regarding the viability of the Assured Vulnerability Paradigm for providing a model for deterrence policy and strategic force structuring for coping with the new regional nuclear powers that will be a part of the strategic landscape in the multipolar twenty-first century international environment. The Assured Vulnerability Paradigm provided the basis for U.S. deterrence policy during the Cold War. As applied during the Cold War it focused on the concept that threats of nuclear retaliation provided a reliable and credible basis for deterrence. Inherent in the calculation of deterrence (Brodie Approach) is the assumption of rational decision making on the part of national leaders. However, defining rational behavior in a specific policymaking environment depends on factors such as culture, values, and attitudes toward risk-taking. Will these diverse factors meant that the traditional deterrence calculations and assumptions that underpin our deterrence policy and shaped our strategic force structure during the Cold War will continue to be sufficient to deter the diverse states and non-state actors that will inevitably obtain nuclear and other weapons of mass destruction in the twenty-first century?

Televising Congress: The Voyage to Public Understanding

Researcher: Professor Stephen Frantzich
Sponsor: The Woodrow Wilson Center

Analysis of the impact of congressional television and C-Span on public attitudes and behavior. The researcher relies on the detailed study of public opinion data as well as examples of public-related consequences.

The Political Spot

Researcher: Professor Stephen Frantzich
Sponsor: Naval Academy Research Council (NARC)

Political campaign spots are some of the most ephemeral advertising media. Little has been done to classify their utilization and capture their content for educational use. This project involves gathering, categorizing, and digitizing a large sample of contemporary campaign advertisements. The project has two goals: (1) to test a variety of hypotheses related to the types of political contests which use specific types of political spots and (2) the creation of a digitized and searchable data base of spots for use in the classroom teaching of political persuasion techniques.

The Effects of Intervention and Mediation on the Process of Genocide: A Comparative Analysis of Three Current Cases

Researcher: Professor Barbara Harff
Sponsor: International Social Science Council, Conflict Early Warning (CEWS)

Senior consultant, White House initiated state failure project, 1994-99. Extensively funded project on accelerators of ethnic conflict and regime crisis. The concept and methodology were developed in my previous empirical research on early warning of genocides. Project director, testing accelerator models on ten cases of genocide (project grant $83,000 administered by the University of Maryland).

Environmental Security in Southern Africa

Researcher: Professor Helen E. Purkitt
Sponsors: INSS U.S. Air Force Academy, Army Environmental Policy Institute, and Naval Academy Research Council (NARC)

The purpose of this project is to design a generic monitoring system of environmental problems that might cause future political conflicts in African regions. The fully implemented system contains relevant data at the international, regional, national, and subregional level for Southern Africa. Data from interviews with a diverse set of individuals in the US and six Southern African systems was use to aid the identification and rank ordering of the key current and future environmental issues that may be linked to future conflicts (Purkitt, 1998). A new method of summarizing intuitive forecasts of diverse groups of experts summarizes the key actors and dynamics of a number of regional problems (Purkitt, 1999, forthcoming). The final section of this report contains recommendations related to how the system can be implemented to monitor relevant trends in any African political region (see http://members.tripod.com/~loose for further detail).

Product outputs generated during this period include a final report to INSS, AEIP, and NARC and three conference papers. I presented some of the results from this project in conference papers at the International Political Psychology Society in Montreal, Canada during July, 1998. The remaining results will be summarized in two additional conferences papers: "How people perceive linkages between Environmental and Security Issues: Insights from Political Psychology," Paper to be presented at the fifth International Interdisciplinary Conference on the Environment, Baltimore, MD, June 23-26, 1999 and "Predicting Future Trends in Environmental Security in Southern Africa." Paper to be presented June 29, 1999 at the nineteenth International Symposium on Forecasting, Washington, D.C.

European Security for NATO Enlargement

Researcher: Professor Arthur Rachwald
Sponsor: 44th Atlantic Treaty Association, Lisbon, Portugal, Nov 16-21, 1998

Despite the end of the Cold War in Europe numerous emerging internal and external threats to peace and stability on the continent provide justification for the continuing existence of several and overlapping security organizations, namely, NATO, PfP, NACC, WEU, OSCE, and the EU. The main threats to European security include attempts to impose hegemony over one or several smaller nations in Europe, an attempt to rupture the trans-Atlantic link between Europe, the United States, and Canada, and any danger of aggression against the territory of any NATO member state. The singular threat of the Soviet Union has been replaced by multiple threats of differing origins and differing intensity, providing justification for a parallel existence of several security pillars in Europe. However, NATO will continue as the principal element of the European security structure, since the continent cannot afford the precipitous withdrawal of American forces.

Conduct Unbecoming an Officer: Captain Rockwood in Haiti and **The Secret Bombing of Cambodia, Part II**

Researcher: Associate Professor Stephen D. Wrage
Sponsor: The Center for the Study of Professional Military Ethics

For more than a generation, it has been recognized that ethics and values can be learned, but can hardly be taught. Lectures cannot impart values. It is more productive to put the students in the position of a decision maker, cause them to commit themselves to a position, then give them an opportunity to examine that position and the thought process that led to it. (See Gragg, C.I. "Because Wisdom Can't Be Told." In The Case Method at the Harvard Business School, ed. M.P. McNair with Anita C. Hersum. New York: McGraw-Hill, 1954. See also Argyris, C. "Some Limitations of the Case method: Experience in a Management Development Program." Academy of Management Review 5 (1980): 291-298 and Berger, M. "In Defense of the Case Method: A Reply to Argyris." Academy of Management Review 8 (1983): 329-333.

Each application requires its appropriate case. With this in mind, The Center for the Development of Military Ethics commissioned the production of three cases this semester. The first is a case of a conflict between conscience and orders and involves an Army intelligence officer in Haiti during the American intervention in September of 1994. He was aware of grave human right abuses occurring in Haiti's prisons, but was forbidden by his chain of command from inspecting them for fear of souring relations with the remnants of the Cedras regime.

The second case examines the bureaucratic workings of a cover-up and traces the measures taken after Henry Kissinger was discovered to have initiated the secret bombing of Cambodia.

The third will examine the exchanges of messages between the commander of United Nations forces in Rwanda in 1994 and the director of the UN Peacekeeping Program in New York. The case, which has yet to be written, will aim to expose the reasons why there was essentially no response from the United Nations to the killing of a half million Rwandans.

Independent Research

Foreign Policy Belief Structures in the U.S.: Comparisons of Elite and Attentive and Non-attentive Publics

Researcher: Associate Professor Eloise Malone

I continue to work with two State Department colleagues analyzing elite and non elite opinion and foreign policy belief structures. Our research based on findings from confirmatory factor analysis (structured equation modeling) will be presented at a 1999 APSA panel my colleagues and I organized. To conduct this research I have learned a new software package (LISREL) along with continuing my use of advanced statistical techniques using SPSS.

The Politics of 'Eco-tourism' in Southern Africa

Researcher: Professor Helen E. Purkitt

This paper uses a comparative case study approach to illustrate how and why on-going efforts to promote "eco-tourism" among countries in Southern Africa may lead to future conflicts. The cases examined include: the decision to lift the ban on ivory exports taken at the CITIES conference in Harare, Zimbabwe in 1997; the Dolphin deal negotiated by the Mpumalanga Parks Board of South Africa during 1996/7; and ongoing efforts to develop transnational "peace parks" throughout Southern Africa. These case studies illustrate the trade-offs that representatives of local communities, national governments, and regional associations throughout the developing world will increasingly confront as they try to promote "eco-tourism", sustainable development, and the preservation of their environments. These studies also support the thesis that eco-tourism issues may an important of source conflicts in the world system in future decades.

An Experimental Study of Cognitive Processes and Information in Political Problem Solving: A Replication

Researcher: Professor Helen E. Purkitt

This experimental study is replication of a budget experiment completed in the early 1980's. The budget problem for this replication mirrors real world fiscal surplus conditions currently being enjoyed by the U.S. federal government while the original experiments mirrored the real world budget deficits of the early 1980's in the U.S. These eventual framings of the same basic political resource allocation problem offers an interesting opportunity to study how framing effects influence political decision-making choice processes. The researcher design and scenario materials for this replication will be presented at the 22nd annual meeting of International Society for Political Psychology in Amsterdam, the Netherlands, July 18-21, 1999.

Experimental data for the study will be collected and analyzed during AY 1999/00 and an article-length manuscript will be circulated for possible publication in a peer review journal by the end of summer, 2000.

Determinants of Political Coups in Sub-Saharan Africa in the 1990's

Researcher: Professor Helen E. Purkitt

This project examines whether earlier models designed to predict coups in sub-Saharan Africa retained their predictive capability throughout the 1990's when most countries experienced dramatic political and economic changes. To address this question I have compiled an updated coup events data for the 1990's and am currently updating economic, social, and environmental statistical data for a regression-based analysis period. My initial hypothesis is that declines in external structural economic variables will continue to be the most potent class of predictors despite the fact that the 1990's was called the decade of transition to democracy in Africa. The regression models developed in this analysis will be presented at a professional conference and used for classroom demonstrations of how regression models are used in political analysis in FP220 – Political Science Methods and FP365 - African Politics.

Lessons Learned? : Comparing Vocational Treatment in Military and Civilian Prisons

Researcher: Assistant Professor Priscilla H. M. Zotti

This conference paper compares the use of vocational treatment as a method of rehabilitation in military and civilian prisons in the United States. The article focuses on the success military prisons have had with relevant and widespread vocational education as compared to the limited use such programs have in civilian prisons. Particulars of these programs are revealed in analyzing the use and success of them at the United States Disciplinary Barracks, Fort Leavenworth and USP Leavenworth.

This paper will be presented at the Southwestern Political Science Association Conference in March 1998. It is currently under review with *Corrections Today*.

Injustice for All: The Tale of Dollree Mapp, the Police, and Arrest and Search and Seizure

Researcher: Assistant Professor Pricilla H. M. Zotti

This project encompasses years of interest in the Fourth Amendment. The aim of this book is to explain the changes in the criminal justice system, in policing, and even to the particular litigants through the lens of the famous U.S. Supreme Court case of Mapp v. Ohio. I have written four chapters of the book and am at work on chapter five. I anticipate this project to take several more years.

Research Course Projects and Trident Scholar Projects

Peace Dividents in the Middle East: A Comparative Study of Israel, Egypt, Syria, and Jordan

Researcher: Midn 1/C Dan Bleicher, USN
Faculty Advisor: Professor Barbara Harff

Bleicher tests various hypotheses about the nature of relations between Egypt/Jordan and Israel-the only countries that normalized relations with Israel. He compares the effects with Syria-a country still officially at war with Israel.

The Validity of Ethnic Motivators Behind Devolution

Researcher: Midn 1/C Bryan M. Everitt, USN
Faculty Advisor: Professor Gale A. Mattox

This honors project addressed the current attempts at devolution by the Scottish people and examined the motivating factors behind the movement to seek devolution. The paper posits that the current devolution movement is, to most Scots, the beginning of a move towards complete independence. The Scots base these aspirations on their unique culture and ethnicity.

Midshipman Everitt concludes that the cultural differences between Scotland and England are many and varied, springing both from their separate historical experiences before the union of the two nations and from the different path of development Scotland has taken within the United Kingdom. These differences are apparent enough to justify the Scots push for devolution and potentially even independence.

The European Arms Industry Consolidation and its Effect on the Interoperability Gap

Researcher: Midn 1/C Jeffrey McNichols, USN
Faculty Advisor: Associate Professor Stephen Wrage with Dr. David Gompert

"The paper seeks to examine the relationship between the American 'Revolution and Military Affairs,' the United States' European allies, and the globalizing defense industries on both sides of the Atlantic, and recommend changes in governmental and industrial policy." [From Mr. McNichols' first draft, page one.]

Consumer Privacy on the Internet: Self-Regulation or Government Intervention

Researcher: Midn 1/C Stephanie Hartin, USN
Faculty Advisor: Associate Professor Priscilla H. M. Zotti

Midshipman Hartin's Honors Project illustrates the significance and magnitude of consumer privacy on the Internet and the most appropriate means to resolve this growing problem. Hartin proposes to solve the problem of consumer privacy on the Internet by recounting how law and governmental regulation have dealt with past technological innovations and gleaning the most effective tools used in the past. Furthermore, she advocates a new method of protecting consumers' rights through a synthesis of certain aspects of self-regulation and government intervention.

Publications

COCHRAN, Charles L., Professor, and Eloise F. MALONE, Associate Professor, Public Policy: Choices and Perspectives, Second Edition, New York: McGraw-Hill, 1999. (ISBN 0-07-290896-3)

This text consists of about 75 percent new material for the second edition of a unique text on the political economy of public policy.

CURTIS, Willie, Associate Professor, Book Review of Dr. John Hillen, Blue Helmets: The Strategy of UN Military Operations, in Marine Corps Gazette.

In Blue Helmets: The Strategy of UN Military Operations, Dr. John Hillen provides us with an excellent analysis of the structural, political, and ideological reasons why the UN is unsuitable for the complex task of managing large military operations. He also provides an excellent historical record of the evolution of UN peacekeeping operations. One of the major contributions of Blue Helmets: The Strategy of UN Military Operations is the examination of the major dilemma for planners and analysts of early post-Cold War peacekeeping operations was the difficulty of defining peacekeeping in the new threat environment of intra-state conflicts.

CURTIS, Willie, Associate Professor, Book Review of Philip B. Heymann, Terrorism and America: A Commonsense Strategy for a Democratic Society, in "The American Bar Association, National Security Law Report."

As the fear of mass destruction terrorism spreads, government policymakers are devoting more attention to developing strategies for coping with the threat of terrorism in America. Philip B. Heymann's book Terrorism and America: A Commonsense Strategy for a Democratic Society presents just such a strategy with its "simple message that we can and must deal intelligently and dispassionately with a resurgent phenomenon that is designed to replace reason with fear and anger." Professor Heymann offers American policymakers a common sense strategy that will effectively counter the terrorists threats without placing at risk the democratic principles and individual liberties so essential to our democracy. He makes it clear that terrorism is a political act, calculated to achieve a political objective and that "reason is essential to dealing with a tactic that, in most cases, only appears to be senseless." While Professor Heymann provides an excellent analysis of international terrorism, this author found the chapters on the risk and possibilities of domestic terrorism of special concern. The United States has not experienced domestic terrorism on the levels of some

European countries and may lack the experience to adjust to the demands on their liberties on the scale of the Europeans.

CURTIS, Willie, Associate Professor, Book Review of Robert K. Brigham, Guerrilla Diplomacy: The NLF's Foreign Relations and the Vietnam War, will be published in The Journal of Politics.

Robert K. Brigham's book Guerrilla Diplomacy: The NLF's Foreign Relations and the Vietnam War is an excellent study of the role and impact of the diplomatic arm of the National Liberation Front (NLF). While the role of the NLF in the war in Vietnam is still debated, Brigham has made a major contribution to understanding the successful role of the diplomatic arm of the NLF by an extensive archival search and interviews with former Communist cadre and high ranking Party officials. He assesses the diplomatic strategy of the NLF and the manipulation of the NLF diplomats by the Lao Dong, Vietnam's Communist Party. The diplomatic arm of the NLF enhanced the Party's ability to mobilize support in the South and the Fronts able diplomats played a major role in obtaining support among other nations for the Communist's cause. Brigham concludes that "Some postwar histories issued in Hanoi have downplayed the NLF's role in the Lao Dong victory, but we have seen that the Front's diplomatic accomplishments were crucial to the revolution's success."

FRANTZICH, Stephen, Professor, Citizen Democracy: Political Activists in a Cynical Age, Rowan and Little Field Publishers (forthcoming, summer, 1999).

Analytical profiles of 24 citizen-activists who affected national public policy through involving themselves in the political process. The book is designed to reveal the variety of strategies citizens can use to mold the decisions of appointed and/or elected officials to their will.

FRANTZICH, Stephen, Professor, The C-SPAN Revolution (with John Sullivan), The University of Oklahoma Press, 1999 (paperback).

The definitive study of the history, operations, and impact of the Cable-Satellite Public Affairs Network as it enters its third decade of covering the political process in-depth.

FRANTZICH, Stephen E., Professor, "C-SPAN: A Window on the Political Process," chapter in David Schultz, (ed) It's Show Time: Media Politics and Popular Culture, Peter Lang Publishers (forthcoming, summer, 1999).

An analysis of C-SPAN in a forthcoming text on the new media environment.

FRANTZICH, Stephen E., Professor, "Teaching Through Tocqueville," featured article in a special issue of PS (Political Science) focusing on Alexis de Tocqueville, June 1999.

A detailed discussion of Tocqueville as a social scientist whose methods and approaches have a great deal to say to students desiring to do systematic social science research.

HARFF, Barbara, Professor, The State Failure Task Force Report: Phase II Findings (with Daniel C. Esty, Jack Goldstone, T.R. Gurr, Marc Levy, Geoffrey D. Dabelko, Pamela T. Surko, and Alan N. Unger), McLean, VA: Science Applications International Corporation, July 31, 1998, page 124.

This report is the second that comprehensively details findings from the State Failure Task Force, a group formed in response to a request from senior policymakers to identify factors associated with serious internal crises.

HARFF, Barbara, Professor, "Systematic Early Warning of Humanitarian Emergencies" (with T.R. Gurr), Journal of Peace Research, Volume 35, Number 5 (1998), pages 551-579.

More than 60 communal minorities were victimized as a result of internal wars and state failures between

1980 and 1996. Two theoretical models provide the basis for systematic early warning of future victimization of communal and political groups. Monitoring of accelerators and de-accelerators in potential crisis situations provides a link between risk assessments based on structural models and early warnings of use to international and national policymakers.

HARFF, Barbara, Professor, "Preconditions of Genocide and Politicide 1956-1996" (with T.R. Gurr and Alan N. Unger) report prepared for the State Failure Task Force, Nov, 1998.

A statistical analysis of the structural preconditions of 36 episodes of genocide and politicide that was presented to the National Security Council. Genocides are most likely after prior state failure, in autocratic regimes whose leaders are ethnically nonrepresentative and adherence of exclusionary regimes, in societies with low trade openness. These factors in combination led to correct post-diction of 70 percent of the 36 historical cases.

HARFF, Barbara, Professor, "A German-Born Genocide Scholar," chapter accepted for publication in Samuel Totten and Steve Jacobs (eds.), Pioneers of Genocide Studies: Confronting Mass Death in the Century of Genocide (Westport, CN: Greenwood Publishers prob. pub 1. date 2000).

MALONE, Eloise F., Associate Professor, Readings in Government and Ethics. 3rd edition (New York: American Heritage Custom Publishing, January 1998).

MATTOX, Gale A., Professor, Geoffrey Oliver and Jonathan Tucker, eds. Germany in Transition: A Unified Nation's Search for Identity, Westview Press. Boulder, 1999.

MATTOX, Gale A., Professor, "European Security Architecture: An American View," Chapter 6, Ukraine and European Security by David Albright, Macmillan Press, London, 1999.

MATTOX, Gale A., Professor, NATO Enlargement: A Step in the Process of Alliance Reform in the Post-Cold War, Working Paper 5.71, University of California, Berkeley. October 1998.

PURKITT, Helen E., Professor, and Gale MATTOX, Professor, "Bridging Gaps: Reflections of Two First Civilian Professors at the United States Naval Academy," pages 152-63 in Francine D. Amico and Laurie Weinstein (Eds.), Gender Camouflage: Women and the U.S. Military, New York: New York University Press.

PURKITT, Helen E., Professor (1999) editor, Annual Editions: World Politics 99/00. Dashiki/McGraw-Hill. This collection of readings from a variety of popular and scholarly sources introduces interested individuals to the study of International Relations. The volume, which is often used as a supplement set of contemporary readings for college courses in world politics, is organized into ten units covering key issues and topics related to future world trends, international political economy, weapons of mass destruction, politics in North America, Latin America, Europe, the former Soviet Union, Asia, Middle East and Africa, and the United Nations and emerging global issues.

PURKITT, Helen E., Professor (1998), "The Cognitive Basis of Foreign Policy Expertise: Evidence from Intuitive Analyses of Political Novices and 'Experts' in South Africa," in D. Sylvan and J. Voss (eds) Problem Representation and Political Decision Making. Cambridge, U.K., Cambridge University Press.

This study examines the nature of political expertise by analyzing how a highly varied sample of South African political experts predicted future trends during a period of maximum political uncertainty. Protocol data for this study was collected in 1993 during a period when transition negotiations hadbroken down and there was a campaign of rolling protest and violent incidents throughout the country. These protocol data were summarized in free-hand casual diagrams that are able to control for variations in the "verbosity" of an individual period. The summary diagrams of these

"think aloud" protocols providing one approach for studying the cognitive basis of political expertise and for systematically identifying similarities and differences in the cognitive representations of political experts from different socio-economic and ethnic backgrounds. The major finding of this study was that South African political "experts," similar to other intuitive expert and novice political decision-makers, developed relatively simple problem representations of the current and future political status quo.

WRAGE, Stephen D., Associate Professor, "Examining the 'Authoritarian Advantage' in Southeast Asian Development in the Wake of Asian Economic Failures." Studies in Conflict and Terrorism 22, Number 1 (1999): 21-32 (article in referred journal).

ZOTTI, Priscilla, Associate Professor, contributor and consultant to the final report, Judicial Retention Evaluation Programs in Four States. American Judicature Society, Chicago, IL, and State Justice Institute, 1998.

I was part of a group of researchers, both within the American Judicature Society and outside consultants who assisted with this study. The study takes a comprehensive look at the role of judicial performance evaluations in the selection of judges and how judicial performance evaluations are perceived by both judges and voters. The study includes an exhaustive literature review, an analysis of the states which use judicial performance evaluations and the legislation of states that are considering using them. Judicial performance evaluations are on of the most significant new developments in judicial administration. The increased concern about judicial independence and judicial competence make this study both timely and significant. My role involved a scholarly review of the literature and assisting in the construction of the survey.

Presentations

COCHRAN, Charles L., Professor, and Malone, Eloise F., Associate Professor, "Promoting International Perspectives in the Military," prepared for delivery at the 4th Annual International Studies Association Convention, Washington, D.C., Feb 16-20, 1999.

CURTIS, Willie, Associate Professor, "An American Perspective on Peacekeeping," presented to the peacekeeping Management, Command and Staff Course (PMCSC) Serial 9802 at the Lester B. Pearson Canadian International Peacekeping rianing Centre, Nova Scotia, Canada, Oct 6, 1998.

FRANTZICH, Stephen E., Professor, C-Span seminar for professors, presenter, Aug, 1998 and Jan, 1999.

FRANTZICH, Stephen E., Professor, "Congress and the Internet," American Political Science Association (round table discussant), Boston, MA, Sept 1, 1998.

FRANTZICH, Stephen E., Professor, "Alice in CD-ROM Land," Keynote speaker, faculty development seminar at Villanova University, Sept 23, 1998.

FRANTZICH, Stephen E., Professor, "Congress and the New Media," guest lecture at Brigham Young University graduate school, Jan 19, 1999.

FRANTZICH, Stephen E., Professor, "Citizen Activism in a Cynical Age," guest lecture at Brigham Young University, Jan 19, 1999.

FRANTZICH, Stephen E., Professor, "Televising Congress: The Voyage to Public Understanding," Woodrow Wilson Center invited paper, Washington, D.C., Mar 19, 1999.

FRANTZICH, Stephen E., Professor, "Teaching Tech-Savvy Students in a Cynical World," Keynote speaker at the first virtual conference on teaching political science (a Web-based text and video conference), Cyberspace, Apr 29, 1999.

FRANTZICH, Stephen E., Professor, Teacher Spotlight, featured teacher on the C-Span in the Classroom Web site, Jan-Mar (with a video and textual presentation).

FRANTZICH, Stephen E., Professor, "A Citizen's Guide to Cyber-Democracy," invited lecture, Maryland Humanities Council Millennium Speaker's Bureau, Baltimore, MD, Apr 21, 1999.

HARFF, Barbara, Professor, Task Force Planning meetings, State Failure Project, Aug 13-14, Sept 22, Nov 12, Jan 26, 1999; Genocide Project meeting, McLean, VA, Feb 25, 1999.

HARFF, Barbara, Professor, Discussant, Conference on Identity and Foreign Policy in the Middle East, University of Maryland, June 11, 1998.

HARFF, Barbara, Professor, presenter, panel on genocide after 1945, Conference on "Ever Again? Evaluating the United Nations Genocide Convention on its 50th Anniversary," Institute for the Study of Genocide, New York City, Dec 2-3, 1998.

HARFF, Barbara, Professor, presenter, "Anticipating Genocides and Political Mass Murder," to USNA faculty by invitation of Prof. Nancy Sherman, Ethics Chair, Feb 2, 1999.

HARFF, Barbara, Professor, invited participant, Special Workshop on Early Warning in Practice: The Case of Tajikistan, Uzbekistan, and Kyrgystan, International Studies Association annual meetings, Washington D.C., Feb 16, 1999.

HARFF, Barbara, Professor, presenter, Genocide Asociation bi-annual meeting, "Disposing Structures and Accelerating Factors of Genocide," Madison, WI, June, 1999.

MALONE, Eloise F., Associate Professor, with Alvin Richman and David Nolle, "Foreign Policy Belief Structures in the U.S.: Comparisons of American Elites and Attentive and Non-Attentive Publics," 94th Annual American Political Science Association Meeting, Boston, MA, Sept 3-6, 1998 (paper nominated for best paper award for APSA section on Domestic Sources of Foreign Policy).

MALONE, Eloise F., Associate Professor, and Charles L. COCHRAN, Professor, "Promoting International Perspectives in the Military," prepared for delivery at the 40th Annual International Studies Association Convention, Washington, D.C., Feb 16-20, 1999.

MALONE, Eloise F., Associate Professor, Provincial Foreign Policy Perspectives: Implications for Canadian Federalism," prepared for delivery at the 11th Biennial Conference of the American Council for Quebec Studies, Charleston, SC, Nov 19-22, 1998.

MATTOX, Gale A., Professor, "The Russians and Kosovo," Chair, Women in International Security and Carnegie Endowment for International Peace, Washington, D.C., May 11, 1999.

MATTOX, Gale A., Professor, "European Security Issues," Conference on German-American Relations, sponsored by American Council on Germany, New Orleans, LA, May 1, 1999.

MATTOX, Gale A., Professor, "Is NATO a Global Actor?" presenter, Conference on Polish-German-American-Ukrainian Security, Warsaw, Poland, Dec 4-6, 1998.

MATTOX, Gale A., Professor, "International Security: Multi-dimensional Approach," International Conference, Sofia, Bulgaria, Oct 16-20, 1998.

MATTOX, Gale A., Professor, "Should the Anit-Ballistic Missile Treaty e Renegotiated?" moderator, Council on Foreign Relations, Washington, D.C., Oct 22, 1998.

PURKITT, Helen E., Professor, "How People Think About Environmental Problems and Political Conflicts in the United States and Southern Africa," paper presented at the 21st Annual ISPP Conference, Montreal, Canada, July 12-15, 1998.

PURKITT, Helen E., Professor, invited participant, U.S. Air Force Academy INSS-sponsored one-day conference to draft research topics for FY 1998/99 Environmental Security Program, May, 1999,

PURKITT, Helen E., Professor, invited participant, Environmental Security session at World Bank, sponsored by UN University, Washington, D.C., May 10, 1998.

PURKITT, Helen E., Professor, U.S. Institute of Peace's Conference on Managing Information Chaos, Washington, D.C., Mar 12, 1999.

RACHWALD, Arthur R., Professor, "The NATO Enlargement Debate: A View from Central Europe," presentation for a roundtable discussion at the 30th National Association for the Advancement of Slavic Studies, Boca Raton, FL, Sept 24-27, 1998.

WRAGE, Stephen D, Associate Professor, "Captain Rockwood's Orders," presentation on panel, "Teaching Cases in Foreign Policy Analysis," annual convention of the International Studies Association, Washington, D.C., Feb 19, 1999.

WRAGE, Stephen D., Associate Professor, "American Foreign Policy Making," Series of four lectures at Johns Hopkins University's School of Advanced International Studies, June 1998 and again in June 1999.

WRAGE, Stephen D., Associate Professor, invited participant, International Studies Association, Washington, D.C., 1998.

ZOTTI, Priscilla, Assistant Professor, panel chair, "Making and Implementing Policy Through the Courts," Southwestern Political Science Association Conference, San Antonio, TX, Mar, 1999.

ZOTTI, Priscilla, Assistant Professor, discussant, "Exploring Issues of Equality and Rights-based Justice," Southwestern Political Science Association Conference, San Antonio, TX, Mar, 1999.

Division of Mathematics and Science

CAPT William C. Ostendorff, USN
Director

DEPARTMENT OF

Chemistry

Professor Boyd A. Waite
Chair

This past year was very successful in terms of external recognition of research accomplishments within the Chemistry Department. Assistant Professor Judy Hartman was recognized in her collaborative work at the Naval Research Laboratory with the Alan Berman Award for NRL's outstanding research publication for 1998. Associate Professor Mark L. Campbell continued receiving funding through the prestigious Henry Dreyfus Teacher/Scholar Award (one of five nation-wide), providing funding for his own research and for the Department. Associate Professor Judith Harrison furthered her international reputation in the field of tribology, and has again supported a post-doctoral associate within the Department. Assistant Professor Dan O'Sullivan also received funding to support a post-doctoral associate for his oceanographic chemistry studies. Professor Cheek and Associate Professor Heuer were awarded the Kinnear Fellowships at the Naval Academy in support of their research programs.

The Chemistry Department faculty and midshipmen chemistry majors are supported by a diverse array of state-of-the-art instrumentation and computational facilities. Eight different midshipmen participated in directed research courses. Several of the midshipmen attended national scientific meetings and presented results of their work during the year.

The Chemistry Department faculty have continued to pursue collaborative research efforts with Navy laboratories and other government and private institutions. This year faculty collaborated with projects at the Naval Research Laboratory, the National Aeronautics and Space Administration, and the Johns Hopkins University. Faculty members were supported by grants from the Air Force Office of Scientific Research, NASA, the Office of Naval Research, the Petroleum Research Fund, the Eli Lilly Pharmaceutical Company, the United States Army Medical Research of Infectious Diseases (Division of Toxicology), and the Research Corporation.

Other research interests of the faculty include: organic synthesis of species for methanol fuel cells, radio-isotope studies in connection to specialized medical scanning technology, detonation simulations, electrochemical studies of fused salts, development of analytical methods based on electrophoretic techniques, synthesis and characterization of organic and organometallic species, and the effects of chemical agents in atmospheric chemistry, among others. The active involvement of both civilian and military faculty in research provides strength to the curriculum and helps prepare our chemistry graduates for the technical challenges awaiting them in the fleet.

Sponsored Research

Kinetics of Gas Phase Oxidation Reactions of Transition Metal Atoms with Oxygen Containing Oxidants

Researcher: Associate Professor Mark L. Campbell
Sponsor: The Camille and Henry Dreyfus Foundation

The objective of this research is to determine the rate constants for reactions of ground state and low-lying excited state transition metal atoms in the gas phase with oxygen-containing oxidants as a function of temperature and pressure. In particular, three projects are in varying stages of completion: (1) reactions of transition metals with N_2O, (2) reactions of ground state and low-lying excited states of niobium and tantalum with several oxidants, and (3) reactions of zirconium and hafnium with water. By obtaining Arrhenius parameters for these reactions, geometric factors and energy barrier effects will be determined. The experimentally measured rate constants and barriers will be analyzed to determine if a relationship exists between these values and the physical properties of the transition metals and reactants. Results for the reactions with N_2O will be compared to the calculated values from a theoretical model developed by Fontijn and co-workers. The reactions of niobium and tantalum will indicate the importance electronic effects have on the reaction rate. The reactions of zirconium and hafnium with water will yield a better understanding of chemical reactions which may occur during accidents in nuclear reactors. Completion of this research will greatly enhance our understanding of transition metal chemical reactions.

Kinetics of Oxidation Reactions of Group 6 and Group 12 Atoms in the Gas Phase

Researcher: Associate Professor Mark L. Campbell
Sponsor: Research Corporation

This research has been concerned with the fundamental parameters which affect gas-phase transition metal chemistry. At present we have studied the Group 6 metals tungsten and molybdenum and will be studying the Group 12 metals in the near future. Our primary focus has been to determine the influence electron configuration has on the reactivity of the transition metal. Our other objective has been to carry out a thorough study of the reactions of N_2O with transition metals to determine if the resonance interaction model proposed by Fontijn and co-workers predicts accurate energy barriers for these reactions. The primary conclusion we have drawn from our work is that transition metals with s^1d^{n-1} configurations (where n is the number of valence electrons) tend to be much more reactive than transition metals with s^2d^{n-2} configurations. For example, the s^1d^5 Mo atom reacts near the gas kinetic collision rate with O_2 while the s^2d^4 W atom has a temperature dependent rate constant with an activation energy of approximately 13 kJ/mole. An excited state of W with a s^1d^5 configuration was also found to react near the gas kinetic collision rate.

Electrodeposition of Niobium from Low-Valent Salts in a Room-Temperature Molten Salt

Researcher: Professor Graham T. Cheek
Sponsor: Air Force Office of Scientific Research (AFOSR)

Previous attempts at electrodeposition of niobium by reduction of Nb(V) salts in the aluminum chloride : 1-ethyl-3-imidazolium chloride had been found to produce poorly adherent deposits. The presence of higher oxidation states in solution may have oxidized previously deposited material, so that use of lower valence states would be expected to produce more adherent deposits. Niobium(II) oxide was introduced into an acidic melt; however, no electrochemical activity was noted. Addition of aluminum powder to a solution of niobium(V) chloride in an acidic melt caused the disappearance of the first two reduction process for Nb(V), and the formation of a redox process at +0.6 V presumably due to Nb(II) and Nb(III). Reduction at the aluminum deposition potential produced an adherent deposit containing approximately 3 atomic% niobium (remainder aluminum).

Synthesis of Polypeptide Analogs

Researchers: Elizabeth Fowler, Broadneck Senior High School and Associate Professor Debra K. Dillner,
Sponsor: United States Army Medical Research of Infectious Diseases (USAMRIID), Division of Toxinology

A main focus of the Division of Toxinology of the U.S. Army Medical Research of Infectious Diseases (USAMRID) is development of antidotes to botulism toxin. Botulism is a particularly devastating form of food poisoning with great potential for development in biological warfare. The Army is concerned that the botulism microorganism could be easily introduced into the food supply. At this time, there is no effective antidote for botulism poisoning. Current medical treatment involves treatment of symptoms and supportive care until the victim recovers or dies. This recovery period can last from weeks to years with the possibility of long-term neurological effects from the neurotoxin produced by the microorganism.

The botulism toxin's structure is known. It is a two-subunit protein, with both units being necessary for activity but only the A subunit containing the active site. The active site binds proteins in the victim which are normally involved in neuro-transmission. One class of potential antidotes are competitive inhibitors of the botulism toxins. If a compound can be found which binds to the active site of the toxin, presumably the deleterious effects could be reversed or mitigated. It is also known that the natural substrates of the toxin contain a histidine amino acid residue and that this histidine is bound to the active site of the toxin. Various strategies are being pursued to synthesize small polypeptides containing a histidine residue. Once these polypeptides are synthesized, they can be tested for inhibition of the botulism toxin.

Two broad classes of polypeptide analogs were synthesized for this project. In the first class, the normal peptide amide linkage is replaced by a covalent, carbon-nitrogen single bond. This would give a substrate of approximately the correct size and structure for binding which could not be cleaved into small fragments by the toxin. In these analogs, a tripeptide unit with a histidine at the N-terminal was synthesized by investigators at USAMRIID at Fort Detrick. These tripeptides were then synthetically modified at the Naval Academy. The modification involved reaction of the tripeptide, bound to a resin, with an alpha keto-acid. This resulted in formation of an imine link between the free amine group of the

histidine. This imine was reduced *in situ* using sodium cyanoborohydride. Four of these substrates were prepared and tested for inhibition of botulism toxin. The testing for inhibition was carried out by biochemists at USAMRIID. While they found to be inhibitors of the toxin, the level of inhibition was not greater than other substrates previously developed.

The second class of compounds contain phosphorous analogs of polypeptides. The synthesis of these compounds is still being pursued. Replacement of the carboxylic acid moiety of an amino acid with a phosphonic acid has been used for the past fifteen years to develop transition state mimics of enzymatic processes and potent pharamaceuticals. In the structures of interest to us, an amide of a tri-peptide will be replaced with a phosphonamide linkage. These types of compounds are known to have approximately the same spatial requirements as natural substrates but to bind irreversibly to the enzymes.

For this portion of the project, amino acid analogs containing a phosphonic acid group, a variety of side chains and specific protecting groups for the N-terminus nitrogen are being synthesized. Once synthesized these materials can be used in solid-state peptide synthesis at USAMRIID. To date, synthetic methods for introducing the phosphonic acid and the desired nitrogen protecting group have been developed. Completion of the project requires extension of these techniques to a wider variety of amino acid side chains. This strategy has been successful for incorporating simple alkyl side chains but difficulties have been encountered with aromatic side chains.

Molecular Dynamics Simulations of Shock-Induced Chemistry in Hydrocarbons

Researcher: Professor Mark L. Elert
Sponsors: Naval Research Laboratory (NRL) and Naval Academy Research Council (NARC)

The high temperatures and pressures achieved in a shock wave can induce polymerization and other chemical reactions in hydrocarbons. These processes may have cosmological significance, since they are thought to have played a role in the formation of prebiotic complex organic molecules in the early solar system due to impacts of carbon-rich comets and meteors. To study such reactions, a reactive empirical bond order (REBO) potential for hydrocarbons, capable of accurately reproducing hybridization changes, radical formation, and other features of chemically reactive hydrocarbons, was incorporated into a molecular dynamics code designed to simulate shock wave phenomena in condensed phases. Preliminary simulations of shock-induced chemistry in solid acetylene were carried out.

Studies of the Mechanism of Anomalous Low Temperature Crystallization on Laboratory Analogs of Interstellar Grains

Researcher: Associate Professor Robert F. Ferrante
Sponsors: NASA/Goddard Space Flight Center and Kinnear Foundation

Comets and other interstellar objects are believed to have formed by the accretion of silicate dust grains upon which volatile molecules have condensed as ices; the particles may have undergone various types of processing both before and after accretion. Laboratory studies have been used to model such condensation processes, and their results employed in the interpretation of the thermal- and radiation-processing

history of the natural systems. Such models have always assumed the formation of amorphous ice at low temperatures. However, our work over the last few years, utilizing silicate grain analogs as a substrate for simple ices of astrophysical interest (H_2O, CH_3OH, etc.), have indicated that the nature of the dust particle surface may have an effect on the crystallization behavior of the ice coating. The ices are observed to form in the crystalline phase, even during deposition at temperatures near 10 K; in contrast, similar studies performed in the absence of the silicate lead only to amorphous ices on low temperature deposition. If these laboratory studies represent good models for the natural process, then a re-evaluation of the amorphous ice assumption is warranted. The work performed here is designed to explore the mechanism of the observed anomalous low-temperature crystallization (LTC). The goal is to provide a better understanding of the significance of these observations towards interpretation of astrophysical data.

Our evidence suggests that the LTC effect is associated with the degree of oxidation of the silicate grains, and with the surface area and pore size distribution of the material. We are using thermal and chemical treatments to vary the surface properties. Silicate "smoke" substrates are baked at varied temperatures and durations, in vacuum, hydrogen and oxygen. Some samples are exposed to chemical oxidation by ozone. Samples are also being processed by electron, proton, and argon ion irradiation in an attempt to alter pore characteristics. Treated samples are analyzed for surface area and pore size distribution, and tested for efficacy in the LTC effect by low temperature FTIR spectroscopy of condensed adsorbate ices. Current evidence suggests that the LTC may be an extreme example of the lowering of phase transition temperatures for materials confined to small pores, or result from an anomaly in surface diffusion rates that places the sample below the theoretical "critical flux" for amorphous ice formation. Additional ices, and other model grain models with different (e.g., Fe and Mg silicates) or sharp (silica aerogels; molecular sieves) pore size distributions will also be utilized.

Explorations of Laboratory Models for the Catalytic Formation of Methane by Silicate Interstellar Dust Grains

Researcher: Associate Professor Robert F. Ferrante
Sponsor: NASA/Goddard Space Flight Center

In the molecular cloud from which the solar system condensed, CO was the most abundant carbon-bearing molecule. However, gas-phase reactions converting CO to methane are quite slow, and are thought to be insufficient to account for the large amount of organic material observed. Catalysis by dust grains, especially those bearing transition metal atoms, may offer an alternative route to methane and other organics. The Fischer-Tropsch synthesis of methane grain $3\,H_2 + CO \rightarrow CH_4 + H_2O$ catalyzed by Fe or Ni surfaces, has been considered theoretically, and appears to provide reasonable yields of organics under some appropriate conditions.

Preliminary studies indicate that the conversion of a 2:1 H_2:CO mixture into simple hydrocarbons is quite facile on our silicate smoke grain analogs, which have been doped to 10% (by mass) with iron. Methane, ethane, and ethene all formed in amounts totaling a few percent conversion in a period of only 3 hours, at relatively low temperatures (300°C). The relative amounts differ from that expected, but probably reflect trapping ability and not intrinsic reaction yield. The formation of NH_3 from a H_2/N_2 mix, a process also of great interest, has not yet been observed. Work on these interesting findings is continuing.

Octa(hydroxymethyl)tetraazaporphyrin: A New Water Soluble Tetraazaporphyrin Macrocycle

Researcher: Associate Professor Jeffrey P. Fitzgerald
Sponsor: National Science Foundation (NSF)

Tetraazaporphyrins bearing peripheral functional groups capable of acting as ligands have recently been reported. The classic example of such a complex is Hoffman's nickel(II) *star*- porphyrazine in which eight thiolate groups on the macrocycle periphery bind four tin(IV) ions (in addition to the nickel(II) ion bound in the center of the tetraazaporphyrin ring). Synthetic routes to macrocycles possessing thiols, amines, ethers and alcohols have also been described.

Our interest in these macrocycles stems not from their ability to coordinate additional metal ions but from how these peripheral functional groups might cause the macrocycles to aggregate. Such molecular assemblies may have novel optical and/or magnetic properties. In this work, we hope to synthesize a novel tetraazaporphyrin macrocycle, octa(hydroxymethyl)-tetraazaporphyrin. Our strategy has been to convert 1,4-dihydroxy-2-butyne to a maleonitrile bearing two protected hydroxymethyl groups. Cyclization of this pecursor followed by deprotection will yield octa(hydroxymethyl)-tetraazaporphyrin. We have successfully prepared the protected macrocycle and are presently working on deprotection conditions.

Vanadium Dicyanoperfluorostilbene: A Charge-Transfer Magnet with Tc ~ 180 K

Researcher: Associate Professor Jeffrey P. Fitzgerald
Sponsor: National Science Foundation (NSF)

In 1991, Miller and coworkers reported the reaction of V(benzene)$_2$ and tetracyanoethylene (TCNE) to yield a solid which is magnetic at room temperature. In the intervening years, other metals have been found to react similarly, however no other organic receptor has been reported to replace TCNE. We have synthesized the novel one-electron acceptor, dicyanoperfluorostilbene, and discovered that it reacts with V(CO)6 in THF to give a solid that appears to order ferrimagnetically with Tc ~ 180 K. This second example of magnetic ordering in a molecule-based magnet may provide needed insight into the mechanism of magnetic ordering in these poorly understood systems.

Molecular Dynamics Investigations of the Tribology of Diamond Surfaces

Researchers: Dr. Alan B. Tutien (postdoctoral associate), Dr. Steven J. Stuart (postdoctoral associate) and Associate Professor Judith A. Harrison
Sponsor: The Office of Naval Research (ONR)

Friction and the related phenomenon of wear are two of the more costly problems facing industry today. Understanding and ultimately controlling friction and wear has long been recognized as being central to many areas of technology. For instance, combustion engines break down and cutting tools become dull

usually because of friction induced wear. Despite the obvious importance of friction and the induced wear, much of the atomic-scale dynamics responsible for these phenomena remain elusive. If the atomic-scale origins of friction and wear were understood, this might ultimately lead to the design of materials with specific friction and wear properties.

Molecular dynamics (MD) simulations have been used to investigate the atomic-scale origins of friction and wear in hydrocarbon systems. Previously, the atomic-scale friction that resulted when two diamond (111) surfaces are placed in sliding contact was examined. Using MD simulations has proven useful in examining atomic-scale friction and relating the results to experimental data. For example, tribochemical reactions and their atomic-scale mechanisms were cataloged. These reactions and their products were consistent with inferences drawn from macroscopic friction experiments on diamond.

More recently, we have re-fit the potential energy function needed to carry out these simulations. We have adapted this potential so that, in addition to solid and gas phase hydrocarbons, liquids can also be simulated. This will allow us to examine the break down of liquid lubricants and self-assembled monolayer systems. This new potential energy function has been documented and submitted for publication to the *Journal of Chemical Physics*.

Atomic force microscope measurements show that the friction of alklysilane chains bound to Si surfaces decreases as the length of the alkyl portion of the chain increases. In an effort to elucidate this non-intuitive result, we have begun to examine the friction of hydrocarbon chains, of various lengths, bound to diamond.

Investigation of the Physical Properties of Carbon Nanotubes

Researchers: Dr. Carter T. White (Naval Research Laboratory), Dr. Daniel H.Robertson (IUPUI), Dr. Steven J. Stuart (postdoctoral associate) and Associate Professor Judith A. Harrison
Sponsor: Naval Research Laboratory (NRL)

It has been recently proposed that carbon nanotubes might constitute well-defined tips for scanning probe microscopies (SPM). Multiwalled nanotubes have been shown to perform well as SPM tips when used in tapping mode, due to their desirable combination of stiffness and flexibility. We have been using molecular dynamics simulations to examine the physical properties of hemispherically-capped carbon nanotubes. These simulations provided insight into the utility of these tubes as scanning force microscope tips. Simulations demonstrate that the capped nanotubes, although undergoing complex deformations, have the remarkable ability to recover reversibly when pushed into a hard substrate, such as diamond.

More recently, the lateral and transverse motions of [n,n] single-walled nanotubes have been investigated. These results show that single-walled nanotubes vibrate in both the transverse and the lateral directions. Examination of [10,10] nanotubes of various lengths revealed that the frequency of the vibrations was linear with the square of the nanotube length. The frequency of lateral vibrations of nanotubes with different radii was shown to be linear with radius. These results were presented at the Fall Meeting of the *Materials Research Society* in Boston.

Molecular Dynamics Investigations of the Tribology of Diamond Surfaces and Films

Researchers: Dr. Alan B. Tutien (postdoctoral associate) and Associate Professor Judith A. Harrison
Sponsor: Air Force Office of Scientific Research (AFOSR)

Microelectromechanical systems (MEMS) represent an emerging technology. These systems have generated a great deal of interest because of their potential use as sensors and actuators. The devices are on the order of microns in size and it is possible to fabricate thousands of devices at one time for a cost of a few cents per device. Consequently, any systems with MEMS-based technologies will be lighter, smaller, and be less expensive than systems utilizing non-MEMS-based technologies. Workers at Sandia National Labs predict that these devices will play a significant role in future technologies with a broad range of commercial and military applications. Possible future applications of MEMS-based devices include accelerometers for use in military systems such as stability control, attitude heading reference, and short-time flight navigation. The use of silicon-based MEMS devices in nanosatellites to form an interconnected aerospace surveillance system has been proposed by The Aerospace Corporation. Workers at Hughes Aircraft Company and collaborators have proposed a MEMS-based system to replace current rocket, missile, and space vehicle navigational systems.

Silicon-based MEMS devices suffer from two major problems. First, because these devices are so small, the fabrication process can leave critical components adhered to one another. The phenomenon, call stiction, renders the MEMS device inoperable. Second, the wear rate of silicon is such that MEMS composed of silicon cannot be used in applications were parts are in relative motion for extended periods of time.

To overcome these problems researchers at the University of California have suggested coating the silicon-based MEMS with carbon coatings. Researchers at the Raytheon Corporation have suggested constructing MEMS devices from diamond because it posesses superior friction and wear properties compared to silicon.

We have extensive experience investigating the friction and wear of diamond, which should lend insight into the construction of diamond-based MEMS. In addition, we are currently debugging a molecular dynamics code that will be capable of examining the friction and wear properties of silicon-based MEMS devices coated with carbon films.

Investigations into the Effects of Tripodal Ligands on Transition Metal Environments

Researcher: Assistant Professor J. R. Hartman
Sponsor: Naval Academy Research Council (NARC)

Midn 1/C Gertner and Midn 2/C Wheat each worked with me for one semester this year on this project. Midn Wheat presents his work in a poster at an ACS student research meeting.

Crown and cryptand ligands are useful for binding metal ions because the constrained nature of crown and cryptand ligands allows them to form metal-complexes in which the metal has unusual steric and electronic properties. Unfortunately, crowns and cryptands are difficult to prepare and purify, and hence expensive.

TREN-Podand

Podands ("many-armed" ligands) can act as either constrained ligands that form cryptand-like metal complexes or as unconstrained ligands that form cross-linked polymeric metal complexes. In the proposed research, the chemistry of a novel series of TREN-based tripodal ligands have been synthesized

and are being studied to characterize their method of binding and to determine where they fit in the scale of preorganization that ranges from linear ligands to cryptands.

I am studying the binding properties of TREN-based podand ligands by determining the properties of both free ligands and metal-ligand complexes. During the last year, we have prepared a series of copper, nickel, and manganese complexes of these ligands. We are currently studying the electronic and structural properties of these complexes.

Supramolecular Inclusion of Non-Linear Optical Chromophores by Amylose

Researcher: Associate Professor William B. Heuer
Sponsors: Naval Research Laboratory (NRL) and Naval Academy Research Council (NARC)

In collaboration with researchers at NRL, we have been investigating the chemistry and photophysical properties of inclusion complexes formed by insertion of rod-like, conjugated dyes into the hydrophobic cavity of host amylose, a helical oligosaccharide derived from starch. In an effort to increase the number density of chromophores in supramolecular films derived from such complexes, the synthesis and characterization of several covalently-linked chromophore assemblies has been carried out. Prelimiary studies of the interaction of soluble dimer dyes with low molecular weight (ca. 4500 g/mol) amylose suggest that only partial inclusion of the dyes is achieved, either due to the presence of polar (amide) functionality in the dye linkage OR perhaps due to insufficient length of the the helical host. Possible counterion effects on the inclusion state are also being investigated.

Preparation of C-11 Labeled WAY 100,635: A Radioligand for Positron Emission Tomographic Studies of Serotonin $5HT_{1a}$ Receptor

Researcher: Assistant Professor Christopher M. Kinter
Sponsor: Eli Lilly Pharmaceutical Company

I have been involved in a research project funded by Eli Lilly Pharmaceutical Company involving the synthesis of [C-11] labeled WAY 100,635. This work has been done in collaboration with Dr. John L. Musachio at the Johns Hopkins University Department of Radiology, Division of Nuclear Medicine. WAY 100,635 is a compound that has been developed for study of the serotonin $5\text{-}HT_{1a}$ receptor. This neuroreceptor has been linked to physiological processes such as the regulation of mood, sleep, and sexual disorders. In addition, the $5\text{-}HT_{1a}$ receptor has been linked to psychiatric disorders such as anxiety, depression, and schizophrenia.

Midshipman Online Laboratory System (MOLS): Web-Based Feedback and Reporting and Online Lab Manual

Researchers: Associate Professor Joseph F. Lomax and Associate Professor Debra K. Dillner
Sponsor: United States Naval Academy Curriculum Development Program

A series of CGI/Perl scripts for a chemistry laboratory report have been written, implemented and tested. These scripts assist the students by providing feedback on their data and analysis. Once the students have learned how to correctly perform the analyses, they submit their results to their instructor, who can use the output for evaluation. Student assessment of this series of scripts is overwhelming positive. The student data and analysis and the calculated analysis using student data is available to the Instructor. Finally, the Plebe Chemistry Laboratory Manual has been electronically published and is accessible to the midshipmen on the Web.

Association Reactions of Manganese, Iron, and Ruthenium with Nitric Oxide

Researcher: Assistant Professor Roy E. McClean
Sponsor: Research Corporation

This work, started in academic year 1996 - 1997, is now complete and has been published.

In brief, the association reactions of ground state manganese, iron, and ruthenium with nitric oxide in the gas phase were studied as a function of total pressure and temperature. Manganese, iron, and ruthenium atoms were produced by the laser photodissociation of methylcyclopentadienyl manganese tricarbonyl, ferrocene, and ruthenocene, respectively. Detection of the formed transition metal atoms was by laser-induced fluorescence.

Results indicate adduct formation. Ruthenium was found to be more reactive towards nitric oxide than manganese and iron. This observation is interpreted in terms of the different electron configurations of the transition metal atoms. Ground state manganese and iron have $[Ar]3d^5 4s^2$ and $[Ar]3d^6 4s^2$ configurations, and ruthenium has a $[Kr]4d^7 5s^1$ configuration. The singly occupied s orbital of ruthenium might overlap favorably with the single electron of nitric oxide and form a bond. Since ground state manganese and iron have closed s-subshells, electronic repulsive effects are encountered on the reactive surfaces of Mn and Fe with NO.

RRKM rate calculations were performed on Mn-NO and Fe-NO to determine their binding energies. The molecular parameters needed for these calculations were obtained from published density functional theory results. Agreement between experiment and RRKM theory was found for binding energies of $\approx$20 (MnNO) and $\approx$36 kcal/mol (FeNO).

Depletion Kinetics of Nickel Atoms by Sulfur Dioxide

Researcher: Assistant Professor Roy E. McClean
Sponsor: Research Corporation

This work, started in academic year 1997 - 1998, is now complete and has been published.

The interaction of sulfur dioxide, SO_2, with transition metals is an attractive subject because SO_2 is an air pollutant. In this work, the gas phase depletion kinetics of ground state nickel atoms in the presence of

SO_2 was studied as a function of temperature and total pressure using argon as the bath gas in order to determine the reactivity of nickel towards SO_2. Nickel atoms were produced by the 248 nm photodissociation of nickelocene and were detected by laser-induced fluorescence. The overall reaction rates increased with increasing total pressure and decreased with increasing temperature, an indication of adduct formation between nickel and SO_2. The reaction rates were relatively fast and reaction were found to proceed with little or no barriers. In order to determine the binding energy of the adduct, density functional theory and RRKM calculations were performed. The DFT calculations provided molecular parameters of the adduct. The rate data and DFT results were then used in the RRKM calculations to estimate the binding energy which was found to be 47 kcal/mol.

Depletion Kinetics of Chromium Atoms by Sulfur Dioxide

Researcher: Assistant Professor Roy E. McClean
Sponsor: Research Corporation

This work is part of a project to determine the reactivity of transition metal atoms toward sulfur dioxide in the gas phase. The focus of this part of the project is on the interaction of chromium and sulfur dioxide. This work is currently in progress and should be completed during the 1999 - 2000 academic year. Results obtained thus far indicate that ground state chromium and sulfur dioxide interact at an exceptional rate. Presumably, these rapid rates are due to the open shell nature of ground state chromium and the relatively high electron affinity of sulfur dioxide (compared to other small oxygen-containing molecules).

The Distribution of Hydrogen Peroxide, Methyl Hydroperoxide and Formaldehyde and their Influence on the Tropospheric Chemistry of Ozone in the Southeastern Pacific

Researchers: Assistant Professor Daniel W. O'Sullivan, Co-PI
and Brian G. Heikes, PI (University of Rhode Island)
Sponsor: National Aeronautics and Space Administration (NASA)

During the NASA's Global Tropospheric Chemistry Pacific Exploratory Mission Tropics (PEM Tropics) field program, we measured the distribution and gas phase concentrations of hydrogen peroxide, methylhydroperoxide, and formaldehyde on board the NASA P3-B aircraft during the first year of the contract. During the final year, these data will be coupled to other measurements to examine the dynamics of tropospheric oxidant chemistry in clean tropospheric air. The peroxides are critically linked to the net production of tropospheric ozone through the reactions of peroxyl radicals. Consequently these measurements will be used to enhance our understanding of the net ozone production in the troposphere, and to constrain tropospheric photochemical models. We will also evaluate the role of atmospheric peroxides in the gas phase oxidation of sulfur dioxide in the lower marine troposphere. In addition we will evaluate the role formaldehyde and methylhydroperoxide have in the oxidation of methane in the remote troposphere. The budget page that follows describes the labor, equipment, supplies and travel costs that will be allocated to the US Naval Academy to complete the data analysis and to repair and replace equipment used during the field portion of the work.

Hydrogen Peroxide, Methylhydroperoxide, and Formaldehyde: Their Relationship to Tropospheric Oxidant Chemistry and Transport Over the Equatorial South Pacific

Researchers: Assistant Professor Daniel W. O'Sullivan, Co-PI
and Brian G. Heikes, PI (University of Rhode Island)
Sponsor: National Aeronautics and Space Administration (NASA)

We propose to make measurements of gas-phase hydrogen peroxide, methylhydroperoxide, and formaldehyde on board both the NASA DC-8 and P3-B aircraft as part of the NASA/GTE PEM-Tropics B mission. The target species are directly coupled to tropospheric oxidants as sources of odd-hydrogen and odd-oxygen radicals, as reservoirs of the same, and as conductors in their loss. The net production of ozone or odd-oxygen in the troposphere is largely predicted on the basis of photochemical point model simulations based upon measured concentrations of hydrocarbons, nitric oxide, water, carbon monoxide, ozone, and sunlight and both measured and model diagnosed concentrations of nitrogen dioxide, perhydroxyl, methylperoxyl, and hydroxyl radicals. The species to be measured provide mechanistic insight and chemical constraints to these purely chemical model simulations and provide an additional measure of confidence in their results. Multi-dimensional space-time models suggest that atmospheric motions, the vertical transport and mechanical redistribution of the hydroperoxides, may have a profound effect on odd-O and odd-H chemistry in the upper troposphere. The proposed hydrogen peroxide, methylhydroperoxide, and formaldehyde measurements will add needed information on transport, chemical redistribution, and scavenging by cloud and precipitation systems (meteorological conditions which are expected to have a larger role in the tropospheric chemistry than in PEM-Tropics A). Also, the target species are coupled to the gas-phase and, more significantly, to the heterogeneous chemistry of sulfur dioxide and its oxidation to sulfuric acid.

Impact of Superoxide Redox Cycling on the Chemical and Optical Properties of Chromophoric Dissolved Organic Matter

Researcher: Assistant Professor Daniel W. O'Sullivan
Sponsor: Naval Academy Research Council (NARC)

Interest in reactive oxygen species in the environment has been stimulated by atmospheric chemical problems such as smog formation, stratospheric ozone depletion, and acid rain. Because of the need to understand these chemical problems, atmospheric gas-phase reactions of oxidants and the related primary photochemical processes have been intensely studied. As a result atmospheric photochemistry has become a highly developed subdiscipline. Aquatic photochemistry is less well developed, largely because of the complex chemical composition of most natural waters. Recent studies indicate that photo reactions producing reactive oxygen species (O_2^-, superoxide; $^1O_2$, singlet dioxygen; OH, hydroxyl radical, and RO_2, organic peroxy radicals) can significantly influence the cycling of carbon, oxygen, sulfur, and biologically important trace metals. As in the atmosphere, reactive oxygen species can act to cleanse the aquatic environment of bioactive pollutants or in some cases, convert wastes into more toxic substances. Superoxide has the highest steady state concentration of reactive oxygen species in natural waters, and is the first intermediate in most oxygen mediated oxidations. Recently photo induced redox reaction involving superoxide have been shown to significantly alter chromophoric dissolved organic matters optical properties in surface waters. In spite of

the central role of superoxide in natural water photochemistry, the kinetics and mechanisms of its formation and destruction are poorly understood. This proposal will continue efforts initiated last summer to address this gap in our understanding of superoxide chemistry in natural waters through the development of a luminol-based chemiluminescence method for superoxide in natural waters. The method will have the sensitivity, selectivity, and sampling resolution required to perform detailed kinetic studies at levels of superoxide and chromophoric dissolved organic material in natural waters.

Particle Diffusion Through Hevea and Guayule Rubber Films

Researcher: Assistant Professor Maria J. Schroeder
Sponsor: Office of Naval Research (ONR)

Controversy exists over the effectiveness of natural rubber (Hevea) films as protective barriers to virus-sized particles. The concern centers on the possible transmission of disease-causing agents such as hepatitis and HIV. Viruses can range between 0.1 and 5 microns in diameter. Defects in rubber latex due to poor manufacturing processes or intrinsic flaws inherent to the material can be orders of magnitude larger than viruses. This project investigates the extent to which small particles can pass through ostensibly intact rubber films, examines possible explanations for any permeation, and suggests alternatives for improved barrier performance.

Barrier performance of natural rubber latex films has been investigated by monitoring diffusion of fluorescently-labeled polystyrene microspheres through commercial samples. Preliminary studies indicate permeation of about 10^6 particles of 0.1 micron size and about 10^3 particles of 1.0 micron size particles through a square centimeter of sample within 30 minutes. Rather than intrinsic flaws in the rubber, the latex processing method may cause the poor barrier performance. Latex rubber is formed from discrete particles, which are coated with naturally occurring proteins and surfactants, and dispersed in an aqueous medium. During commercial processing, drying and curing occur almost simultaneously. This can lead to incomplete coalescence resulting in a residual capillary structure and concomitant permeability. To investigate the theory that the processing method leads to defects, permeation studies of melt processed natural rubber films are being conducted. During melt processing, no drying step is required as curing occurs in the melt at elevated temperatures and pressures.

Another alternative is to study the barrier performance of a non-Hevea product, one derived from the guayule shrub. Naturally occurring proteins in guayule are much different than in Hevea, therefore its processing and coalescence properties might produce films of improved barrier quality. Permeation studies on guayule films prepared by latex and melt processing methods are currently being investigated.

Investigations into Electrodeposition Processes in Room–Temperature Molten Salts

Researchers: Dr. John Mitchell (ASEE Post-Doctoral fellow), Maj. Hugh C. De Long (AFOSR), PI,
Associate Professor Paul C. Trulove (USNA), Dr. Patrick Hagans (NRL)
and Professor Graham T. Cheek (USNA)
Sponsor: Air Force Office of Scientific Research (AFOSR)

Aluminum alloys with enhanced resistance to chloride-induced pitting corrosion have been produced using solute elements such as Ti, Cr, Mn, Cu, Zr, Nb, Mo, Ta, and W. These "stainless" aluminum alloys are of interest both for use as bulk deposits and as coatings over existing structural aluminum alloys. Producing improved corrosion resistance in the aluminum alloys often requires solute concentrations (up to 50 atom percent, a/o) that are far in excess of the equilibrium solubility limit (ca. 1 a/o). Consequently, nonequilibrium methods such as sputter deposition, melt spinning, and ion implantation have been employed to prepare these metastable single-phase aluminum alloys. Unfortunately, these techniques are of limited commercial utility because of their high inherent cost and the difficulty associated with their application to large structures. Electrochemical deposition is an alternative method for producing nonequilibrium aluminum alloys that generally does not suffer from the cost and applicability disadvantages of the above methods.

Room-temperature molten salts provide some unique properties which make them ideal for studying the deposition of aluminum and aluminum alloys. Aluminum can be reversibly electrodeposited from acidic melt compositions. The molten salts readily solubilize both ionic and molecular species, they possess a wide electrochemical window, they have high intrinsic conductivities, and they are thermally stable over a very wide temperature range.

We have demonstrated the deposition of Al-Mn, Al-Co, Al-Ni, Al-Nb, and Al-Cr from the molten salts. Characterization of these deposits shows them to be non-equilibrium alloys with solute concentrations up to 80 a/o. Aqueous corrosion studies indicate significant improvement in the chloride pitting potential over unalloyed aluminum.

Investigations of Ionic Liquid-Polymer Gel Electrolytes

Researchers: Dr. Thomas E. Sutto (ASEE Post-Doctoral Fellow),
Associate Professor Paul C. Trulove (USNA), PI, Maj. Hugh C. De Long (AFOSR),
and Professor Graham T. Cheek (USNA), Co-PI
Sponsor: Air Force Office of Scientific Research (AFOSR)

Room-temperature ionic liquids composed of perfluoroanions and 1,3- dialkylimidazolium and 1,2,3-trialkylimidazolium cations possess a number of unique properties that make them ideal electrolytes for compact power sources. In particular, they are nonflammable, nonvolatile, and chemically inert, and they display wide electrochemical windows, high inherent conductivities, and wide thermal operating ranges. Also, unlike room-temperature ionic liquids based on chloroaluminate anions, these perfluoroanion electrolytes are not moisture sensitive.

For manufacturing and design optimization, solid-state electrolytes with high ionic conductivities are preferred to liquid electrolytes. In this research program we are investigating the generation of solid-state electrolytes that incorporate perfluoroanion ionic liquids into a poly(vinylidene fluoride)-hexafluoropropylene copolymer. These free-standing rubbery electrolytes appear to retain much of the desirable properties of the perfluoroanion ionic liquids.

In this project we will be investigating the physical and electrochemical properties of these gel electrolytes using thermal mechanical analysis, differential scanning calorimetry, imbedded microelectrode techniques, AC-impedance, and luminescent probe molecules. In addition this project will evaluate graphite intercalation anodes and cathodes with the ionic liquid-polymer gel electrolytes in solid-state cells employing the dual intercalating molten electrolyte (DIME) concept.

Synthesis of Molecules for Liquid Crystalline Displays

Researcher: Assistant Professor Craig Whitaker
Sponsor: Dr. R. Shashidhar, Naval Research Laboratory (NRL)

The goal of this research is to demonstrate a new alignment process that does not require mechanical rubbing and is suitable for flat panel displays. The new process, which involves a combination of chemisorption and photo polymerization, creates an anisotropic surface that guides the orientation of the liquid crystal molecules. The process is a room temperature process, easy to scale-up for manufacturing, applicable to different types of surfaces and capable of fine-control of the pre-tilt needed for active-matrix display devices. The research is aimed at demonstrating the feasibility of the process for attaining stable and varying pre-tilt angles with out compromising the quality of the alignment and show the applicability of the process for active matrix and passive matrix displays.

The following molecules have been synthesized to achieve pre-tilt angle in the range of 1 - 5° with an accuracy of +/- 0.2^{o}.

Self Assembly of Rodcoil Molecules

Researcher: Assistant Professor Craig Whitaker
Sponsors: Petroleum Research Fund (ACS-PRF) and Naval Academy Research Council (NARC)

The goal of this research project is to design, synthesize and evaluate molecules which self assemble into novel, functional materials. These materials are of interest because of their potential to be used as nonlinear optical films and photorefractive composites. It is a great scientific challenge to learn how to encode in the structure of simple molecules the thermodymanic factors that will lead to their programmed assembly into identical, supramolecular structures. Such structures are not currently accessible by conventional synthetic chemistry. Learning to control the macroscopic self assembly of materials into functional devices is a fascinating prospect for technology.

The creation of a variety of multi-functional materials will begin with the design of molecules which possess the intrinsic ability to spontaneously form regular shaped units when cast from a solution. These compounds can be described as miniaturized triblock polymers. The molecules contain one block of a bulky styrene or carbazole oligomer, a second block of a flexible isoprene oligomer and the third block of a mesogenic (liquid crystalline) unit containing multiple biphenyl or thiophene groups. One could say the triblock molecules have a “rodcoil” architecture since a stiff, rod-like chemical sequence (mesogenic units) is covalently connected to a more flexible diblock segment (styrene and isoprene oligomers). When films

of the triblock molecules are cast from a solvent, they will spontaneously form nearly identical nanometer sized aggregates. Interestingly, the nanostructures should pack into layered polar stacks, resulting in the bulk self assembly of a polar film. The materials can exhibit intriguing properties based on the polar assembly of the films.

Independent Research

Aluminum Reduction in the Acetonitrile/Aluminum Chloride Solvent System

Researcher: Professor Graham T. Cheek

Previous studies have shown that aluminum(III) reduction in the acetonitrile / aluminum chloride solvent system occurs in a very poorly defined process. In the present study, other aluminum salts were also placed in solution, resulting in the appearance of other reduction processes. These salts involved ligands such as 8-hydroxyquinoline, fluoride, and nitrate. It was found that reduction currents were substantially higher in some cases than in the original solvent system; however, only slight evidence of aluminum stripping was ever found.

Preparation of N1'-([F-18]Fluoroethyl)Naltrindole: A Radioligand for Positron Emission Tomographic Studies of Delta Opioid Receptors

Researcher: Assistant Professor Christopher M. Kinter

Previously we have developed N1'-([C-11]methyl)naltrindole as a radioligand for selective localization of the delta opioid receptor by positron emission tomography (PET). In order to monitor the pharmokinetics of radioligand binding to the delta receptor over a longer time interval with improved signal intensity and counting statistics we are also investigating naltrindole analogs that are radiolabeled with fluorine-18. This research has led to the synthesis of N1'-([F-18]Fluoroethyl)Naltrindole, [F-18]FEtNTI, which is currently undergoing evaluation as a radioligand for use in PET. The precursor for radiolabeling was obtained in a four step synthesis from naltrexone hydrochloride in an overall yield of 47%. Nucleophilic displacement of a tosyl leaving group by [F-18] fluoride, followed by hydrogenolysis of a benzyl protecting group gave [F-18]FEtNTI. The average time for radiosynthesis, HPLC purification, and formulation was 77 minutes from end of bombardment. [F-18]FEtNTI was produced in sufficient radiochemical purity and specific activity to permit initial in vivo binding studies which shows specific binding to the delta opioid receptor in vivo. Thus, [F-18] FetNTI warrants further investigation as a radioligand for PET studies of delta opioid receptors.

Synthesis and Characterization of Acidic Pillared Metal(IV) Phosphates

Researcher: Associate Professor Joseph F. Lomax

The project objectives are to synthesize and characterize a series of pillared metal phosphonates whose properties will be rationally adjusted by changes in the pillar length and functional groups attached to the pillar. This will involve three parts. First, organic diphosponates with functional groups will be synthesized. Next, pillared metal diphosphonates will be made by reacting the diphosphonates and phosphoric acid with metal oxychlorides.

Finally, structural, thermal, electronic and chemical properties of these compounds will be measured. Properties to be investigated include: 1) the pillar arrangement that can be deduced from powder and crystal X-ray diffraction and computer molecular modeling, 2) the number and thermal stability of the layer/pillar bonds and the water resident between the pillars investigated by thermal gravimetric analysis interfaced with infrared spectroscopy or gas chromatography, 3) the mechanism and magnitude of ion (in particular proton) conductivity as determined by audio frequency impedance/admittance measurements using state of the art devices; 4) the intercalation and ion exchange behavior of these compounds.

Photochemical Study of Cyano-Isocyanide-Phosphine Complexes of Iron and Ruthenium

Researcher: Professor Joyce E. Shade

The chemistry of carbonyl-cyano-phosphine complexes of iron has been studied extensively for the last ten years. In general, reflux or photolytic reaction conditions have been employed to initiate the loss of a carbonyl (CO) group from cyclopentadienyl-iron-carbonyl starting materials with a subsequent inclusion of a phosphine or phosphite ligand on the metal center. The resulting complexes obtained in these studies, however, all contain at least one carbonyl group. The purpose of this research was to prepare a series of anionic, neutral and cationic cyano, mono- and bisisocyanide complexes for reaction with phosphine or phosphite groups under photolytic conditions.

Photolysis of the monoisocyanide complex, $(ç^5\text{-}C_5H_5)Fe(CO)(CN)(CNCH_3)$, in the presence of a slight excess of triphenylphosphine at room temperature gave the desired product $[(ç^5\text{-}C_5H_5)Fe(CN)(CNCH_3(PPh_3)]$ with loss of one equivalent of carbon monoxide. Two additional products have been obtained, however: $(ç^5\text{-}C_5H_5)Fe(CNCH_3)_2(CN)$ and $(ç^5\text{-}C_5H_5)Fe(CN)(PPh_3)_2$. Similar results were obtained with a variety of phosphine, phosphite, arsine and antimony ligands. Several of the reaction products have been isolated from the fairly clean reaction mixtures and a variety of spectral data have been obtained to verify their identity. Further purification and characterization of these compounds is continuing. In addition, trends of reaction product yields with bulk and basicity of ligand are being studied. Effect of ligand identity (both on the metal prior to photolysis and as an incoming group), wavelength of the photolysis lamp and temperature of the reaction mixture are being studied as they affect the reaction products obtained. Anionic and cationic starting materials are being investigated under a variety of reaction conditions in order to analyze the system for any trend which might develop as a function of complex charge. A collaborative effort was established with Professor Antony Rest at The University in Southampton in an effort to conclusively identify the reaction intermediate(s). The results of this work have been very promising and the identity of the reaction intermediate has been postulated, as a result of low-temperature matrix isolation studies conducted by

Prof. Rest. Work on the project is continuing with a shift in focus to the analogous ruthenium species. Manuscripts on the synthetic portions of the project as well as the spectroscopic matrix work are being prepared and final spectral data is being obtained for inclusion in the papers.

Charge Delocalization in Fluoromethyl Fluorophenols: Model Compounds for Fluorinated Tyrosines

Researchers: Assistant Professor Joseph J. Urban and Maj. Robert L. von Tersch, Ph.D., USA

This work has involved computational investigations of the degree of charge delocalization from a phenol oxygen atom to a fluoromethyl group located in the para position. The effect of ring fluorination on this charge delocalization has also been examined. The motivation for this work is that fluoromethyl phenols represent model compounds for the beta fluorinated derivatives of the amino acid tyrosine. These compounds are substrates for the enzyme tyrosine phenol-lyase (TPL). TPL catalyzes the cleavage of the phenol portion of tyrosine and has been used to stereoselectively synthesize fluorinated derivatives of tyrosine. The beta fluoro tyrosines have a short lifetime under the reaction conditions presumably due to the elimination of fluoride. The lifetime is extended when the ring is also fluorinated. In the current research ab initio calculations have been carried out to examine the effect of ring fluorination and aqueous solvation on the electronic charge distribution in these compounds. The work has been accepted for publication in the *Journal of Organic Chemistry*.

Conformational Analysis of Acetylcholine and Related Compounds

Researcher: Assistant Professor Joseph J. Urban

Acetylcholine is a major neurotransmitter in both the central and peripheral nervous systems. The cholinergic nerve transmission system is of particular importance to the military because this system is the target of the organophosphorous G nerve agents. The mechanism of action of these agents is to block nerve transmission by inhibition of the enzyme acetylcholinesterase, an essential component of the nerve transmission process. Upon binding to its receptor acetylcholine undergoes a conformational change and NMR studies that have been reported in the literature provide a hypothesized "bound conformation" (to the nicotinic acetylcholine receptor). The energy cost associated with this conformational change, however, is not known and is extremely difficult to estimate experimentally. In this work a combination of molecular modeling techniques have been employed to determine the difference in energy between the bound and unbound conformations of acetylcholine. The results indicate that the bound conformation reported in the previous NMR work lies significantly above the ground state in energy. This suggests that further experimental work is needed to establish the bioactive conformation of acetylcholine when bound to its receptor. In addition, this work established the effects of substituents (N-methyls) and the surrounding environment on the conformational preferences of acetylcholine and similar systems.

Computational Analyses of 4-Aminopyridine and its Analogues

Researchers: Maj. Robert L. von Tersch, Ph.D., USA and Assistant Professor Joseph J. Urban

Tetrodotoxin and saxitoxin are potent neurotoxins affecting the transmission of nerve impulses through their disruption of sodium channels. Aminopyridines, such as 4-amino- or 3,4-diamino-, have been shown by a number of researchers to be efficacious in reversing the effects of these toxins if they are administered shortly after toxin exposure. Even though extensive experimental studies have been performed with the aminopyridines, very little computational analyses have been undertaken in an effort to understand the interactions of these materials with the aqueous biological environment in which they exert their effect. To address this point, we have been studying both gas phase and solvation effects on various neutral and protonated analogues of 4-aminopyridine. All calculations have been performed on a Silicon Graphics Indigo II at AM1 or HF 6-311+G(2d,p) level of theory with and without solvent as implemented in the SPARTAN and Gaussian94 software packages. The results of these calculations are considered with a view toward the possible biological fate of these materials.

Computational Analyses of Ethopropazine Hydrochloride and its Interaction With Human Butyrylcholinesterase

Researchers: Maj. Robert L. von Tersch, Ph.D., USA, Assistant Professor Joseph J. Urban
and Dr Ildiko Kovach, Chemistry Department, Catholic University

Ethopropazine hydrochloride is a tricyclic neuroleptic used to treat Parkinsonism through an unknown mechanism. Recently this compound has been shown to be a potent inhibitor of the human butyrylcholinesterase enzyme. Studies analyzing the active site gorge of members of the cholinesterase family suggest that the inhibition that is observed derives from the larger volume found in human butyrylcholinesterase. Molecular dynamics (MD) calculations could help to further explain the interaction of ethopropazine hydrochloride with human butyrylcholinesterase. As a prelude to MD studies, high level ab initio calculations have been conducted to generate suitable force-field parameters for ethopropazine hydrochloride.

Structure Elucidation of Possible Anti-Malarial Compounds from Verbinia sp

Researcher: Maj. Robert L. von Tersch, PhD, USA and Associate Professor Debra K. Dillner
(in collaboration with Walter Reed Army Institute of Research - COL John Scovill, PhD, USA)

This work has focused on elucidating the structure of biologically derived compounds that have shown efficacy against organisms that pose a threat to US forces in various theaters of operation. The materials have previously been extracted from foliage native to Thailand and have been assayed for efficacy against Plasmodium falciparum. Structure determination has involved a number of analytical techniques, most notably high performance liquid chromatography and one- and two-dimensional nuclear magnetic resonance spectroscopy.

Analysis of the Stereoisomers of 3,3-Dimethyl-

butyl-2-ol-methylphosphonofluoridate(Soman) and Related Compounds

Researcher: Maj. Robert L. von Tersch, PhD, USA (in collaboration with the US Army Medical Research Institute of Chemical Defense - Dr David Lenz and Steroids Limited - Dr Robert Moriarty)

The generation of biological scavengers capable of hydrolyzing nerve agents is a major research effort of the chemical defense program of the Army. The scavenger molecules currently under investigation are genetically-engineered proteins such as human butyrylcholinesterase or catalytic antibodies. In either project, it is of considerable importance to ascertain the stereospecificity of the scavenger molecule with respect to the nerve agent whose hydrolysis is being catalyzed. Since we wish to maximize the effectiveness of such scavenger molecules in conferring protection against nerve agent intoxication, knowledge of the absolute configuration of the nerve agent molecules is necessary to determine the amino acids to be subjected to site-directed mutagenesis or the design of the transition state analogues. Since soman possesses two chiral centers, four stereoisomeric analogues have been synthesized. The structures have been verified by X-ray analysis and attached to a succinyl spacer group prior to attachment to proteins for use as immunogens. As a means of assessing the stability of the resulting adducts, ^{31}P nuclear magnetic resonance (NMR) spectroscopy was employed to determine whether the phosphorous chiral center had degraded or had been cleaved from the succinylated protein molecule. These experiments coupled with ^{13}C NMR data correlate the NMR chemical shift with the relative configuration at the soman phosphorous and carbon chiral centers. Similar studies have indicated the phosphorous and carbon chemical shift position of soman analogues of known absolute configuration at phosphorous and carbon. The initial data suggests the following correlations: C(+)P(+) = C(S)P(S), C(-)P(+) = C(R)P(S), C(+)P(-) = C(S)P(R), and C(-)P(-) = C(R)P(R). Molecular modeling using conformational search techniques has begun to address the stereochemical binding environment of the toxic soman stereoisomers. Taken together these experiments can provide a reference relating absolute and relative phosphorous stereochemistry by NMR and will permit this technique to be used as a novel method of rapidly screening the stereospecificity of newly developed biological scavengers.

Research Course Projects and Trident Scholar Projects

Self Assembly of Rodcoil Molecules

Researcher: Midn 2/C Burkholder, USN
Faculty Advisor: Craig Whitaker
Sponsor: Petroleum Research Fund (ACS-PRF)

The purpose of the project is the synthesis and evaluation of how changes in the coil portion of rodcoil molecules effects its self assembling properties. Rodcoil molecules possessing an oligo(styrene-b-isoprene) coil segment with 9 units of styrene and 9 units of isoprene where found to self assembling into mushroom type structures when cast as thin films. We wanted to explore how changes in the coil structure effect the self assembling properties of the system. The initial change examined was the addition of a methyl

group at the para position of the styrene monomer. Mr. Burkholder synthesized the rodcoil molecule (**1**) and evaluated its self assembling properties using a polarizing optical microscope. Rodcoil **1** when examined under cross polars in the optical microscope at temperatures ranging from 25 ºC to 250 ºC showed no birefringence. We believe the steric repulsions of the additional methyl groups to the styrene units prevent the formation of any nanostructures. Work will be continued to study the effects of changing the coil length from (9,9) oligo(p-methylstyrene-b-isoprene) to (9,15) and (15,15) on the self assembling properties of the materials.

Determination of Carbon Monoxide in Hemoglobin using Capillary Isoelectric Focusing

Researcher: Midn 1/C Daniel Williamson, USN
Faculty Advisor: Assistant Professor Christine L. Copper

Capillary Isoelectric Focusing (CIEF) was studied with an ultimate goal of using this technique to determine the amount of carboxyhemoglobin in blood samples. Carboxyhemoglobin is formed when a person is exposed to carbon monoxide gas. The carboxyhemoglobin level in a person's system is often important in the determination of the cause of death in an accident (such as a military plane, helicopter, or vehicle crash). The current separation and detection methods employed for carboxyhemoglobin analysis have some flaws in their reproducibility and accuracy.

CIEF is a separation method that can be used to analyze proteins such as hemoglobin. In this work, a commercial instrument that was designed to perform capillary electrophoresis, a separation technique similar to CIEF, was modified to perform CIEF. Optimal column rinsing procedures, focusing and separation solution combinations, injection, focusing and separation voltages, and sample composition were determined. It was shown that CIEF can be used to analyze hemoglobin samples however separation of hemoglobin from carboxyhemoglobin was not completed in the time frame of this project.

Histone Deacetylase and Methylation Inhibitors: Their Effect on Mitosis in Human Mammary Tumor Cells

Researcher: Midn 1/C Christine Weeks, USN
Faculty Advisor: Assistant Professor Christine L. Copper

This project, a study of the target biological processes of antitumor drugs, had a goal of providing information relevant to the biological mechanism of cell growth inhibition.

DNA methylation and hypoacetylation of core histones have been linked to repression of gene expression. Studies of gene silencing in imprinted mammalian genes have proven this phenomenon to depend on mitotic inheritance of repressed chromatin states. This study, carried out with the MCF-7 human mammary tumor cell line, sought to show that deoxy-azacytidine, a methylation inhibitor, blocked cells in mitosis. It also investigated the interaction between histone deacetylase inhibiting drugs FR-901228 and Trichostatin A and the methylation inhibitor deoxy-azacytidine. Results revealed that the number of cells blocked in mitosis increases with administration of histone deacetylase inhibitor in addition to methylation

inhibitor deoxy-azacytidine. No connection was found between dosage of deoxy-azacytidine and number of mitotic cells, though the overall number of mitotic cells increased with treatment with the methylation inhibitor.

Development and Analysis of a Superoxide-luminol Chemiluminescent System in Aqueous Solutions

Researcher: Midn 1/C Gregory T. Chesnut, USN
Faculty Advisor: Assistant Professor Daniel W. O'Sullivan

A study to develop luminol based chemiluminescence as a means of analyzing superoxide in aqueous solutions is presented. This analysis uses a specially developed continuous-flow apparatus that allows the desirable interaction between superoxide and luminol to be quantitatively recorded. The intensity of the chemiluminescent reaction between luminol and superoxide is measured by a photomultiplier tube. Critical to this study is the preparation of stock superoxide solutions for analysis. Saturated superoxide solutions in DMSO prepared by filtration proved to the most effective preparation method for this study. Due to the high reactivity of the superoxide molecule, laboratory techniques for effective superoxide study were developed. The use of a sodium bicarbonate buffer to keep the reaction pH at 7 proved to be instrumental in the study of superoxide kinetics, as the signal at lower pH's was inconsistent and a lower sensitivity. A standard curve for signal intensity versus superoxide concentration was developed and a study of the reaction kinetics of superoxide decay was initiated.

Rates and Reaction Mechanisms of Iron (II) with Superoxide Using a Flow Injection Apparatus

Researcher: Midn 1/C Cory Durant, USN
Faculty Advisor: Assistant Professor Daniel W. O'Sullivan

This experiment employed the use of a flow injection system for the analysis of iron(II) in aqueous solutions. The purpose for the project was to design and construct a flow injection system to measure the kinetics of the reaction between Fe(II) and superoxide. The method for measuring was rapid and detected Fe(II) concentrations in both the micromolar and nanomolar ranges. The experiment demonstrates how Fe(II) interacts with superoxide intermediates in the presence of luminol reagent. The concentrations of Fe(II) was found to be linearly related to chemiluminescence intensity. Experiments were conducted to optimize the chemiluminescence intensity as a function of reagent flow rates, and reaction pH.

Comparison of Gas and Solid Phase Structures for a series of Aminopyridine Complexes

Researcher: Midn 2/C Robert J. Wheat, USN
Faculty Advisors: Associate Professor Wayne H. Pearson and Assistant Professor J.R. Hartman

We were involved with Mr. Wheat in the the characterization of several multidentate nickel and copper compounds. We guided the X-ray structural work. He was able to solve several structures and report the results at an ACS student affiliate meeting in Blacksburg, VA. Publication is pending.

Permeation of Organic Solvents Through Natural and Synthetic Rubber Films

Researcher: Midn 1/C Brett Sterneckert, USN
Faculty Advisor: Assistant Professor Maria J. Schroeder

Natural and synthetic rubber films are intended as chemical and physical barriers to potentially harmful agents such as viruses, pathogens, and toxic chemicals. Many of these products are typically manufactured from natural rubber latex (*Hevea Brasiliensis*). Natural rubber can be processed into very thin films which allow for high elasticity and tensile strength, yet it remains relatively inexpensive to manufacture. One weakness is that rubber gloves are known to rip and tear, reducing their ability to protect the user against possible contaminants. Defects in natural rubber arising from the manufacturing process or inherently present in the material can also lead to failure. The goals of this project were to investigate permeation of organic solvents through natural and synthetic rubber gloves and examine the applicability of Raman spectroscopy in such studies. Permeation times for benzene, cyclohexane, toluene, p-xylene, m-xylene, and o-xylene through various commercial samples were determined using Raman spectroscopy. However, further refinement of the experimental apparatus and conditions is required. Supporting evidence of permeation was obtained by Scanning Electron Microscopy (SEM) studies of the surface and edge topology of the rubber films. By examining solvent-exposed and unexposed samples, it was determined that natural rubber gloves are more susceptible than synthetic gloves to damage from the organic solvents tested.

Development of the Plebe Chemistry Curriculum: Laboratory Experiments and Demonstrations

Researchers: Midn 1/C Jacqueline McDowell, USN and Midn 1/C Susan Smith, USN
Faculty Advisor: Assistant Professor Maria J. Schroeder

Development of new laboratory experiments intended for the Plebe Chemistry course was the focus of this research project. Experiments related to Navy applications and everyday life were created. Activities with Naval applications included the operation of the CO_2 scrubber on a submarine, the chemistry of scuba diving, and boiler water analysis. The submarine atmosphere and scuba diving activities utilized Naval applications to teach chemistry concepts such as gas laws, chemical reactions, and solubility. The applied

nature of these exercises *(i.e.,* what is the maximum depth a diver can descend with a certain nitrogen/oxygen ratio in his or her tank?) would seem to spark interest in the midshipmen. The boiler water analysis suggested a procedure to include an unknown water sample. In lab, the students would be required to devise a procedure to analyze their water sample for contaminants and report their findings in a clear, technical memorandum. Considerations such as sample size, accuracy, and time would have to be addressed by the students. Experiments related to real-world applications included the analysis of Coke and the synthesis of soaps. Because Coke is a popular beverage among midshipmen, it was selected as a test sample. The relationship of sugar content and acidity to tooth decay would be investigated and explicitly observed by the students. The use of Quattro Pro, the TI-92 calculator, and the Computer Based Laboratory (CBL) units would also provide exposure to other technology in the laboratory. The synthesis of soaps experiment would provide a good introduction to organic chemistry and the process of saponification as well as teaching students about something they use everyday.

Publications

CAMPBELL, Mark L., Associate Professor, "Temperature Dependent Study of the Gas-Phase Kinetics of $Zr(a^3F_2)$ and $Hf(a^3F_2)$," *Journal of the Chemical Society, Faraday Transactions*, 94 (1998), 1687-1693.

The gas phase reactivity of $Zr(a^3F_2)$ and $Hf(a^3F_2)$ with O_2, N_2O, CO_2, NO, H_2O, SO_2 and SF_6 is reported. For $Zr(a^3F_2)$ the bimolecular rate constants (in $molecule^{-1}cm^3s^{-1}$) are described in Arrhenius form by $k(O_2) = (2.6\pm0.5)x10^{-10}exp(-6.2\pm0.7\ kJ\cdot mol^{-1}/RT)$, $k(N_2O) = (1.6\pm0.3)x10^{-10}exp(-3.3\pm0.6\ kJ\cdot mol^{-1}/RT)$, $k(CO_2) = (1.4\pm0.2)x10^{-10}exp(-5.1\pm0.4\ kJ\cdot mol^{-1}/RT)$, $k(NO) = (1.6\pm0.3)x10^{-10}exp(-1.9\pm0.5\ kJ\cdot mol^{-1}/RT)$, $k(SF_6) = (3.4\pm1.3)x10^{-10}exp(-28\pm2\ kJ\cdot mol^{-1}/RT)$ where the uncertainties are ±2ó. The rate constants for Zr reacting with H_2O and SO_2 were temperature insensitive with room temperature rate constants of $9.1x10^{-11}$ and $3.5x10^{-10}$ $molecule^{-1}cm^3s^{-1}$, respectively. For $Hf(a^3F_2)$ the rate constants (in $molecule^{-1}cm^3\ s^{-1}$) are described in Arrhenius form by $k(O_2) = (1.2\pm0.1)x10^{-10}\ exp(-2.8\pm0.3\ kJ\cdot mol^{-1}/RT)$, $k(N_2O) = (1.5\pm0.2)x10^{-10}exp(-11.3\pm0.5\ kJ\cdot mol^{-1}/RT)$, $k(CO_2) = (1.4\pm0.2)x10^{-10}exp(-17.5\pm1.2\ kJ\cdot mol^{-1}/RT)$, $k(H_2O) = (2.1\pm0.3)x10^{-11}exp(-3.4\pm0.6\ kJ\cdot mol^{-1}/RT)$, $k(SF_6) = (7\pm5)x10^{-10}exp(-41\pm3\ kJ\cdot mol^{-1}/RT)$. The rate constants for Hf reacting with NO and SO_2 were temperature insensitive with room temperature rate constants of $1.0x10^{-10}$ and $3.0x10^{-10}$ cm^3s^{-1}, respectively. The disappearance rates for all the reactants are independent of total pressure indicating a bimolecular abstraction mechanism.

CAMPBELL, Mark L., Associate Professor, "Kinetic Study of Gas-Phase $Y(a^2D_{3/2})$ and $La(a^2D_{3/2})$ with O_2, N_2O, CO_2 and NO," *Chemical Physics Letters*, 294 (1998), 339-344.

The second order rate constants of gas-phase $Y(a^2D_{3/2})$ and $La(a^2D_{3/2})$with O_2, N_2O, CO_2 and NO as a function of temperature are reported. In all cases, the reactions are relatively fast. The disappearance rates are independent of total pressure indicating bimolecular abstraction processes. For $Y(a^2D_{3/2})$, the bimolecular rate constants (in $molecule^{-1}cm^3s^{-1}$) are described in Arrhenius form by $k(O_2) = (2.2\pm0.1)x10^{-10}exp(-3.5\pm0.6\ kJ\cdot mol^{-1}/RT)$, $k(N_2O) = (1.9\pm0.2)x10^{-10}exp(-4.0\pm0.8\ kJ\cdot mol^{-1}/RT)$, $k(CO_2) = (1.0\pm0.1)x10^{-10}exp(-2.3\pm0.6\ kJ\cdot mol^{-1}/RT)$, where the uncertainties are ±2ó. The rate constants for Y reacting with NO are temperature insensitive with a value of $1.0x10^{-10}$ $molecule^{-1}cm^3s^{-1}$. For $La(a^2D_{3/2})$, the bimolecular rate constants for all the reactants are near the gas kinetic collision rate.

CAMPBELL, Mark L., Associate Professor, "Rules for Determining the Ground State of a j-j Coupled Atom," *Journal of Chemical Education*, 75 (1998), 1339-1340.

Rules for determining the ground state term and J state for atoms described by jj coupling are presented. The rules are straightforward and give the same ground state values of J determined using Hund's rules for L-S coupling. A table of jj coupled terms with their associated J values is presented. Tables of the ground state term and J state are included for all the neutral atoms and for ions with only one partially filled subshell.

CAMPBELL, Mark L., Associate Professor,"Kinetic Study of the Reaction of Rh($a^4F_{9/2}$) with N_2O, O_2 and NO," *Laser Chemistry*, 17 (1998), 219-237.

The gas phase reactivity of Rh($a^4F_{9/2}$) with N_2O, O_2 and NO is reported. Removal rate constants at 20 Torr for the excited states of rhodium below 13,000 cm^{-1} are also reported. Rhodium atoms were produced by the photodissociation of dicarbonyl(acetylacetenato) rhodium and detected by laser-induced fluorescence. The reaction rate of the ground $a^4F_{9/2}$ state with N_2O is relatively temperature insensitive. The rate constants are described in Arrhenius form by $(1.3\pm0.3)x10^{-12}exp(-1.3\pm0.8\ kJ\cdot mol^{-1}/RT)$ $molecule^{-1}cm^3s^{-1}$ where the uncertanties are ±2ó. The disappearance rates in the presence of N_2O are independent of buffer gas pressure indicating a bimolecular abstraction mechanism. The reaction rates of the $a^4F_{9/2}$ state with O_2 and NO are pressure dependent and decrease with increasing temperature indicating adduct formation. For O_2, the limiting low pressure third-order, k_o, and limiting high-pressure second-order, k_∞, room temperature rate constants in argon buffer are $(6.6\pm0.6)x10^{-30}$ $molecule^{-2}cm^6s^{-1}$ and $(2.1\pm0.2)x10^{-11}$ $molecule^{-1}cm^3s^{-1}$, respectively. For NO, k_o and k_∞ are $(1.3\pm0.2)x10^{-30}$ $molecule^{-2}$ cm^6s^{-1} and $(1.2\pm0.4)x10^{-11}$ $molecule^{-1}cm^3s^{-1}$, respectively. The removal rates of the excited states in N_2O, O_2 and NO are faster than the ground state by a factor of 2 or more.

CAMPBELL, Mark L., Associate Professor, co-author, "Association Reactions of Manganese, Iron, and Ruthenium with Nitric Oxide," *Journal of Physical Chemistry*," 103 (1999), 2659-2663.

The gas phase association reactions of ground-state manganese, iron, and ruthenium atoms with nitric oxide are reported. The transition metal atoms were produced by the 248 nm photodissociation of 2-methylcyclopentadienylmanganese tricarbonyl, ferrocene, and ruthenocene. Detection of these transition metal atoms was by laser-induced fluorescence. Manganese was found to be the least reactive with nitric oxide of the transition metals in this work. The limiting low-pressure third-order rate constant, k_o, of Mn + NO + Ar can be expressed as $(9.5\pm2.5)x10^{-33}$ $exp(-6.3\pm1.7\ kJ\cdot mol^{-1}/RT)$ $molecule^{-2}cm^6s^{-1}$. The k_o for Fe + NO + N2 at 296 K is $(2.3\pm0.5)x10^{-32}$ $molecule^{-2}cm^6s^{-1}$; this reaction is independent of temperature over the range 296-622 K. Ruthenium was found to be the most reactive toward NO. In Ar buffer, $k_o = (7.3\pm1.0)x10^{-30}$ $molecule^{-2}cm^6s^{-1}$ and the limiting high-pressure rate constant $k_\infty = (3.8\pm0.8)x10^{-11}$ $molecule^{-1}cm^3s^{-1}$ for a fixed broadening factor of $F_c = 0.6$. The uncertainties here represent precision. Recent density functional theory calculations on transition metal mononitrosyls were combined with RRKM calculations to estimate the binding energies of the Mn-NO and Fe-NO adducts.

CHEEK, Graham T., Professor, "Electrochemical Studies of Tantalum and Niobium in Chloroaluminate Systems," Proceedings of the Eleventh International Symposium on Molten Salts XI, P.C. Trulove, H.C. De Long, G.R. Stafford, and S. Deki, The Electrochemical Society, Inc., PV 98-11, pp. 205 - 216.

The electrochemical behavior of Nb^{4+} and Nb^{3+} in the aluminum chloride: 1-ethyl-3-methylimidazolium chloride molten salt system has been studied. Although Nb^{3+} is virtually insoluble in the acidic melt, Nb^{4+} is sufficiently soluble to allow study of its voltammetric characteristics. Electrochemical studies of $TaCl_5$ in the aluminum chloride : acetontrile solvent system have also been carried out, and the results shed some light on the

various pathways available to Ta^{5+} reduction.

CHEEK, Graham T., Professor, "Structure of Niobium and Tantalum Complexes in Room-Temperature Molten Salts Using EXAFS," Proceedings of the Eleventh International Symposium on Molten Salts XI, P.C. Trulove, H.C. De Long, G.R. Stafford, and S. Deki, The Electrochemical Society, Inc., PV 98-11, pp. 217 - 226.

Coordination numbers for Ta^{+5} and Nb^{+5} in the aluminum chloride : EMIC molten salt system have been derived from EXAFS data. The values are consistent with known melt properties, decreasing as the melt acidity increases. The coordination numbers are interpreted as corresponding to the number of chloride ligands on the cental metal atom. The proposed structures also explain the potential shift observed as initially basic melts are made acidic.

COPPER, Christine L. Assistant Professor and KOUBEK, Edward, Professor, "Kinetics of the Molybdate and Tungstate Catalyzed Oxidation of Iodide by Hydrogen Peroxide", Inorganica Chimica Acta Vol 288/2 pp 229-232.

Several studies of the Mo(VI) and W(VI) catalyzed reaction of H_2O_2 with various substrates have been documented previously. The experiments described herein attempt to settle some apparent contradictions in these reports. Specifically, the oxidation of I^- with H_2O_2 in the presence of molybdate or tungstate ion in an acid solution was studied. The rate law for this system was found to be $rate_1 = k_{cat}[MoO^2{}_4^-][I^-]+k_{uncat}[H_2O_2][I^-]$ with values of k_{cat}=3.87 M^{-1} s^{-1} and k_{uncat} of 9.5 x 10^{-3} M^{-1} (at 22.8°C). The values of $\Delta H\neq$ for the molybdate catalyzed and uncatalyzed reactions were found to be 39.4 and 56.8 kJ mol^{-1}, respectively. Similarly, the value of k_{cat} was found to be 32.7 M^{-1} s^{-1} and $\Delta H\neq$ was found to be 41.1 kJ mol^{-1} (at 21.8°C) for same system catalyzed with tungstate rather than molybdate.

COPPER, Christine L., Assistant Professor, co-author,"Probing Cyclodextrin-Guest Associations Using Electrospray Mass Spectrometry," Supramolecular Chem., 1998, 9, 263-276.

Mass spectrometric investigation of noncovalent interactions has been made possible with the advent of electrospray ionization technique. Early electrospray studies of these interactions have typically examined biopolymers such as proteins and nucleic acids. Noncovalent interactions also exist between host cyclodextrins and various guest molecules. In this work, we use electrospray mass spectrometry to examine noncovalent host-guest associations between cyclodextrins and several organic molecules with the goal of identifying the types of interactions that predominate in the inclusion complexes formed. The importance of "mild" electrospray conditions and sample preparation procedures are discussed in reference to these studies. Ortho-, meta-, and para-nitrophenol are used as guest molecules with á, â and ã cyclodextrin hosts to study the effects of host size, guest substituent position, and host:guest concentration ratio on complex formation. Relative binding affinities are determined for meta- and para-nitrophenol and agree with other solution phase studies. We also present the first report of complexes between the very hydrophobic polycyclic aromatic hydrocarbon pyrene and â-cyclodextrin as observed under "mild" electrospray conditions.

GOMBA, Frank J., Associate Professor, co-author, "Phosphazenes" in *Synthetic Lubricants and High-Performance Functional Fluids,2nd* Ed, Leslie R. Rudnick and Ronald L. Shubkin, Eds., Marcel Dekker: New York•Basel (1999), 297-311.

Phosphazenes are ring or chain compounds consisting of alternating phosphorus(P) and nitrogen (N) atoms with two substituents attached to the phosphorus. The physical properties of the phosphazenes vary considerably with molecular weight and choice of substituents. Many of the cyclic phosphazenes are either liquids or low melting solids. As the molecular weight is increased by increasing the size of the substituent or number of P-N repeating units, one can obtain oils and greases; ultimately, elastomers and thermoplastics are

formed. Since phosphazenes contain phosphorus and nitrogen, phosphazenes are inherently fire resistant and much interest has been focused upon applications where fire resistance and thermal stability are important properties. When halogen atoms are in the makeup of the substituents, the fire resistance is enhanced. The military has been especially interested in these properties and early work (1960s) was centered around the development of fire-resistant, compression-ignition-resistant hydraulic fluids to meet the requirements of MIL-H-19457A. By 1986 the Ethyl Corporation produced 280 gallons of the Navy's Phosphazeneesterhydraulic fluid: $N_3P_3(OCH_2CF_3)_{3.5}(OC_6H_5)_{1.25}(OC_6H_4m\text{-}CH_3)_{0.87}(OC_6H_4\text{-}p\text{-}CH_3)$0.38.This fluid met the Navy's physical and chemical property specifications. Although the Phosphazene hydraulic fluid showed considerable promise as a replacement for the current MIL-H-19457 fluid, the Navy curtailed the program because of the projected cost ($12/lb, $144/gal). This high cost is due to the limited demand for Phosphazene fluids and the need for expensive starting materials (trifluoroethanol and chlorotrimer).The Navy has made the hydraulic fluid available to other groups for testing purposes. A high temperature lubricant, designated as X-1P by the Dow Chemical Company has been shown to be superior to polyphenylene ether fluids in four ball wear tests. It also improved the friction and wear properties of a commercial pentaerythritol tetraester (PET) fluid. Other cyclophosphazenes are under investigation for use as rotary pump lubricants, transmission oils, hydraulic fluids, electrical insulating media, electroviscous/electrorheological fluids, magnetic recording media, liquid cores for optical waveguides, chemical analysis, and as stabilizers for oils and greases. The chemistry of polyphosphazene fluids is closely related to that of polyphosphazene, and large scale development in one of these areas could be a stimulus for commercial development of all Phosphazene technology.

HARRISON, Judith A., Associate Professor, co-author, "Friction in the Presence of Chemical or Hard Coatings", Mat. Res. Soc. Bull., 23 (1998) 27-31.

An atomic force microscope (AFM) can be used to measure tribological properties on the microscopic scale by measuring forces between the tip and sample that give rise to twisting or torsion of the tip. To obtain meaningful results, one must have knowledge of the tip shape and radius, knowledge of the cantilever force constants, and the specifics of nanometer-scale contact mechanics. Tribological properties also can be studied on the atomic scale using molecular dynamics (MD) simulations. In this work, molecular mechanisms of energy dissipation, the chemical nature of tribological interfaces, and tribochemistry and wear are all examined with both an AFM and MD simulations. These data complement each other and lend insight into the fundamental nature of the tribology that occurs at interfaces.

HARRISON, Judith A., Associate Professor, Handbook of Micro/Nanotribology, ed. B. Bhushan, second edition, Boca Raton: CRC Press, 1999, Chapter 11, "Atomic-Scale Simulations of Tribological and Related Phenomena", pp. 525-594.

Atomistic computer simulations have had a major impact in many areas of chemical, physical, material, and biological sciences. This is largely due to enormous recent increases in computer power, increasingly clever algorithms, and recent developments in modeling interatomic interactions. The last development in particular has made it possible to study a wide range of systems and processes using molecular dynamics simulations. First, the details of molecular dynamics simulations which have contributed to the success of this approach in the study of adhesion, friction, wear, and related areas was reviewed. Second, an overview of the molecular dynamics technique itself was presented. Finally, the recent scientific literature was reviewed and recent results presented. For example, simulations which examine the indentation of metals and non-metals and the machining of metal surfaces were discussed. The simulated properties of liquid films confined to thicknesses on the order of atomic dimensions were also examined. The tribological properties of solid surfaces, such as diamond and self assembled monolayers, were also reviewed.

HARRISON, Judith A., Associate Professor, Tribology Issues and Opportunities in MEMS, ed. B. Bhushan, Dordrecht: Kluwer Academic Publishers, 1998, "The Tribology of Hydrocarbon Surfaces Investigated using Molecular Dynamics", pp. 285-299.

Diamond's potential usefulness as a material for MEMS has renewed interest in the atomic-scale friction and wear properties of diamond. With this in mind, molecular dynamics simulations have been used to examine the tribology of diamond surfaces in contact under a number of experimentally relevant conditions. Friction was examined as a function of applied load, in systems with hydrocarbon chains chemisorbed to one diamond surface, and in systems with molecules trapped between the contacting surfaces. The origin of friction was shown to be directly related to the amount of energy dissipated during sliding. Differences in the friction were correlated to the differences in simulation systems and atomic-scale sliding mechanisms. Conditions that lead to the wear of the diamond surfaces and specific tribochemistry of the trapped molecules were elucidated.

HARTMAN, JudithAnn R., Assistant Professor, co-author, Ion-Molecule Reactions in a Quadrupole Ion Trap as a Probe of the Gas-phase Structure of Metal Complexes. *J. Mass. Spec.*, 1998, 33, 1209-25.

A method is described in which the coordination number in metal complexes can be determined using ion-molecule reactions in a quadrupole ion trap mass spectrometer. Complexes of first-row transition metals in the +2 oxidation state, including manganese through zinc, are isolated and allowed to react in the gas-phase, and the coordination number is ascertained by observing the reagent ligands that successfully react with the complex. It was generally observed that six-coordinate complexes are unreactive, five-coordinate complexes react with pyridine and ethylamine, four-coordinate complexes react with pyridine, ethylamine, and ammonia, and three-coordinate complexes react with all the reagent ligands studied including water and methanol. The order of reactivity for a given complex reacting with the various reagent ligands is found to follow the order of the electron-donating ability of the reagent ligands. In addition, the effect of the metal center on the reactivity of the complexes in the gas-phase is analogous to solution-phase trends, suggesting that electronic structure strongly influences the gas-phase reactions. The results presented here represent initial attempts to use ion-molecule chemistry to study the structures of metal complexes.

HARTMAN, JudithAnn R., Assistant Professor and Jonathan FAGINS, Midn 3/C, Be All That You Can Be?; "Excellence at What Cost?", Editors: G. Lucas, R. Madison, and C. Sompkins-Mullins; Annapolis, MD; 1999 pp. 43 - 51.

We are all familiar with the army's advertising slogan "Be all that you can be." and at first glance it's difficult to see how anyone could argue with the values expressed in this slogan. In this IDS session we will explore the ethical limits to the means that should be used to maximize a persons mental and physical capabilities. Specifically we will explore the ethical issues around using chemical methods (supplements/drugs) to improve on the "natural ability" of people.
The selected texts are from a special report in the *"Navy Times"* that explores the use of supplements by officers and enlisted men in the Navy. These articles summarize the current state of supplement use in the Navy and the known benefits and risks of a variety of supplements.

HEUER, William B., Associate Professor, co-author, "Influence of Hemicyanine Dye Structures on Spectral Properties of their Supramolecular Complexes with Amylose" *Chem. Commun.*, 1998, 2649-2650.

Hemicyanine chromophores bearing long-chain alkyl substituents on the donor and/or acceptor ends have been prepared. Absorption and emission spectra of their supramolecular complexes with amylose have been studied in order to relate them to their supramolecular structures.

HEUER, William B., Associate Professor, co-author,

"Spectral Properties of Hemicyanine Dye in Supramolecular Confinement by Helical Amylose" *Macromol. Symp.*, 1999, 138, pp. 79 - 84.

The Hemicyanine dye structure is modified with a C_{16}-alkyl chain to amino-head and a C_1, C_8 or C_{16} alkyl to pyridinium-tail. Spectral properties of the dyes in supramolecular inclusion complexation with amylose are studied in order to assess the mono-functional polarity sensing activity of the pyridinium cations in DMSO/H_2O mixtures. Inclusion complexation brings the l_{max} of $C_{16}DASPC_1$ to a blue-shift (relative to that of the free-dye state) while those of the $C_{16}DASP(C_8$ and $C_{16})$ dyes remain almost unchanged.

ISLAM, Mohammad Q., Assistant Professor, co-author, "Lithium Complexes and the Kinetics of Interactions of Zinc Ions with Tetra(N-methyl-4-pyridyl)porphyrin in Basic Solution," *Transition Metal Chemistry*, 23 (1998), 727-733.

The acidity of the H_2P(4,3,and 2) porphyrins in base have been explored and found evidence for the dianions $P(X)^{2-}$. This allows calculation of metalloporphyrin formation constants. The dianions also forms mono-lithium adducts. Kinetic studies on the rates of aquo and hydroxy zinc species reacting with various protonated forms of the peripherally tetrapositively charged H_2-P(4) are included. The reactivity patterns are different from those previously noted with octanegative porphyrins such as uroporphyrin-I. The nature of such transition metal ion reactions with porphyrins is discussed.

KOUBEK, Edward, Professor, and COPPER, Christine L. Assistant Professor, "Kinetics of the Molybdate and Tungstate Catalyzed Oxidation of Iodide by Hydrogen Peroxide", Inorganica Chemica Acta Vol 288/2 pp 229-232, 30 May 1999.
Several studies of the Mo(VI) and W(VI) catalyzed reaction of H_2O_2 with various substrates have been documented previously. The experiments described herein attempt to settle some apparent contradictions in these reports. Specifically, the oxidation of I^- with H_2O_2 in the presence of molybdate or tungstate ion in an acid solution was studied. The rate law for this system was found to be $rate_1 = k_{cat}[MoO^{2-}_4][I^-]+k_{uncat}[H_2O_2][I^-]$ with values of k_{cat}=3.87 M^{-1} s^{-1} and k_{uncat} of 9.5 x 10^{-3} M^{-1} (at 22.8°C). The values of $\Delta H\neq$ for the molybdate catalyzed and uncatalyzed reactions were found to be 39.4 and 56.8 kJ mol^{-1}, respectively. Similarly, the value of k_{cat} was found to be 32.7 M^{-1} s^{-1} and $\Delta H\neq$ was found to be 41.1 kJ mol^{-1} (at 21.8°C) for same system catalyzed with tungstate rather than molybdate © 1999 Elsevier Science S.A. All rights reserved.

LOMAX, Joseph F, Associate Professor and DILLNER, Debra K., Associate Professor, "A Series of CGI/Perl Scripts for Web-Based Feedback and Reporting in the General Chemistry Laboratory: Colorimetry", *Chem. Educator*, 1998, 3(6):S 1430-4171(98) 06258-8. Avail. URL: http://journals.springer-ny.com/chedr/.

A series of CGI/Perl scripts for a chemistry laboratory report have been written, implemented and tested. These scripts assist the students by providing feedback on their data and analysis. Once the students have learned how to correctly perform the analyses, they submit their results to their instructor, who can use the output for evaluation. Student assessment of this series of scripts is overwhelming positive. Scripts are included and programming considerations are discussed.

McCLEAN, Roy E., Assistant Professor, "Depletion Kinetics of Nickel Atoms by Sulfur Dioxide," *Journal of Physical Chemistry A*, 103 (1999) 75.

The gas phase depletion kinetics of Ni(a^3F_J, a^3D_J) in the presence of SO_2 are reported. Nickel atoms were produced by the 248 nm photodissociation of nickelocene and were detected by laser-induced fluorescence. The ground term of Ni, a^3F_4, and the two lowest-energy spin-orbit states, a^3D_3 and a^3D_2, were found to react termolecularly (and with identical rate constants) with SO_2, an indication of rapid interconversion between these states. The limiting low-pressure third-order rate constant, measured over the temperature range 296 - 612 K,

can be expressed as $k_o(T) = 7.455 - 24.41 (\log T) + 3.993 (\log T)^2$ cm^6 $molecule^{-2}$ s^{-1}. A binding energy of 47 kcal mol^{-1} was estimated by combining the kinetic results with unimolecular rate theory and density functional methods. The limiting high-pressure second-order rate constant over the temperature range is on the order of the collision rate. The other spin-orbit states of both terms depleted quite rapidly in the presence of SO_2, with rate constants also on the order of the collision rate.

McCLEAN, Roy E., Assistant Professor, co-author, "Association Reactions of Manganese, Iron, and Ruthenium with Nitric Oxide," *Journal of Physical Chemistry A*, 103 (1999) 2659.

The gas phase association reactions of ground state manganese, iron, and ruthenium atoms with nitric oxide are reported. The transition metal atoms were produced by the 248 nm photodissociation of 2-methylcyclopentadienyl manganese tricarbonyl, ferrocene, and ruthenocene. Detection of these transition metal atoms was by laser-induced fluorescence. Manganese was found to be the least reactive with nitric oxide of the transition metals in this work. The limiting low-pressure third-order rate constant, k_o, of Mn + NO + Ar can be expressed as $(9.5 \pm 2.5) \times 10^{-33} \exp[-1.5 \pm 0.4$ kcal mol^{-1}/RT cm^6 $molecule^{-2}$ s^{-1}. k_o for Fe + NO + N_2 at 296 K is $(2.3 \pm 0.5) \times 10^{-32}$ cm^6 $molecule^{-2}$ s^{-1}; this reaction is independent of temperature over the range 296 - 622 K. Ruthenium was found to be the most reactive towards NO. In Ar buffer, $k_o = (7.3 \pm 1.0) \times 10^{-30}$ cm^6 $molecule^{-2}$ s^{-1} and the limiting high-pressure rate constant $k_\infty = (3.8 \pm 0.8) \times 10^{-11}$ cm^3 $molecule^{-1}$ s^{-1} for a fixed broadening factor of $F_c = 0.6$. The uncertainties here represent precision. Recent density functional theory calculations on transition metal mononitrosyls were combined with RRKM calculations to estimate the binding energies of the Mn-NO and Fe-NO adducts.

O'SULLIVAN, Daniel W., Assistant Professor, co-author, "The Carbon Dioxide System in the Arabian Sea," Deep Sea Research, (December, 1998), 45(10/11), 2225-2253.

In 1995 the WHOI (C. Goyet) and MIAMI (F. J. Millero) groups participated on a number of research cruises in the Arabian Sea as part of the Joint Global Ocean Flux Study (JGOFS) sponsored by the National Science Foundation (NSF). This paper gives the results of our total inorganic carbon dioxide (TCO_2), total alkalinity (TA) and potentiometric pH measurements made on Arabian Sea water samples during these cruises. Measurements made on Certified Reference Material (CRM) indicate that the reproducibility of ± 0.007 in pH, ± 3.2 µmol kg^{-1} in TA, and ± 1.5 mol kg^{-1} in TCO_2 (N = 180). The surface measurements (0 to 30 m) of pH and normalized TCO_2 and TA were quite uniform throughout the year (pH = 8.1 ± 0.05, $NTCO_2$ = 1950 ± 20 µmol kg^{-1} and NTA = 2290 ± 5 µmol kg^{-1}). The larger variations in $NTCO_2$ in the surface waters are related to changes due to primary production and the upwelling in the coastal waters. The depth profiles of pH, pCO_2, TA, and TCO_2 were similar to those in the Equatorial Pacific Ocean. The components of the carbonate system (CO_2, HCO_3^-, CO_3^{2-}) and the saturation state (Ù) for calcite and aragonite were determined from the measurements of TA and TCO_2. The waters below 600 m and 3400 m in the Arabian Sea were under-saturated (Ù < 1.0) for aragonite and calcite, respectively.

The CO_2 measurements have been combined with the nutrient data to examine the stoichiometric ratios of C/N, C/P, C/O_2, and C/SiO_2 of the waters. Marked differences were found for the waters above and below the oxygen minimum zone. The surface water results have been used to develop the following stoichiometry for phytoplankton in the Arabian Sea$(CH_2O)_{125}(NH_3)_{14}(H_3PO_4)(SiO_2)_{13}$. The oxidation of this material is due to reactions with O_2 (77%) and NO_3 (23%) with the resultant formation of N_2 and N_2O. The maximum amount of organic carbon oxidized has been estimated to e 3.1µmol kg^{-1} in the deep waters with as much as 0.9 µmol kg^{-1} in the oxygen minimum zone with NO_3.

These results, together with the organic material data collected from the sediment traps, should be useful in characterizing the formation and

degradation of plant material in the Arabian Sea.

O'SULLIVAN, Daniel W., Assistant Professor, co-author, "Temporal variation of the sea surface CO_2/carbonate properties in the Arabian Sea", Marine Chemistry, (December, 1998), 63(1), 69-79.

As part of the U.S. JGOFS program in the Arabian Sea we have measured total CO_2 (TCO_2), and total alkalinity (TA) throughout the water column at selected station locations. In addition we measured the fugacity of CO_2 in surface seawater and in the air above seawater along the cruise tracks. Between 10ºN and 20ºN, these measurements, repeated five times in January, March, July, November, and December 1995, show different temporal variations of the carbonate properties in surface seawater depending upon the different regional hydrological and biological regimes. In order to estimate the relative importance of each process (physics, biology and thermodynamics) on the temporal carbon cycle in these regions, we use a 1-D process model initialized with the data from January 1995 and forced with climatological fields. The outputs of the model applied at three locations (10ºN 65ºE; 14.5ºN 65ºE; and 19ºN 65ºE) in the Arabian Sea are compared with US-JGOFS observations. The forcing terms and the "standard" biological parameters reproduce the CO_2 cycle at 10ºN and 14.5ºN. At 19ºN, the "standard" biological activity has to be reduced by a factor two to approach the observed CO_2 concentrations. The model outputs further point out seasons of minimum and maximum fCO_2 in surface seawater at time periods where no data are available in October and May/June, respectively.

O'SULLIVAN, Daniel W., Assistant Professor, co-author, "Temporal variations of pCO_2 in surface seawater of the Arabian Sea in 1995", Deep-Sea Research, (July, 1998), 45(1), 609-623.

As part of the JGOFS program in the Arabian Sea we continually measured the partial pressure of CO_2 gas in surface seawater (pCO_2^{sea}) and in the atmosphere above the sea surface (pCO_2^{air}) along six similar cruise tracks in January, February, March , July , November, and December of 1995. The observed variations of pCO_2^{sea} reached over 260 µatm close to the Omani coast in January-February and July-August. Off shore the pCO_2^{sea} variations with time were relatively small (< 40 µatm). The pCO_2^{air} shifted by 15 µatm between the northeast and southwest monsoons.

In order to estimate monthly and annual mean of CO_2 flux in the Arabian Sea, we used sea surface temperature and wind speed data, given on a 2.5° x 2.5° resolution, from FNMOC and interpolated the observed pCO_2^{sea} data both in time and space. Close to the Omani coast, the estimated monthly mean CO_2 efflux across the air-sea interface varies from 8.3 to 44 mmol m^{-2} $month^{-1}$ during most of the year and up to 312.8 mmol m^{-2} $month^{-1}$ during the southwest monsoon season (July/August). Overall, the annual mean CO_2 flux from the northern Arabian Sea to the atmosphere is estimated to be 0.46 mol m^{-2} yr^{-1} or 7.0 Tg C yr^{-1}.

O'SULLIVAN, Daniel W., Assistant Professor, "The Distribution of Hydrogen Peroxide and Methylhydroperoxide over the Pacific and South Atlantic Oceans", Journal of Geophysical Research,(March, 1999), 104(D5), 5635-5646.

The gas phase hydrogen peroxide and methylhydroperoxide concentrations were measured in the troposphere over the tropical Pacific Ocean as a component of NASA's Global Tropospheric Experiment/Pacific Exploratory Mission Tropics A field campaign. Flights on two aircraft covered the Pacific from 70°S to 60°N and 110°E to 80°W and south Atlantic from 40 °S to 15°N and 45°W to 70°E, and extending from 76 to 13,000 m altitude. H_2O_2 and CH_3OOH have the highest concentrations at a given altitude at the equator and decrease with increasing latitude in both the Northern and Southern hemisphere. Above 4 km the gradient is substantially reduced for both H_2O_2 and CH_3OOH with latitude, and at altitudes in excess of 8 km there is no latitudinal dependence. H_2O_2 and CH_3OOH exhibit maximum mixing ratios between 1 and 2 km at all latitudes. The mean mixing ratio of H_2O_2 at the equator was 1600 ± 600 parts per trillion by

volume (pptv) decreasing to 500 ± 250 pptv at latitudes greater than 55 degrees North and South between 1 and 2 km altitude. CH_3OOH at the equator was 1400 ± 250 pptv, decreasing to 330 ± 200 pptv at high latitudes at altitudes between 1 to 2 km. The concentration of peroxides at high latitudes in the Northern hemisphere was generally a factor of two higher than at corresponding latitudes in the Southern hemisphere. The ratio of H_2O_2 to CH_3OOH was between 1 to 2 from 45°S to 35°N at altitudes below 4 km. Between 5 to 15°N the ratio is less than one, due to preferential removal of H_2O_2 in the Inter-Tropical Convergence Zone(ITCZ).

SCHROEDER, Maria J., Assistant Professor, co-author, "Normal Mode Relaxation of Polyisoprene in Blends with Vinyl Polybutadienes," *Macromolecules*, 32(6), 2000-2003.

When probe chains are dispersed in a network or higher molecular weight matrix, the expectation from the reptation model is that the terminal relaxation function will narrow, due to suppression of constraint release. Previous experiments found no support for this prediction, although they relied on time-temperature superpositioning to obtain spectra. These studies also made use of polyisoprene (PI)/1,4-polybutadiene blends, whose thermodynamic miscibility is problematic. We report measurements acquired with a broad-band dielectric spectrometer of the terminal relaxation of PI in blends with polybutadiene having substantial 1,2-content. This mixture is thermodynamically miscible, thus excluding the possibility of phase separation. Corroborating earlier work, we find that the experimental behavior is qualitatively opposite to the prediction. Suppression of constraint release broadens the terminal dispersion, increasing the deviation from the theoretical relaxation function. This suggests that the common assumption that reptation and constraint release are independent processes is incorrect.

SCHROEDER, Maria J., Assistant Professor, co-author, "Vapor Deposition Polymerization of 4-Fluorostyrene and Pentafluorostyrene," *Journal of Vacuum Science and Technology - Part B*, 17(1), 90-94.

Solventless deposition of thin, uniform dielectric films is of considerable interest and importance in the microelectronics industry due to environmental concerns and increasing wafer sizes. This work demonstrates a solvent-free method for atmospheric pressure chemical vapor deposition polymerization of thin films on a variety of substances, including silicon, molybdenum, platinum and copper. Polymerization of 4-fluorostyrene (4FS) and pentafluorostyrene (PFS) is used as a model system. Depth profiling is performed using x-ray photoelectron spectroscopy, ellipsometry, and step profilometry. Film growth is found to be independent of substrate, and proceeds with activation energies of 14 ± 1 and 15 ± 1 kcal/mol, respectively for 4FS and PFS deposition between 425 and 550 K. Films are shown by gel permeation chromatography to consist of low molecular weight polymer and oligimer species (between 3 and ~140 repeat units). Atomic force microscopy analysis of films grown by this method indicates that the root mean square thickness variation along the surface is about 2.5%.

TRULOVE, Paul C., Associate Professor, editor, *Proceedings of the Eleventh International Symposium on Molten Salts*, Vol. 98–11, The Electrochemical Society: Pennington NJ, 1998.

The Eleventh International Symposium on Molten Salts was held during the 193rd Meeting of the Electrochemical Society in San Diego, California, May 3-9, 1998. Over 70 papers were presented on topics ranging from theoretical studies to technological applications of molten salts. Authors were from over fifteen different countries with well over half from outside North America. Funding for this meeting was provided by the Physical Electrochemistry, the High Temperature Materials, and the Electrodeposition divisions of the Electrochemical Society. Further funding was provided by the Air Force Office of Scientific Research.

TRULOVE, Paul C., Associate Professor, co-author,

"Investigations of the Electrodeposition of Aluminum and Chromium from an Acidic Chloroaluminate Molten Salt," *Molten Salt Chemistry and Technology 5*, H. Wendt, Ed., Travis Tech Pubs. Ltd., Switzerland, 1998, pp. 593.

The electrochemical reduction of chromium (II) in acidic $AlCl_3$:EMIC (1-ethyl-3-methylimidazolium chloride) room temperature molten salt results in codeposition of aluminum and chromium. Two reduction peaks are observed in staircase cyclic voltammetry, with the first peak significantly smaller than the second. Constant potential deposition in the region of the first reduction peak results in the deposition of chromium rich BCC chromium-aluminum alloys. Constant potential deposition in the region of second peak results in the formation of aluminum rich FCC chromium-aluminum alloys. Evaluation of the chronoamperometric transient behavior on platinum during electrodeposition of the first peak shows that the codeposition of chromium and aluminum proceeds via three-dimensional progressive nucleation with diffusion controlled growth.

TRULOVE, Paul C., Associate Professor, co-author, "Structure of Niobium and Tantalum Complexes in Room–Temperature Chloroaluminate Molten Salts Using XAFS," in *Proceedings of the 11th International Symposium on Molten Salts*, Paul C. Trulove, Hugh C. De Long, Gery R. Stafford, and Shigehito Deki, Eds.; Vol. 98–11, The Electrochemical Society: Pennington NJ, 1998, pp. 217–226.

Coordination numbers for Ta^{+5} and Nb^{+5} in the aluminum chloride:EMIC molten salt system have been derived from EXAFS data. The values are consistent with known melt properties, decreasing as the melt acidity increases and the number of chloride ligands decreases. The proposed structures also explain the potential shift observed as initially basic melts are made acidic.

TRULOVE, Paul C., Associate Professor, co-author, "Electrochemical Studies of Tantalum and Niobium in Chloroaluminate Systems," in *Proceedings of the 11th International Symposium on Molten Salts*, Paul C. Trulove, Hugh C. De Long, Gery R. Stafford, and Shigehito Deki, Eds.; Vol. 98–11, The Electrochemical Society: Pennington NJ, 1998, pp. 205–216.

The electrochemical behavior of Nb^{4+} and Nb^{3+} in the aluminum chloride:1-ethyl-3-methylimidazolium chloride molten salt system has been studied. Although Nb^{3+} is virtually insoluble in the acidic melt, Nb^{4+} is sufficiently soluble to allow study of its voltammetric characteristics. Electrochemical studies of $TaCl_5$ in the aluminum cholride:acetonitrile solvent system have also been carried out, and the results shed some light on the various pathways available to Ta^{5+} reduction.

TRULOVE, Paul C., Associate Professor, co-author, "Investigation of the Underpotential Deposition of Lead on Gold in Basic and Acidic Room–Temperature Chloroaluminate Molten Salts," in *Proceedings of the 11th International Symposium on Molten Salts*, Paul C. Trulove, Hugh C. De Long, Gery R. Stafford, and Shigehito Deki, Eds.; Vol. 98–11, The Electrochemical Society: Pennington NJ, 1998, pp. 66–77.

The underpotential deposition (UPD) of lead on polycrystalline gold was used to investigate the characteristics of the electrochemical quartz crystal microbalance (EQCM) in room-temperature chloroaluminate molten salts. The bulk and UPD reduction of lead on gold was observed in both acidic and basic molten salts. The mass of the lead UPD in both acidic and basic melts, as determined from both EQCM charge and frequency data, were essentially identical. These data indicate that the EQCM is well behaved in these systems.

TRULOVE, Paul C., Associate Professor, co-author, "The Electrodeposition of Aluminum–Manganese Alloys from Room–Temperature Chloroaluminate Molten Salts," in *Proceedings of the 11th International Symposium on Molten Salts*, Paul C. Trulove, Hugh C. De Long, Gery R. Stafford, and Shigehito Deki, Eds.; Vol. 98–11, The Electrochemical Society: Pennington NJ, 1998, pp.

40–54.

The electrochemical reduction of manganese (II) in acidic $AlCl_3$:EMIC (aluminum chloride: 1–ethyl–3-methylimadzolium chloride) room temperature molten salt results in codeposition of aluminum and manganese. Constant potential deposition in the region of the reduction peak results in the deposition of manganese rich amorphous manganese-aluminum alloys. Constant potential deposition in the region of diffusion control results in the formation of aluminum rich amorphous manganese-aluminum alloys. Evaluation of the chronoamperometric transient behavior on platinum during electrodeposition at the foot of the wave shows that the codeposition of manganese and aluminum proceeds via three-dimensional instantaneous nucleation with diffusion controlled growth.

URBAN, Joseph. J., Assistant Professor, co-author, and Robert, L VON TERSCH, Major, USA co-author, "Conformational Analysis of the Isomers of Lewisite" *Journal of Physical Organic Chemistry*, 12, (1999), 95-102.

Chlorovinyldichloroarsine, also known as Lewisite, is a powerful vesicant that has been used in the past as a chemical weapon. Its extreme toxicity makes obtaining experimental data to characterize this notorious chemical system very challenging. In this work, we have carried out ab initio calculations on the geminal, cis, and trans isomers of Lewisite at a variety of levels of theory employing both all-electron and effective-core potential basis sets. The aims are to ascertain the relative stability of these three isomeric forms of Lewisite and to characterize their structures, dipole moments, and conformational preferences. The trans isomer of Lewisite is found to be the most stable and the geminal the least. This is consistent with the experimental data available on the compositions of Lewisite mixtures.

Presentations

CAMPBELL, Mark L., Associate Professor, "Reactions of Gas Phase Transition Metal Atoms," 15th International Symposium on Gas Kinetics, Bilbao, Spain, 9 September 1998.

CHEEK, Graham T., Professor, "Electrodeposition of Niobium from a Room-Temperature Molten Salt," (Poster Session) Gordon Conference on Electrodeposition, New London, New Hampshire, 10 August 1998.

CHEEK, Graham T., Professor, "Electrochemical Studies of Tantalum and Niobium in Chloroaluminate Systems," (Poster Session) Gordon Conference on Electrochemistry, Ventura, California, 19 January 1999.

COPPER, Christine L., Assistant Professor, co-author, "Isolation and Characterization of Metabolic Intermediates from Polycyclic Aromatic Hydrocarbon Biodegradation," paper presented at The Frederick Conference on Capillary Electrophoresis, Frederick, MD, October, 1998.

FERRANTE, Robert F., Associate Professor, co-author, *Deposition Surface Properties and the Spectra of Deposited Ices*, 30th Annual Meeting of the Division of Planetary Sciences, American Astronomical Society, Madison, WI, October 1998.

FERRANTE, Robert F., Associate Professor, co-author, *Laboratory Investigations of Catalysis on Grain Analogs*, 30th Annual Meeting of the Division of Planetary Sciences, American Astronomical Society, Madison, WI, October 1998.

FERRANTE, Robert F., Associate Professor, co-author, *Surface Effects and the Low Temperature Crystallization of Ices*, Symposium on Phase Transitions at Ice Surfaces, Centennial Meeting of the American Physical Society, Atlanta, GA, March 1999.

FITZGERALD, Jeffrey, Associate Professor, co-author, "New Subphthalo-cyanines and Subtriazaporphyrins," 1998 Gordon Research Conference on Inorganic Chemistry, Newport, RI, 19 July, 1998.

HARRISON, Judith A., Associate Professor, "New, Reactive Potential Energy Function to Study the Tribology of Hydrocarbon Systems", *International Conference of Metallurgical Coatings and Thin Films*, San Diego, CA, April 12-15, 1999.

HARRISON, Judith A., Associate Professor, "The Atomic-Scale Friction of Hydrocarbon Self-Assembled Monolayers", *National Meeting of the American Chemical Society*, Anaheim, CA, March 21-25, 1999.

HARRISON, Judith A., Associate Professor, "Adhesion, Friction, and Wear of Anchored Hydrocarbon Molecules on Diamond", *Gordon Research Conference on Polymers (West)*, Ventura., CA, January10-15, 1999.

HARRISON, Judith A., Associate Professor, "Molecular Dynamics Simulations as a Tool for Investigating Tribological Phenomena", *ASME/STLE International Tribology Conference and Exposition*, Toronto, Canada, October 25-28, 1998.

HARRISON, Judith A., Associate Professor, "Utility of Carbon Nanotubes when used as SPM Probes: A Molecular Dynamics Study", *Fall meeting of the Materials Research Society* ," Boston, MA, Nov 30-Dec 4, 1998.

HARRISON, Judith A., Associate Professor, "Development of a New, Reactive Potential Energy Function to Study the Tribology of Hydrocarbon Systems", *AFOSR/ONR/NSF Tribology Program Review*, Annapolis, MD, June 22-25, 1998.

HARTMAN JudithAnn R., Assistant Professor, PEARSON, Wayne G., Associate Professor, WHEAT, Robert J., MIDN 2/C, co-authors "Solid, Solution, and Gas-Phase Structural Studies for Nickel(II) and Copper(II) Complexes of a Series of Aminopyridine Ligands.", American Chemical Society 19th Annual Undergraduate Research Symposium, Blacksburg, VA, 30 March 20, 1999.

HEUER, William B., Associate Professor, co-author, "Effect of Inclusion State of Hemicyanine Dye on the Spectral Properties" 2nd International Conference on Polymer-Solvent Complexes and Intercalates" Fisciano, Italy, 31 August 1998.

HEUER, William B., Associate Professor, co-author, "Spectral Studies of Supramolecular Complexation of Hemicyanine Dyes by Helical Amylose"Chemistry Department Faculty Research Seminar, U. S. Naval Academy, Annapolis, MD, 17 March, 1999

HEUER, William B., Associate Professor, co-author, "Spectral Properties of Hemicyanine Dyes in Supramolecular Confinement by Helical Amylose" American Chemical Society National Meeting, Anaheim, CA, 22 March, 1999.

MCDONALD, David M., Commander, USN, "Weather", Waynewood Elementary School, Alexandria, Virginia 4 February 1999.

O'SULLIVAN, Daniel W., Assistant Professor, "Atmospheric chemistry of the hydroperoxides", Chemistry Department Seminar Series, USNA,

Annapolis MD, 21 October 1998.

PEARSON, Wayne G., Associate Professor, HARTMAN JudithAnn R., Assistant Professor, WHEAT, Robert J., MIDN 2/C, co-authors "Solid, Solution, and Gas-Phase Structural Studies for Nickel(II) and Copper(II) Complexes of a Series of Aminopyridine Ligands.", American Chemical Society 19th Annual Undergraduate Research Symposium, Blacksburg, VA, 30 March 20, 1999.

SCHROEDER, Maria J., Assistant Professor, "Learning Polymer Chemistry in the Undergraduate Laboratory," *Middle Atlantic Regional Meeting of the American Chemical Society*, Fairleigh Dickinson University, Madison, New Jersey, 19 May 1999.

SCHROEDER, Maria J., Assistant Professor, collaborator, "Segmental and Terminal Dynamics in Miscible Rubber Mixtures," *154th Rubber Division (of the American Chemical Society) National Meeting*, Nashville, Tennessee, 30 September 1998.

SHADE, Joyce E., Professor, co-author, "Frozen Nujol Matrix and Solution Photochemistry of Linked Cyclopentadienyl-Allyl Compounds of Molybdenum and Chromium." 216th National Meeting of the American Chemical Society, Boston, MA, 23-27 August 1998.

SHADE, Joyce E., Professor, co-author, "Photolysis of Rhodium Carbonyl Complexes in Solution and Frozen Nujol Matrices." 217th National Meeting of the American Chemical, Anaheim, CA, 21-25 March 1999

TRULOVE, Paul C., Associate Professor, co-author, "Investigation of The Electrodeposition of Aluminum and Manganese from and Acidic Chloroaluminate Molten Salts." European Research Conference – Molten Salts: From Structural Aspects to Waste Processing, Parquerolles Island, Hyeres France, 27 June – 3 July 1998.

TRULOVE, Paul C., Associate Professor, co-author, "Electrodeposition and Pitting Corrosion of Aluminum–Manganese Alloys from Room–Temperature Chloroaluminate Molten Salts," Gordon Research Conference on Electrodeposition, Colby–Sawyer College, New London, NH, 9-11 August 1998 (Poster Presentation).

TRULOVE, Paul C., Associate Professor, co-author "Electrodeposition of Niobium from a Room–Temperature Molten Salt," Gordon Research Conference on Electrodeposition, Colby–Sawyer College, New London, NH, 9 – 11 August 1998 (Poster Presentation).

TRULOVE, Paul C., Associate Professor, co-author, "Application of the EQCM to the Study of Electrodeposition from Room–Temperature Chloroaluminate Molten Salts," Gordon Research Conference on Electrodeposition, Colby–Sawyer College, New London, NH, 9 – 11 August 1998 (Poster Presentation).

URBAN, Joseph J., Assistant Professor, "Use of 3-D Molecular Models in Instructional Chemistry Web Pages" Curriculum Development Presentation, United States Naval Academy, 22 Sept, 1998.

WHITAKER, Craig M., Assistant Professor, "Chemistry in My Life," US Naval Academy Internal Seminar Series, Annapolis, MD, March 2, 1999.

Computer Science

Commander Joseph G. Kovalchik, USN
Chairman

During the 1998-1999 academic year, the Computer Science Department continued to conduct important research including that which solidly involved Midshipmen. Student research continued to prosper. The department encouraged its faculty to seek summer support through outside funding. Last summer the Naval Research Laboratory and the National Science Foundation funded faculty members of the department. The Computer Science Department had a productive year. Overall, there were seven publications and six presentations.

Sponsored Research

Advanced Decision Aids

Researcher: Professor Patrick R. Harrison
Sponsor: Office of Naval Research (ONR)

Decision Aids (DA) are used to support information intensive tasks such as help-deck, diagnosis, training systems, distance education, non-linear tactical planning and training. In large-scale, real-time planning, strategic and tactical situation assessment and other complex domains critical to the Navy, current DA technologies needs to be extended and developed in a variety of ways. In particular, progress is needed in verification and validation, indexing information, reasoning about possible solutions, solution adaptation and the integration of varieties of representations. DA systems rarely can solve complex problems in a stand-alone mode. Rather, they must be integrated with and embedded in other tools. Therefore, DA practitioners must have access to tools that address practical issues in the course of building their applications. These include the ability to identify and consider the merits of alternative forms of solution representation and reasoning including prototyping and simulation support. This program includes building, demonstrating and eventually disseminating such next-generation capabilities.

Situation Readiness in Autonomous Systems (SARAC)

Researcher: Professor Patrick R. Harrison
Sponsor: Office of Naval Research (ONR)

Future unmanned vehicles require sensor systems and software that can cope with tactical situations that involve an adversary, response to a changing environment, navigate, adapt to degraded levels of situational awareness, resist spoofing, jamming and other countermeasures, learn and work cooperatively with allied vehicles.

This project involved a match race using two sailboats with (at least) one containing a cognitive system that would evaluate sensor input and provide tactical suggestions. The course was either linear or triangle. In either event, the first mark was always upwind. With a linear course, the second mark was directly downwind. After rounding the second mark the boats headed upwind to the finish line. With a triangle course, the second mark was approximately 225 degrees from the first mark, while the third mark was 180 degrees from the first mark. After rounding the third mark, the boats headed upwind to the finish line. The first objective during the race was to stay between the opponent and the next mark. For the lead boat, this involved forcing the opponent beyond the lay lines, thus requiring the opponent to sail a longer course. In order to accomplish this, the lead boat might have to move outside the lay lines as well. The goal of the trailing boat was to maximize its options. This was accomplished by staying towards the middle of the course. It was also important for the trailing boat to avoid getting caught outside the lay lines during wind shifts. There were certain rules of the road that applied to both boats. It was essential to be able to define who had the right of way, and to use this right of way as a technical advantage. It was also necessary to understand which rules applied in a given situation. The defining points for situational awareness were as follows: 1) Same tack/Opposite Tack, 2) Right of Way/No Right of Way, 3) Windward/Leeward, 4) Close Hauled/Reaching Running. From these defining points, 24 basic situations were established in Option Space.

Two types of sensors were used on the boat. Global Positioning System (GPS) provided latitude, longitude, and time. B&G provided options such as boat speed, heading, apparent wind speed, true wind speed, and wind angle. The boat had a laptop computer running Windows NT (at least 233 MHz) with 64 MB of RAM. The system ran GIS and Tactician software. GPS and B&G data is fed asynchronously through COM ports to the GIS software. The data transfer was between 1Hz and 4Hz. GIS fused this data into a *data string* which is then sent to the Tactician software.

Intelligence Decision Aids in the Enterprise

Researcher: Professor Patrick R. Harrison
Sponsor: Office of Naval Research (ONR)

This research program is focused on n-tiered Client-Server concepts to redevelop and reinvent Intelligent Decision aids. The goal is to define and implement powerful Decision Aids that provide for very quick delivery and that encourage high degrees of interaction between clients. Current work has been exploring technologies and approaches that support the design and implementation of applet-based thin clients. Rapid advances in software technology and internet-based solutions are enabling research to rapidly take

new directions. Agent concepts are being re-evaluated and developed against the backdrop of advanced software concepts such as SERVLETS, CORBA, DCOM and Enterprise Java Beans. Next generation decision systems will integrate these technologies into N-tiered architectures with fully integrated database support. This research also focuses on intelligence directed towards query generation, focus and transformation, knowledge reorganization, data reduction and data quality. These elements will becoming increasingly important in fast delivery interactive systems with essentially instant customer response time. Response time to delivery and system modification is clearly a major step forward. The degree to which the user can interact with the system during development also is producing new models of design, development and especially testing.

During the current period, several distributed applet-based systems have been designed and implemented using CORBA and servlets. A basic model for the development of these systems and management of security has resulted. This model is detailed in a Technical Report currently being written. For this year, the goal is to deliver a proof of concept in the form of design concepts for web-based Decision aid tool that allows for interactive use over the net.

Computational Solutions for Protein Structure Prediction

Researcher: Associate Professor Andrew T. Phillips
Sponsor: National Science Foundation (NSF)

This research project, currently in its third year, involves the study of solution methods for the protein structure prediction problem. The protein structure prediction, or protein folding problem, attempts to predict the native, or folded, state of a protein in three-dimensional space, given its primary sequence of amino acids. One common approach for a solution is to treat each complex amino acid as a single sphere, or "united atom," and to model each peptide linkage between residues by a virtual bond between spheres. Computational efforts being examined rely on two major assumptions: (1) for any specific molecular conformation, a corresponding potential energy function can be computed, and (2) the three-dimensional, folded state corresponds to the global minimum of this energy function. The optimization method being used to minimize the potential energy involves collecting a large number of conformers, each attained by finding a local minimum of the potential energy function from a random starting point. The information from these conformers is then used to form a convex quadratic global underestimating function for the potential energy of the known conformers. The minimum of this under-estimator is used to predict the global minimum for the function, allowing a localized conformer search to be performed based on the predicted minimum. The new set of conformers generated by the localized search can serve as the basis for another quadratic underestimation. After several repetitions, the global minimum can be found with reasonable assurance. The conformer which lies at the global minimum represents the three-dimensional folded state of the molecule.

The Andes Project

Researcher: Professor Kay G. Schulze
Sponsor: Office of Naval Research (ONR)

Classical physics is a prerequisite for virtually all university-level study of science and technology, and yet is notoriously difficult for students to learn. The Andes Project is an intelligent tutoring system that is intended to be used as a "homework helper" for students taking Physics I. One of the main objectives of the project is to help students at the U. S. Naval Academy understand the concepts underlying force, energy, work, motion, and other topics in classical mechanics.

Independent Research

Asynchronous Transfer Mode (ATM) Network Analysis Tool

Researcher: CDR J. G. Kovalchik, USN

This is a cooperative research program with Naval Research Laboratory Information Technology Divisional Communications System Branch, Integrated Communication Technology, Code 5523. State-of-the-art technologies are being applied to develop software applications to test commercial ATM network equipment under various qualities of service and traffic descriptors on Windows NT platforms. Software models are constructed using the Unified Modeling Language. Active Data Objects are used to access the underlying database.

Weighted MinMax Algorithm for Color Image Quantization

Researcher: Assistant Professor Paula Reitan

The maximum intercluster distance and the maximum quantization error that are minimized by the MinMax algorithm are shown to be inappropriate error measures for color image quantization. A fast and effective (improves image quality) method for generalizing activity weighting to any histogram-based color quantization algorithm is presented. A new non-hierarchical color quantization technique call weighted MinMax that is a hybrid between the MinMax and Linde-Buzo-Gray (LBG) algorithms is also described. The weighted MinMax algorithm incorporates activity weighting and seeks to minimize WRMSE, whereby obtaining high quality quantized images with significantly less visual distortion than the MinMax algorithm..

Publications

NEEDHAM, Donald M., Assistant Professor, S. Demurjian and M. McMahon, "Concurrency in Object-Oriented Propagation Modeling Using Ada95", Proceedings of the 12th Annual ASEET Symposium, Monterey, CA., July 27-30, 1998. pp. 92-100.

Modeling object interdependency within an object-oriented application requires design-time mechanisms for specifying object interrelationships, as well as software constructs for the runtime maintenance of these relationships. In this paper, we present our technique for the design-time modeling of propagations (our term for the relationships between interdependent objects), with a focus on the concurrently executing portions of our propagation model. We examine our propagation model as implemented using Ada95's tasking constructs, and present the source level mechanisms through which our model achieves concurrency. The concurrency embedded within our approach to propagation modeling allows the development of software applications that more fully utilize environments supportive of multi-tasking.

NEEDHAM, Donald M, Assistant Professor, S. Demurjian and T. Peters, "Towards a Distributed Object-Oriented Propagation Model Using Ada95", Proceedings of SIGAda99, Redondo Beach, CA, October 17 - 21, 1999, pp. 203 - 210..

Representing interdependencies between the objects of an object-oriented software application requires design-time mechanisms for specifying object interrelationships, as well as software constructs for the runtime maintenance of these relationships. In this paper, we present a portion of our software engineering research environment ADAM, (short for Active Design and Analyses Modeling), which incorporates a tchnique for the design-time modeling of propagations (our term for the relationships between interdependent objects). We examine the ADAM environment's support for the automated generation of Ada95 software constructs that maintain object interdependency at runtime. We focus on our propagation model's use of Ada95 tasking constructs and protected objects, with an emphasis on the source level mechanisms through which our model utilizes concurrency. We present constructs required for an Ada95 distributed propagation model that supports communication through CORBA.

REITAN, Paula J., Assistant Professor, "3D Visualization of Color Image Histograms". Computer Network and ISDN systems, 30(20-21) (November 1998), 2025-35.

Color quantization is a useful method for obtaining high-quality compressed images for storage and subsequent distribution via the World Wide Web. The first step of most color quantization techniques is to create a histogram of the colors in the truecolor image. The dramatic differences in time and space efficiency of various data structures used to represent truecolor image histograms are visually explored in 3D. Spatial subdivisions use buckets to store colors in a portion of the RGB cube. Linked lists are the typical data structure used for buckets; we propose using red-black trees and treaps. Our visualizations highlight the clustering property of spatial subdivision methods.

REITAN, Paula J., Assistant Professor, "Hybrid Approaches to Color Image Quantization", Ph.D. Dissertation, University of Maryland Baltimore County, 1999.

Color image quantization is the irreversible transformation of a truecolor image into a color-mapped image consisting of K carefully selected representative colors. There are many possible mappings of a truecolor image to a quantized image using K colors. The primary goal of color quantization is to minimize the visual distortion between the

original image and the quantized image.

This dissertation proposes a heterogeneous-cut algorithm that combines the speed of oct-cut methods with the accuracy of 24 bit precision, variance-minimization and principal component oblique-cut methods to achieve high quality quantized images quickly. This dissertation also presents a fast and effective (improves image quality) method for generalizing activity weighting to any histogram-based color quantization algorithm. The value of the heterogeneous-cut algorithm and activity weighting is validated by a comprehensive empirical analysis of thirty-nine other hierarchical color quantization techniques using a test set consisting of twenty-five diverse images. Of the high quality quantization techniques studied in the analysis, the proposed heterogeneous-cut algorithm is the fastest.

This dissertation shows that the maximum intercluster distance is not an appropriate error measure for color image quantization (MinMax). Furthermore, this dissertation proposes a new non-hierarchical color quantization technique called weighted MinMax that is a hybrid between the MinMax and Linde-Buzo-Gray (LGB) algorithms. The new method incorporates frequency (or activity weighting) information in order to obtain high quality quantized images with significantly less visual distortion than he MinMax algorithm. However, the running time of both the MinMax and the weighted MinMax algorithm is not competitive with any of the hierarchically divisive methods.

Technical Reports

HARRISON, Patrick, Professor, (co-author), “NAC: An Adaptive Case-Based Reasoning Tool for Experimenting with Retrieval and Indexing”, NRL Report NRL/MR/5520-98-8146, 1998.

NAC is a testbed for experimenting with concepts of retrieval and indexing in Case-Based Reasoning (CBR). The paper describes similarity functions and decision functions used for retrieval as well as methods for re-indexing and case organization. The paper also describes methods for weighting attributes, analyzing their dependence and evaluation the importance index of a singly stored case. Methods employed for retrieval and indexing are based on mathematically sound techniques developed in classification, clustering and decision analysis. NAC includes basic functions for specifying similarity, normalizing data and evaluation.. Retrieval is done using both non-parametric and parametric statistical procedures with weighted attributes.

SCHULZE, Kay G., Professor, and Lisa B. Achille, Astrid Schmidt-Nielsen, Bronwen Deubner, and Janet Group, “A Networked Wizard-of-Oz Experiment to Study the Effect of Communication on Decision-Making Performance”, NRL/FR/5510--99--9901,1999

Verbal communication is a crucial aspect of Naval Command anc Control (C(C) environments and an frequently be so heavy as to overwhelm the entire CIC process. We began this research to identify verbal communication that could possible be eliminated or transferred to the computer interface in order to reduce he verbal communication traffic on the command net. This paper describes the implementation of a networked, software package that compares human-to-human, human-to-computer, computer-to-human and computer-to-computer communications.

This software is a Wizard-of-Oz simulation in which the subject must determine the threat level of two targets. The threat-level can be determined by querying eight attributes, such as speed, for each target and classifying each as very threatening, somewhat threatening, or non threatening. Based on these classifications, the subject can choose among

five threat levels. The subject perceives that the attribute information is being provided by two people, although only one wizard is used. The communication of the attribute information and the appropriate acknowledgments are either verbal or computer generated.

Presentations

NEEDHAM, Donald M., Assistant Professor, "An Object-Oriented Approach to Maintaining Topological Tolerances for CAD/CAM", Naval Research Laboratory, Stennis Space Center, MS, February 18, 1999.

NEEDHAM, Donald M., Assistant Professor, "Concurrency in Object-Oriented Propagation Modeling Using Ada95", 12th Annual ASEET Symposium, Monterey, CA., July 30, 1998.

REITAN, Paula, J., Assistant Professor, "Hybrid Approaches to Color Image Quantization.", Ph.D Dissertation defense, University of Maryland Baltimore County, 11 December 1998.

SCHULZE, Kay G., Professor, "ANDES: A Coached Problem-Solving System for Basic Physics," Educating Our Nation's Leaders, West Point, NY, April 1999.

SCHULZE, Kay G., Professor,"Computer Ethics Five Years Later: How Far Have We Come and Where Are We Going," Workshop at SIGCSE '99, New Orleans, LA, March 1999.

SCHULZE, Kay G., Professor, "A Tutoring System for Classical Physics" American Association of Physics Teachers, Anaheim, CA, January 1999.

Mathematics

Professor Michael W. Chamberlain
Chair

Mathematics provides a logical framework and a language indispensable to understanding the technical world in which we live. The following description summarizes the many contributions to this field of study made during the past academic year by the faculty and midshipmen of the Mathematics Department of the U.S. Naval Academy. The results cited reveal the great scope, diversity, and applicability of mathematics and offer glimpses of its intellectual beauty and appeal.

Several midshipmen conducted research projects either as Honors Mathematics Majors or in specially created projects under the guidance of faculty members. Several faculty spent many hours serving as mentors and readers for capstone projects required of all midshipmen majors. Listed next are some of our mathematics majors, projects and the faculty mentors:

-Brendan Beer, (Honors) "Determining Buoy Pattern and Ownship's Position from Bearing Information" (Peter Andre)

-Richard Bower, (Honors) "Tiling Rectangles with Rectangles"(T.S. Michael)

-Jeremy Hoffmann, "Parallel Knockout Processes on Graphs" (T.S. Michael)

-Alexander Holston, (Honors) "Bipartite Ramsey Problems" (T.S. Michael)

-Alexander Leanos, (Honors) "Properties of Elliptic Curves and Their Applications Toward the Proof of Fermat's Last Theorem" (Courteny Moen)

-Pavel Lincoln, (Honors) "The Symmetric Level Index System of Computer Arithmetic" (Peter Turner)

-Justin Montague, (Honors) "A Solution to Ulam's Problem with Error Correction Codes" (David Joyner)

-Kate Oliver, (Honors) "Tiling Infinitely in Three Flavors" (William Withers)

-Joshua Wood, (Honors and Trident Scholar) "Error Statistics of Time-Delay Embedding Prediction on Chaotic Time Series" (Erik Bollt)

Once again, the USNA Mathematics Department produced a wide range of scholarly work that appeared as technical reports or publications in refereed journals throughout the world. Dozens of particles appeared as applications of mathematics or as pure mathematical research. Topics that Mathematics Department faculty researched include: mathematics pedagogy, chaos and dynamical systems, mathematical physics and cosmology, parallel computer applications, astronomy, algorithms for computers, wavelets, cryptology, ocean acoustics, navy ship degaussing, missile systems assessment, antenna design, and basic mathematical research in areas such as algebra, combinatorics, differential equations, matrices, number theory, operator theory, and statistics.

In addition to many independent research projects, several research projects were sponsored in whole or part by a variety of sources, such as:

The Johns Hopkins University/Applied Physics Lab
Office of Naval Research
Naval Research Laboratory
Naval Air Warfare Center
Naval Surface Warfare Center
Naval Academy Research Council
National Science Foundation
National Security Agency
Natural Sciences & Engineering Council of Canada

During the past year, members of the USNA

Mathematics Department presented the results of their scholarly activities on nearly sixty occasions at professional mathematical meetings and colloquia throughout the United States and abroad. This activity,along with publication, enhances the academic stature of the Naval Academy and promotes the professional growth and reputation of those individuals involved. Through research activity, the faculty expand their intellectual horizons and stay vital in their disciplines. They contribute to the discovery of new mathematics. And they develop new materials and ideas that they can share with midshipmen students in their mathematics courses and research projects.

Sponsored Research

Shallow Ocean Acoustics

Researcher: Professor James L. Buchanan
Sponsor: National Science Foundation (NSF)

In order to realistically model sound transmission in a shallow ocean the acoustic properties of the seabed below must be taken into account. The seabed has been modeled variously as a completely rigid slab, a dense fluid, or an elastic slab. A more realistic model needs to admit the porous nature most surficial sediments. In a poroelastic sediment model the seabed is taken to consist of a viscoelastic frame with an interstitial pore fluid. For the last five years the researcher and his collaborators have been investigating sound transmission in the ocean over a poroelastic seabed. Recent work has included computing acoustic pressure in the near field over a one layer seabed using a modal solution combined with integrals along certain branch cuts, computing acoustic pressure in an ocean with depth-varying sound speed, computing pressure in the far field over a two layer seabed using a modal solution, and computing pressure in the far field using a numerical technique called parabolic approximation. The solution of the problem described above is a component of the solution of an important practical problem in ocean acoustics, that of recognizing the shape and/or composition of an object in the water or lying on the seabed. The investigator and his collaborators made progress on the problem of recognizing the location and shape of an object floating in the ocean under the simple assumption that the seabed is perfectly reflecting. Our approach was to simulate the scattered acoustic field by solving systems of linear equations derived from integrals of the acoustic field over the surface of the scatterer. Two methods of reconstructing the shape of the scatterer, assumed to be a solid of revolution, are being investigated. The first one is the Intersecting Canonical Boundary Approximation (ICBA) which attempts to match the acoustic field locally to the field of a cylinder. This method works well unless the source/receiver is located at a near null of the acoustic field. Hence for this method to be successful the frequency of the source must be varied to avoid such nulls. Another limitation is that it yields an estimate of the radius of the object only at depths where a source/receiver unit is located. A second approach that was tried was to recover the Fourier coefficients of the scatterer. This method uses perturbation expansions of the integrals used to calculate the forward field to obtain expressions for the scattered field as a function of the Fourier coefficients of the scatterer which allow calculation of the field efficiently enough to be used in an inversion scheme. Many inversion techniques require this distance to be known a priori. Second it is capable of finding the location and dimensions of the object from relatively sparse source-receiver configurations. Further worked planned on this problem includes extension of the technique to shapes more general than solids of revolution and use of the

more sophisticated models of the seabed described above.

Closed-loop Degaussing Using Both Naval Vessels and Scale

Researcher: Associate Professor Gary O. Fowler
Sponsor: Naval Surface Warfare Center (NSWC)

Naval vessels containing ferrous material emit detectable magnetic signals. The Naval Surface Warfare Center (NSWC) administers a project that studies and measures this phenomenon. Data is collected from naval vessels under a variety of conditions and from scale models under similar conditions. A goal of the project is to connect this data in a manner that will allow measurements from the scale model to predict measurements on the naval vessel. This analysis is both statistical and mathematical in nature. It includes both the design of the experiments and the analysis of the data.

Extraction of Pulsar Signals Buried In Noise

Researchers: Associate Professor Sonia Garcia, Associate Professor Colin Ratcliffe (Mechanical Engineering Department), and Professor Bill Bagaria (Aerospace Engineering Department)
Sponsors: Naval Research Laboratory (NRL) and Naval Academy Research Council (NARC)

Pulsars that are in the Milky Way Galaxy can be used for orbital velocity and position determination. The signals from the pulsars are periodic pulses. However, because the signal level is very low (the signals can be 10 orders of magnitude below the noise) classic signal processing procedures to detect and analyze the signal require averaging the signal over a period of hours to months. In order to use the pulsar signals for orbital velocity and position determination, it is necessary to analyze the pulsar signal based on as short of a time as possible (on the order of minutes). Prior to the current research, preliminary tests were conducted using existing lab equipment. Signals for durations of about two minutes were captured, digitized and stored. A unique method of data extraction was developed based on random vibration techniques. Custom software programs were written (by Professor Ratcliffe) to extract the pulsar signal from the background noise. During this past summer, new lab equipment was ordered for this research project. This equipment has now been delivered, and is being set up. The theoretical research, conducted this past summer, developed the mathematical basis for the unique data extraction technique. The starting point for the theory was the cross-correlation function. This theory was then modified and developed into a data extraction technique called the RBG (Rapid Binary Gage) function. The cross-correlation function requires on the order of O(N^2) multiples, and on the order of O(N^2) adds, where N is the number of data points in the digitized signal. The RBG function only requires O+(Np N) adds. Here, Np equals the number of data points during the pulsed portion of the signal, and NP N. Therefore, the required number of adds is greatly reduced. Also, the RBG does not require any multiplies! Using the RBG function, the period of the pulsar signal is determined. An unexpected result of the theory was that the temporally averaged waveform of the pulsar signal could also be determined! In order to use pulsars for navigation, it was only necessary to extract the period of the pulsar signal from the noise. Being able to determine the temporally averaged waveform allows the conduction of pulsar research using “smaller” (about 12 m) aperture antennas rather

than the "larger" (about 90m) aperture antennas. A technical paper of this research is in progress, and will be submitted for publication. Acknowledgments: The preliminary idea to use pulsar for navigation was due to LtCol B. Smith. The preliminary signal extraction technique and computer program was due to Professor C. Ratcliffe. The preliminary cross-correlation theory was due to Professor Bagaria. The detailed mathematical analysis was by Professors S. Garcia, and W. Bagaria.

Stability of Spacetimes with Mild Singularities or Cauchy Horizons

Researcher: Professor Deborah A. Konkowski
Sponsor: National Science Foundation (NSF)

The researcher is studying mild singularities and Cauchy horizons in spacetime models. Mild singularities include quasiregular and nonscalar curvature singularities. In the former, particle paths may end with no accompanying catastrophes, while in the latter, some particles moving near the singularity will feel infinite tidal forces, but not all do. In most cases the spacetime models examined satisfy Einstein's equations. In particular, the researcher is using a conjecture she and T.M. Helliwell first published in 1985 to predict whether various mild singularities and Cauchy horizons are stable. Thus far the conjecture has held true for the quasiregular singularities in Taub-NUT-type cosmologies and in Khan-Penrose spacetime when fields are added. When applied to the quasiregular singularity in Bell-Szekeres spacetime and the nonscalar curvature singularity and Cauchy horizon in a type-V LRS spacetime, a prediction was possible but no exact solutions were available for comparison. A study of the Cauchy horizons in Reissner-Nordstrom spacetime using the conjecture correctly predicted the effects of null dust when compared with exact solutions. The Cauchy horizons in the Kerr spacetime were predicted to be generally unstable to the addition of null dust but no exact solutions were known for comparison. Two years ago the Cauchy horizons in anti-deSitter spacetime were shown to be unstable to the addition of null dust. For the first time the conjecture failed – it predicted correctly the occurrence of a singularity but not the type. Therefore last year the instability was studied more thoroughly using scalar fields. It was determined that the main problem was the unphysical nature of null dust which is pressure-less even when it piles up. A new improved conjecture was postulated which accounted for the "shell-focusing" singularities in anti-deSitter spacetime and for a beam of null dust incident on an impulsive gravitational wave. A more serious problem was indicated, however. The conjecture could fail when a curvature singularity occurred only in the Weyl tensor and not the Ricci tenor. The previous examples were "fixable" since they depended solely on the null dust behavior, but other examples were found which were more serious. These occurred in Reissner-Nordstrom or Reissner-Nordstrom-deSitter with power law in-falling but impulsive outgoing null dust. The improved conjecture failed in these cases because the outgoing radiation creates a Weyl curvature singularity which persists along the Cauchy horizon to the future of its point of origin. Null dust density always stays finite. The conjecture has been shown to be completely reliable in indicating Ricci-tensor singularities. In a multitude of cases where exact solutions have not been carried out, it can indicate whether singularities form, and what type they should be. It is, of course, no substitude for exact back-reaction calculations. With an eye towards proving the conjecture, we examined the Cauchy horizons which occur in plane-wave spacetimes. Two stability theorems, based on the conjecture, for aligned fields (scalar, electromagnetic, and null dust) were proven. In addition, the conjecture's predictions for Cauchy horizons in colliding fields and in the nonsingular interaction regions of colliding wave spacetimes were compared

with exact solutions. In the process two new exact solutions to Einstein's equations were constructed. This work extends and clarifies the work first presented at a workshop two years ago in Israel and reported in its proceedings. This work has been accepted for publication in the British journal **Classical and Quantum Gravity**. Most recently we have begun studying the effects of quantum fields on spacetimes with mild singularities. We have begun with a simple spacetime with an "almost-conical" singularity and we are studying what happens in the limit that the "almost-conical" singularity turns conical. We are in the preliminary stages of this research.

Antenna Design

Researchers: Dr. S.N. Sammaddar, Dr. E.L. Mokole (Naval Research Laboratory-Radar Division)
and Professor Peter A. McCoy
Sponsors: Naval Research Laboratory and Naval Academy Research Council (NARC)

The infinite biconical antenna is an idea pulse radiator that is characterized by frequency dependence when a point source is located at the apex of the cone. When the voltage is applied at the apex, the surface charges, currents and electromagnetic fields are associated with spherical waves of the form $\Pi(q, j)e^{-jkr}/r$ where the radiation pattern $\Pi(q, j)$ is a function that depends strictly on latitude and longitude (q, j). New conformal mapping techniques are utilized to provide simpler closed form solutions then those previously known for the antenna's fields, currents and relevant characteristic parameters. Numerical examples are given to illustrate the results.

Fast Computation of the Characteristic Polynomial

Researchers: Professor George Nakos and Dr. Robert M. Williams
Sponsors: Naval Academy Research Council (NARC) and Naval Air Warfare Center (NAWC)

This is a report on the Samuelson-Berkowitz-Abdeljaoued Algorithm (SBA), which is a very efficient computation of the characteristic polynomial in an arbitrary ring. We describe in detail Abjeljaoued's improved version of the Berkowitz Algorithm which was based on Samuelson's Formula. We offer step-by-step examples and a Mathematica package that implements SBA. More precisely, we explore J. Abdeljaoued's work on the computation of the characteristic polynomial over any commutative ring. The work is based on an improved sequential version of the Berkowitz algorithm which in turn is based on Samuelson's Formula. In the course of our discussion we provide several concrete examples and test some of the findings of Abdeljaoued. We are particularly interested in the complexity of the end algorithm. As an alternative to Abdeljaoued's Maple program, we offer a Mathematica package that computes the characteristic polynomial in essentially the same way. There are two reasons that make this Samuelson-Berkowitz-Abdeljaoued approach very interesting indeed. First this approach yields perhaps the fastest and most efficient algorithm of its kind known today. Secondly, the algorithm is completely free of division and it applies to any commutative ring with unit. Other efficient algorithms such as the Leverrier-Fadeev algorithm based on Newton's formulas, require characteristic zero, or at least

characteristic greater than the size of the matrix. The resulting manuscript was submitted in the Mathematica for Education and Research.

Shifts on Operator Algebras

Researcher: Professor Geoffrey L. Price
Sponsors: National Security Agency (NSA) and National Science Foundation (NSF)

One of the key problems in the theory of von Neumann algebras is to study and to classify the position of subfactors of a prescribed index in the hyperfinite II, factor R. In some ways this problem resembles the Galois theory of automorphisms of finite groups; in fact, the group-theoretic notions of index, normality, and conjugacy all have analogues in the theory of subfactors. Over the past few years Price has worked with R. T. Powers to study a family of subfactors in R on which one can define a sort of non-commutative version of the Bernoulli shift of index 2. These shifts are called Powers shifts. For each Powers shift there is a corresponding bitstream of 0's and 1's which defines the shift. The structure of the shift is reflected in certain properties possessed by the bitstream, the most conspicuous of which is whether or not the bitstream is eventually periodic. In fact, the bitstream is eventually periodic if and only if there is a finite positive integer k such that the kth power s^k of the shift s has range s^k(R) with nontrivial relative commutant in the hyperfinite factor R. Price has shown that all Powers shifts with relative commutant index 2 are cocycle conjugate (a natural sort of equivalence for automorphisms and endomorphisms on von Neumann algebras) and has made some progress on the higher relative commutant case. Price has also established a connection between the conjugacy classes of binary shifts of commutant index 2 and polynomials over the field of 2 elements which have a certain duality property. Recently Price has proved that there exist shifts of relative commutant index 2 on R which are not Powers shifts, and it is of interest to try to determine whether these new examples are cocycle conjugate to Powers shifts also of commutant index 2. The central problem in the study, though, is to try to finish the classification of the cocycle conjugacy classes of Powers shifts of higher relative commutant index.

Cruise Missile/TACAIR Effectiveness Assessment Software

Researcher: Professor Thomas J. Sanders
Sponsor: The Johns Hopkins University / Applied Physics Laboratory (JHU/APL)

This project involved the continued development of a cruise missile and tactical air (TACAIR) effectiveness assessment system that is being done by the Joint Warfare Analysis Department of the Johns Hopkins University Applied Physics Laboratory (APL). The purpose of this system is to aid an analyst in scenario development, scenario analysis, survivability analysis, mission planning, and equipment performance prediction. During the summer of 1998, this investigator added options and improved the DTED map program (DTMA). This program was written in C++ and MacApp, and may be used by an analyst to display and manipulate Digital Terrain Elevation Data (DTED) files. Enhancements added include a module

for generating ballistic trajectories based on predefined flight paths, a RAM saving feature that reduces the resolution of a map whenever available RAM is low, an interface that allows communication with the 3-D modeling software DOORS, enhancements to the path profile display to help in determining optimal command altitudes for flight path generation, and a module that allows the user to "fly" a predefined vehicle interactively. The final module was also ported into both UNIX and PC environment.

Differential Simplicity and Rational Singularities

Researcher: Assistant Professor William N. Traves
Sponsors: Natural Sciences and Engineering Research Council of Canada and
Naval Academy Research Council (NARC)

Grothendieck showed that the ring of differential operators on a smooth complex algebraic variety is always generated by derivations. In prime characteristic this fails, even for Euclidean space. The main thrust of the first part of this project is to extend Grothendieck's theorem to arbitrary characteristic by introducing the Hasse-Schmidt derivations. Along the way, I show that Hasse-Schmidt derivations extend over etale extensions, generalizing results due to Brown and Kuan and, separately, Ribenboim. I also present a counterexample to an old question posed by Brown and Kuan: do Hasse-Schmidt derivations localize? Their conjecture is reformulated in terms of the Hasse-Schmidt algebra. In the second part of this project, I show that under mild conditions excellent differentially simple rings determine (pseudo-) rational singularities in prime characteristic. The proof uses the theory of tight closure and techniques pioneered by Smith in the study of D-simplicity. In particular, I show that the parameter test ideal is differentially stable. The material is currently being written-up for publication.

Residue Polynomial System

Researcher: Professor Peter R. Turner
Sponsors: Naval Air Warfare Center (NAWC) and Naval Academy Research Council (NARC)

The fundamental idea is for a new system of representation of polynomials within Computer Algebra Systems. The basic idea is not new but it has been regarded as practicable largely because of the problem of obtaining a satisfactory division algorithm. However that problem is solved in this work. The idea is to represent a polynomial by its residues at a set of nodes and to perform polynomial arithmetic and manipulation in terms of these residues rather than using the conventional coefficient representation. In the two new papers below, the basic ideas and properties of the Residue Polynomial System (RPS) are presented. The basics of the representation are manifestations of standard results in polynomial interpolation. The biggest problem with residue representations is performing division. In a polynomial ring, however, this turns out to be a tractable problem. An algorithm for division is presented. This is then extended to other polynomial algorithms which render RPS a potentially practical system for polynomial manipulation within Computer Algebra Systems.

Image Recognition Problems

Researchers: Professor Peter R. Turner and Dr. Robert M. Williams
Sponsors: Naval Air Warfare Center (NAWC) and Naval Academy Research Council (NARC)

From the previous work for NAWC, the potential for use of Gauss elimination in an integer computing environment is significantly enhanced by an improved fraction-free integer Gauss elimination algorithm. This algorithm has the further benefit of eliminating all unnecessary common factors in matrix elements without the need for any additional computational effort to find these factors. The modified algorithm is also applicable in the situation where the matrix elements (coefficients) are taken from a more general ring such as a ring of real polynomials. Also within the realm of RNS arithmetic a new algorithm for exact integer linear division within the RNS system has been developed. This could be combined with the fraction-free algorithm since the divisions required there are known to be exact. This may have the effect of making the RNS-based approach more practical. The complexity analysis of this algorithm has not yet been fully explored. These two developments combine to make a more practical method for solving integer linear systems with the fast parallel arithmetic of RNS. The developments in fraction-free algorithms, and their extensions to a fraction-free LU algorithm make it possible to combine these ideas within a computer algebra setting with the earlier work of Nakos on using Dixon resultants for the solution of polynomial systems. These are important within the realms of threat analysis, robot control and object recognition. This is all the subject of continuing research sponsored again by NAWCAD, Patuxent River this year.

Implementation and Applications of Level-Index Arithmetic

Researchers: Professor Peter R. Turner and Midn 1/C Pavel Lincoln, USN
Sponsor: Naval Academy Research Council (NARC)

The principal recent objectives have been to investigate further the implementation and application of LI and SLI arithmetic and the comparison of these with other proposed new computer arithmetics. The primary goal was to begin the implementation of this system on the Mathematics Department MasPar MP-1 system to investigate the advantages to be derived from a massively parallel implementation. This aspect of the work was enhanced during the summer of 1995 by the visit of Nicolas Schabanel, a graduate student from the Ecole Normale Superieure, Lyon, France who spent his summer internship working here at USNA. His work on implementing SLI arithmetic on the MasPar is summarized in his Technical Report. The methods of investigation included mathematical analysis, the development and use of algorithms for various arithmetic systems and their application to the evaluation of mathematical functions. This included a comparative study of the various schemes. The study also included research into recent hardware design developments and their possible use in eventual implementations of the level-index scheme. The other major areas of activity here have been and are concerned with the use of parallel processors and the implications of the parallelism for the arithmetic system used. The principal output of this research has been in the form of research papers and the development of ideas for further developments and publications.

Independent Research

Computational Algorithms in Algebraic Number Theory

Researcher: Associate Professor JoAnn S. Turisco

This project is a continuation of my previous work which involves the use of Maple and Mathematica for computations and to generate examples with the goal of making progress towards the solution of some open and difficult problems in algebraic number theory. One part of this work is the explicit computation, which involve the determination of eigenvalues of large matrices whose elements are multivariable polynomials of invariants associated with smooth maps of Euclidean space which have produced generalized hypergeometric functions. I am also studying the problem of the existence of normed bilinear maps from an algebraic viewpoint, using Jordan algebras and triple systems. Examples are generated with Maple and Mathematica by associating to each map a family of rectangular matrices which satisfy certain idempotent and anti-commutative properties. In addition, I am continuing my work on Maple and Mathematica programs which determine prime numbers and class numbers of certain algebraic number fields.

Derivative Polynoials and Associate Integer Sequence

Researcher: Professor Michael E. Hoffman

Let P_n and Q_n be the polynomials defined by $f^{(n)}(x) = P_n(f(x))$ and $g^{(n)}(x)=Q_n(f(x))g(x)$, where $f(x) = \tan(x)$ and $g(x) = \sec(x)$. In an earlier paper the author obtained closed forms for the exponential generating functions:

$$P(u,t)=\sum_{n=0}^{\infty} p_n(u)\frac{t^n}{n!} \text{ and}$$

$$Q(u,t)=\sum_{n=0}^{\infty} Q_n(u)\frac{t^n}{n!},$$

From these closed forms come various relations, among the generating functions, e.g. $P(P(u,t),s)=P(u,t+s)$. The author also obtained a result expressing infinite series of the form

$$\sum_{n=1}^{\infty} \frac{f(n)}{n^k},$$

where f (n) is a periodic function of n, in terms of the polynomials P_{k-1} and Q_{k-1}. The purpose of this project is to apply these results to understand the

numerical sequences $P_n(u)$ and $Q_n(u)$ for specific values of u.

Results: Using general relations among the generating functions, the author obtained general fomulas relating the values of the polynomials P_n and Q_n at u to their values at P(u,t), for any t. These formulas were then applied to the numerical sequences $P_n(u)$ and $Q_n(u)$ for u=0,1, $\sqrt{3}$. The sequences $P_n(0)+Q_n(0)$,$Q_n(1)$, and $P_n(1)-Q_n(1)$ have combinatorial interpretations: they count various types of "up-down" sequences corresponding to the three infinite classes of Coxeter groups. The sequences $\sqrt{3}P_n(\sqrt{3})$ and and $\sqrt{3}Q_n(\sqrt{3})$ are less familiar, but a combinatorial model can be given for them as well. Further, all rational values of Euler polynomials can be expressed in terms of polynomials P_n and Q_n.

Status: A paper "Derivative polynomials, Euler polynomials and associated integer sequences" has appeared in the Electronic Journal of Combinatorics. Investigation of additional sequences related to the derivative polynomials continues.

Integrating Computer Vision Research into the Undergraduate Mathematics Major Curriculum

Researcher: Professor Carol Crawford

The major focus of this research effort is the design of methods and procedures to create classroom implementations of applied graph theory. In particular, graph representations for algorithm design are applied to robot vision systems and to the formulation of graph matching neural networks for the matching and classification of fingerprint images. Special emphasis is given to the integration of these topics into traditional mathematics courses such as Linear Algebra, Matrix Theory and Discrete Structures.

On a Question of C. SIMS

Researcher: Professor Anthony M. Gaglione

Let $r \geq 2$ be a natural number, $F = F_r$ is the free group on the alphabet $X = \{x_1, x_2, \cdots, x_r\}$. Let C $= x_1, x_2, \ldots, x_r, c_{r+1}, \ldots$ be any sequence of basic commutators that starts out with the ordered alphabet X. For the definition of basic commutators, see for example "The Theory of Groups" by M. Hall, Chapter 11. We write $g_n = g_n(F)$ for the nth term of the lower central series of F, $g_n := [g_{n-1}, F]$, i.e., the group generated by all commutators $[x, y] = x^{-1}y^{-1}xy$ with $x \in g_{n-1}$ and $g \in F$. We also let N_n be the normal closure in F of the set of basic commutators of weight n from C. Charles Sims raised the question of whether or not $g_n = N_n$ and answered this question positively for $n \leq 4$ (and all r) and for n = 5,r = 3 which as far as we know was unknown before this time. We have also proven that Sims' question has a positive answer for the variety of metabelian groups. The

question, however, in general is still open, so that our research on it is still ongoing.

Formations and Model Theory

Researcher: Professor Anthony M. Gaglione

A nonempty class X of finite groups which is closed under taking homomorphic images and subdirect products of two (and therefore inductively, finitely many) factors is a formation of groups. In the presence of closure under homomorphic images the second condition above is equivalent to the following: If G is a finite group (not necessarily in X) and K_1 and K_2 are subgroups normal in G and such that G/K_i lies in X, i=1,2, then $G/(K_1 \cap K_2)$ also lies in X. If, in addition, $H \in X$ if and only if $H/\Phi(H) \in X$, where $\Phi(H)$ is the Frattini subgroup of H, then the formation is saturated. These concepts first introduced by W. Gaschutz in 1963 within the class of finite solvable groups, especially that of saturation, provoked an interest over the next thirty years that resulted in a tremendous output in contributions to the literature and a proliferation of associated ideas that still attract attention today. Since the underlying theme of the initial concepts relates to properties imposed on well-defined subsets of chief factors in a group, H. Bechtell examined this relationship as a basis for extending the formation concept into other algabraic systems. With an eye toward his nascent generalization, Professor Bechtell posed the following question to myself and my colleague Dr. Dennis Spellman:

Question 1: Which properties of groups give rise to formations?

Because of the broadness of Question 1, we have chosen to attack the more modest:

Question 2: Which first-order properties give rise to formations?

Although formations were nestled in the cradle of finite groups, first-order axiomatizability is in general incompatible with finiteness conditions because of the Compactness Theorem and Lowenheim-Skolem type results. (A set of first-order sentences having arbitrarily large finite models will have models of arbitrarily large infinite powers.) For that reason we have chosen to modify the classical definition to suit our purposes to the extent that we no longer insist that our structures in a formation need be finite. Hence, we now define: A nonempty class X of groups to be a formation of groups provided X is closed under taking homomorphic images and whenever G is a group (not necessarily in X) and K_1, K_2 are subgroups each normal in G and such that $G/K_i \in X$, i=1,2 one must have $G/(K_1 \cap K_2) \in X$. We also generalize this notion to other algebraic structures. Since most of the results go through in the context of universal algebra, we have chosen to consider this material in a universal algebraic setting. It would appear that at no point was there an effort to re-examine the fundamentals of the theory of formations through Model Theory - even though the work of R.C. Lyndon on properties preserved under homomorphisms and subdirect products was well-known. It is the purpose of this research project to do just that.

Moving Space-Time Mixed Finite Element Methods

Researchers: Associate Professor Sonia M.F. Garcia and Dr. Rafael Santos

The researchers are defining and analyzing mixed finite element methods for solving time dependent partial differential equations. Our methods are based on a previous paper "Analysis of Some Moving Space-Time Finite Element Methods", by R. Bank and Rafael Santos where one method allows for adding and deleting knots in a continuous fashion and the other allows for discontinuous changes in the mesh. We believe the combination of mixed finite element methods with the moving techniques will bring surprising results for parabolic equations models.

A technical paper of this research is in progress, and it will be submitted for publication.

A Primer for Apprentice Mathematicians

Researcher: Professor C. C. Hanna

The objective of the text is to ease the transition from engineering-oriented mathematics, emphasizing techniques for solving particular problems, to mathematicians' mathematics, emphasizing discovery and proofs of mathematical truths. The text begins with an introduction to basic mathematical concepts - sets, logic, numbers, functions, sequences, and vectors. There follows an extensive discussion of how to understand and construct proofs of simple statements. Finally, the readers are invited to apply these techniques in a deeper discussion of the basic ideas. Additional chapters will consider equivalence relations (applied to modular arithmetic and construction of number systems), vector spaces, sequences and their limits, and an introduction to real analysis. Only my section of SM291 used the notes as their primary text in the spring semester of 1999. The existing material is nearly in final form. I contemplate extensive expansion this summer to include supplementary material on number theory, sequences, and polynomials.

The Omega Limit Set of a Class of Integro-Differential Equations

Researcher: Associate Professor T. J. Mahar

This work deals with the long time behavior of solutions to a class of integro-differential equations similar to those which arise in models of visco-plastic flow. It is shown that a periodic function becomes part of the omega limit set of the equation when certain parameter conditions are satisfied. The fact that the periodic function does not actually satisfy the integro-differential equation is a novelty. This result is an analog of the Hopf bifurcation theorem for differential equations, except that the periodic function arising in the differential equation problem actually solves the equation.

Symmetry and the Existence of Multiple Eigenvalues for Laplacians

Researcher: Associate Professor Robert Lockhart

Generally a Laplace operator on a compact manifold has only simple eigenvalues. This is also true for elliptic boundary value problems for Laplacians on compact manifolds with boundaries. In research done several years ago, however, the researcher showed that if the manifold has a symmetry of order three or more, then there are infinitely many multiple eigenvalues. Furthermore, if the manifold is in fact homogeneous, then all but the first eigenvalue is multiple. During the past year the researcher has been investigating the extent to which some symmetry is necessary for the existence of multiple eigenvalues. Put simply, does the existence of infinitely many multiple eigenvalues imply the existence of a symmetry? In the past year he has also been able to extend the original work from Laplacians to general self adjoint operators on a Hilbert space which are real and have a discrete spectrum.

Classification of Singularities with SHEEP/CLASSI

Researcher: Professor Deborah A. Konkowski

Investigating ways to apply computer algebra programs (*e.g.*, SHEEP/CLASSI) to the problem of singularity classification. This computer algebra research was begun during a recent sabbatical in London at Queen Mary and Westfield College with Professor Malcolm MacCallum's group and has been continued during periodic visits to London. Although it is impossible to classify topological singularities such as quasiregular singularities in this manner, scalar curvature and non-scalar curvature singularities should yield to analysis. Ways to study scalar and nonscalar curvature singularities using a complete listing of curvature invariants and frames related to parallel propagated orthonormal ones are currently under consideration.

Various Problems

Researcher: Associate Professor Courtney Moen

Working on various problems on tiling and number theory. One class of problems concerns the following sequence of integers. Pick a positive real number r. Define a sequence by letting x(n) be the integer part of the r-th power of n. We would like to examine the solutions of the equation x(a)+x(b)=x(d), where a,b and d are positive integers. If r is an integer greater than two, this problem is Fermat's Last Theorem. I worked on this with MIDN Leanos during the fall semester. A second problem is: given r, find an integer k such that every positive integer is the sum of at most k elements of the sequence x(n). If r is an integer, then this is Waring's problem. Another class of problems is concerned with packing and tiling. A conjecture which I formulated which is probably very difficult is the following. For each j between 1 and n, let R(j) be a rectangle with integer sides and area j. Let R be a rectangle with integer sides whose area is

the sum of the areas of the R(j). Assume that each R(j) fits in R. Then the set {R(1),...,R(n)} tiles R. T.S. Michael has pointed out to me that this conjecture is analogous to the famous tree-packing conjecture in graph theory, which has not been resolved for more than 20 years. This conjecture can be generalized extensively.

The NSP-world and Action-At-A-Distance

Researcher: Professor Robert A. Herrmann

Using the Nonstandard Physical World (NSP-world) model, a model that cannot be eliminated from scientific discourse, it was predicted that specific processes exist such that information between objects within our natural environment would appear to be transmitted instantaneously. In this article, certain aspects of this model are discussed as well as experimental evidence that establishes as fact the model's prediction that a type of nonlocal instantaneous action-at-a-distance does occur in objective reality.

Information Theory, Consequence Operators and the Origin of Life

Researcher: Professor Robert A. Herrmann

In this article, the Gitt (1997) concept of information as it is represented by a mental-like sequence of activities is compared with the mental activity represented by consequence operators. It is shown how consequence operators model mathematically these Gitt notions and how a specific ultralogic and four ultrawords yield an identical foundation for Gitt's information theory scenario for the origin of life. Consequence operator theory, as a model for Gitt information theory, is used to establish that, relative to this model and without external modification to the processes, it is not possible, using fixed pragmatic information, to increase or decrease the complexity of a biological entity by selecting from two distinct independently produced biological entitles as these entities are characterized at the apobetic level. This signifies that if random mutations are **random** alterations in the characteristics of a biological entity that are, necessarily, not dependent upon the original biological characteristics, then this model would tend to disallow random mutations as a viable source for biological alterations. On the other hand, for fixed pragmatic information, an increase or decrease in complexity by selecting from two distinct apobetic level biological entities is possible if a very special dependency exists between their characteristics. Further, complexity can also be increased by applying the semantic level consequence operator to an increased portion of the information contained within the genetic code in the DNA, information that exists originally.

The Wondrous Design and Non-random Character of "Chance" Events

Researcher: Professor Robert A. Herrmann

In this article, it is shown specifically that natural system chance events as represented by theory predicted (a priori) probabilistic statements used in such realms as modern particle physics, among others, are only random relative to the restricted language of the theory that predicts such behavior. It is shown that all such "chance" natural events are related one to another by a remarkably designed, systematic and wondrous collection of equations that model how the natural laws and processes specifically yield such natural events. A second result shows theoretically that all such "chance" behavior is caused by the application of well-defined ultralogic. These results show specifically that the fundamental underlying behavior associated with all natural systems that comprise our universe is controlled internally by processes that cannot be differentiated from those that mirror the behavior of an infinitely powerful mind.

Explicit Construction of Complete Kahler Metrics of Saper Type by Desingularization (Formerly titled: " Generating Functions for Metrics on Singular Kahler Varieties)

Researcher: Associate Professor Caroline Grant Melles

The authors construct complete Kahler metrics of Saper type on the nonsingular set of a subvariety X of a compact Kahler manifold using (a) a method for replacing a sequence of blow-ups along smooth centers, used to resolve the singularities of X, with a single blow-up along a product of coherent ideals corresponding to the centers and (b) an explicit local formula for a Chern form associated to this single blow-up. These Kahler metrics have a particularly simple local formula, involving essentially a product of distances to the centers of the blow-ups used to resolve the singularities of X. The proof of (a) uses a generalization of Chow's theorem for coherent ideals, proved using the Direct Image Theorem.

Polynomial System Triangularization with the Dixon

Researchers: Professor George Nakos and Dr. Robert M. Williams (NAWC)

Recently, the Dixon resultant (Dixon 1908) has been revisited and generalized by Kapur, Saxena, and Yang. The restrictions on the coefficients of the polynomial system in the generalized form are very mild and the method can be applied to almost any system of n+1 equations and n unknowns (parametric coefficients allowed). In this paper we address the question of how to actually solve a polynomial system by using the Dixon resultant. We describe a certain triangularization of the polynomial system based on the computation of several Dixon resultants. This method exploits the special structure of the matrix whose determinant is the Dixon polynomial. The new idea here is the following: instead of computing the

determinant of this matrix directly, a fraction-free Gauss elimination is performed based on the well-known Gauss-Bareiss algorithm. When done properly, this elimination produces the principal minors of the original matrix on the main diagonal. Each of these minors yields a corresponding Dixon resultant with an increasing number of variables. Eventually, all these resultants form a triangular system whose solutions include - in general - the solutions of the original one. The resulting manuscript will be published in Word Scientific Proceedings following the CSCC'99 Athens Conference.

Nakai's Conjecture for Varieties Smoothed by Normalization

Researcher: Assistant Professor William N. Traves

Nakai's conjecture concerns a very natural question: can differential operators detect singularities on algebraic varieties? On a smooth complex variety, it is well known that the ring of differential operators is generated by derivations. Nakai asked whether the converse holds: if the ring of differential operators is generated by derivations, is the variety smooth? In this paper, the notion of D-simplicity is used to give a short proof that varieties whose normalization is nonsingular satisfy Ishibashi's extension of Nakai's conjecture to arbitrary characteristic. This yields a new, characteristic-free proof of Nakai's conjecture for curves. The argument is concise and rederives characteristic dependent results of Mount and Villamayor (characteristic zero) and Ishibashi. The argument also provides a new proof of Nakai's conjecture for Stanley-Reisner rings and, more generally, unions of smooth varieties. The proof plays off Hasse-Schmidt stability against D-simplicity in a subtle way. The paper is to appear in the Proceedings of the American Mathematical Society.

Bayesian Searching

Researcher: Professor John C. Turner

The problem of searching with Bayesian updates provides a real world example of Bayes Theorem. Analysis of the characteristics of the updates can lead to insights about the updating process.

Research Course Projects and Trident Scholar Projects

Error Statistics for Embedding Prediction of Chaotic Time-Series

Researcher: Midn 1/C Joshua T. Wood, USN, Trident Scholar
Faculty Advisor: Assistant Professor Erik M. Bollt

This project investigates a statistical method for analyzing the error on predictions made through the process of time-delay-embedding of chaotic time series. When viewed as a time-series, chaotic data appears to be unpredictable and random. A chaotic system actually has an orderly representation when viewed in its proper state space (the space consisting of the pertinent variables of the system, when the data is recorded time if often incorporated into the analysis. This creates a problem when making predictions on a chaotic system, since a prediction is a forecast of the system at a later time. A remarkable result from the study of chaotic dynamical systems shows that present in almost any single time-series is information from all the variables of the state space. The technique of time-delay-embedding provides a method for reconstructing a topological equivalent of the state space attractor from this single time-series. The reconstructed attractor can then be used to make predictions on the evolution of the system. This project describes an algorithm for determining an appropriately fitted model for time-delayed data. A prediction is then made from this model along with confidence intervals which measure the reliability of the expected response. This model is tested on large sets of both computer-generated and experimentally-gathered chaotic data. Large data sets are used to verify the accuracy of the confidence bands. While this project involved many different data sets, the purpose was not to analyze these specific data sets, but to begin work on a general algorithm which could theoretically be used on any chaotic system.

Nonperiodic Tilings

Researcher: Midn 1/C Kate Oliver, USN
Faculty Advisor: Professor W. Douglas Withers

This paper is a brief exploration into the complex world of tiling. We begin by setting the stage for the study of tilings by introducing the basic concepts inherent to the field: symmetry relations and periodicity. After developing these foundations for our investigation into tilings in general, we will enter the world of nonperiodic tilings. Using the language we developed in our analysis of periodic tilings, we will examine tilings that cover the plane to infinity without exhibiting any of the characteristics of periodicity. Finally, we will contrast nonperiodic tilings with an even more interesting type of tessellation, the aperiodic variety. Our exploration of aperiodicity will highlight the distinguishing factors between the two types of tilings, while introducing the main characteristics of aperiodicity. Last we will consider applications of aperiodicity to the natural world, conceptualized by the new science of quasicrystals.

Publications

HERRMANN, Robert A., Professor, "Newton's Second Law of Motion Holds in Normed Linear Spaces," Far East Journal of Applied Math 2(3)(1998), 183-190.

By application of elementary laboratory observations, Newton's Second Law of Motion is derived for any normed linear space. The derivation assumes that the same elementary physical observations made by Newton hold in a normed linear space and uses the elementary theory of Robinson infinitesimals and Frechet differentials. The theory of Robinson infinitesimals is a rigorous approach to the informal Newtonian theory of the infinitely little.

HERRMANN, Robert A., Professor, "A Possible Solution to the Heat Issue Within Catastrophic Plate Tectonics," CRS Quarterly, 35(2)(1998), 110-111.

In a recent publication, Carl R. Froede Jr., discussed the problem of the heat generated during the short flood period by the processes known as catastrophic plate tectonics, CPT. The author states that the rapid removal of such energy is an unexplained aspect of the CPT model. However, ongoing theoretical research may give a possible solution to this and other problems such as the rates of radioactive decay. Using the linear effect line element and a pure complex substratum term, a type of "time compression" is obtained that would increase the rates for all modes of heat dispersal.

HERRMANN, Robert A., Professor, "Answers to Three Questions Posed by Carl R. Froede Jr.", CRS Quarterly, 35(4)(1999), 234.

In this letter, the questions, how rapidly did the heat generated dissipate? What is the maximum temperature attained? And what physical processes were involved in the heat transfer? For the model proposed in CRSQ 35(2) (1998), 110-111 are answered in the only way such a model is capable of answering such specific questions.

HOFFMAN, Michael, Professor, "Derivative polynomials, Euler polynomials, and associated integer sequences" Electronic Journal of Combinatorics 6 (1999) #R21 (13 pages).

Let P_n and Q_n be the polynomials obtained by repeated differentiation of the tangent and secant functions respectively. From the exponential generating function of these polynomials we develop relations among their values, which are then applied to various numerical sequences which occur as values of the P_n and Q_n. For example, $P_n(0)$ and $Q_n(0)$ are respectively the nth tangent and secant numbers, while $P_n(0)+Q_n(0)$ is nth Andre' number. The Andre' numbers, along with the numbers $Q_n(1)$ and $P_n(1)-Q_n(1)$, are the Springer numbers of the root systems of types A_n, B_n, and D_n respectively, or alternatively (following V.I. Arnol'd) count the number of "snakes" of these types. We prove this for the latter two cases using combinatorial arguments. We relate the values of P_n and Q_n, at $\sqrt{3}$ to certain "generalized Euler and class numbers" of D. Shanks, which have a combinatorial interpretation in terms of 3-signed permutations as defined by R. Ehrenborg and M. A. Readdy. Finally, we express the values of Euler polynomials at any rational argument in terms of P_n and Q_n, and from this deduce formulas for the Springer and Shanks numbers in terms of Euler polynomials.

KONKOWSKI, Deborah A., Professor, "Address of the Guest of Honour: Some Thoughts About S. Chandrasekhar," News Bull. Cal. Math. Soc., 21, pp. 15 - 16, 1998.

KONKOWSKI, Deborah A., Professor, "The Strengths and Limitations of a Stability Conjecture for Cauchy Horizons," Proceedings of the International Symposium on Mathematical Physics, Bull. Cal. Math. Soc., 91, pp. 49 - 58, 1999.

A stability conjecture for Cauchy horizons is stated and described. A review is given of its application to Reissner-Nordstrom, Kerr, and other black-hole spacetimes. Its limitations are discussed primarily in the anti-deSitter case.

MEYERSON, Mark D., Professor, "Visualizing Space-Filing Curves with Fractals (As Limits of Curves of Continuously Varying Dimension)," Electronically published in Communications in Visual Mathematics, a new electronic journal sponsored by the Mathematical Association of America, vol. 1, no.1., (Http://www.geom.umn.edu/~dpvc/CVM/1998/01/welcome.html)

Common assumptions about the concept of dimension seem to be violated by the existence both of fractals and of space-filling curves. Here we use a continuum of iterated functions systems (IFS's with a time parameter) to produce families of fractal curves that in the limit of a discrete sequence of polygonal, one-dimensional curves (as is usually done), but rather as the limit of curves that continuously increase in dimension)or in area) to that of the space filled region. This leads naturally to the visually elucidating production of animations showing the construction of space-filling curves.

MCCOY, Peter A., Professor, "Multipower Legendre Series in Several Variables," Kernel Functions & Their Applications, Saburou Saito (editor) Kluwer Academic Publishers, Boston, pp 1-11.

Nehari's theorem links the singularities of Legendre series in C_z with those of associated Taylor's series in C_t. Recently, the theory was generalized to products of powers on m Legendre polynomials in C^m. This paper continues the development of series of products of powers of Legendre polynomials in C^m.

MICHAEL, T.S., Assistant Professor and Thomas Wuint, Sphere of influence graphs in general metric spaces, Mathematical and Computer Modelling, 29 (1999) 45-53.

PRICE, Geoffrey L., "Shifts on the hyperfinite II, factor" Journal of Functional Analysis 156(1998) 121-169.

Let $u_o, u_{1,\ldots}$ be a sequence of hermitian unitary operators in a von Neumann algebra which are assumed pairwise either to commute or to anticommute, and which satisfy the further property that for any positive integer k the pair of operators $u_{i+k} u_{j+k}$ have the same commutation relations as do the pair u_i, u_j. If the commutation relations are sufficiently chaotic the weakly closed algebra generated by these operators is isomorphic to the hyperfinite II_1 factor R. Due to the translation invariance of the commutation relations one can define a shift endomorphism s on R which satisfies $s(u_i) = u_{i+1}$ for all non-negative integers i. Endomorphisms of R defined in this way are called Powers shifts. The commutant index of s is defined to be the first positive integer k such that the von Neumann subalgebra $s^K(R)$ of R has non-trivial relative commutant in R. In this paper the author generalizes his result, to higher commutant indices, that any pair of Powers shifts of relative commutant index 2 are cocycle equivalent.

PRICE, Geoffrey L., Professor, "The Entropy of Rational Powers Shifts", Proceedings of the American Mathematical Society, 1998, vol. 126, no. 6, pp. 1715 - 1720.

Let $u_o, u_{1,\ldots}$ be a sequence of hermitian unitary operators in a von Neumann algebra which are assumed pairwise either to commute or to anticommute, and which satisfy the further property that for any positive integer k the pair of operators $u_{i+k} u_{j+k}$ have the same commutation relations as do the pair u_i, u_j. If the commutation relations are sufficiently chaotic the weakly closed algebra generated by these operators is isomorphic to the hyperfinite II_1 factor R. Due to the translation invariance of the commutation relations one can define a shift endomorphism s on R which satisfies $s(u_i) = u_{i+1}$ for all non-negative integers i. Endomorphisms of R defined in this way are called Powers shifts.

The Connes-Stormer entropy for automorphisms of the hyperfinite II_1 factor R is modeled on the classical

entropy defined for commutative dynamical systems. The Connes-Stormer entropy may also be defined for Powers shifts. Narnhofer, Stormer and Thirring have published results of Powers shifts which have Connes-Stormer entropy 0. In the paper above Price shows that all Powers shifts of finite relative commutant index have Connes-Stormer entropy ½log2. It is an outstanding problem to try to determine whether there are Power shifts whose entropy is other than 0 or ½log2.

WARDLAW, William P., Professor, "Quickie Q882 and Answer A882," Mathematics Magazine Vol 71 no. 3 (June 1998) p. 226 and p. 231.

Q882. Proposed by William P. Wardlaw, U.S. Naval Academy, Annapolis, Maryland let F_q denote a field with q elements. Suppose that A is an m x n matrix over F_q that has a right inverse over F_q. How many right inverses does A have over F_q?

A882. The matrix A has $q^{m(n-m)}$ right inverse over F_q. To see this, we note that since $AB = I_m$ for some n x m matrix B, A must have full rank m. Hence, the nullspace of A has dimension n - m and consists of q^{n-m} vectors in the nullspace of A.

WARDLAW, William P., Professor, "Solution 10487" American Mathematical Monthly vol. 105 no. 8, October 1998, p. 773.

Let R be a commutative ring with 1 and let A be an n-by-n matrix over R. If $x=\langle x_1, x_2, \ldots, x_n\rangle$ is a vector with entries in R, let (x) denote the ideal generated by the entries of x. Show that (xA) = (x) for every n-tuple x over R if and only if A is invertible.

WARDLAW, William P., Professor, and SPELLMAN, Dennis "Problem 1567" Mathematics Magazine, vol. 72 no. 1, pg. 65, February 1999.

1567. Proposed by Dennis Spellman, Philadelphia, Pennsylvania, and William P. Wardlaw, United States Naval Academy, Annapolis, Maryland, Find the Smith normal form over the integers of the n x m matrix A with entries $a_{ij} = j^i$.

WOOD, Joshua T, Midn 1/C and Bollt, Erik, M., Assistant Professor, "Error Statistics of Time-Delay Embedding Prediction on Chaotic Time Series", USNA Trident Scholar Report No. 271, U.S. Naval Academy, May 1999.

This project investigates a statistical method for analyzing the error on predictions made through the process of time-delay-embedding of chaotic time series. When viewed as a time-series, chaotic data appears to be unpredictable and random. A chaotic system actually has an orderly representation when viewed in its proper state space (the space consisting of the pertinent variables of the system, when the data is recorded time if often incorporated into the analysis. This creates a problem when making predictions on a chaotic system, since a prediction is a forecast of the system at a later time. A remarkable result from the study of chaotic dynamical systems shows that present in almost any single time-series is information from all the variables of the state space. The technique of time-delay-embedding provides a method for reconstructing a topological equivalent of the state space attractor from this single time-series. The reconstructed attractor can then be used to make predictions on the evolution of the system. This project describes an algorithm for determining an appropriately fitted model for time-delayed data. A prediction is then made from this model along with confidence intervals which measure the reliability of the expected response. This model is tested on large sets of both computer-generated and experimentally-gathered chaotic data. Large data sets are used to verify the accuracy of the confidence bands. While this project involved many different data sets, the purpose was not to analyze these specific data sets, but to begin work on a general algorithm which could theoretically be used on any chaotic system.

Presentations

BOLLT, Erik M., Assistant Professor, "Model Selection, Confidence and Scaling in Predicting Chaotic Time-Series" SIAM Dynamical Systems Conference, Snowbird, Utah, May 1999.

BOLLT, Erik M., Assistant Professor, "Dynamics of coding in communicating with chaos" SIAM Dynamical Systems Conference, Snowbird, Utah, May 1999.

BOLLT, Erik M., Assistant Professor, "Optimal Targeting" SIAM Dynamical Systems Conference, Snowbird, Utah, May 1999.

BOLLT, Erik M., Assistant Professor, "On the Inverse Frobenius-Perron Problem: Global Stabilization of Arbitrary Invariant Measures" SIAM Dynamical Systems Conference, Snowbird, Utah, May 1999.

BOLLT, Erik M., Assistant Professor, "Model Selection, Confidence and Scaling in Predicting Chaotic Time Series" Chaos Brown Bag Lunch, University of Maryland, April 22, 1999.

BOLLT, Erik M., Assistant Professor, "On the Inverse Frobenius-Perron Problem: Global Stabilization of Arbitrary Invariant Measures" Invited Colloquium Lecture, University of Kansas at Lawrence, February 26, 1999.

BOLLT, Erik M., Assistant Professor, "On the Inverse Frobenius-Perron Problem: Global Stabilization of Arbitrary Invariant Measures, Invited Colloquium Lecture, February 12, 1999.

BOLLT, Erik M., Assistant Professor,"Chaos, Control; Opposite sides of the same coin" Math Club, U.S. Naval Academy, Annapolis, Maryland, November 1998.

BOLLT, Erik M., Assistant Professor, "On the Inverse Frobenius-Perron Problem: Global Stabilization of Arbitrary Invariant Measures, Invited Colloquium Lecture, Boulder, Colorado, October 23, 1998.

BOLLT, Erik M., Assistant Professor, "On the Inverse Frobenius-Perron Problem: Global Stabilization of Arbitrary Invariant Measures" Math Colloquium, U.S. Naval Academy, Annapolis, Maryland, October 1998.

BUCHANAN, James L. and Gilbert, R. P., Paraobolic approximation of acoustic pressure over a poroelastic seabed. Presented 17 July 1998 at PIERS98, Nantes, France.

BUCHANAN, James L. and Gilbert, Wirgin, A. and Xu, Y. Identification of the size and shape of a soft body of revolution located within a waveguide. Presented May 11, 1999, Fourth ICTCA, Trieste, Italy

CRAWFORD, Carol G., Professor, "Integrating Computer Vision Research into Undergraduate Discrete Mathematics Courses" International Conference on Mathematics/Science Education and Technology, San Antonio, Texas, March 3, 1999.

GAGLIONE, Anthony M., Professor, "On a Question of Charles Sims Relativized to the Metabelian Case" U.S. Naval Academy Math Department Seminar, Annapolis, Maryland, October 1998.

GAGLIONE, Anthony M., Professor, "Formations and Varieties of Groups" New York Group Theory Conference, CUNY Graduate Center, New York, New York, October 2, 1998.

GAGLIONE, Anthony M., Professor, "On a Question of Charles Sims" SUNY at Albany Group Theory Conference, Albany, New York, October 11, 1998.

GAGLIONE, Anthony M., Professor, "Fully Residually Free Groups and Free Exponential Groups" New York Group Theory Conference, CUNY Graduate Center, New York, New York, March 12, 1999.

GAGLIONE, Anthony M., Professor, "Applications of

Group Theory for Undergraduate Mathematics" Fairfield University, May 28, 1999.

GAGLIONE, Anthony M., Professor, "On a Question of Charles Sims" Ohio-Denison Group Theory Conference, Binghamton University, Binghamton, New York, May 22, 1999.

HOFFMAN, Michael, Professor, "What is a Hopf algebra?" Mathematics Colloquium, U.S. Naval Academy, September 9, 1998.

KAPLAN, Harold M., Professor, "Exact subsample tests for two samples with invariance," 1998 Mid-Atlantic Regional Probability and Statistics Day, United States Naval Academy, Annapolis, Maryland, October 3, 1998.

KIDWELL, Mark E., Professor, "Bridges and Tangles". Knots Miniconference at Georgetown University, October 1998.

KONKOWSKI, Deborah A., Professor, "Instability of Plane-Wave Cauchy Horizons," Poster Presentation at 19th Texas Symposium on Relativistic Astrophysics, Paris France, December 1998.

KONKOWSKI, Deborah A., Professor, "Testing a Stability Conjecture with Plane-Wave Cauchy Horizons," presented at the American Physical Society's Centennial Meeting, Atlanta, Georgia, March 1999.

LOCKHART, Robert B., Associate Professor, Math Department, Quantum Information Theory" presented in the Mathematics Colloquium at the U.S. Naval Academy, Annapolis, Maryland, June 1999.

MCCOY, Peter A., Professor, "Discrete and Continuous Sampling in Several Variables", American Mathematical Society Annual Meeting, San Antonio, Texas, January 13, 1999.

MCCOY, Peter A., Professor, "Transformation and Structure of Sampling Series." SIAM Annual Meeting, Atlanta, Georgia, May 15, 1999.

MELLES, Caroline Grant, Associate Professor, "An Explicit Construction of Complete Kahler Saper Metrics by means of Desingularization," AMS Special Session, Joint Mathematics Meetings, San Antonio, Texas, January 14, 1999.

MELLES, Caroline Grant, Associate Professor, "Coherent Ideal Sheaves and Blow-ups," United States Naval Academy

MICHAEL, T.S., Associate Professor, "Ryser's Embedding Problem for Hadamard Matrices," 30th International Southeastern Conference on Combinatorics, March 1999.

MICHAEL, T.S., Associate Professor, "Problems in Combinatorial Matrix Theory" University of West Florida, April 1999.

MICHAEL, T.S., Associate Professor, "Combinatorics Problems of Ryser and Erdös," University of Delaware, April 1999.

MICHAEL, T.S., Associate Professor, "Pranks by Design," Conference on Coding Theory, Cryptography, and Number Theory, United States Naval Academy, Annapolis, Maryland, October 1998.

MICHAEL, T.S., Associate Professor, "Permanents," United States Naval Academy, January 1999.

MICHAEL, T.S., Associate Professor, "Faculty Panel on Library Research," 25th Anniversary Celebration of Nimitz Library, September 1998.

MICHAEL, T.S., Associate Professor, "Discrete Mathematics: Resources for Faculty and Midshipmen," Report to Faculty of Curriculum Development project, September 1998.

PENN, Howard L., Professor, "Homerun Hitting, an Application of Projectile Motion." MAA Summer National Meeting, Toronto, Ontario, July 1998.

NAKOS, George, Professor, and Dr. Williams, Robert (NAWC) "Obtaining Triangular Polynomial Systems with the Dixon Resultant", Poster presented at the East Coast Computer Algebra Conference, Raleigh, North Carolina, 24 April 1999.

PRICE, Geoff, L., Professor, "Equivalence of shifts on the hyperfinite II_1 factor", Functional Analysis Seminar, University of California, Berkeley, September 1998.

PRICE, Geoff, L., Professor, "The Structure of binary shifts" Graduate Student Seminar, University of California, Berkeley, March 8, 1999.

PRICE, Geoff, L., Professor, "The structure of binary shifts" USNA Mathematics Department Colloquium, March 17, 1999.

STANFORD, Theodore B., Assistant Professor, "Knots modulo braid commutators," Knots in Hellas Conference, Delphi, Greece, August 10, 1998.

STANFORD, Theodore B., Assistant Professor, "Vassiliev's knot invariants and the structure of the braid groups," Topology Seminar, University of Rochester, Rochester, New York, November 6, 1998.

STANFORD, Theodore B., Assistant Professor, "Free Newton polynomials and the concordance group of two-strand string links," George Washington University, February 12, 1999.

STANFORD, Theodore B., Assistant Professor, "Brunnian links, braids, and free group elements," United States Naval Academy, Annapolis, Maryland, February 17, 1999.

STANFORD, Theodore B., Assistant Professor, "Symmetries of 2-strand string links up to concordance," Special Session of the AMS Spring Western Section Meeting, Las Vegas, Nevada, April 10, 1999.

STANFORD, Theodore B., Assistant Professor, "Brunnian braids and links, n-triviality, and group commutators," Special Session of the AMS Spring Eastern Section Meeting, Buffalo, New York, April 24, 1999.

STANFORD, Theodore B., Assistant Professor "A move on diagrams that generates S-equivalence of knots," mini-conference at George Washington University, Spring 1999.

TRAVES, William N., Assistant Professor, "Application of Commutative Algebra to Internet Reliability." Graduate Program in Algebra, Mathematical Sciences Research Institute, July 1998.

TRAVES, William N., Assistant Professor, "Differential Operators on Toric Varieties." Computational Issues Seminar, Mathematical Sciences Research Institute, November 1998.

TRAVES, William N., Assistant Professor, "Introduction to Differential Operators." Postdoctoral Seminar, Mathematical Sciences Research Institute, December 1998.

TRAVES, William N., Assistant Professor, "Derivation in Prime Characteristic," Eisenbud Seminar, University of California (Berkeley), December 1998.

TURNER, Peter R., Professor, "Image and Moving Object Identification in Computer Vision" ICIAM 99, Edinburgh, Scotland, July 1999.

TURNER, Peter R., Professor, "Teaching Scientific Computing through Projects", FIE99, Puerto Rico, November 1999.

WARDLAW, William P., Professor, "A Course in Number Theory and Cryptology", MA Summer MathFest at Ryerson University, Toronto, Ontario, Canada, July 16, 1998.

WARDLAW, William P., Professor, "A Maple Implementation of the RSA Public Key Cipher", MAA

Summer MathFest at Ryerson University, Toronto, Ontario, Canada 17 July 1998.

WARDLAW, William P., Professor, "Matrix Completion and Good Matrices", U.S. Naval Academy Mathematics Department Colloquium, Annapolis, Maryland, October 2, 1998.

WARDLAW, William P., Professor, "The RSA Public Key Cipher Algorithm", U.S. Naval Academy Conference on Cryptology and Coding Theory, Annapolis, Maryland, October 26, 1998.

WARDLAW, William P., Professor, "Matrix Completion and Good Matrices", Annual Meeting of AMS and MAA, San Antonio, Texas, January 15, 1999.

WARDLAW, William P., Professor, "A note on e", Spring meeting of the MD-VA-DC Section of the MAA, James Madison University, Harrisonburg, Virginia, April 10, 1999.

Oceanography

Captain Dennis J. Whitford, USN
Associate Professor
Chair

The Oceanography Department has the largest undergraduate physical oceanography program in the nation. In addition to rotating military faculty, this program is anchored by only five tenure track faculty and one externally-funded research faculty. Their meteorology and oceanography (METOC) scientific and pedagogical research productivity, especially when teamed with midshipmen, was quite impressive for the 1998-1999 research year.

The department commenced its research efforts by hosting its fifth Maury Project summer workshop in July 1998. Twenty-six K-12 science teachers from across the nation were introduced to physical oceanography teaching methodologies. Physical oceanography is recognized by pedagogical researchers as being more attractive to students than the more intimidating topics of physics, mathematics, and chemistry; yet it includes applications of all these fields. Thus these K-12 teachers will use physical oceanography to get their students excited about science and mathematics.

Through involvement in the department's Independent Research Courses, twenty-two midshipmen were directly involved in METOC research. Their research projects were cooperative efforts by the midshipmen and their research advisors. The projects introduced the midshipmen to the excitement and responsibility of data collection and analysis, as well as exposing the midshipmen to independent scientific thought and evaluation. At the end of each semester, these midshipmen presented their results to the department's faculty in a formal presentation. As a result of these efforts, several midshipmen went on to deliver oral and poster

presentations at scientific conferences. In addition, the department was fortunate to have another Trident Scholar this year. Midn 1/C James Coleman's research, entitled "Optical Variability in an Estuarine Environment", was awarded the Harry E. Ward Trident Prize for its competitive selection as the best Trident Research for the 1998-1999 academic year.

In a natural extension of the Maury Project, Associate Professor David Smith received a $2M pedagogical research grant, to be used over a 4.5 year period, to fund a distance learning project entitled "Water in the Earth System.". This is the largest external grant ever received by a USNA faculty member.

The annual Oceanographic Yard Patrol (YP) Summer Cruise aboard YP686 was conducted in June 1999. This cruise took on an added dimension this year in that data acquisition was conducted to directly support Project PROBE (Plankton Research on Bay Environments), a state-of-the-art research project being conducted by two faculty members. Data will be used to support publishable refereed research.

All faculty continued their strong research efforts with multiple articles submitted for publication.

Sponsored Research

Shipyard Trace Metal Removal System for Hull Cleaning Operations

Researcher: Professor John W. Foerster
Sponsor: Naval Research Laboratory (NRL)

With the requirements to reduce and eliminate environmental contamination, the Navy now has a problem with trace metals produced during shipyard hull refurbishment (grinding and repainting a hull). At present, there is no simple method to reduce this contamination in a timely and cost effective manner. This work studied a relatively portable and cost effective method for removing this contamination. The method takes advantage of a common waste (shells from shrimp). Coarse ground shells received a chemical treatment to produce the product chitosan, a polyglucosamine. Chitosan absorbs trace metals and is regenerated with dilute aqueous acid (acetic acid). This allows for cost effective recovery of the trace metals without costly landfill burial (chemical precipitation and zeolite methods). The advantage is that the system is simple to use, re-usable, and provides water recycling. Results are quick and the process requires little personnel training. Coupling this cleaning system to a testing comparator (patent pending) makes cleaning and tracking the waste less complicated and costly than other methods (chemical precipitation, ion exchange, chelation).

Development of Specific Ion Probes for Use in Seawater

Researcher: Professor John W. Foerster
Sponsor: Naval Research Laboratory (NRL)

Research will be conducted into developing polymer based specific ion probes for detecting chromium (VI) and lead in seawater. Both diphenylcarbizide (for Cr) and dithizone (for Pb) dyes will be incorporated into an ionomeric membrane (Nafion) and a test developed for measuring these trace metal contaminants. This project is relevant to Navy environmental projects and shipyard contamination monitoring.

Measuring Copper in the Marine Environment

Researcher: Professor John W. Foerster
Sponsor: Naval Research Laboratory (NRL)

A major source of trace metal contamination in the marine environment is the copper containing anti-foulant paints on ship hulls. An anti-fouling paint containing copper (I) presents a challenge to the environment because its design is to leach continuously over a period of time. This study tests the hypothesis that the organic molecule, 2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline-disulfo nic acid (Bathycuproinedisulfonic acid = BCS) is a reliable chemical to use in developing a sensor capable of measuring copper (I) in seawater. The purpose is to acquaint environmental users and managers with a system easily used to determine levels of copper contamination. A sensor system that will measure trace metal contamination quickly will help in the deployment of remedial methods to avert an environmental problem. The sensor must have

- parts per billion (ppb) detection limits,
- environmental immersion capability, and
- the ability to detect the copper (I) oxidation state.

Results of this study show copper one leaching at a rate of 1.2 ppb/hour. After 2 hours copper (I) begins to convert to copper (II). Both ions are toxic above very low ppb concentrations (<5.0 ppb). Initially for the first 2 hours you have 100% copper (I) leaching into the water and by 20 hours the ratio is 38% copper (I) to 62% copper (II). The BCS chemical is a quick and relatively easy way to determine the concentration of copper (I) in marine and estuarine waters.

TerraBase II: Computerized Terrain Analysis Training System

Researcher: Associate Professor Peter L. Guth
Sponsor: U.S. Army Engineer School, Ft. Leonard Wood, MO

TerraBase II is a training system to expose soldiers to the nature and types of digital terrain data, procedures for visualizing terrain, and integrating terrain into tactical planning. The program runs on standard desktop, laptop, and notebook computers with the Windows 95 or NT operating system, and uses standard terrain data from the National Imagery and Mapping Agency. The program provides base maps for tracking situation, terrain computations (*e.g.,* line of sight, slope for cross country mobility, sunrise/sunset), and 3D visualizations. The program integrates digital elevation models and satellite imagery. This year's work greatly increased the number of data sets the program used, increased the number of display and analysis options, and improved display capabilities.

Illuminance Trends during Clear & Overcast Twilights: Spectroradiometric Time Series & their Practical Application (within "Twilight and the Naked-eye Observer: Models and High-resolution Measurements")

Researchers: Midn 1/C Stephen Coffee, USN and Adjunct Visiting Assistant Professor Raymond L. Lee, Jr.
Sponsor: National Science Foundation (NSF)

In recent decades, little research has been done on outdoor illuminance trends during twilight. This data has both military and civilian applications, including evaluating lighting for architecture, transportation, and naval operations. Given the availability of field-portable spectroradiometers, measuring twilight skies' spectral irradiances is now relatively easy. The resulting illuminance time series (or trends) show just how well we can actually see during twilight, and they can provide valuable information about atmospheric structure. With Prof. Lee's assistance, Midn. 1/C Coffee measured many clear-sky and overcast spectral irradiances during the 1998-99 academic year. Specifically, we measured temporal trends in illuminance and spectral irradiance falling on a horizontal surface outdoors, a standard technique for determining visibility during twilight. Subsequent analysis of these time series was the basis for Coffee's well-received May 1999 research presentation.

For clear skies, we found that illuminance trends are quite similar from day to day and that a simple equation accurately predicts twilight illuminance given sun elevation h_0. For overcast twilights, illuminance depends both on h_0 and on the overcast's optical depth t. Because of this optical-depth dependence, overcast illuminance can fluctuate considerably around its overall decreasing trend during evening twilight. This is quite different from the smooth, predictable decreases measured during clear twilights. Overcast illuminances normalized by their clear-sky counterparts yield a quantitative measure of overcast t and physical thickness h. This in turn provides a practical and inexpensive way to measure a presently unmeasured meteorological quantity, overcast thickness. In addition to having practical applications in aircraft operations, our research can benefit numerous atmospheric radiative transfer models by providing yet another standard for testing those models' realism.

The Influence of Dynamics and Thermodynamics on the Diagnosis of Marine Atmospheric Boundary Layer Statistics by Synthetic Aperture Radar

Researchers: Assistant Professor Todd D. Sikora and Midn 1/C John C. Bleidorn, USN
Sponsor: Office of Naval Research (ONR)

An algorithm for calculating marine atmospheric boundary layer statistics from synthetic aperture radar (SAR) 10m neutral wind imagery in the presence of convection is tested on 6 Radarsat images. The 6 Radarsat images are scenes from off the East Coast of the United States during cold air outbreaks. Comparisons are made between the results for the Obukhov length of the SAR algorithm and those from a bulk flux algorithm which uses corresponding buoy data as input. In general, the agreement is better, the more unstable the surface layer as defined by the Bulk Richardson Number. Deviations range from 23% to

two orders of magnitude. It is hypothesized that the effects of non-surface forced convection such as cloud radiative cooling and precipitation evaporation can lead to the SAR algorithm out performing the bulk flux algorithm. Potential sources of error for the SAR algorithm are discussed.

The Maury Project - Exploring the Physical Foundations of Oceanography

Researcher: Associate Professor David R. Smith
Sponsors: National Science Foundation (NSF),
Commander, Naval Meteorology and Oceanography Command
and Maryland Space Grant Consortium

The Maury Project is a teacher enhancement program on the physical foundations in oceanography for pre-college educators. Each year approximately twenty-five teachers are brought to the United States Naval Academy to attend a summer workshop where they learn about fundamental concepts in physical oceanography. This includes a combination of lectures, hands-on laboratory exercises, field experiences, and tours of oceanographic facilities. Upon completion of the summer workshop, these teachers return to their respective states where they conduct peer-training sessions for other teachers using materials developed by project staff.

The Douro Estuary (Portugal): Hydrodynamic Study

Researchers: Associate Professor Mario E. C. Vieira and Dr. A. Bordalo
Sponsor: Porto University, Porto, Portugal

The Douro River (Northwest Portugal) forms an estuary in the last 22 km of its course. Due to damming and diversion for irrigation, the fresh water inflow has been reduced since 1985; further reductions are forthcoming after an agreement between the governments of Portugal and Spain. Additionally, breakwater construction is planned at the mouth. There being no literature on the hydrodynamic behavior of this waterway, this project consists of analysis of hydrographic data collected by investigators of Porto University. It has been found that this is a mesotidal estuary featuring a very dynamic salt wedge highly dependent on river discharge. The tide is a standing wave throughout the length of the estuary, which explains its atypical behavior. This is an ongoing project, started during my sabbatical in the Spring of 1998.

Internal Tides in the Setúbal Canyon (Portugal)

Researchers: Associate Professor Mario E. C. Vieira, LCDR F. Coelho PN, and Dr. A. Clemente
Sponsor: Portuguese Hydrographic Institute

The Setúbal submarine canyon starts its descent through the narrow Portuguese continental shelf at

depths of about 50 m, attaining abyssal depths of 4000 m after running for about 100 km. This investigation focuses on the hydrodynamics at the head of the canyon and adjacent shelf through the analysis of hydrographic data taken by the Portuguese Hydrographic Institute. The hypothesis is that tidal and atmospheric forcing determine the injection of energy from the open ocean into the canyon and onto the shelf, whereupon the vertical structure of the column responds at inertial and subtidal frequencies. A linear model is giving encouraging results. This is an ongoing project, started during my sabbatical in the Spring 1998.

Independent Research

Sentinel Species: Managing Trace Metals in a Large Estuarine System

Researcher: Professor John W. Foerster

Oyster toadfish (*Opsanus tau*) and the American oyster (*Crassotrea virginica*) are resident, non-migratory species important to the estuarine benthic food web along the eastern coast of North America. They are sentinel species with the potential to extract potentially toxic environmental trace metals. To test this hypothesis, samplings are from areas away from direct industrial or commercial effluents. Using a proton induced x-ray emissions (PIXE) system, this study concentrates on trace metals found in the liver of the oyster toadfish and the gill and muscle tissue of the oyster. The PIXE system is a rapid method to determine trace metal types, concentrations and for archiving samples. Present analyses of various size toadfish show that the livers contained concentrations of chromium (6-52 mg/L), copper (3-26 mg/L), and zinc (9-30 mg/L). For the toadfish, the trace metals vary as a function of the size, age, and sex of the fish. Generally, the trace metals have an accumulation pattern of chromium>zinc>copper. The life history stage of the toadfish is an important factor in trace metal accumulation. Oysters tend to concentrate trace metals in the ratio of zinc>copper>selenium with varying concentrations of lead and arsenic (1-10 mg/l). The lead, arsenic and copper accumulation in these animals fit patterns of land use. Therefore, trace metal accumulation relative to life history stages, and land use practices in the northern Chesapeake Bay indicates these two species are useful sentinel species for various trace metals.

Research Course Projects

and Trident Scholar Projects

The Influence of Dynamics and Thermodynamics on the Diagnosis of Marine Atmospheric Boundary Layer Statistics by Synthetic Aperture Radar

Researcher: Midn 1/C John C. Bleidorn, USN
Faculty Advisor: Assistant Professor Todd D. Sikora

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illuminance can fluctuate considerably around its overall decreasing trend during evening twilight. This is quite different from the smooth, predictable decreases measured during clear twilights. Overcast illuminances normalized by their clear-sky counterparts yield a quantitative measure of overcast ô and physical thickness h. This in turn provides a practical and inexpensive way to measure a presently unmeasured meteorological quantity, overcast thickness. In addition to having practical applications in aircraft operations, our research can benefit numerous atmospheric radiative transfer models by providing yet an other standard for testing those models' realism.

Optical Variability of the Chesapeake Bay

Researchers: Midn 1/C James E. Coleman, Jr., USN, Trident Scholar
Faculty Advisors: Adjunct Associate Professor Richard W. Spinrad, Associate Professor David R. Smith and Associate Professor Steven N. Montgomery (Physics Department)

This project investigates the seasonal variation in the in-water optical properties of the Chesapeake Bay estuary. Understanding this variability allows for the proper employment of optical measurement techniques as well as a foundation for accurate interpretation of remotely sensed visible imagery.

The absorption and scattering properties of the Bay water column can be expected to change with major physical variations. The most significant source of physical variation in the Bay is associated with the fall destratification or mixing event. As autumn progresses, atmospheric cooling causes a temperature inversion in the water column, thereby weakening the salinity-stratified pycnocline. Combining this inversion with increased winds associated with fall storm systems causes a top to bottom mixing of the water column.

An intensive study combining *in situ* hydrographic and optical measurements as well as laboratory characterization of the suspended load is performed across a destratification event in the northern Bay. These data and analysis are combined with theoretical modeling to characterize the physical variation in terms of changes in the absorption, scattering, and hence suspended load properties of the Bay.

A Study of the Effect of El Nino on the Weather of U.S. Cities

Researcher: Midn 1/C Susan T. Feher, USN
Faculty Advisor: Associate Professor David R. Smith

El Nino, as proven in previous studies, alters the tracks of extratropical cyclones to the south during the winter months. An analysis of data sets for fourteen different stations across the continental United States was conducted to determine the effects of El Nino on the normal weather conditions of U.S. cities. This study reveals the specific effects on the weather for these stations due to the 1997-98 El Nino. The analysis was completed for the winter months, December through March to determine deviations from normal due to the changes associated with the 1997-1998 El Nino. This analysis was accomplished by calculating the deviations from normal for both temperature and precipitation on a monthly basis on a spreadsheet and graphing the results. All of these stations' weather changed due to the El Nino event. Furthermore, the results show that most stations experienced an increase in precipitation and

temperature. Also, the southern-most stations deviated further from normal than did the northern-most stations.

A Study of the Effect of La Niña on the Weather of U.S. Cities

Researcher: Midn 1/C Susan T. Feher, USN
Faculty Advisor: Associate Professor David R. Smith

La Niña, as proven in previous studies, alters the tracks of extratropical cyclones to the north during winter months. An analysis of data sets for fourteen different stations across the United States was conducted to determine the effects of La Niña on the normal weather conditions of U.S. cities. This study reveals the specific effects on the weather for these stations due to the 1998-99 La Niña. The analysis was completed for the winter months (December through March) to determine the deviations from normal due to the changes associated with the 1998-99 La Niña. This analysis was accomplished by calculating the deviations from normal for both temperature and precipitation on a monthly basis on a spreadsheet and graphing the results. Cooler and drier conditions were expected due to the La Niña event. The weather conditions did show significant deviations from normal due to the La Niña, but in many cases the temperatures were still above normal. The precipitation had much more distinct results. Most of the southern stations were either much drier than normal, as nearly all storms passed to the north. The northern stations were either at or above normal as the storms tracked across the northern United States. The greatest deviations were experienced in stations along the west coast and most closely experienced the predicted weather conditions for a La Niña event.

Computer-Aided Visualization and Animation of Ocean Wave Dynamics

Researcher: Midn 1/C Charles F. Gould, USN
Faculty Advisor: Captain Dennis J. Whitford, USN

Ocean waves are the most recognized phenomena in oceanography. Students majoring in oceanography first encounter the complex mathematical theories of these surface gravity waves in upper level undergraduate and lower level graduate courses. Linear wave theory is the simplest theory which mathematics models these waves, yet its complex mathematical equations are often difficult and confusing to students. This difficulty is due to linear wave theory's inherent dependence on time and space along with its mixture of linear, hyperbolic, and trigonometric functions in its equations. As a result, verbal descriptions and two-dimensional illustrations are often insufficient for in-depth student comprehension. Thus, computer-aided visualizations and animations are a welcome pedagogical supplement to traditional methods of instruction.

A MATLAB® software program was developed to compute, visualize, and animate various ocean wave dynamics topics for instructional pruposes. These topics include: water particle orbital paths, displacements, velocities and accelerations; static, dynamic and total sub-surface pressures; and velocity potentials and streamlines. By using the developed computer code, others may produce these visualizations of ocean wave dynamics without the benefit of an extensive background in computer programming.

Gravity Wave Initiation of a Severe Thunderstorm over the Chesapeake Bay

Researcher: Midn 1/C Clarence Neslen, USN
Faculty Advisors: Assistant Professor Todd D. Sikora, Associate Professor David Smith
and Richard M. Giannola of Johns Hopkins University Applied Physics Laboratory

On 7 September 1998 there was the development of a severe thunderstorm over the Maryland Eastern Shore. This study explored whether the cause of this convection was a gravity wave. The effects and development of the gravity wave were investigated to quantify the amplitude, period, wavelength, and pressure oscillations. The wave had a period of 3-5 hr and pressure oscillations between -1.110 and 1.72 mb. The wave propagated in an east-southeast direction. The intensity of the thunderstorm was also influenced by the effects of the Chesapeake Bay. The mesoscale circulation and the development of a gust front over the Chesapeake Bay played a major role in the intensification of the storm on the Eastern Shore.

To observe the variations in the temperature, dew point temperature, wet bulb temperature, relative humidity, wind speed, wind direction, and barometric pressure, data from 19 Automated Weather Stations were used. In each example, the atmospheric variables played a major role in identifying an atmospheric instability leading to the development of convection.

From the temperature and pressure data, the equivalent potential temperature (e) was measured at 19 stations along a band from Harper's Ferry, WV to Berlin, MD. The equivalent potential temperature increased over the stations near the Chesapeake Bay as a result of the increased moisture content. More significantly, the e values increased on the Eastern Shore which caused the thunderstorm to intensify as a result. The effects of the Appalachian Mountains also played a major role in the external forcing of wave trains in producing an increase in energy and momentum. The gravity wave was first observed near Harper's Ferry, WV and increased in energy as it moved eastward.

The Fast Fourier Transform (FFT) was used to observe waves at specific frequencies. A FFT analysis was performed by taking into account the pressure oscillations between a crest and a trough to identify high amplitude waves at specific frequencies. The FFT was useful in identifying gravity waves from larger diurnal or secondary oscillations. It was speculated that a gravity wave may have initiated the thunderstorm that occurred over Kent Island, Maryland on 7 September 1998.

Publications

COLEMAN, James E., Jr., Midn 1/C, SMITH, D. R., Associate Professor and MALEK-MADANI, R., Professor, "Serrin's Vortex Revisited," Preprints of the 19th AMS Conference on Severe Local Storms, American Meteorological Society, Boston, MA, pp. 72-75.

Serrin's vortex (1972), a particular solution to the Navier-Stokes equation for rotating flows, is revisited utilizing Mathematica software to model tornadic flow. The solution assumes an inverse relationship between particle velocity and radial distance from the vortex line, a no-slip condition at the surface, and a balance between buoyancy and gravity. Varying parameter values, indicative of the average level of turbulence of the flow, results in unique solutions resembling one and two-celled tornadic flows. Analysis and animations of the solutions correlate well with documented laboratory measurements of velocity fields and with flow visualizations of laboratory vortices.

The simplicity of the solution allows for in-depth analysis including vorticity contours, pressure distributions and component changes in velocity, vorticity, and pressure affecting a single particle transitioning the flow. This paper will describe the model used and present examples of vortical flows and how they relate to naturally occurring tornadoes.

COLEMAN, James E., Jr., Midn 1/C, SMITH, D. R., Associate Professor, SPINRAD, R. W., Adjunct Associate Professor, "Optical Variability in the Northern Chesapeake Bay," Proceedings of the Ocean Community Conference '98 (CD-ROM). Marine Technology Society, Washington, DC, 5pp

The utility of optical properties to identify water masses has been well documented in the open ocean. The nature of these properties is poorly understood in case II waters like the Chesapeake Bay. This study investigates this relationship by focusing on the connection between the total beam attenuation coefficient, a measure of the loss in radiant energy of a monochromatic light beam per unit length, and the total suspended mass. For a given particulate distribution, total beam attenuation coefficient correlates to total suspended particulate mass. Therefore, particulate distributions can be monitored and potentially used to describe water masses or physical processes like distratification. A seven-week study at four sites on an east-west transect of the bay just south of the mouth of the Severn River explored this process. A SeaTech transmissometer was used in conjunction with Sea Bird CTD to collect hydrographic and transmission data. Samples were taken at various depths and analyzed with a Spectrex Laser Particle Counter to determine the size distribution and concentration of the suspended load. These data were used to calculate total suspended volume, which were correlated to beam attenuation in place of total suspended mass. Separating the data temporally based on the occurrence of the mixing event associated with destratification yields two distinct slopes of beam attenuation versus suspended volume. Smoothing of the data by assuming an exponential size distribution lessens the statistical variation caused by slight variation in the counts of larger particles by allowing extrapolation to those particles instead of relying on the original data. The log-log slope of the particle size distribution plotted against beam attenuation can also be used to identify water masses in a manner similar to T-S plots. Similarly, separating these data reveals two separate regions, validating the results obtained with the suspended volume versus beam attenuation plots. It is clear from the study that these optical properties can be used to identify the physical process of destratification, however the ability of these properties to identify water masses in the case II regime is suspect.

COLEMAN, James E., Jr., Midn 1/C, MALEK-MADANI, R., Professor, and SMITH, D. R., Associate Professor, "Visualization of fluid flows using Mathematica," Proceedings of the Ocean Community Conference '98 (CD-ROM). Marine Technology Society, Washington DC 10pp.

The symbolic manipulator Mathematica has high utility in visualizing and analyzing many fluid flows. Serrin's swirling vortex, represented by a nonlinear boundary value problem, can be analyzed and displayed in as much as one page of code using the two techniques of the shooting method and Picard successive iteration. Solutions obtained via Mathematica matched those of Serrin's original differential equations obtained from the discretized velocity profiles. The author succeeded in generating the motion of parcels of fluid for various sets of parameter values. The points comprising these parcels were tracked for particular time intervals. The resulting snapshots are then animated. The visual representations of two distinct solutions of the fluid flow correlate well with flow images from laboratory simulations of one-cell and two-cell meteorological tornadoes. The basic flow dynamics of the simulations agree well with the dynamics of the physical phenomena. Additionally, vorticity and pressure contours obtained are qualitatively similar to those predicted by the meteorological finite difference schemes and laboratory measurements. These results substantiate the ability of a simple fluid dynamic

model to acurately describe axisymmetric tornadic events as well as provide insight into the principle factors affecting tornado size and its destructive capability. The strategy of flow visualization is also utilized to study the flow in the wake of a wind utilizing the vortex lattice method and to understand chaotic advection in the Raleigh-Benard flow.

COLEMAN, James E., Jr., Midn 1/C, SPINRAD, R. W., Adjunct Associate Professor, SMITH, D. R., Associate Professor, and MONTGOMERY, S. N., Associate Professor, "Optical Variability of the Chesapeake Bay," USNA Trident Scholar Report No. 263, U.S. Naval Academy, May 1999.

This project investigates the seasonal variation in the in-water optical properties of the Chesapeake Bay estuary. Understanding this variability allows for the proper employment of optical measurement techniques as well as a foundation for accurate interpretation of remotely sensed visible imagery.

The absorption and scattering properties of the Bay water column can be expected to change with major physical variations. The most significant source of physical variation in the Bay is associated with the fall destratification or mixing event. As autumn progresses, atmospheric cooling causes a temperature inversion in the water column, thereby weakening the salinity-stratified pycnocline. Combining this inversion with increased winds associated with fall storm systems causes a top to bottom mixing of the water column.

An intensive study combining *in situ* hydrographic and optical measurements as well as laboratory characterization of the suspended load is performed across a destratification event in the northern Bay. These data and analysis are combined with theoretical modeling to characterize the physical variation in terms of changes in the absorption, scattering, and hence suspended load properties of the Bay.

FOERSTER, John W., Professor, "Copper Circulation in Two Tidally Influenced Marinas Studied Using a Nafion Polymer Probe," *Field Analytical Chemistry and Technology* 3, 1999, pp. 1-12.

Being able to assess the effects, and predict the movement of an anthropogenic trace metal released into a marine or estuarine environment is a major focus in pollutional studies. One major source of trace metal contamination in these environments is the copper containing anti-fouling paints on ship hulls. This study uses the distribution of total available ionic copper [Cu (I) and Cu(II)] as a means of exploring copper circulation and distribution in two tidally influenced marinas. The central hypothesis is that ionic copper gives a reliable indication of water circulation within a semi-enclosed basin. A secondary, but equally important hypothesis, is that that the organic dye molecule, 2, 9-dimethyl-4, 7-diphenyl-1, 10-phenanthroline (Bathocuproine = BCP) embedded in the polymer Nafion 117 is a reliable system for developing a probe capable of measuring Cu (I) in seawater. Results show that total available ionic copper is circulated, mixed and released into an estuary with the tide relative to the physical parameters in the marina basin. The circulation and mixing are functions of the flushing rate and exchange ratio. In addition, the Nafion 117 containing BCP probe allows for quick and accurate measurement of the Cu (I) component of the total available ionic copper. It is within 17% of the measurements made with the aqueous BCS Standard Method procedure. The polymer impregnated with Bathocuproine (BCP) is a rapid method useful for detecting Cu(I) released into the marine environment. This copper distribution allows for estimation and prediction of the total available ionic copper circulating into the environment.

FOERSTER, John W., Professor, "Sentinel Species: Managing Trace Metals in a Large Estuarine System," *Coastal Communities in the 21st Century*, Coastal Zone Canada Meeting '98, 1, pp. 138-139.

Oyster toadfish (*Opsanus tau*) and the American oyster (*Crassotrea virginica*) are resident, non-migratory species important to the estuarine benthic food web along the eastern coast of North America. They are sentinel species with the potential to extract potentially toxic environmental trace metals. To test this

hypothesis, samplings are taken from areas away from direct industrial or commercial effluents. Using a proton induced x-ray emissions (PIXE) system, this study concentrates on trace metals found in the liver of the oyster toadfish and the gill and muscle tissue of the oyster. The PIXE system is a rapid method to determine trace metal types, concentrations and for archiving samples. Present analyses of various size toadfish show that the livers contained concentrations of chromium (6-52 mg/L), copper (3-26 mg/L), and zinc (9-30 mg/L). For the toadfish, the trace metals vary as a function of the size, age, and sex of the fish. Generally, the trace metals have an accumulation pattern of chromium>zinc>copper. The life history stage of the toadfish is an important factor in trace metal accumulation. Oysters tend to concentrate trace metals in the ratio of zinc>copper>selenium with varying concentrations of lead and arsenic (1-10 mg/l). The lead, arsenic and copper accumulation in these animals fit patterns of land use. Therefore, trace metal accumulation relative to life history stages, and land use practices in the northern Chesapeake Bay indicates these two species are useful sentinel species for various trace metals.

GUTH, Peter L., Associate Professor, “Contour Line ’ghosts’ in USGS Level 2 DEMs”: *Photogrammetric Engineering and Remote Sensing*, vol.65, no.3, (1999) pp.289-296.

Characteristics of Digital Elevation Models (DEMs) differentiate those produced from digitized contour lines from those produced directly from imagery. Contour to grid algorithms produce more grid-node elevations with the same elevation as the contour lines compared to elevations different from contour line elevation; this Aghost@ artifact reflects the DEM generation process and not the underlying topography. In new USGS Level 2 DEMs, elevations corresponding to the source map contours can occur twice as often as similar elevations between contour lines, and overall contour line elevations are over represented by about 30%. Three independent techniques demonstrate the contour line ghosts: visual examination of elevation histograms, the power spectrum from a fast Fourier transform of the elevation distribution, and direct computation of a contour ghost ratio.

GUTH, Peter L., Associate Professor, "Military Geology in War and Peace: An Introduction": in Underwood, J.R., Jr., and Guth, P.L, eds., Military Geology in War and Peace: Geological Society of America Reviews in Engineering Geology, vol. XIII, 1998, pp.1-4.

In warfare military geologists pursue five main categories of work: tactical and strategic terrain analysis, fortifications and tunneling, resource acquisition, defense installations, and field construction and logistics. In peace they train for wartime operations, and may be involved in peace keeping and nation building exercises. While many geologists view military geology as a branch of engineering geology, the U.S. military does not include geologists in its force structure and gets geologic assistance on an ad hoc basis. The Army does, however, include organic terrain teams at division and higher levels to provide routine information for mission planning and execution. The classic dilemma for military geology has been whether support can best be provided by civilian technical-matter experts or by uniformed soldiers who routinely work with the combat units.

GUTH, Peter L., Associate Professor, (co-author), eds., Military Geology in War and Peace, Reviews in Engineering Geology, vol.XIII, Geological Society of America, 1998, 245 p.

This volume contains 24 chapters in 6 sections. The first 11 chapters cover aspects of the history of military geology in the United States and the United Kingdom. Three chapters deal with the current status of geology in the armed forces. Three chapters cover terrain analysis, three chapters cover the use of geology in military engineering, and three chapters cover the use of geology in military peace keeping and nation building exercises. The final chapter explores the future relations of geology and the U.S. Army.

GUTH, Peter L., Associate Professor, "Quantifying Topographic Fabric: Eigenvector Analysis Using Digital Elevation Models": in 27th Applied Imagery Pattern Recognition (AIPR) Workshop:Advances in Computer-Assisted Recognition, R.J. Merisko, ed., vol.3584, 1999, pp.233-243.

Digital elevation models (DEMs) provide an estimate of the topographic fabric (the tendency for topography to have a preferred orientation) of the earth's surface. The algorithm extracts the eigenvectors and eigenvalues from a 3x3 matrix of the sums of the cross products of the directional cosines of the surface normals computed at each point in the DEM. The ratio of eigenvalues S_1 (largest) and S_2 measures the ruggedness of the terrain. The ratio of eigenvalues S_2 and S_3 (smallest) measures the tendency for the terrain to have a preferred orientation, while their orientation reflects the direction of dominant topographic fabric. Sample sizes of about 500-2500 points provide robust statistics, allowing sample regions of 1/2 to 1/3 square degree for global data sets and about 600 meters on a side with 30 m US topography. Topographic fabric appears to be a fundamental characteristic of landforms amenable to quantitative study. It should be included in terrain analysis and classification, and may lead to better estimates for cross-country mobility.

LEE, Raymond L., Adjunct Visiting Assistant Professor, "Regnbuens Farver," Kvant 9 (# 4 December 1998), pp 14.

A color map that shows how the primary rainbow's colors vary with drop size and angle from the sun (or deviation angle; a deviation angle of 138° is 180° – 138° = 42° from the shadow of an observer's head). Each column in this map of George Airy's rainbow theory shows the sequence of colors in a rainbow (or fogbow) caused by one droplet of a given size. As in the natural primary rainbow, reds and oranges are on the exterior of these theoretical rainbows, while greens and purples are on their interior. As drop size decreases, rainbows broaden and become more pastel, ultimately becoming fogbows when the drop radius is less than about 0.07 mm. The alternating greenish and purplish bands inside the bows are called supernumerary bows. Despite their "superfluous"-sounding name, the supernumeraries are an inherent part of the rainbow and can often be seen inside bright fogbows and rainbows.

SIKORA, Todd D., Assistant Professor and Young, G. S., "Distinguishing boundary layer signatures from mesoscale and ocean-clutter in SAR imagery". *Preprints, International Geoscience and Remote Sensing Symposium 98,* IEEE, Seattle, WA, 6-10 July 1998, pp. 1385-1387.

A spectral-based method for filtering synthetic aperture wind imagery (derived from synthetic aperture radar imagery) is presented. The resulting filtered spectra are employed in mixed-layer similarity theory to yield estimates of convective velocity scale. Results are compared to ground-truth data as well as to convective velocity scale derived from a previously a presented study.

SIKORA, Todd, D., Assistant Professor, Phillips, P., and Gadparovoic, R. F., "Gulf Stream web site". *Preprints, Eighth Symposium on Education*, AMS, Dallas, TX, 10-15 January 1999, pp. 68 - 69.

The Gulf Stream is a major component of the North Atlantic circulation. This World Wide Web site, developed as a student project, presents a chronology of the major historical events in the development of our understanding of the Gulf Stream characteristics, a description of observational techniques, and a discussion of its significance for weather, climate and naval operations. The historical treatment includes examples of the earliest nautical charts indicating the location of the Stream, along with brief biographies of many of the scientists who made important contributions to Gulf Stream oceanography. The observational techniques discussed range from early and modern in situ instruments to present day satellite observations with infrared, optical and microwave remote sensors. In addition to on-line access via the Internet, the site is available as a CD-ROM with a Netscape browser interface for use on desktop

computers

SIKORA, Todd D., Assistant Professor and Young, G. S., ”Richardson number dependence on the diagnosis of marine atmospheric boundary layer structure from synthetic aperture radar” *Preprints, Thirteenth Symposium on Boundary Layers and Turbulence*, AMS, Dallas, TX, 10-15 January 1999, pp. 373-374.

Synthetic Aperture Radar (SAR) imagery can be converted to neutral wind imagery using a standard transfer function such as CMOD4. Two methods have previously been presented which employ Monin-Obukhov and mixed layer similarity theory to produce Obukhov length, convective velocity scale, buoyancy flux, and a stability corrected wind speed from the SAR-derived neutral wind imagery. These procedures are based on the variance and spectral shape of the neutral wind imagery in the face of a mottled SAR image where mottling is a SAR signature of boundary layer convection. The ability of SAR to reveal the existence of convection via the mottling is, among other things, a function of the MABL static stability and mean wind speed. In the presence of MABL convection, it is reasonable to expect that as the static stability and mean wind speed change, mottling variability will also change. An increase or decrease in MABL static stability will cause a corresponding decrease or increase in mottling variability, all else being equal. An increase or decrease in mean wind speed will cause a corresponding decrease or increase in mottling variability, all else being equal. It is therefore reasonable to expect that there is a static stability / mean wind speed limit in SAR=s ability to detect the presence of MABL convection. This limit is when the mottling variability approaches zero but the MABL is still convective, not neutral. In short, it is hypothesized that SAR is not a perfect convection finder. This poses a potentially serious problem when employing SAR for the above mentioned MABL techniques. The current research will present neutral wind spectra from Radarsat imagery of the sea surface in the face of varying degrees Richardson Number in order to quantify and account for this potential problem.

SMITH, D. R., Associate Professor, Moran, J. M., and Smow, J. T., “Report on the Fourth International Conference on School and Popular Meteorological and Oceanographic Education.” Bulletin of the American Meteorological Society, 79(7), 1998, pp. 1387-1395.

The Fourth International Conference on School and Popular Meteorological and Oceanographic Education was held 22-26 July 1996 in Edinburgh, Scotland. Conference attendees included 125 educators, meteorologists, oceanographers, and government officials representing 19 nations. The themes of the conference were the roles of meteorology and oceanography in science education and the benefits derived from improved environmental awareness and scientific literacy, particularly weather awareness, meteorological literacy, and understanding of the ocean. Formal presentations, workshops, poster sessions, and demonstrations provided information on programs for teacher enhancement, computer-aided instruction, and classroom access to real-time weather information through the World Wide Web.

SMITH, D. R., Associate Professor, “Meeting Report on the Seventh AMS Symposium on Education,” Bulletin of the American Meteorological Society, 79(12), 1998, pp. 2733-2340.

The American Meteorological Society held its Seventh Symposium on Education in conjunction with the 78th Annual Meeting . The theme of the Symposium was “Atmospheric and Oceanographic Education: Advancing our Awareness”. Thirty-six oral presentations and 47 poster presentations summarized a variety of educational programs or examined educational issues relevant for both the precollege and university levels.

There were also joint sessions with the Second Conference on Coastal Atmospheric and Oceanic Prediction and Processes and the Ninth Conference on Interaction of the Sea and Atmosphere, as well as the Tenth Symposium on Meteorological Observations and Instruments. Over 200 people representing a wide spectrum of the Society attended one or more of the sessions in this two-day event.

SMITH, David R., Associate Professor, Geer, I. W., and McManus, D. E., "The Maury Project: a Program on the Physical Foundations For Pre-college Teachers" Proceedings of the Ocean Community Conference '98 (CD-ROM). Marine Technology Society, Washington, DC, 1998, 5pp.

The Maury Project is a joint venture of the American Meteorological Society (AMS) and the United States Naval Academy, with funding from the National Science Foundation. This unique pre-college teacher enhancement program focuses on the physical foundations of oceanography. Since its initiation in 1994 both the Navy (Naval Meteorology and Oceanography Command and the Office of Naval Research) and NOAA (National Environmental Satellite, Data and Information Service and the National Ocean Service) have become sponsors of this unique educational partnership. The primary activity of the Maury Project is the annual two-week summer workshop for teachers on various aspects of the physical foundations of oceanography. The participant teachers become peer trainers, conducting workshops for their colleagues, normally at statewide science teachers conferences, using teacher's guides on the physical aspects of oceanography as the subject matter area of the workshops. These workshops have reached thousands of teachers at workshops nationwide over the past five years.

This presentation will focus on the activities of the Maury Project over the past five years. In addition, there will be an examination of the accomplishments of the program and its impact on precollege teachers, who have participated in the summer workshops as well as the peertraining sessions conducted across the country and beyond. Finally, there will be a glimpse toward the future to see the directions where the Maury Project will be headed in its efforts to promote the study of the oceans in the precollege classroom.

SMITH, David R., Associate Professor and McManus, D. E., "AMS Maury Project Teacher Guides: Shallow-Water Ocean Waves and *El Niño*, Proceedings of the Ocean Community Conference '98 (CD-Rom). Marine Technology Society, Washington, DC 1998, 3pp.

The Maury Project is the American Meteorological Society's pre-college teacher enhancement program that focuses on the physical foundations of oceanography. This program conducts workshops each summer at the United States Naval Academy. Also, educational resource materials are developed for peer-training by our summer participants for teachers in their home states.

One of the most prominent physical features of the coastal ocean, are shallow-water waves. They are of interest to teachers because of their impacts on coasts, the economy, recreation, and defense. Tides and tsunamis, are special examples of shallow-water waves. Although there is still interest in shallow-water waves as a source of pollution-free renewable energy, present day research is more focused on their role in nearshore geological, chemical, and biological processes. Breaking waves are also being investigated for their impact on beach erosion and coastal habitats as well as an important mechanism contributing to the exchange of energy and material across the air-sea interface.

The first demonstration will focus on a Maury Project hands-on activity that investigates shallow-water waves using Wave Tubes constructed of inexpensive and readily available material. The activity will use the simulated advance of surface waves toward shore to investigate changes in wave characteristics that eventually lead to breakers and surf.

One of the best known examples of global scale air-sea interaction is El Niño and the Southern Oscillation, often described together as ENSO. This is of interest to teachers because its impacts on worldwide weather can lead to major ecological, social, and economic disruptions.

The second demonstration will focus on a Maury Project hands-on activity that investigates air-sea interaction using a device called the ENSO-lyzer to compare and contrast tropical Pacific ocean and atmospheric conditions that occur during El Niño with long term average conditions. This educational device will help teachers to describe the average ocean and

atmospheric conditions of the tropical Pacific, the ocean and atmospheric conditions that occur during El Niño, and the relationships among different atmospheric and oceanic conditions during long-term average and El Niño.

SMITH, David R., Associate Professor, Geer, I.W., Moran, and J.M., Weinbeck, R.S., "The Educational Programs of The American Meteorological Society: A Model For Teacher Enhancement And Leadership Development," Preprints of the 8th AMS Symposium on Education, American Meteorological Society, Boston, MA, 1999, pp. 205-208.

The American Meteorological Society (AMS) has been actively engaged in teacher enhancement programs since 1991. It's first program, Project ATMOSPHERE, created a national network of Atmospheric Education Resource Agents (AERAs), teachers who are instrumental in training their peers with AMS-developed resource materials on selected topics in weather and climate. In addition, AERAs became leaders in their respective states in promoting the study of the atmospheric environment across the K-12 curriculum. They also serve as agents of change in curriculum and assessment within their state educational systems.

In 1994, the Maury Project was begun. Modeled after Project ATMOSPHERE, the Maury Project provides a similar teacher enhancement program on the physical foundations of oceanography. An outgrowth of Project ATMOSPHERE is the DataStreme Project which utilizes near-real-time observational data to enhance the study of weather topics using the Internet as a delivery system. A common thread that runs through all of these teacher enhancement programs is the cultivation of a cadre of teachers with both the necessary scientific background and the leadership skills to serve as educational resource agents in their respective schools and states. These teachers serve an invaluable role of transferring their knowledge acquired through AMS summer workshops to their peers in their home states. Such a network of resource agents working within their own educational systems have made it possible for the AMS educational programs to achieve a level of effectiveness and accomplishment that otherwise would have been impossible. A key component in the development of resource agents is the evolution of the unique AMS model of leadership training for teachers. This paper will examine this leadership model and how it serves the respective AMS educational programs.

SMITH, David R., Associate Professor and Domencic, C. S., "An Analysis of Conditions that Cause Heavy Precipitation: Case Study of 1 March 1997," Preprints of the 14th AMS Conference on Hydrology, American Meteorological Society, Boston, MA, 1999, pp. 233-236.

Flash floods are capable of occurring everywhere in the United States. These events are extremely destructive and are responsible for the most deaths every year of any weather-related phenomena. Flash floods occur most often when a large amount of precipitation falls in a short amount of time. When the ground is not able to absorb this precipitation it flows into streams and waterways. If the water overflows the banks of a waterway, flooding begins. In order to get a better understanding of the conditions that cause flash flooding, it is useful to study weather situations that cause heavy precipitation events.

This investigation examines the circumstances responsible for flooding in south central Kentucky on 1 March 1997. This heavy rain event received significant synoptic-scale forcing from a cold front advancing into the area from the Mississippi River Valley. Additionally, the Appalachian Mountains over eastern Kentucky stalled this system and altered the windflow, leading to enhanced moisture convergence over the state. Further, significant convective activity occurred due to the high degree of instability and synoptic-scale forcing. The end result was as much as 30 cm of rainfall in some locations.

PC-GRIDDS, was used to analyze the initialization data for the ETA-model to investigate this scenario. PC-GRIDDS allows for model output to be analyzed at a variety of atmospheric levels. A valuable aspect of this software is that it enables one to

analyze not only conventional meteorological variables (e.g., sealevel pressure, moisture content, or winds), but more complex calculations (e.g., lifted index, moisture convergence, or absolute vorticity). Through the use of this software package, forecasters can determine conditions that contribute to heavy precipitation, thereby leading to improved warnings of flash flood events.

SMITH, David R., Associate Professor, Croft, P.J., Karr, and F. H., Tucker, D. F., "The Bachelor's Degree in Atmospheric Science - Revision of the 1995 AMS Statement," Preprints of the 8th AMS Symposium on Education, American Meteorology Society, Boston, MA, 1999, pp. 188-190.

The AMS Board of Meteorological and Oceanographic Education (BMOEU) has been requested to revise the 1995 AMS statement on the bachelor's degree in atmospheric science. This revision was deemed necessary because of the rising importance of the private sector in meteorology. The BMOEU formed a subcommittee to develop a revised statement. This paper will present the current status of the revised statement.

Although the statement outlines minimum requirements which are not particular to any career path, it is felt that students wishing to pursue a specific type of career should be aware that additional coursework may be helpful to them. The new statement contains short supplemental lists of courses which would be helpful to students interested in a couple of sample career paths.

SMITH, David R., Associate Professor, Garcia, D., and Strong, A.E., "Teleconnections between ENSO and the Atlantic Basin Tropical Cyclone Frequency, Intensity and Cyclogenesis," Preprints of the 23rd AMS Conference on Hurricanes and Tropical Meteorology, American Meteorological Society, Boston, MA, 1999, pp. 423-426.

The El Niño Southern Oscillation (ENSO) is a phenomenon that is not clearly understood. The ability to determine ENSO cycles is extremely vital, but equally important is an understanding of its global impacts and the physics behind the ENSO occurrence. Interannual variations of ocean surface temperatures in the equatorial Pacific, has apparently had effects on weather patterns in other parts of the world. Inter-linked changes, among other phenomena, has lead to the concept of "teleconnections," that is connections between different processes occurring at locations widely-separated across the globe. During ENSO events, the normal pattern of tropical precipitation becomes disrupted, which affects tropical atmospheric circulation features, such as jet streams in the subtropics and in the temperate latitudes. One of several possible disturbances caused by ENSO is the disruption of normal hurricane occurrences in the Atlantic Basin, which includes the North Atlantic, the Caribbean Sea, and the Gulf of Mexico.

According to William Gray, the Atlantic Basin experiences more season-to-season hurricane variability than any other tropical ocean basin. There are seven factors currently being used by Gray and Landsea, to determine tropical cyclone activity, and the presence of ENSO is among one of them. It is obvious that many factors are used in the prediction of hurricanes, but when ENSO occurs, it appears that it not only tends to have an overriding effect over the other influences, but it may well alter other predictive signals. The purpose of this study is to examine connections between ENSO occurrence and hurricane activity in the Atlantic Basin. For this study, the years selected as representing the ENSO warm phase (El Niño) were 1987 and 1997, and those selected as representing the ENSO cold phase (La Niña) years were 1988 and 1995. Sea surface temperature anomalies (SSTAs), presented in this paper are from the month of August, which was chosen since it is one month before the peak hurricane frequency month and mid-way through the season. In this study a "normal" year, 1986, is selected and compared to cold and warm phase ENSO years.

In general, the following patterns were discovered: (a) during an El Niño year tropical cyclone frequency was lower than the average of the last 4 decades, intensity of storms was reduced, and cyclogenesis occurred in higher latitudes, (b) during a La Niña year tropical cyclone activity was more prolific than the

average of the last 4 decades, the intensity of the storms was significantly stronger, and storm cyclogenesis occurred lower in latitude.

This study helped to establish the teleconnection that exists between the ENSO events and Atlantic Basin hurricanes, but attempting to base hurricane activity solely on the effects that ENSO has, would not be valid. Although general patterns were evident, certain aberrations were present. However, this teleconnection should be useful to forecasters for long range prediction of tropical cyclones during ENSO versus non-ENSO years.

The ability to uncover accurate teleconnections between ENSO, from both oceanic and atmospheric conditions and other global events is extremely vital to an improved understanding of the coupled systems and their feedbacks on our planet. This ability, which helps to predict the hurricane season in the Atlantic Basin, will become very important in years to come to many sectors of society, if ocean temperatures continue to rise.

SMITH, David R., Associate Professor and Ledridge, M.J., "The Effect of El Niño on Extratropical Cyclone Tracks in North America," Preprints of the 10th AMS Symposium on Global Change Studies, American Meteorology Society, Boston, MA, 1999, pp. 77-80.

The El Niño/Southern Oscillation event has widespread effects on global atmospheric conditions. During El Niño years, it has been observed that the tracks of extratropical cyclones over the United States are altered compared to those during non-El Niño years. How cyclone tracks are affected during an El Niño event is the focus of this study. Cyclone tracks are plotted across the North American continent for the period 1 December 1997 – 31 March 1998. The frequency of occurrence and the location of the tracks during this period are compared to two other El Niño years (1982-83 and 1987-88) and two non-El Niño years (1985-86 and 1995-96). This paper examines results from both El Niño and non-El Niño cases. There appears to be an equatorward shift in the cyclone tracks during El Niño years compared to non-El Niño years, which can have a significant impact on the weather patterns of areas that are crossed (or missed) by cyclones during an El Niño year.

WHITFORD, Dennis J. , Captain, USN, D. R. SMITH, Associate Professor and W. A. Wright, "The Physical Oceanography and Meteorology Curriculum at the U.S. Naval Academy: Environmental Education for Naval Officers in the 21st Century." Proceedings of the Marine Technology Society Ocean Community Conference '98, (CD-Rom), Washington DC, 1998, 5pp.

The naval warfare environment extends from the bottom of the ocean to the sea surface and well into the atmosphere. In order to effectively perform in such diverse operational arenas, naval officers require an understanding of not only waves, tides and currents, but the characteristics of the deep ocean and the littoral zone, the processes governing the atmosphere as well as the ocean, and, most importantly, knowledge of how the marine environment of an understanding of how it affects one's weapon system is of vital importance to the naval warrior.

The mission of the United States Naval Academy (USNA) is to prepare midshipmen for their future careers as U.S. Navy and U.S. Marine Corps officers. The Oceanography program at USNA is a unique program, designed to provide future officers with a thorough understanding of the ocean and atmospheric environment in which they will be operating in their professional military careers. This undergraduate program focuses on the scientific disciplines of physical oceanography and meteorology with practical application toward naval operations. In addition, the program contains a heavy dose of science, mathematics and engineering courses to provide midshipmen with a strong technical background that forms a solid foundation for any of the naval technical schools and for graduate school.

This presentation will describe the oceanography program at USNA. The Oceanography program builds upon a core of mathematics, science, engineering and

professional military courses taken by all midshipmen with a curriculum of physical oceanography and meteorology courses. There are a wide variety of upper division elective offerings which include biological, chemical, geological and physical oceanography; meteorology; and remote sensing, as well as independent research opportunities. The presentation will focus on how the most recent curriculum revisions are designed to prepare the midshipmen as they prepare for their future military careers in the 21st century.

Technical Reports

FOERSTER, John W., Professor, "Copper Sensor System for Unattended Marine Operations II: Development of a Polymer Sensor and Field Tests," NRL REPORT #NRL/MR/6120-98-8131

A major source of trace metal contamination in the marine environment is the copper containing anti-fouling paints on ship hulls. This research examines the potential of 2, 9-dimethyl-4, 7-diphenyl-1, 10-phenanthroline (Bathocuproine = BCP) embedded in the polymer, Nafion 117, for use as a reliable chemical for developing a sensor capable of measuring Cu(I) in seawater. The sensor must have

- parts per billion (ppb) detection limits,
- marine environmental immersion capability, and
- the ability to detect the Cu(I) oxidation state.

Results of this study show the Nafion 117 containing BCP measures Cu(I) within 17% of measurements made with the Standard Method BCS procedure. The use of the polymer with Bathocuproine (BCP) allows for a rapid electronic measurement. This electronic measurement uses optical fibers running from a small spectrophotometer to either a flow through or a submersible device containing the BCP impregnated polymer. Response times for the devices depend on the size of the membrane used and the flow rate. The flow cell takes 8 minutes to reach a peak optical density while the submersible probe takes 1 minute. Nafion 117 polymer impregnated with Bathocuproine (BCP) is a rapid method useful for detecting Cu(I) released into the marine environment.

Presentations

FOERSTER, John W., Professor, "Sentinel Species: Managing Trace Metals in a Large Estuarine System," at the Coastal Zone Canada '99 meeting in Victoria British Columbia, MD.

GUTH, Peter L., Associate Professor, "Terrain

classification from digital elevation models: Geological Society of America Abstracts with Programs", vol.30, no.7, p.A-137--A-138. Annual meeting, Toronto, Canada, 26-29 October 98

SIKORA, Todd, D., Assistant Professor and G. S. Young, "Distinguishing boundary layer signatures from mesoscale and ocean-clutter in SAR imagery". International Geoscience and Remote Sensing Symposium '98, IEEE, Seattle, 6-10 July 1998.

SIKORA, Todd D., Assistant Professor, R. F. Gasparovic and P. Phillips, "Gulf Stream web site." Eighth Symposium on Education, AMS, Dallas, TX, 10-15 January 1999.

SIKORA, Todd D., Assistant Professor and G. S. Young, "Richardson number dependence on the diagnosis of marine atmospheric boundary layer structure from synthetic aperture radar." Thirteenth Symposium on Boundary Layers and Turbulence, AMS, Dallas, TX, (10-15 January 1999).

SIKORA, Todd, D., Assistant Professor, "Testing the diagnosis of MABL structure from SAR." Emerging Coastal and Marine Applications of Wide Swath SAR Symposium, The Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland, (23-25 March 1999).

SMITH, David R., Associate Professor, "The Effect of El Niño on Extratropical Cyclone Tracks in North America" (with M.J. Ledridge), 10th Symposium on Global Change Studies, Dallas, TX, (January 1999).

SMITH, David R., Associate Professor, "An Analysis of Conditions Responsible for a Heavy Precipitation Event: The Storm of 1 March 1998" (with C.S. Domencic), presented at the 14th Conference on Hydrology, Dallas TX (January 1999).

SMITH, David R., Associate Professor, "Teleconnections of ENSO and the Atlantic Basin Tropical Cyclone Frequency, Intensity and Cyclogenesis" (with D. Garcia and A.E. Strong), 23rd Conference on Hurricanes and Tropical Meteorology, Dallas TX (January 1999).

SMITH, David R., Associate Professor, "Visualization of Fluid Flows Using *Mathematica*" (with J.E. Coleman and R. Malek-Madani), Marine Technology Society's Ocean Community Conference'98, Baltimore, MD (November 1998).

SMITH, David R., Associate Professor, "Serrin's Vortex Revisited" (with J.E. Coleman and R. Malek-Madani), 19th Conference on Severe Local Storms, Minneapolis, MN (September 1998).

SMITH, David R., Associate Professor, "The Educational Program of the American Meteorological Society: A Model for Teacher Enhancement and Leadership Development", (with I.W. Geer, I.W., R.S. Weinbeck and J.M.Moran) 8th AMS Symposium on Education, Dallas, TX (January 1999).

SMITH, David R., Associate Professor, "The Bachelor's Degree in Atmospheric Science - Revision of the 1995 AMS Statement"(with D.F. Tucker, F.H. Karr, and P.J. Croft), 8th AMS Symposium on Education, Dallas, TX (January 1999).

SMITH, David R., Associate Professor, "The Maury Project: A Program on the Physical Foundations of Oceanography for Pre-college Teachers" (with I.W. Geer and D.E. McManus), Marine Technology Society's Ocean Community Conference '98, Baltimore, MD (November 1998).

SMITH, David R., Associate Professor, "The Maury Project Teacher's Guides: *Shallow Water Ocean Waves* and *El Niño*" (with D.E.McManus), Marine Technology Society's Ocean Community Conference '98, Baltimore, MD (November 1998).

SMITH, David R., Associate Professor, "The Physical Oceanography and Meteorology Curriculum at the U.S. Naval Academy: Environmental Education for Naval Officers in the 21st Century (with D.J. Whitford and W.A. Wright,III), Marine Technology Society's

Ocean Community Conference '98, Baltimore, MD (November 1998).

VIEIRA, Mario E. C., Associate Professor, "The Douro Estuary: a Mesotidal Salt Wedge Case." Fall meeting of the *Atlantic Estuarine Research Society*, Stone Harbor, NJ, October 1998.

VIEIRA, Mario E. C., Associate Professor, "The Douro Estuary: Does a Standing Wave Control its Behaviour?" Spring meeting of the *Atlantic Estuarine Research Society*, Gloucester Point, VA, April 1999.

WHITFORD, Dennis J., Captain, USN, and D. R. Smith, Associate Professor, "The Physical Oceanography and Meteorology Curriculum at the U.S. Naval Academy: Environmental Education for Naval Officers in the 21st Century." Marine Technology Society Ocean Community Conference '98, Baltimore, MD (November 1998).

Physics

Professor Francis D. Correll
Chair

Physics Department faculty members were vigorously engaged in research and scholarship during the 1998-1999 academic year. Their efforts helped them keep current in their various areas of specialization, allowed them to expand the use of research-based teaching techniques in our classrooms and laboratories, and

provided opportunities for midshipmen to develop as independent scholars.

The reports that follow describe studies in such traditional areas of physics research as acoustics, astronomy and astrophysics, atomic physics, condensed matter physics, cosmology, nonlinear optics, nuclear structure physics, and planetary physics. They also relate work in a variety of interdisciplinary fields, including cognitive science, applied electromagnetics, environmental science, geoacoustics, materials science, and medical acoustics. Additionally, they describe a number of important efforts to understand how students learn physics and how to teach it more effectively.

External research sponsors included the National Science Foundation, the Office of Naval Research, the U.S. Department of Education, the Naval Research Laboratory, the Naval Surface Warfare Center, Los Alamos National Laboratory, and the Swiss National Science Foundation. Internal support came from the Naval Academy Research Council and the Naval Academy Curriculum Development Program.

Several of our faculty received special recognition for their research and scholarship. Professor Irene M. Engle received a Kinnear Fellowship to support her studies of planetary magnetospheres. Associate Professor Jeffrey R. Vanhoy was awarded beam time to conduct nuclear structure experiments using accelerators at the Paul Scherrer Institute in Zurich. Commander Alan Whiting received observing time at the Cerro Tololo Observatory in Chile to study galactic astronomy. Assistant Professor Debora Katz-Stone was awarded observing time to conduct astrophysics research using the Very Large Array. Assistant Professor Phillip E. Stallworth received a visiting research appointment at the Laboratory of Electrochemistry and Analytical Chemistry of the CNRS in Paris to study materials for use in advanced photovoltaic cells.

Our faculty shared the results of their research by publishing scholarly articles in journals and presenting talks and posters at conferences. They published twelve refereed articles this year and made 37 presentations, including some at international meetings in Canada, France, Scotland, South Africa, and Taiwan.

The relationship between our faculty and our students remained close and productive. One Trident Scholar developed an improved computational model of the magnetosphere of Saturn, which he presented at an international conference. Nine midshipmen participated in a variety of independent research courses, and several of them gave talks based on their work at professional meetings. In addition, two students from St. John's College gained valuable research experience by assisting Physics Department faculty members in their laboratories.

Sponsored Research

Infrared Studies

Researcher: Professor Donald W. Brill

Sponsor: Naval Surface Warfare Center, Carderock Division (NSWCCD)

This project supports the development of a Bi-Directional Reflectometer (BDR) facility at NSWC, Carderock, led by Peter Sarman. This device performs measurements on the infrared (IR) energy reflected from a surface: an incident beam having a prepared intensity and linear or circular polarization is scattered by the target surface into a receiver which analyzes the polarization and intensity of the scattered beam as a function of the angular position of the receiver relative to the target.

The data received from the target surface is compared with similar data received from a flat gold reference surface. This means that the scattering characteristics of the gold surface should be well understood and reproducible.

During the summer of 1997, a study was made of the Fresnel relationships giving the reflection and transmission coefficients for a smooth, flat interface between a dielectric (air) and a conductor (gold). Plots were made of the reflection coefficients as a function of the laser beam's angle of incidence at the frequencies which Mr. Sarman uses. These plots compared favorably with data he obtains using his test facility.

Since then, the work has been extended to the more difficult case of scattering from a rough gold surface. A literature search produced a list of publications pertaining to this type of problem. The works of Beckmann and Spizzichino and also Ogilvy have been the most helpful introduction to the methods and results which are available for the case of electromagnetic scattering.

Creation of Geoacoustical Maps for Selected Littoral Zone Areas

Researcher: Professor Douglas W. Edsall
Sponsor: Naval Research Laboratory (NRL)

This project builds upon the work of M. D. Max and incorporates existing data, within the framework of known geological processes, to produce geoacoustical maps of selected littoral areas. From a bathymetric, geologic, and acoustic perspective, most of the littoral zone is poorly known or understood. One method of expanding the knowledge of these important properties within the littoral zone is to extrapolate existing topographic and geologic information from the adjacent continental area. Maps produced in this manner can be used to understand existing data and to plan future tests.

Properties of Fuel Cell and Battery Materials

Researchers: Professor John J. Fontanella, Professor Mary C. Wintersgill,
Assistant Professor Phillip E. Stallworth and Assistant Professor Charles A. Edmondson
Sponsor: Office of Naval Research (ONR)

The goal of the project is to determine the ion transport mechanism in materials proposed for use in fuel cells

and batteries. The materials of interest include ion-exchange membranes for fuel cells and liquid and polymer electrolytes for batteries. NMR studies of cathode materials will also be carried out. For ion-exchange membranes, studies will be made of the sulfonated block copolymer membranes developed by Wnek and coworkers at Virginia Commonwealth University and the PSSA-PVdF and composite membranes described in the ONR proposal by S. G. Greenbaum. One battery material of interest is a hybrid electrolyte composed of PFdF-HFP copolymer containing fumed silica developed by Bellcore. In addition, liquids such as propylene carbonate (containing a lithium salt), phosphoric acid and room temperature molten salts will also be studied.

Heavy-ion Backscattering Using a Magnetic Spectrometer

Researcher: Associate Professor James R. Huddle
Sponsor: Naval Research Laboratory (NRL)

When a beam of ions scatters from atoms in a target, the scattered ions emerge with a distribution of charge states. For thick targets, in which the ions experience many collisions, equilibrium charge state distributions can be calculated, and the calculations are in reasonable agreement with experiment. But non-equilibrium charge state distributions for ion-atom collisions in thin targets are more difficult to calculate, and the experiments to measure these distributions generally have used gas jet targets, which are not feasible for elements that are not gaseous at room temperature, and are expensive when feasible. Since a magnetic spectrometer registers ions which satisfy the condition $mE = kq^2B^2$, where m is the ion's mass, E is its kinetic energy, k is a constant, q is the ion's charge state and B is the magnetic field inside the spectrometer, using such an instrument with thin films deposited onto solid substrates offers an attractive alternative.

Thin films of niobium were evaporated onto silicon substrates. The film thicknesses were measured using high-resolution Rutherford backscattering to be 10 and 25 Angstroms. 2 MeV helium ions were directed onto the 10-Angstrom film, and ions scattered at 135 degrees to the incident beam were analyzed with the NRL 20-inch double focussing magnetic spectrometer. We found approximately 20 times more ions in charge state +1 than in +2, in agreement with a simple theory. The magnetic spectrometer cannot detect neutrals. 2 MeV carbon ions were directed onto the 25-Angstrom film, and we found approximately equal numbers of ions in charge states +2 and +3, fewer in +4, and essentially none in other charge states. The theory predicts, for equilibrium, approximately 21% of the scattered ions to be in charge state +2, 52% in +3, and 28% in +4. The next step in this work should be to determine whether this difference is due to statistical or systematic error, or if we have indeed reached non-equilibrium conditions.

Radio Observations of Tycho Supernova Remnant

Researcher: Assistant Professor Debora M. Katz-Stone
Sponsors: Naval Research Laboratory (NRL) and Naval Academy Research Council (NARC)

This ongoing research makes use of the most sensitive low-frequency radio observations of the Tycho Supernova remnant. The analysis involves techniques developed by the researcher to isolate overlapping spectral components, and it has already unveiled features that were not previously identified. Further investigation may reveal fundamental information about the acceleration process in this Supernova remnant.

Electron Populations and Ages in Radio Galaxies

Researcher: Assistant Professor Debora M. Katz-Stone
Sponsor: National Science Foundation (Professor Lawrence Rudnick, University of Minnesota)

Previous investigations of radio galaxies have revealed sheath engulfed jets. These features were not previously identified, but this research has shown that they may be common. As part of an international research team, the researcher has analyzed recently acquired data to determine which of these features are present in a number of radio galaxies and determine the age and dynamics in these sources.

Design and Development of PC-IMAT: Teaching Strategies for Acoustical Oceanography

Researcher: Professor Murray S. Korman
Sponsor: USNA Curriculum Development Program

This program supports development of the Personalized Curriculum for Interactive Multisensor Analysis Training (PC-IMAT). PC-IMAT is a flexible, effective computer-based platform that helps students master Anti-Submarine Warfare (ASW) and other tasks which require extensive analysis, classification and interpretation skills.

Students taking SP411 (Underwater Acoustics and Sonar) have been actively involved in the development of scientific visualizations using PC-IMAT. Their work seeks to find the best ways to display a sequence of scientific visualizations combining the physics of wave motion, acoustical oceanography, and the complex environment associated with ASW scenarios, to help students acquire skills that can be transferred to the analysis of new situations.

Fixing the Photorefractive Soliton

Researcher: Associate Professor Steven R. Montgomery

Sponsor: Naval Academy Research Council (NARC)

Under normal circumstances, a laser beam focused to a small spot expands significantly a short distance downstream of the beam waist due to diffraction. When focused on the input face of a photorefractive crystal with transversely applied DC electric field, however, the beam can alter the index of refraction of the crystal in such a way that a waveguide forms to maintain the minimum beam waist throughout the crystal, effectively turning off the diffraction. The resulting waveguide is called a spatial soliton that can be formed and erased dynamically, as conditions warrant.

The sensitivity of the photorefractive spatial soliton to laser beam power, electric field strength, and background light has limited its usefulness: vary any of these things too much, and the soliton would erase. The objective of this study was to produce a fixed soliton that could survive large variations in those parameters. This was accomplished by manipulating ferroelectric domains in the soliton channel relative to the bulk of the crystal. Once such a fixed soliton is formed, its erasure requires raising the temperature above the Curie temperature or applying a DC field greater than 1000 V/cm (the coercive field) so that the waveguide can even be moved to another setup days later without loss of waveguide efficiency.

Implementation of Real-Time Physics into the Introductory Physics Course

Researchers: Professor Eugene P. Mosca, Associate Professor John P. Ertel, and Major Andrew R. MacMannis, USMC

Sponsor: U.S. Department of Education (Professor David R. Sokoloff, University of Oregon)

The goals of this project are to implement the Real-Time Physics (RTP) laboratory curriculum in the Naval Academy's core physics courses and assess its effectiveness in helping midshipmen master fundamental concepts of mechanics and electricity.

Real-Time Physics is a laboratory curriculum developed by Professors David R. Sokoloff (University of Oregon), Ronald K. Thornton (Tufts University), and Priscilla W. Laws (Dickinson College). It is characterized by the use of carefully designed guided activities that are enhanced by the use of computer-interfaced sensors and an integrated suite of data presentation and analysis programs. Research conducted at a number of schools has shown that RTP has helped students master important concepts in mechanics (motion, force, and energy) and electricity (charge, current, and circuits).

In the first year of this two-year project supported by the Department of Education's Fund for the Improvement of Post-Secondary Education (FIPSE), the researchers received training in the goals and methods of the RTP curriculum in a workshop with participants from five other colleges and universities. In addition, they adapted laboratory curricular materials and experiments to conform to the requirements of our SP211 and SP212 laboratories. They have also begun administering a series of standard pre- and post-tests to assess the effectiveness of the RTP in helping students learn the targeted concepts.

Optical Spectroscopy of Upconversion Processes in Rare Earth Doped Crystalline Solids

Researchers: Assistant Professor Anne-Marie Novo-Gradac and Jason Derleth (St. John's College)
Sponsor: Naval Academy Research Council (NARC)

Upconversion is a process which results in the emission of light from a material that is being optically pumped by light lower in frequency than the emission. This is achieved by converting two or more low frequency input photons into a single high frequency output photon. As a result, it is possible to produce blue emission from a crystal that is being pumped by an infrared diode laser. The upconverting crystal can be coupled wit the diode pump laser into a compact package to produce a visible light laser. Such systems have immediate applications in the optical data storage industry. Lasers of this nature have been constructed, but are not yet commercially viable due to limitations in performance of known upconverting materials. It is the purpose of this ongoing project to identify new upconverting materials, determine the particulars of the upconversion process itself, and identify the conditions necessary to optimize the process sufficiently to produce laser emission.

Computer Technology in Cooperative Instruction of Basic Physics

Researchers: Professor Carl S. Schneider, Assistant Professor Debora M. Katz-Stone
and Ensign Jennifer M. Childs, USN
Sponsor: USNA Curriculum Development Program

The goal of this project was to enhance the utility of the Physics Department's ClassTalk instructional system by expanding the type and number of questions available and by organizing the questions in such a way that instructors would find the system easy to use.

ClassTalk is a computer-based classroom polling system that implements a pedagogical technique called peer instruction. The effectiveness of peer instruction in basic physics classes was demonstrated by Professor Eric Mazur of Harvard University, who developed several hundred short conceptual questions that he calls ConcepTests He presents a number of these questions during each class meeting and gives his students time to convince one another of the correctness of their responses. This process of peer instruction has been shown to be very effective in correcting misconceptions among students.

In the present project, the researchers developed over three hundred additional questions, four for each of the roughly 85 lessons in the core physics course. For each lesson, they devised three reading questions to encourage daily preparation and one demonstration question to focus attention on a physical demonstration presented in class. The difficulty level of the reading questions was designed to be moderate, so that the questions both stimulated learning and rewarded study. The format of the demonstration questions included both conceptual items (which asked what happens) and quantitative ones (which asked how much).

To make the new questions easily available to instructors, the researchers created two web pages, one for SP211 and one for SP212, with hyperlinks to the questions suitable for each lesson. A brief survey indicated that 23 of 28 faculty with access to the ClassTalk system used it several times per week.

ANDES: A Tutoring System for Classical Physics

Researcher: Professor Robert N. Shelby
Sponsor: Office of Naval Research (ONR)

Classical physics is a prerequisite for virtually all university level study of science and technology, yet is a notoriously difficult subject for students to learn. We are building a tutoring system named ANDES that will help students learn physics. ANDES is based on the latest research in Cognitive Science as well as input from a team of physics instructors with years of experience in instructional reform. When completed, ANDES will be used at the U. S. Naval Academy to enhance the introductory physics course, which is taken by approximately 1000 students per year.

The coding and cognitive science portions of the system are being done by Professor Kurt VanLehn's group at the Learning Research and Development Center (University of Pittsburgh), the domain knowledge is being developed by Professors Treacy, Wintersgill, and Shelby of the USNA Physics Department, and knowledge base construction, coding, and coordination is being done by Professor Schulze of the USNA Computer Science Department.

The project is currently in its fourth year and will include a 7-section trial of the current system in the fall semester of 1999 and a 2-section trial in the spring semester. The present focus of the project is on increasing material coverage, knowledge base expansion, addition of more difficult problems and improving the quality of the help being given by the tutor. These changes are designed to improve acceptance of the system by the students and use of the system by professors.

Applied Studies of Imaging and Pattern Recognition

Researcher: Professor Lawrence L. Tankersley
Sponsor: Naval Research Laboratory (NRL)

Research has continued on optical detection and analysis of debris in turbine engine lubrication fluids, imaging through turbid media and modulator studies using multiple quantum well devices. A specific, fruitful effort developed a method to decrease the power consumption of quantum well modulators. The power savings makes the devices more suited for communications satellites and even possibly for a planetary probe.

Work performed under this program includes: (1) theoretical investigation of non-linear effects involving longitudinal fields; (2) optical evaluation of lubricating fluids using partial-volume sampling; (3) optical studies of small wear particles in lubricants; (4) real-time evaluation of debris in turbine engine lubricants; (5) quantum well photorefractive image correlators; (6) development of support electronics; and (7) design studies for a new generation of magnetic capture chip detectors.

Nuclear Structure of ^{120}Te via the ^{118}Sn(alpha,2n-gamma) Reaction and ^{120}I Decay

Researchers: Associate Professor Jeffrey R. Vanhoy and Midn 1/C Robert T. Coleman, USN; Sally F. Hicks, M. Walburn, and B. Sklaney (University of Dallas); P. E. Garrett and N. Warr (University of Kentucky); F. Corminboeuf,. L. Genilloud, J. Jolie, J. Kern, and J.L. Schenker (University of Fribourg)
Sponsors: National Science Foundation (NSF), Swiss National Science Foundation, and Paul Scherrer Institut

Tellurium-120 appears to have many characteristics of a harmonic-vibrational nucleus. It is known, however, that other configurations, such as particle and intruder structures, play an important role in neighboring nuclei. Spectroscopic information such as spins and parities, branching ratios, and transition rates are required to search for both collective and particle-like structures and to examine their interplay. One of the best ways to obtain this information is with in-beam gamma-ray spectroscopy. Excitation function and angular distribution measurements were performed during summer 1998 on the ^{120}Te nucleus using the ^{118}Sn(alpha,2n-gamma) reaction at the Paul Scherrer Institut (PSI) in Switzerland. In late November, measurements were made using (alpha,2n-gamma-gamma) coincidence techniques and a beta-decay measurement using the ^{110}Pd(14N,4n) reaction. These measurements provide an impressive amount of data and it will not be until late summer 1999 that analysis should be complete. At the present time, the level scheme has been developed up to 3.3 MeV excitation.

Basic Nuclear Physics with the GEANIE Array at LANSCE/WNR

Researchers: Associate Professor Jeffrey R. Vanhoy and the GEANIE collaboration
Sponsor: National Science Foundation (NSF) and Los Alamos Neutron Science Center

GEANIE is a planar and coaxial germanium detector array installed at LANSCE/WNR. The high neutron energies available at the facility allow access to nuclei not accessible from stable targets and also provide access to different spin regimes in stable nuclei. Open exit channels involve the emission of up to 15 nucleons. Applied interests; i.e., the need for (n, xn) cross-section measurements over a range of energies drive the data taken using GEANIE. The question arose as to what extent the facility could also be used for spectroscopic studies. The LANSCE groups were also interested in developing an external user program.

As GEANIE was designed for use in high-multiplicity heavy-ion reactions, it was suggested that an array with greater angular coverage might be suitable for (n,xn) nuclear structure studies. The University of Kentucky 4-element HpGe array KEGS (Kentucky Gamma-Ray Spectrometer) was transported to LANSCE and installed on a Target-4 beamline to evaluate its performance. Some of the concerns to be answered were (1) whether an array such as KEGS can safely reside in the beamline shielding and collimation environment, (2) whether the present KEGS data acquisition system can process events in the beam-burst environment of WNR, (3) whether the various (n,xn) channels can be cleanly extracted from the time-structure and still maintain usable statistics, and (4) whether isotopically enriched targets from the RMC collection can be used without activating them. The test period ran from September through October 31, 1998. Short data sets were obtained for ^{196}Pt and ^{181}Ta targets, and a longer 19-day run on ^{186}W was performed. The KEGS array easily passed the first three tests. Insufficient data was obtained to draw any conclusions about the use of RMC targets.

Development of an Intelligent Tutoring System

Researchers: Professor Mary C. Wintersgill, Professor Donald J. Treacy,
Professor Robert N. Shelby, and Professor Kay G. Schulze (Computer Science Department)
Sponsor: Office of Naval Research (ONR)

The student modeling module of an intelligent tutoring system (ITS) infers a student's line of reasoning from the student's user interface actions. It thereby determines what pieces of knowledge a student employed in taking those actions, and thus what knowledge the student possesses. The ITS makes important pedagogical decisions based on both the student's line of reasoning and the student's knowledge mastery.

The existing technology for student modeling needs improvement. Its first problem is combinatorial. Because the ITS assigns the problem the student is working on, student modeling is usually done by pre-computing the whole problem space for the problem, then searching it to find a solution path that matches the student's actions. In many task domains, the problem spaces are too large to use this technique, so the ITS designers artificially reduce their sizes by designating only some possible solution paths as "correct." In many task domains, it appears possible to vastly reduce the size of the pre-computed data structures by taking advantage of certain redundancies in the problem space.

The second problem is that inferring a line of reasoning from student actions is fraught with uncertainty. Students may know a rule, but fail to recall and use it. Sometimes students generate correct actions via lucky guesses. Often an action can be derived either by correct or incorrect lines of reasoning. Existing student modeling systems often use heuristics to cope with such uncertainties.

This ITS will use sound, probabilistic reasoning instead. In particular, the system will use Bayesian belief networks. Because the reasoning is sound, the systems' assessments should be able to hold up to the same psychometric and legal standards that are applied to conventional multiple choice tests. This project will develop a student modeling module based on these ideas, and demonstrate its combinatorial feasibility by using it in the context of simple ITS for university physics. The internal validity of the assessments will be evaluated using artificial students. The external validity will be evaluated using real students and verbal protocols.

Independent Research

An Optical Survey of Large Interstellar Structures

Researchers: Professor C. Elise Albert; L. Danly and P. Lee (Space Telescope Science Institute);
C. Sneden and D. Hiltgen (U. of Texas); D. Hartmann (Center for Astrophysics);
B. Burton (Sterrewacht Leiden); and F.J. Lockman (National Radio Astronomy Observatory)

Over the past decade, studies of the interstellar medium in our galaxy have highlighted the prevalence and importance of large-scale structures in the distribution of gas in the disk and halo. Heiles (1984)

presented a catalog of H I shells, shell-like loops and worms. Some of these structures are believed to be several kiloparsecs in size and show coherent structure in space and velocity. The researchers obtained interstellar absorption spectra of Ca II H and K lines and Na I D1, D2 lines at high resolution (about 7 km/s) toward 61 stars in the directions of interstellar H I shells. Intermediate velocity gas is observed toward a number of our program stars. Results from the optical observations are being compared to H I data on the shells to evaluate their distances, kinematics and abundances.

Electrical Properties of Nafion Membranes Intended for Use in Methanol Fuel Cells

Researchers: Assistant Professor Charles A. Edmondson, Professor John J. Fontanella and Professor Mary C. Wintersgill

The primary objective of this work is to gain insight into ion motion in the ion exchange membrane Nafion via complex impedance measurements. Detailed studies of the complex impedance as a function of water content and pressure have been conducted. Since these membranes are intended for use in the presence of methanol, current efforts are directed at evaluating the effect of methanol and methanol-water mixtures on their conductivity.

Investigation of the Human Voice Mechanism

Researchers: Professor Samuel A. Elder and P. F. Castellanos (University of Maryland School of Medicine)

This is a joint research project involving Professor S. A. Elder of the United States Naval Academy Physics Department and Dr. P. F. Castellanos, an otolaryngological surgeon on the staff of the University of Maryland School of Medicine. Over the past two years, papers have been presented at meetings of the Acoustical Society of America, the International Congress on Acoustics, the Association for Research in Otolaryngology, and the American Broncho-Esophagological Association.

The work is being carried out in the Acoustics Laboratory of the USNA Physics Department. Experimental methods involve the USNA anechoic chamber facility and make use of state-of-the-art computerized speech laboratory equipment. Investigations involve both in-vivo and in-vitro specimens. An excised larynx preparation, driven by warm moist air, radiates as a point source in an anechoic chamber. By integrating the measured acoustic sound pressure one may obtain the effective volume flow source strength of the larynx as a sound generator. Making use of a photo-glotto-graphic sensor, this has been directly correlated with the changing glottic area of the vibrating vocal folds, giving insights into the source mechanism of the oscillation. Comparisons are being made with in vivo subjects to determine if the mechanisms are the same.

Evidence is accumulating that in vivo, and therefore “normal”, laryngeal sound production is dominated by a monopole source function, with some dipole or quadrupole contributions at the beginning and end of the open cycle. Currently it is of particular interest to the investigators that epithelial damage to the vocal folds in pathological specimens has been observed to occur typically at the location along the folds at which they begin to part on opening. This suggests a possible mechanism for damage: adhesion from a condition of abnormally high surface tension.

Establishing this connection is currently a primary goal.

Magnetospheric Physics

Researcher: Professor Irene M. Engle

Several topics in magnetospheric physics were studied during the past year. They include:

Modeling, from first principles, a representation of the Jovian magnetosphere during a semi-inflated state, as observed during the Voyager II flyby. The expanded version of the Voyager II Era magnetosphere field model was the one most applicable to correct predictions and useful data analysis for the July 1994 Shoemaker-Levy 9 Encounter with the Jovian magnetosphere (which culminated in the collision with the planet). A floppy magnetodisk to replace a rigid magnetodisk is currently being explored, but some fundamental problems have arisen. The mathematical forms used to fit the disk are Euler potentials whose behavior in the neighborhoods outside the regions where the parameter fits were made is bizarre. This discovery was combined with similar difficulties encountered by other investigators into a generalized work on the hazards of such modeling approaches.

A new look at the Mercury magnetospheric field, in response to a published review on Mercury which contains some conclusions that are not supported by this investigator's experience. In addition, there is new interest in obtaining time dependent configuration modeling for analyzing recently observed photo-ionization of heavy ions (especially sodium) near the disc of Mercury. The researcher presented her work at the European Space Agency Workshop for planning a new mission to Mercury and her model was formally requested and supplied for use in mission planning. The associated paper was published in a special issue of Planetary and Space Science (January 1997). Ensign Jacob Scott undertook as a special project the mapping of the boundaries of the magnetospheric models being used by ESA investigators for mission planning and made a favorably received presentation of results. An associated manuscript has been submitted to a referred journal.

Modeling, either from first principles or by scaling from a function set, self-consistent, three-dimensional global magnetospheres of Uranus and Neptune.

Adapting alternate sets of orthogonal functions for three-dimensional representation of magnetospheres for earth and other planets with intrinsic planetary magnetic fields.

Investigations of the relation of observed temporal variations of magnetospheric configurations to the proximate causes and consequential phenomena; investigations of the mechanisms for transport of particles, momenta, and energy related to the aforesaid phenomena. Attempts are being made to model upstream shock waves attributable to diurnal variations of Jovian magnetopause position.

Modeling, from first principles, a representation of the Saturnian magnetosphere as observed during the Pioneer 11 and Voyager I and II flybys. An expanded paper written jointly with Sylvestre Maurice was published in the *Journal of Geophysical Research*. Midshipman Mark Skubis worked on an "upgrade" of the model by incorporating a non-equatorial plane incidence of the solar wind as his 1995-96 Trident Project. A follow-up paper on details of possible size and shape configurations when a plausible range of direction of incident solar wind and solar wind pressure was published with Mark Skubis, Sylvestre Maurice and Michel Blanc. The model was adopted by the CASSINI mission investigators as their basic magnetic field model for planning the now-launched mission to Saturn. Several presentations based upon the work have been made in Europe. Trident Scholar

Jeremy J. Bruch for 1998-99 produced an "upgrade" to the model by incorporating a realistic representation of a magnetotail.

Scattering of Acoustical Power from Unribbed and Regularly Ribbed Panels

Researchers: Associate Professor John P. Ertel, Joseph W. Dickey (Naval Surface Warfare Center, Carderock Division, Annapolis Detachment) and Gideon Maidanik (Naval Surface Warfare Center, Carderock Division)

Research continues on the radiation and partial radiation efficiencies as well as the radiated and partially radiated power from point and line driven panels. Current studies compared the mechanical power dissipated in a point-driven, fluid-loaded panel to the radiated power. The interdependence of the mechanical and radiated powers was investigated, and they were related as fractions of the total input power. The dependencies of the mechanical and radiated power on frequency, fluid loading, and mechanical loss have been further studied. The mechanical power and the radiation efficiency have been shown to increase with increased damping in a panel, while the radiated power decreases. These results again show the fallibility of the conclusion that higher radiation efficiency necessarily implies more radiated power. A paper including all of the above together with the most recent results of computer experiments is in preparation.

Accuracy and Precision of a Commercial GPS Receiver

Researcher: Associate Professor James R. Huddle

Precise measurements of the beginning and end of some astronomical events are useful for astrometric applications. In order for such measurements to be valuable, the latitude and longitude of the observing station must be known to within 30 meters. While manufacturers of commercial Global Positioning System (GPS) receivers generally quote an accuracy of 50 to 100 meters for a single "fix" of latitude and longitude, preliminary data indicate that a precision of as little as 10 meters can be achieved under optimum conditions if 20 fixes can be taken over a period of 2 hours.

In a typical experiment, three GPS receivers were placed within a six-inch circle centered on a National Geodetic Survey benchmark, for which the latitude and longitude are known to within a few centimeters. The latitude and longitude were recorded at intervals of five to six minutes over a period of about two hours. After the data were collected, averages and standard deviations were computed for the latitude and for the longitude readings. In all cases, the known latitude and longitude fell within one standard deviation of the average, so the standard deviation appears to be a conservative estimate of the accuracy. Eight such experiments have been done to date. The median standard deviation in latitude and in longitude for two Garmin model GPS-38 receivers was about 30 meters; for a Garmin GPS-12XL, it was about 20 meters.

Video Analysis of the Solar Flash Spectrum

Researchers: Associate Professor James R. Huddle and Martin Connors (Athabasca University)

By placing an inexpensive plastic holographic diffraction grating over the objective lens of a common camcorder, spectra of light sources of narrow angular extent can be recorded. Using a helium Geissler tube in the laboratory, a full-width resolution of about 25 Angstroms was achieved with a spectral range of about 3500 Angstroms. The uncertainty in measured wavelengths using this method was about 13 Angstroms. At maximum zoom, a resolution better than 10 Angstroms can be achieved, but the spectral range is only about 450 Angstroms.

Such an instrument was used to record the chromospheric flash spectrum during the total solar eclipse that was visible from the Caribbean on 26 February 1998. Nine spectral lines were detected in the flash spectrum. Seven lines have been identified and attributed to neutral hydrogen, helium, and sodium. Another line is a superposition of lines due to neutral magnesium, chromium and iron, and the last line is due to singly ionized titanium and iron.

Current camcorder technology limits this technique to pedagogical applications, but the technology is improving rapidly, and the technique may soon reach a sensitivity, accuracy, and resolution comparable to photographic emulsions.

HyperText Physics Tutor (HyPT)

Researcher: Professor Eugene P. Mosca

The researcher is working with a team of programmers and graphics artists on a prototype of HyperText Physics Tutor (HyPT), to be released on compact disk. This educational tool will teach physics problem solving, integrating QuickTime movies of simulations and video out-takes with more traditional instructional media.

Development of Infrared Ytterbium Vanadate Laser

Researchers: Assistant Professor Anne-Marie d. Novo-Gradac; William Scharpf, and Alan Lux (Naval Air Warfare Center, Electro-Optics and Sensors Branch)

Currently there are numerous industrial and military applications for the neodymium doped yttrium aluminum garnet laser (Nd:YAG). This laser operates at a wavelength of 1064 nm with wall plug efficiencies ranging from 3% to 10%. The purpose of this research project is to investigate the viability of ytterbium doped vanadate (Yb:YVO4) as a competitive laser material to Nd:YAG. It is predicted that Yb:YVO4 will produce laser emission around 1030 nm with wall plug efficiencies substantially greater than Nd:YAG. This would significantly reduce the expense and bulk of such laser systems.

Current work is in preparation for future funded research with the Naval Air Warfare Center Electro-Optics and Sensors Branch (NAWC). Since much of the experimental work will be conduced at USNA, the

on-site laboratory has been modified in preparation for the upcoming experiments. Current work has also included an assessment of the existing work done by NAWC and advising them of how to modify their approach.

Future work at the United States Naval Academy will primarily consist of detailed characterization of samples of the laser crystals provided by NAWC. Measurements will include high-resolution absorption and emission spectra, as well as radiative transition rates. Samples will be assessed for contaminants and any impact they have on stimulated emission processes. Experimental methods and theoretical models will be employed to assess the ideal dopant concentration to achieve efficient laser action in Yb:YVO4.

Development of Isotopic Analysis Techniques Using the USNA Pelletron

Researchers: Associate Professor Jeffrey R. Vanhoy and D. M. Moore; K. J. Crandell (St John's College)

Chemical and accelerator-based elemental analysis techniques are generally used to determine the chemical composition of materials. In some instances, it is also useful to know the isotopic composition of materials. Any variations in isotopic abundance which deviate from standard values may be due to sensitivity of chemical reaction rates to the isotopic mass of the reactants or to sensitivity of physical processes (transport, crystallization, etc.) to the isotopic composition.

Proton induced gamma-ray emission techniques are being developed at the USNA Pelletron laboratory. We are presently concentrating on the magnesium and oxygen isotopes. Oxygen abundances are known to be particularly sensitive to mean temperature variations in stratified ice deposits, paleo-carbonates, geothermal water, and ocean waters. Preliminary measurements were made on the Murchison meteorite.

Visual Survey for Local Group Dwarf Galaxies

Researcher: CDR Alan B. Whiting, USNR

Dwarf galaxies are central to theories of galaxy formation and shed important light on star formation. In addition, they act as tracers of dark matter. Extremely low-luminosity dwarfs are only detectable at very short distances, effectively in and near the Local Group of galaxies. A visual search of southern sky photographic survey plates has resulted in a list of candidate Local Group low-luminosity dwarf galaxies. Follow-up observations have confirmed two as previously unknown members of the Local Group, four as nearby dwarfs just outside the Group and about forty as more distant low-luminosity galaxies.

Dynamic Modeling of Small Galaxy Groups

Researcher: CDR Alan B. Whiting, USNR

Groups of galaxies containing only a few large (massive) members are generally not relaxed dynamical systems, which means that information about their formation can in principle be extracted

from their present locations and motions. In practice, data of the necessary accuracy is available only for the nearest groups. Applying a simple model of the Local Group's motions, the researcher calculates a mass for the whole group of about 1.6×10^{12} Solar masses and an age of 10-12 billion years. This age presumably applies to the rest of the universe as well, allowing a comparison with more distant and exotic cosmological calculations. Applying another simple dynamical model to the spins of the galaxies in the nearby Sculptor Group, he finds that their directions are consistent with having been generated by tidal interactions among themselves.

Research Course Projects and Trident Scholar Projects

Incorporation of a Magnetotail into the Model of the Global Saturnian Magnetosphere

Researcher: Midn 1/C Jeremy J. Bruch, USN, Trident Scholar
Faculty Advisor: Professor Irene M. Engle

An extension to the global Saturnian magnetosphere model can be developed by adding a realistic magnetotail. The magnetotail structure provides a mechanism for the rejoining of deflected solar wind particles after they have traveled beyond the planet, following the deflection from their original paths as a result of interaction with the magnetospheric field. These particles generate a dawn-to-duskward crosscurrent as they re-merge to eventually form a neutral plasma streaming outwards. The cross-tail current sheet with its associated return currents generates a magnetotail magnetic field, an additional contribution to the overall Saturnian magnetospheric field. The incorporation of a magnetotail into Saturn's magnetosphere has enhanced the range wherein the model may be said to be applicable.

Electromagnetic Launch

Researcher: Midn 2/C Rebecca E. Bowen, USN
Faculty Advisors: Associate Professor John P. Ertel and Professor Carl S. Schneider

Electromagnetic launch is currently of interest to the Navy as a possible means for accomplishing quieter and more efficient launch of aircraft and quieter firing of torpedoes. In this project, the physics of electromagnetic launch was reviewed in the context of the recently published paper "A Classroom Jumping Ring" by the advisors. Further studies were done on the numerical simulator developed for that paper in order to begin the process of revising the launch process from AC to DC. The review included Maxwell's Equations, the phenomenon of demagnetization, AC circuits, symmetry, and time averaging. The studies of the numerical simulator included a cell-by-cell review of the algorithms and

their output to check for accuracy and computational instabilities. Towards the end of this project, the goals and milestones for a follow-on project were developed to include acquisition of a new database of spatially dependent transient responses to step-function driving input. This is expected to yield the data required for a computationally stable simulation of a single stage DC electromagnetic lunch process.

Tracking Near Earth Asteroids

Researcher: Midn 2/C Douglas T. Campbell, USN
Faculty Advisor: Assistant Professor Debora M. Katz-Stone

This research was performed in preparation for Midshipman Campbell's Trident Scholar project for Academic Year 1999-2000, which will use the reflecting telescope on the roof of Michelson Hall to track Near Earth Asteroids. These are asteroids which have been recently discovered and which require several months of observations to determine their orbits. In addition, Midshipman Campbell will determine the rough composition of a subset of the asteroids that he tracks.

Study of ^{120}Te by the ^{118}Sn(alpha,2n-gamma) Reaction

Researcher: Midn 1/C Robert T. Coleman, USN
Faculty Advisor: Associate Professor Jeffrey R. Vanhoy

In-beam gamma-ray spectroscopy was used to study ^{120}Te. A partial level scheme has been developed using gamma-gamma coincidence and excitation function techniques. Eleven new levels have been found to date. Final analysis must wait until all of the observed gamma rays have been placed into a level scheme. A partial check of the analysis procedure is possible, however. Consistent slopes are found for several gamma rays originating from the same level. Discrepancies generally indicate the presence of unresolved doublet lines.

A Spectroscopic Study of Nd^{3+}:$GdLiF_4$

Researcher: Midn 1/C Brad W. Hoff, USN
Faculty Advisor: Assistant Professor Anne-Marie Novo-Gradac

Violet upconversion emission was observed under visible light excitation in Nd^{3+}:$GdLiF_4$ Absorption and fluorescence measurements at low temperatures were used to make level assignments for the Nd^{3+} ion in this host for energies up to 35000 cm^{-1}.

Upconversion in $GdLiF_4$:Nd^{3+}

Researcher: Midn 1/C Kevin J. Kitcey, USN and Midn 2/C Justin A. Sarlese, USN
Faculty Advisor: Assistant Professor Anne-Marie Novo-Gradac

Upconversion was studied in $GdLiF_4:Nd^{3+}$ crystals in a two-stage experiment. During the first stage, the crystal's absorption spectrum and fluorescence spectrum were obtained to find the upconversion and to find which of the crystal's energy levels absorb the most energy. During the second stage, lifetimes for fluorescence at various wavelengths were obtained in order to determine the transition rates and assess the efficiency of the upconversion. Experimental results thus far indicate that $GdLiF_4:Nd^{3+}$ is a good candidate for producing violet light under a green pump and possibly even under an infrared pump.

Interaction of a Two-phase Turbulent/Bubbly Submerged Water Jet with a Single-Phase Jet: Measurements of the Enhanced Hydrodynamic Near-field Spectrum, Part II.

Researchers: Midn 2/C John V. Tobin, USN and Midn 2/C Kathryn M. McMahon, USN
Faculty Advisor: Professor Murray S. Korman

The interaction of mutually perpendicular submerged turbulent water jets was studied from measurements of the hydrodynamic near-field pressure spectrum. One jet is a conventional single-phase, free turbulent shear flow circular jet, while the other jet is a two-phase bubbly jet of similar construction. The overlap region is located at a distance of four nozzle diameters (4D) away from each orifice. A small hydrophone located outside the overlap region on the symmetry line 45° from each jet axis (and in the far quadrant from each nozzle exit) measures the near-field pressure signature. Spectra are measured at different radial positions from the overlap region (typically 4D - 10D). Very small gas bubbles are generated in the two-phase turbulent jet by pressurized nitrogen gas passing through a fritted disk housed in a Buchner funnel located near the nozzle entrance. Spectra are compared for different void fractions and different Reynolds numbers (based on jet diameter). Typically, volume void fractions of about 0.001 significantly amplify the flow noise coming from jet nozzles (D=0.635 cm) with nozzle exit velocities of 10m/s.

From the Speed of Light to the Speed of Sound to Chaos: Demos for All Occasions

Researchers: Midn 2/C John V. Tobin, USN and Midn 2/C Kathryn M. McMahon, USN
Faculty Advisor: Professor Murray S. Korman

This project involves the development of several demonstrations for classroom use. In 1676, the Danish astronomer Olaf Roemer discovered variations in the periods of the four known satellites of Jupiter. The periods of these satellites can be determined by means of their eclipses, i.e., the times at which they enter Jupiter's shadow. Roemer found that the periods increased when the earth moved away from Jupiter and decreased when the earth moved towards Jupiter; and he concluded that it must take a finite amount of time

for light to traverse the diameter of the earth's orbit. From his knowledge of the earth's orbit, he computed the velocity of light to be 227,000 km/s, which was the first evidence for a finite speed of light. In this project, an apparatus was developed which can illustrate Roemer's result using the Doppler effect and bring it to life using sound waves. In this apparatus, a stationary source of sound plays the role of the satellite and a distant microphone on a radius arm that rotates (or orbits) plays the role of the earth. Using Doppler shift versus time information obtained from the microphone, the speed of sound is ultimately determined. Another apparatus was developed which displays a compass needle going from simple harmonic motion to chaotic behavior in a periodically reversing magnetic field.

Design of a Practical Spherical Bubble Cloud Encapsulated by a Thin Spherical Shell for Sound Scattering Experiments

Researcher: Midn 3/C Elizabeth Simmons, USN
Faculty Advisor: Professor Murray S. Korman

The scattering of sound by a spherical bubble cloud is a much studied problem in acoustics. Some theoretical solutions are known which can predict resonances in the backscattering cross section in the case where the volume void fraction is very small, the bubbles are uniform in size and distribution, and the individual resonances from each bubble are much higher in frequency than that of the incident plane wave. The resonances are due to the collective oscillations of the two-phase bubbly flow whose sound speed is much less that the speed of sound in the surrounding medium.

This project involves the design and testing of a submerged spherical bubble cloud that is encapsulated by a polyurethane shell with filling ports along the north and south pole axes. The bubbly two-phase flow consists of a whipped-up suspension of bubbly castor oil. The design involves sealing a propeller, its shaft, and supporting bearings along the axis of one of the filling ports. An external coupling and high torque motor will be used to drive the propeller for whipping up the suspension so that the effects of buoyancy upon the bubbly flow can be countered. Along the other port, a miniature piezo-electric spherical transducer will be housed so that the element can be translated from the filling port to the center of the cloud when necessary. Therefore experiments involving the transmission of sound from the cloud, radiating into the surrounding media (as a function of frequency) can be compared to the more difficult backscattering experiments that need to be investigated at the relatively low frequencies important to the sonar community.

Publications

EDMONDSON, C. A., Assistant Professor, STALLWORTH, P. E., Assistant Professor, WINTERSGILL, M. C., Professor and FONTANELLA, J. J., Professor, "Electrical Conductivity and NMR Studies of Methanol/Water Mixtures in Nafion Membranes," *Electrochimica Acta*,

43 (1998), pp. 1295-1299.

Complex impedance studies have been carried out in acid form Nafion 117 treated with various amounts of methanol and methanol-water mixtures. At room temperature and atmospheric pressure the conductivity for Nafion treated with 'pure' methanol is about a factor of ten less than for Nafion that contains the same wt. % of water. In samples treated with the water-methanol mixtures, the conductivity is lower than for samples having the same total wt.% of water. However, for low mixed fluid wt.% the conductivity is significantly higher than for samples with the same amount of water, only, as was in the mix. This enhancement of conductivity over that for the corresponding water uptake is attributed to a plasticizing effect of the methanol facilitating segmental motion of the polymer. At higher water concentrations, the conductivity is generally lower in the mixed solution-treated samples than in samples treated with the corresponding amount of water. This is to be expected since in this regime, proton conduction occurs in the fluid-rich regions, which in the solution case, contains a large fraction of methanol. For a 40 wt.% 1.4:1 molar ratio film, the studies were carried out at pressures up to 0.3 GPa. It is found that the electrical conductivity decreases with increasing pressure. Both the electrical conductivity and the activation volume are similar to the result for Nafion containing the same amount of water only. Deuteron NMR spin-lattice relaxation measurements of isotopically enriched methanol/water mixtures in Nafion 117 at elevated pressure demonstrate greater molecular level interactions between methanol and Nafion than between water and Nafion. This is consistent with the plasticizing effect observed in the conductivity results.

ERTEL, John P., Associate Professor and Burt, P. E., *General Physics Laboratory Manual, 1998-1999* (Harcourt-Brace Custom Publishing, ISBN 0-03-044733-X).

FOERSTER, John W., Professor, LaMontagne, Robert A., CORRELL, Francis D., Professor and EDSALL, Douglas W., Professor, "Sentinel Species: Managing Trace Metals in a Large Estuarine System," in Wilson, R. and Pringle, J. (eds.), *Coastal Zone Communities in the 21st Century*, Proceedings of Coastal Zone Canada '98, p. 138.

Food safety and introduction of pollutants into coastal marine environments pose a risk to public health. Coastal zone managers and regulators must understand in particular the roles of waste disposal and toxin impacts on their coastal system. Targeting specific organisms and using them as indicators of the health and safety of the coastal waters is a method for assessing the condition of the waterway. Trace metals in low concentrations (picograms) are mostly useful in the physiology of aquatic plants and animals. The useful trace metals are biotic (i.e. copper, zinc, chromium). Other trace metals are not useful and, therefore, toxic. The non-useful trace metals are exenobiotic (*i.e.*, lead, mercury). However, the movement of trace metals through the aquatic system is complicated. Understanding a particular organism and its response to trace metals is an important tool in assessing the health of a coastal environment. Oyster toadfish (*Opsanus tau*) and the American oyster (*Crassostrea virginica*) are resident, non-migratory species important to the estuarine benthic food web along the eastern coast of North America. They are sentinel species with the potential to extract toxic environmental trace metals. To test this hypothesis, samples were collected in the Northern Chesapeake Bay, away from direct industrial or commercial effluents. Using a proton induced x-ray emissions (PIXE) system, this study concentrates on trace metals found in the liver of the oyster toadfish, and the gill and muscle tissue of the oyster. The PIXE system is a rapid method to determine trace metal types and concentrations and for archiving. Present analyses of various sized toadfish show that the livers contained a range of concentrations of chromium (6-52 mg/L), copper (3-26 mg/L), and zinc (9-30 mg/L), depending on the size, age, and sex of the fish. Generally, the trace metals have an accumulation order of chromium > zinc > copper. The life history stage of the toadfish is an important factor in trace metal accumulation. Oysters tend to concentrate trace metals in the order zinc > copper > selenium with varying concentrations

of lead and arsenic (1-10 mg/L). The lead, arsenic and copper accumulation in these animals fit patterns of land use. Therefore, trace metal accumulation relative to life history stage and land use practices in the Northern Chesapeake Bay indicates these two species are useful sentinels for various trace metals. To aid the manager in determining the level of problems in a waterway, a case study of copper is discussed. This case study includes simple analytical methods for determining trace metals and a procedure for their removal.

FONTANELLA, John J., Professor, WINTERSGILL, Mary C.,Professor and IMMEL, Jeffrey J., "Dynamics in Propylene Carbonate and Propylene Carbonate Containing $LiPF_6$," *Journal of Chemical Physics*, 110 (1999), pp. 5392-5402.

Electrical Conductivity and differential scanning calorimetry studies (DSC) have been carried out on 1M $LiPF_6$ in propylene carbonate (PC) from 187 to 296 K. The electrical conductivity data are analyzed in terms of Vogel-Tammann-Fulcher (VTF), Williams-Landel-Ferry (WLF) and Bendler-Shlesinger (BENSH) formalisms. In addition, literature data for viscosity and relaxation times for PC (not containing salt) are analyzed using the same formalisms. Large, systematic variations are found in both the VTF and WLF fitting parameters with temperature interval. The large variation of the parameters with temperature demonstrates the failure of both formalisms and shows that care must be taken when utilizing the VTF/WLF parameters to draw conclusions concerning the behavior of systems. One conclusion which can be reached is that the VTF results indicate a significant difference between the molecular motions in PC and PC-containing $LiPF_6$. Another is that the WLF parameter, C1 is about 11 for low temperature data, referenced to the DSC glass transition temperature, T_g, which shows that for PC and PC-based liquids the value of all three dynamical quantities at T_g is about 11 decades smaller than the value predicted for very high temperatures. Finally, all data are found to be better fit by the BENSH equation.

HUDDLE, James R., Associate Professor, untitled article about the Caribbean total solar eclipse of 26 February 1998 in The Ambassador, Fall 1998, p. 73.

Jones, Douglas E., Alexander, Claudia J, and ENGLE, Irene M., Professor, "On the Use of Euler Potentials to Model the Magnetosphere of Jupiter," in the Proceedings of the Chapman Conference on *Magnetospheric Current Systems*, Kona, HI, 11-15 January 1999.

A study of several Euler potential models of the Jovian magnetosphere, each incorporating some version of a Harris sheet current, is presented. It is found that in each and every case, he specific functional form and the nature of model parameters obtained by fitting the model to data acquired at low latitudes lead unfortunately to non-physical currents in the vicinity of the magnetic axis. These non-physical currents in turn create severe high-latitude distortion of the calculated net magnetic field, particularly near those currents. Although the fitted Euler potential modeling approach discussed herein can be used to provide insights regarding the nature of the "equatorial" current sheet distortions, it appears to be not entirely reliable for use in global modeling.

KATZ-STONE, Debora M., Assistant Professor, Rudnick, L., Butenhoff, C., and O'Donoghue, A., "Coaxial Jets and Sheaths in Wide-Angle Tailed Radio Galaxies," *Astrophysical Journal*, 516 (1999), pp. 716-728.

We add 20, 6 and 3.6 cm VLA observations of two wide-angle tails (WATs), 1231+674 and 1433+553 to existing VLA data at 6 and 20 cm in order to study the variations of spectral index as a function of position. We apply the spectral tomography process that we introduced in our analysis of 3C 67, 3C 190, and 3C 449 (Katz-Stone, 1995; Katz-Stone and Rudnick, 1997). Both spectral tomography and polarization maps indicate that there are two distinct extended components in each source. As in the case of 3C 449, we find that each source has a flat spectrum jet surrounded by a steeper spectrum sheath. The steep components tend to more highly polarized than the flat components. We discuss a number of possibilities for

the dynamics of the jet/sheath systems and the evolution of their relativistic electron populations. Although the exact nature of these two coaxial components is still uncertain, their existence requires new models of jets in FR I sources and may also have implications for the dichotomy between FR I and FR II galaxies.

Klotz, Matt; Meng, Hongzing; Salamo, Gregory J., Segev, Mordechai; and MONTGOMERY, Steven R., Associate Professor; "Fixing the Photorefractive Soliton," *Optics Letters*, 24 (1999), pp. 77-79.

We report the formation of permanent two-dimensional 12-mm waveguides in a bulk strontium barium niobate crystal. The waveguides are made by formation of a photorefractive spatial soliton in which the space-charge field induces ferroelectric domains that are permanently polarized opposite to the crystal c axis. The fixed waveguide propagates light with 80% efficiency. These results make possible the permanent recording of intricate optical circuitry in the volume of a bulk crystal.

SCHNEIDER, Carl S. Professor and ERTEL, John P., Associate Professor, "A Classroom Jumping Ring", *American Journal of Physics*, 66 (1998), pp. 686-692.

We present the design of a compact alternating current jumping ring apparatus which can electromagnetically launch conducting rings across a classroom. Jump energy and height are calculated for core and ring length, radius, thickness and material. The effects of core saturation, permeability, hysteresis and demagnetizing field, ring shielding and convective derivative are described. Even rings with small phase lag can pass by the magnetic pole of the primary in one quarter of a cycle. Large ring size relative to skin depth delays the ring current close to the 180 degrees of Lenz's law. Contactless jump height measurement enables ring resistivity determination. Demonstrating the effects of voltage, frequency, conductivity, permeability and geometry contributes to understanding electromagnetism in the classroom.

Tucker, J. E., Schultz, A., Lu, C., Sebok, T., Holloway, C., TANKERSLEY, L. L., Professor, McClelland, T., Howard, P. L., Reintjes, J., and Galie, T., "LASERNET FINES Optical Wear Debris Monitor: A Navy Shipboard Evaluation of a CBM Enabling Technology," in *Intelligent Shipboard Technologies for the 21st Century*, Proceedings of the Intelligent Ships Symposium, American Society of Naval Engineers, Philadelphia, PA (14-15 June 1999) pp. 137 - 149.

Analysis of debris that is present in machinery lubricating systems has long had the potential to provide fault-specific information in a timely manner to support diagnostics and prognosis of machinery maintenance. This capability allows the avoidance of catastrophic failures and enables improved cost-effective asset-management philosophies, especially in the area of timely maintenance and reduction of maintenance induced failures. Essential to achieving these asset management and condition based maintenance goals, are technologies that can provide reliable early identification of fault or failure mechanisms and the degree of degradation of the machine's performance capability. These technologies must also assess the effect of the performance degradation with its impact on the machine's mission requirements, the system that it supports in a shipboard environment or the affected factory environment. The LASERNET FINES instrument delivers a technology which has significant potential in these areas. This instrument determines the type, severity and rate of progression of mechanical faults by measuring the size distributions, rate of production and the morphological analysis of debris particles in fluids. Although the system algorithms and characterization capabilities are still in the advanced development state in the S&T arena, significant information can be gained by in-situ shipboard evaluation of technology and its current analysis capabilities in the areas of suitability for shipboard operation and baselining of operational equipment to provide a basis for comparison for future fault detection and diagnosis. Within this context, the Amphibious SMARTSHIP community has supported the installation and use of the first production LASERNET FINES instrument aboard the USS RUSHMORE. The ship introduction,

test and demonstration process is described. In addition, the performance of LASERNET FINES optical oil debris monitor is described. Shipboard data are still in the process of being acquired and analyzed. However, concurrent analysis of two of accelerated gearbox failure tests are described to provide tangible information and examples of how the technology may be employed to diagnose and prognose machinery failures.

WHITING, Alan B., CDR, USNR, "Angular Momentum in the Sculptor Group," *Astronomical Journal*, 117 (1999), pp. 202-205.

The spins of the major galaxies in the nearby Sculptor Group agree with those calculated to be produced by tidal interactions among themselves. The agreement is closer than would be expected from published uncertainties in distances, indicating either that these uncertainties are smaller than calculated or that they are correlated. Three pairs of galaxies (NGC 55 and 300, 247 and 253, and 45 and 7793) are in approximate two-body orbits; the direction of orbital angular momentum for the first two pairs is derived.

WHITING, Alan B., CDR, USNR, "Age and Mass of the Local Group from Satellite Galaxy Dynamics," in Whitelock, P. and Cannon, R. (eds.), *The Stellar Content of Local Group Galaxies*, (Provo, UT: Astronomical Society of the Pacific, 1999) pp. 420 - 426.

The present kinematics of an unrelaxed system such as the Local Group can be used to investigate its dynamics on a cosmological time scale. In particular, the classical timing argument of Kahn and Woltjer may be extended to distant satellite galaxies of the Local Group whose distances and velocities are known with some accuracy. Including a correction for the fact that the Local Group was not always isolated, I derive a mass for the Local Group of about 1.6×10^{12} solar masses and an age of 1.0 to 1.2×10^{10} years.

WINTERSGILL, Mary C., Professor and FONTANELLA, J. J., Professor, "Complex Impedance measurements on Nafion," *Electrochimica Acta*, 43 (1998), pp. 1533-1538.

The need to develop an electrolytic membrane for an efficient, environmentally sound fuel cell has led to intense interest in proton conducting polymers in general and Nafion in particular. While it does not appear very likely that Nafion itself will ultimately prove to be the best choice of material, it may be considered as a prototype membrane material. Initial interest focused on Nafion's potential use in a hydrogen fuel cell, in which case its conductivity in the presence of water is important, and so extensive studies of the electrical properties of Nafion at various levels of humidity were carried out. Two distinct regimes were identified, one at lower water contents and the other at high water contents. The possible conduction mechanisms associated with those regimes will be discussed. In addition, studies carried out at high pressure yielded activation volumes which provide further clues as to the conduction mechanism involved. More recently, interest in Nafion as a membrane material in methanol fuel cells has prompted investigation of its electrical properties in the presence of methanol alone and of methanol/water mixtures. It is clear that not only is Nafion an excellent proton conductor but it also exhibits significant methanol transport. This represents a serious crossover problem for fuel cell applications and it is important to be able to characterize the mechanisms involved.

WINTERSGILL, Mary C., Professor and FONTANELLA, J. J., Professor, "High Pressure Electrical Conductivity Studies of Acid Doped Polybenzimidazole," *Electrochimica Acta*, 43 (1998), pp. 1289-1294.

Electrical conductivity studies of acid doped polybenzimidazole (PBI) and 85% phosphoric acid have been carried out. The PBI contained about 600 mol% of 85% phosphoric acid and the electrical conductivity was deduced from complex impedance studies which were made at frequencies from 10 to 107 Hz. Measurements were made at pressures up to 0.25 GPa and temperatures of 25,50 and 75oC. Similar measurements were also carried out on 85% phosphoric acid. At room temperature the electrical conductivity decreases with increasing pressure for

both acid doped PBI and 85% phosphoric acid. This behavior is expected for normal liquids and for ions in polymers where viscosity increases with pressure. The resultant positive activation volume for acid doped PBI has a magnitude similar to that for polymer electrolytes based on perfluorosulfonic acid containing relatively small amounts of water. Further, as temperature increases, the activation volume becomes smaller. Consequently, the acid doped PBI behaves like a polymer electrolyte where ion transport is mediated by segmental motions of the polymer. On the other hand, the activation volume at room temperature for 85% phosphoric acid is much smaller than for acid doped PBI. In addition, at 75oC the electrical conductivity increases with increasing pressure, which gives rise to a negative activation volume. Consequently, there is very little similarity between the electrical behavior of the 85% phosphoric acid and of acid doped PBI which were studied in the present work.

Presentations

ALBERT, C. Elise, Professor, "Research with the International Space Station", International Club of Annapolis, MD, 12 May 1999.

EDMONDSON, Charles A., Assistant Professor, "Effect of High Pressure on the Electrical Conductivity of Ion-Exchange Membranes and Related Acids", Gordon Research Conference on Ion Containing Polymers, New London, NH, 22-27 June 1997.

EDMONDSON, Charles A., Assistant Professor, "Properties of Fuel Cell and Battery Materials", ONR Electrochemistry Review, Ventura, CA, 15-16 January 1998.

EDMONDSON, Charles A., Assistant Professor, "Electrical Conductivity of 'Dry' PEM's at Elevated Temperatures", ONR/ARO/DARPA Workshop on Advanced Fuel Cell Membranes, Las Vegas, NE, 28 April -1 May 1998.

EDSALL, Douglas W., Professor, "Cenozoic Development of the Southeast Georgia Embayment", 1998 Annual Meeting of the Geological Society of America, Toronto, Canada, 26 October 1998.

EDSALL, Douglas W., Professor, "Geoacoustical Characterization of Selected Littoral Zones: Similarities/Differences between United States and Western Pacific Areas", 1998 Western Pacific Geophysics Conference, Taipei, Taiwan, 21-24 July 1998.

EDSALL, Douglas W., Professor, "Trace Element Concentrations and Variability in Sulfides from Middle Valley of Bent Hill Site, 1035, ODP Leg 169", 1998 Western Pacific Geophysics Conference, Taipei, Taiwan, 21-24 July 1998.

ELDER, Samuel A., Professor, "Integrated sound pressure as a tool for analyzing glottic source wave", 136th meeting of the Acoustical Society of America, Norfolk, VA, 14 October 1998.

ENGLE, Irene M., Professor, "On the Use of Euler Potentials to Model the Magnetosphere of Jupiter", Chapman Conference on Magnetospheric Current Systems, Kona, HI, 11-15 January 1999.

ERTEL, John P., Associate Professor, "Introduction to Interactive Physics III and Its Use in the Undergraduate Classroom/Laboratory", Summer Meeting of the American Association of Physics Teachers, Lincoln, NB, 4 August 1998.

ERTEL, John P., Associate Professor, "Intermediate

and Advanced Interactive Physics III and Its Use in the Undergraduate Classroom/Laboratory", Summer Meeting of the American Association of Physics Teachers, Lincoln, NB, 4 August 1998.

ERTEL, John P., Associate Professor, "Introduction to Interactive Physics III and Its Use in the Undergraduate Classroom/Laboratory", Winter Meeting of the American Association of Physics Teachers, Anaheim, CA, 10 January 1999.

ERTEL, John P., Associate Professor, "Intermediate and Advanced Interactive Physics III and Its Use in the Undergraduate Classroom/Laboratory", Winter Meeting of the American Association of Physics Teachers, Anaheim, CA, 10 January 1999.

FONTANELLA, J. J., Professor, "High Pressure Electrical Conductivity and NMR Studies on Liquid and Plasticized Polymer Electrolytes", 9th International Meeting on Lithium Batteries, Edinburgh, Scotland, 12-17 July 1998.

HUDDLE, James R., Associate Professor, "Experiments During a Total Solar Eclipse", Northern Virginia Astronomy Club, Fairfax, VA, 15 July 1998.

HUDDLE, James R., Associate Professor, "Experiments During a Total Solar Eclipse", Summer Meeting of the American Association of Physics Teachers, Lincoln, NE, 3-8 August 1998.

HUDDLE, James R., Associate Professor, "Experiments During a Total Solar Eclipse," USNA Physics Department Colloquium, Annapolis, MD, 28 April 1999.

KATZ-STONE, Debora M., Assistant Professor, "Teaching the Introductory Physics at the U. S. Naval Academy", Teach Conservation Laws First Conference, Cambridge, MA, 12-26 June 1998.

KATZ-STONE, Debora M., Assistant Professor, "Extending Particle Acceleration Studies to Long Wavelengths", Space Based Radio Observations at Long Wavelengths Conference, Paris, France, 19-23 October 1998.

KATZ-STONE, Debora M., Assistant Professor, "Using a Classroom Communication System that Works!", "Educating Our Nation's Leaders" Conference for Federal Service Academies, West Point, NY, 8-9 April 1999.

KORMAN, Murray S., Professor, "Interaction of a two-phase jet: Measurements of the enhanced hydrodynamic near-field spectrum, part II", 136th Meeting of the Acoustical Society of America, Norfolk, VA, 12-16 October 1998.

KORMAN, Murray S., Professor, "From the speed of light to the speed of sound to chaos: Demos for all occasions" 136th Meeting of the Acoustical Society of America, Norfolk, VA, 12-16 October 1998.

NOVO-GRADAC, Anne-Marie, Assistant Professor, "Visible to Ultraviolet Upconversion in Nd^{3+}:$GdLiF_4$," Centennial Meeting of the American Physical Society, Atlanta, GA, 21-26 March 1999.

NOVO-GRADAC, Anne-Marie, Assistant Professor, "Radiative Lifetimes for Nd^{3+}:$GdLiF_4$," Centennial Meeting of the American Physical Society, Atlanta, GA, 21-26 March 1999.

NOVO-GRADAC, Anne-Marie, Assistant Professor, "Upconversion in Nd^{3+}:$GdLiF_4$," Society of Physics Students Conference on Undergraduate Research, Virginia Military Institute, Lexington, VA, 10 April 1999.

SCHNEIDER, Carl S., Professor, "ClassTalk, a Classroom Communication System that Works!", "Educating Our Nation's Leaders" Conference for Federal Service Academies, West Point, NY, 9 April 1999.

SHELBY, Robert N., Professor, "Andes: A Tutoring System for Classical Physics", Winter Meeting of the American Association of Physics Teachers, Anaheim, CA, 11-14 January 1999.

SHELBY, Robert N., Professor, "Andes: A coached problem solving system for basic physics", “Educating Our Nation’s Leaders” Conference for Federal Service Academies, West Point, NY, 8-9 April 1999.

TANKERSLEY, Lawrence L., Professor, “LASERNET FINES Optical Wear Debris Monitor: A Navy Shipboard Evaluation of a CBM Enabling Technology.”, Intelligent Ships Symposium “Intelligent Shipboard Technologies for the 21st Century”, American Society of Naval Engineers, Philadelphia, PA, 14-15 June 1999.

VANHOY, Jeffrey R., Associate Professor, “An Introduction to Radiation Health/Safety Concerns for Emergency Response Personnel”, Winterfest ‘99 EMS Training, Tilghman Island, MD, 31 January 1999.

VANHOY, Jeffrey R., Associate Professor, “Development of Isotopic Analysis Techniques using the USNA Pelletron”, Meeting of the Society of Physics Students, Region 4, Virginia Military Institute, Lexington, VA, 24 April 1999.

VANHOY, Jeffrey R., Associate Professor, “Electromagnetic Transition Rates and Multiphonon Excitations Observed in the Cerium-140 Nucleus”, Meeting of the Texas Academy of Science, Texas Lutheran University, Sequin, TX, 4-6 March 1999.

VANHOY, Jeffrey R., Associate Professor, “Low-Energy Excited Levels of Te-122 Through Gamma-Ray Spectroscopy Following Inelastic Neutron Scattering”, Meeting of the Texas Academy of Science, Texas Lutheran University, Sequin, TX, 4-6 March 1999.

WHITING, Alan B., CDR, USNR, “Age and Mass of the Local Group”, International Astronomical Union Symposium 192, The Stellar Content of Local Group Galaxies, Capetown, South Africa, 10 September 1998.

WHITING, Alan B., CDR, USNR, “Extension of the Timing Argument Using Satellite Galaxies”, Astronomical Department, University of Washington, Seattle, WA, 9 March 1999.

WHITING, Alan B., CDR, USNR, “A New Local Group Galaxy in Cetus”, Meeting of the American Astronomical Society, Chicago, IL, 3 June 1999.

WINTERSGILL, Mary C., Professor, “High Pressure Electrical Conductivity and NMR Studies on Liquid and Plasticized Polymer Electrolytes”, 9th International Meeting on Lithium Batteries, Edinburgh, Scotland, 12-17 July 1998.

Division of Professional Development

CAPT Louis J. Geanuleas, USN
Director

DEPARTMENT OF

Leadership, Ethics and Law

CAPT (sel) Mark N. Clemente, USN
Chair

The faculty of the Department of Leadership, Ethics and Law made tremendous contributions in research, publications, and presentations during the 1998 - 1999 academic year. Their superb talent and dedication is readily apparent in the significant scholarly advancements and pursuits which have garnered recognition both inside and outside the Naval Academy. As the critical role that leadership, ethics, and human behavior play within the military profession becomes increasingly apparent, the importance of these contributions can't be overstated. Department faculty members have demonstrated their commitment to advancing in relevant ways the knowledge base in these areas. Their works will have a lasting impact not only on future naval officers and the Fleet, but among academic colleagues as well.

Sponsored Research

Nobility Ethics: Sacrifice and Supererogation

Researcher: Assistant Professor Shannon E. French
Sponsor: Naval Academy Research Council (NARC)

This paper opens with the argument that the Kantian and Utilitarian models of ethical reasoning do not adequately account for the moral status of supererogatory behavior: that is, behavior that is morally praiseworthy but not morally required. This forces proponents of these theories to either subsume supererogatory acts into the category of duties or dismiss them as morally neutral, neither of which does justice to the often heroic or even saintly nature of such actions. Therefore the suggestion is made that a more intuitive account of supererogation is needed and may be constructed on the foundations of Aristotelian character - or virtue-based ethics. This new account will incorporate the concept of nobility, defined as a morally praiseworthy goal set by agents who voluntarily pursue an excellence of character beyond that which is minimally required in order to avoid the charge of moral negligence.

Warrior Ethics

Researcher: Assistant Professor Shannon E. French
Sponsor: Naval Academy Research Council (NARC)

An outgrowth from "Military Ethics: The Code of the Warrior" philosophy elective course, this research expands on the historical development of a code of ethics for the profession of arms through several warrior traditions, including those of the ancient Greeks, the Vikings, the Romans, the Celts, medieval knights, African Tribesmen, Native Americans, Chinese warrior monks, Japanese samurai, and warriors of the 20th century. Complex ethical issues and philosophical questions concerning honor, shame, nobility, justice, sacrifice, duty, loyalty, religious conviction and martial commitment have been encountered in the development of this course. This research will expand into these areas and explore in the context of each warrior culture four critical questions: (1) Why do they fight? (2) How do they fight? (3) What brings them honor? And (4) What brings them shame? These questions reveal a wealth of information about what their values really are and how they prioritize them; whether they believe in human rights or human dignity; how they conceive of retributive and distributive justice; their views on sacrifice, supererogation, duty and obligation; and event their theories concerning the ultimate purpose and meaning of human existence. Our moral characters can be defined by what we are - and are not - prepared to kill and die for and how we are prepared to judge ourselves and others when our moral commitments are truly put to the test. War is a crucible in which pretense and rhetoric are seared away, exposing the best and worst of raw human nature. Every ethical decision is forced and final, making for a superb setting to further the investigation of moral psychology. This research will support a book on "Warrior Ethics," recently put under contract.

Independent Research

The History of Moral Education at the United States Naval Academy

Researcher: Assistant Professor Aine Donovan

This research project will outline the history of moral education at the U.S. Naval Academy. The Naval Academy's Ethics Center has requested a proposal for the project and has conditionally agreed to publication of the finished project. Additionally, a collaborative analysis with Professor Lori Bogle into the moral education program at USNA, and Dr. Bogle's research on the history of moral education at West Point will take place. The projected date of completion for this project is July 2000.

The Military Community as a Moral Force in Late-Adolescent Development

Researcher: Assistant Professor Aine Donovan

The historical appeal to military service has been character-shaping; taking boys and "making men out of them." American society traditionally placed great value on the public service of military duty; yet with the increasing targeted demographics of enlistee, the moral gap between civilian and military segments of society is widening at an alarming rate. The role of the military community in character formation is still a vital component of military service. However, the danger arises as that group begins to identify themselves as morally superior to the civilian population which serves as their oversight.

Moral Education and Teacher's Self-Perceptions

Researcher: Assistant Professor Aine Donovan

An educational institution cannot avoid being involved in the moral lives of students, and this involvement is most commonly found in the person of the teacher. This research project sought out a select group of first and second-year teachers and through a year-long process of in-depth interviews assessed the teacher's role as a moral educator. One of the more significant findings of this year-long study was the fact that more than half of the teachers held to a distinctly relativistic orientation and refused to acknowledge their role as a moral educator.

To Die For: Warriors and the Identification of Moral Value

Researchers: Assistant Professor Shannon E. French and Assistant Professor Susan Dwyer

Tensions that arise in the wake of increased globalization and the rise of ethnic nationalism suggest it is time to revisit a central theme of the philosophical debate about moral relativism - viz., the problem of how to identify the moral values of diverse cultures. We proceed on the assumption that what is required is a diagnostic that will both (a) reveal the distinctive values of particular cultures, given the fact of intra-cultural diversity and (b) be applicable across the widest range of known cultures. We argue that an examination of warrior ethics will fit the bill, where "warrior ethics" refers to the values and principled commitments exemplified among the members of a socially or constitutionally sanctioned subset of a culture which is dedicated to that culture's protection. We advance a number of reasons for believing that a culture's values are thrown into sharp relief by the consideration of what members of its warrior class are prepared to die for and we provide several historical examples as illustrations.

With Your Shield or On It: Challenging the Pacifist Mother Archetype

Researcher: Assistant Professor Shannon E. French

Motherhood is uniquely feminine experience, such that if we validate the view that maternal commitments are incompatible with support for martial endeavors, we go a long way towards alienating women from the martial realm altogether. If we adopt the position that the pacifist mother archetype is the only acceptable mother archetype, then we limit the role of mothers in wartime to just those roles traditionally sanctioned by the patriarchy: that of the victim, the protester, and the mourner. This research expands beyond these roles and explores alternative conceptions of what motherhood entails.

Publications

ANDERSEN, Gene R., Editor "Leadership: Theory and Application", Simon and Schuster, Needham Heights, MA, 1999.

Leadership is the single vital quality in any effective military unit or organization. It has been said that every graduate of the Naval Academy receives a degree in leadership. This book is intended to provide some scholarly basis for that claim. Naval Officers study topics from aircraft maintenance and amphibious warfare tactics to underwater acoustics and radar performance theory in order to sustain a high level of operational excellence. They must also study leadership, if they are to excel in that as well. This book is built around the fact that experts in the many academic disciplines that comprise the field of leadership studies have something to say that leaders can put to use. Each scholarly selection either provides a clear application for the junior naval officer or is accompanied by an application focused article from a military source. Each selection has been chosen to provide the reader with both a deeper understanding of the topic and set of leadership tools that can be used in the Fleet or Fleet Marine Force.

DONOVAN, Aine, JOHNSON, David E., LUCAS, George R., and ROUSH, Paul E. "Ethics for Military Leaders," Simon and Schuster, Needham Heights, MA, 1998.

This comprehensive overview of ethics, with a particular emphasis on military ethics, examines the moral life from a variety of perspectives. The book is unique in its approach to ethics in that it presents an application to the theories through case analysis. The cases are carefully selected to suit the needs of junior military officers and their potential dilemmas.

DONOVAN, Aine, "Celestial Navigation with a Moral Compass," Journal for a Just and Caring Education, Corwin Press, June 1999, pp. 285 - 297.

The moral education of military leaders in the service academies was seen, traditionally, as an integral aspect of military training. The method for transmitting that moral education relied heavily up a Kantian notion of principle-based reasoning. This abstract form of reasoning has a place within the military structure but arguably, does not adequately address the needs of a mixed gender peace-keeping force. The model proposed withing this paper is one which relies upon the acceptance of duty and obedience (i.e., justice) as well as the cultivation of reflective concern for individual choice and responsibility (i.e., caring).

DONOVAN, Aine, "The Case for Ethics Education",

Shipmate, January 1999.

DONOVAN, Aine, Review of Introduction to Philosophy/Ethics Database, Pearson Publishing, 1999.

Dominy, N. L., *Johnson, W. B.* (Assistant Professor), & Koch, C. (2000). Perception of parental acceptance-rejection and satisfaction with life in women with binge eating disorder. The Journal of Psychology, 134, 23-36.

This study contributed to the validating literature for Binge Eating Disorder (BED) by examining parental perceptions and satisfaction with life among obese women with and without BED. Subjects were female patients recruited through a private medical clinic. Subjects were assigned to groups on the basis of body mass index (BMI) and scores on the Questionnaire on Eating and Weight Patterns (QEWP, Spitzer et al., 1992). Groups consisted of (a) obese BED women (n=32), (b) obese noneating-disordered women (n=5 1), and (c) non-obese noneating-disordered women (n=30). All subjects completed the Parental Acceptance-Rejection Questionnaire (PARQ, Rohner, 1986), Satisfaction With Life Scale (SWL, Fischer & Corcoran, 1994), and the Beck Depression Inventory (BDI, Beck & Steer, 1987). Obese women with BED perceived their fathers as more rejecting than did women in the other groups. Further, they perceived their fathers as significantly more rejecting than their mothers. The BED group indicated lower satisfaction with life and higher levels of depression than the noneating-disordered groups. These findings further validate the diagnostic category of BED. Obese women with BED appear to be a distinct subgroup of the obese population. Results indicate a need for further assessment of the father-daughter relationship in connection to BED and other eating disorders.

DWYER, Susan, "Moral Competence," Philosophy and Linguistics, edited by K. Murasugi and R. Stainton. Westview Press, Boulder, CO, 1990, 169-190.

The argument is made that at a certain level of abstraction there are striking parallels between the exercise and development of moral competence, on the one hand, and the exercise and development of linguistic competence on the other. The parallels motivate pressing the so-called linguistic analogy well beyond the epistemological use to which Rawls puts it and into substantive service as a psychological hypothesis. Facts about the abilities that comprise moral competence and the conditions in which those abilities develop strongly suggest that children come equipped with something akin to universal Moral Grammar. Variability in moral codes tends to raise doubts about the universality of moral principles. However, such variability occurs overwhelmingly at the level of particular moral judgments. Moreover, the recognition of a distinction between moral and conventional domains, and the belief that moral considerations are imbued with special force and authority appear to be universal features of human life. Thus, the argument is made for the utility of a further appropriation from linguistics. Variability in human languages exists against the backdrop of deep commonalities and is explained in terms of the notion of parameter-setting; a similar explanation might be available in the case of moral variability as well.

DWYER, Susan, "Reconciliation for Realists," Ethics and International Affairs, 13 (April 1999), 81-98.

Reconciliation is being urged upon people who have been bitter and murderous enemies, upon victims and perpetrators of terrible human rights abuses, and upon groups of individuals whose very self-conceptions have been structured in terms of historical and often state-sanctioned relations of dominance and submission. The rhetoric of reconciliation is particularly common in situations where traditional judicial responses to past wrongdoing are unavailable because of corruption in the legal system, staggeringly large numbers of offenders, or anxiety about the political consequences of trials and punishment. But what is reconciliation? How is reconciliation to be achieved? And under what conditions should it be sought? The notable lack of answers to these questions prompts the worry that talk of reconciliation is merely a ruse to disguise the fact that a "purer" type of justice cannot be realized - that, in being asked to focus on reconciliation rather than on

punishment, victims of past wrongdoing are having to settle for the morally second best. Underlying our pre-theoretical understanding of reconciliation is a core concept of reconciliation as narrative incorporation. This conception of reconciliation suggests a way in which reconciliation might be pursued and grounds a response to moral qualms provoked by the use of an unanalyzed conception of reconciliation.

DWYER, Susan, "Does Moral Philosophy Have a Future?," Review of Fieldwork in Familiar Places, by Michele M. Moody-Adams, Ethics and International Affairs 13 (April 1999), 269-271.

DWYER, Susan, Review of Reclaiming the History of Ethics, edited by Andrews Reath, Barbara Herman, and Christine M Korsgaard. Philosophy in Review, 18 (August 1998), 294-297.

DWYER, Susan, Review of Sex, Preference, and the Family, edited by David M. Estlund and Martha C. Nussbaum, Ethics, 109 (October 1998), 184-187.

HOLMES, Elizabeth K., Mateczun, J.M., LALL, R., and Wilcove, G.L., "Pilot Study of Suicide Risk Factors Among Personnel in the United States Marine Corps (Pacific Forces)," Psychological Reports, 1998, 83, 3-11.

Risk factors for suicide among active-duty members of the United States Marine Corps were investigated. Three groups were suicide attempters (n=172), completers (n=22), and a non-psychiatric comparison group (n=384). A series of multiple regression and discriminant analyses were conducted to assess whether any of the 137 selected risk-factors differentiated the suicidal group from the comparison group. The following factors differentiated suicide attempters and completers from the comparison group and were associated with increased suicide risk: History of Abuse, Neglect or Rejection, Lower Performance Evaluation, Symptoms of Depression, No History of Gambling Behavior, Younger Age, History of Alcohol Abuse, and Hopelessness. A discriminant analysis using these seven variables resulted in a 77% accuracy rate. When evaluating variables that could be obtained by a review of military records alone, three variables differentiated the attempters and completers from the comparison group, Lower Performance Evaluation, Younger Age, and a History of Military or Legal Problems. These variables correctly classified 73% of the sample. Implications for suicide-risk assessment for individuals in the Marine Corps are provided.

Houston, B., Bufford, R. K., & JOHNSON, W, Brad, Assistant Professor, Distinctive components and perceived sources of gain in Christian counseling. Journal of Psychology and Christianity, 18, 238-253.

This article describes the results of two survey studies designed to assess Christian practifioner's perspectives regarding both the distinctive components and undergirding sources of gain in Christian counseling. Both studies utilized members of the Christian Association for Psychological Studies (CAPS). Study 1 employed a convenience sample of 17 CAPS members, while study 2 obtained a sample of 161 CAPS psychologists. Results of the studies were congruent and offered support for a multi-dimensional model of Christian counseling. Respondents were most likely to endorse God's active involvement in counseling and the counselor's faith as the most distinctive components of Christian counseling. The most highly endorsed active ingredient leading to change was the activity of God, Jesus Christ, or the Holy Spirit.

JOHNSON, David E., Professor , "The Relation of Tradition to Judgment." in Scott Lee and Allen Speight, *Tradition d Innovation*. New York: University Press of America, 1999.

This paper discusses the introd~Iion of a c re ethics course into the Naval Academy's curriculum. Part of the design included a c, ire text edited by those teaching the course to provide a focus on professional military et%hi. ' T e questions addressed include, how and why did we design such a course, what problems we' encountered, and what expectations did the Academy have for this course to contribute to the character development of those taking the course?

Since our faculty contains both civilian and military faculty we confronted the best mix of faculty in presenting the course.

JOHNSON, W. Brad, Assistant Professor, DiGiuseppe, R., & Ulven, J. (1999). Albert Ellis as mentor: National survey results. Psychotherapy, 36, 305-312.

As the founder of Rational-Emotive Behavior Therapy (REBT), Albert Ellis is among the most prolific and influential psychotherapists of all time. He has personally trained and supervised hundreds of therapists at his Institute in New York and annually provides didactic instruction for thousands more. Ellis is often described as cold, aloof and abrasive interpersonally. He generally has little time for relationships, devoting most of his time to writing, training and seeing clients.

JOHNSON, David E., Professor, "Ethical Education in the Military: Controlling the Institution of Violence." In Deane Curtin and Robert Litke, eds, *Institutional Violence.* Amsterdam: Editions Rodopi B.V., 1999.

From the time of Plato's *Republic* the problem of institutionalized violence has been center stage. In a metaphor of guard dogs Plato asks how can shepherds raise dogs to protect their flocks without becoming like wolves. The Tailhook scandal heightened this issue when some those trained and practiced in using violence to contain Iraq in the Gulf War, turned their violence to fellow citizens and officers. Plato concludes that the state would be safeguarded if the auxiliaries have been finely educated. The article then addresses what might constitute a good education for the managers of violence.

JOHNSON, W. Brad, Assistant Professor, Huwe, J. M., & Lucas, J. L. (2000). Rational mentoring. Journal of Rational-Emotive and Cognifive-Behavior Thergpy, 18 39-54.

Psychologists and other mental health professionals often serve as mentors to graduate students, interns and junior professionals. Mentor relationships are often long-term and emotionally complex and ideally involve provision of both career and psychosocial functions which prepare proteges for careers in the profession. Although experienced and accomplished, mentors often
fall prey to a range of irrational thinking which may compromise their effectiveness in the mentor role. In this article we briefly define - mentoring, describe the practices of effective mentors, highlight the irrational beliefs which most often prove troubling to mentors and outline several strategies for effectively coping with these beliefs. We hypothesize that routine and overt disputation of mentor-related irrational beliefs will enhance both the effect and enjoyment of mentoring.

JOHNSON, W. Brad, LALL, R., Bongar, B. and Nordlund, M., "The Role of Objective Personality Inventories in Suicide Risk Assessment: An Evaluation and Proposal," Suicide and Life Threatening Behavior, 29 (1999) 165-185.

Objective personality assessment instruments offer a comparatively underutilized source of clinical data in attempts to evaluate and predict risk for suicide. In contrast to focal suicide risk measures, global personality inventories may be useful in identification of long-standing styles which predispose persons to eventual suicidal behavior. This article reviews the empirical literature regarding the efficacy of established personality inventories in predicting suicide. The authors offer several recommendations for future research with these measures and conclude that such objective personality instruments offer only marginal utility as sources of clinical information in comprehensive suicide risk evaluations. Personality inventories may offer greatest utility in long-term assessment of suicide risk.

JOHNSON, W. Brad and Nelson, N., "Mentor-Protege Relationships in Graduate Training: Some Ethical Concerns," Ethics and Behavior, 9 (1999), 189-210.

Theoretical and empirical writings from psychology and other fields characterize mentor-protege relationships as long-term, complex and multifaceted. Mentoring appears to share components in common

with academic advising and counseling, yet remains distinct from these roles. Mentor-protege relationships offer graduate students both enhanced career opportunity and personal/psychosocial benefits, and may become emotionally intimate and incorporate a wide range of shared activities and contexts. For these reasons, mentoring relationships at the graduate level appear unique in posing previously unexplored ethical dilemmas. In this article, we consider several ethical concerns related to mentoring psychology graduate students including competence to mentor, describing the nature of mentoring relationships, equal access to mentoring, exploitation in mentoring relationships and multiple role demands related to mentoring. We conclude with several salient recommendations for graduate programs relative to preparing both faculty and students for mentor-protege relationships.

JOHNSON, W. Brad and Corser, R., "Learning Ethics the Hard Way: Facing the Ethics Committee," Teaching of Psychology, 25 (1998), 26-28.

This article describes an approach to enhancing the value of case study material in teaching professional ethics in psychology. The mock committee approach involves a series of hearings convened by students who rotate membership on a class ethics committee. Members of the class participate randomly as psychologists accused of various ethical violations. While the class observes, formal complaint hearings occur that result in official rulings and the setting of appropriate penalties and remedial requirements. The larger class then joins in active feedback and exchange with the committee to highlight and discuss salient ethical issues. We present and discuss student evaluation data for this technique and comment on the potential advantages of this teaching approach.

JOHNSON, W. Brad and Johnson, W. L., "Self-Help Books Used by Religious Practitioners," Journal of Counseling and Development, 76 (1998), 459-466.

Self-help books are frequently utilized by mental health professionals as adjuncts to the counseling process. This was the first study to assess self-help utilization among explicitly religious practitioners. All practitioner members of the Christian Association for Psychological Studies (N=784) were mailed a copy of the Self-help book Survey. Ninety-two percent of the 243 respondents used self-help books with clients at least some of the time. There were differences between master's and doctoral level respondents with respect to how self-help books were used and the criteria used in selecting self-help books for clients. Most books recommended were explicitly Christian in nature. Those self-help books most frequently recommended are listed and may be useful to practitioners who counsel Christian clients.

JOHNSON, W. Brad and Nielsen, S. L., "Rational-Emotive Assessment with Religious Clients." Journal of Rational-Emotive and Cognitive-Behavior Therapy, 16 (1998), 101-123.

Rational emotive behavior therapy's (REBT's) methods for fostering change are similar to the kinds of activities one would expect to encounter in many organized religions. REBT also bears a strong theoretical affinity with religion because of its preferred therapeutic goal of helping clients examine and change their beliefs. Furthermore, the formal religious traditions to which many clients adhere will usually include doctrinal material in agreement with the cardinal tenets of REBT, material which can be enlisted during REBT to help religious clients evaluate and change their self-defeating, irrational beliefs. A case integrating religious belief with REBT is presented, future directions for research, and issues related to matching client with therapist beliefs are briefly discussed.

JOHNSON, W. Brad, Assistant Professor, Ridley, C. R., & Nielsen, S. L. (2000). Religiously sensitive Rational Emotive Behavior Therapy: Elegant solutions and ethical risks. Professional Psychology: Research and Practice, 31, 14-20.

Rational Emotive Behavior Therapy (REBT) can be an elegant treatment modality for explicitly religious clients. This is true in spite of the traditional anti-religious stance of Albert Ellis. This article summarizes the evolution of Ellis' views on religion

and mental health, considers potential ethical dilemmas caused by utilizing REBT with religious clients, and recommends strategies for reducing violation of ethical and specialty guidelines in work with religious clients. We conclude by proposing a general model for religiously-sensitive psychotherapy which may serve to undergird theorizing and research on the application of REBT and other treatment approaches to religious clients.

JOHNSON, W. Brad, "Military Psychologist: Training and Practice." In C. Cronin (Ed.), Military Psychology" An Introduction, (pp. 201-218). New York: Simon & Schuster, 1998.

This chapter describes the training and practice opportunities for military psychologist. It describes the structure and requirements of military internships, the unique training opportunities available to psychologists predoctorally and postdoctorally, and highlights the most significant stressors inherent in military practice. It describes the most common practice components and range of duty assignments for military psychologists. It concludes with a discussion of the unique ethical and practice quandaries presented by military contexts and conflicts.

Roid, G and JOHNSON, W. Brad, "Computer Assisted Psychological Assessment," in A.S. Bellack and M. Hersne (Eds.) Comprehensive Clinical Psychology (pp. 501-523). New York: Pergamon, 1998.

A common dilemma for the clinical psychologist is the tension between the need for diagnosis and the complexities of the individual case. Time may be limited or client resources may be limited, making extended assessment difficult to complete. In the midst of this dilemma, various methods of computer assisted psychological assessment (CAPA) have become prominent, especially with the advent of personal computers. This chapter surveys the definition, history, types of implementation, advantages and disadvantages, reliability and validity concerns, and issues of ethical and professional responsibility in the use of computers in assessment.

LALL, R., HOLMES Elizabeth K., Brinkmeyer, K. R., Johnson, W. B. And Yatko, B. R. " Personality Characteristics Among Future Military Leaders." Military Psychology, 1999.

Relatively little is known about the personality characteristics of military personnel, particularly those who are most successful in military careers. This study evaluated the personality characteristics of 530 third year Midshipmen at the United States Naval Academy. Participants completed the Hogan Personality Inventory (HPI) and a demographic questionnaire. Class ranking data was also obtained as an indicator of success at the Naval Academy. Results indicated that in comparison to national norms, midshipmen scored somewhat higher on scales of ambition, sociability, intellectance and school success and lower on scales of adjustment, likability and prudence. Ambition, prudence, intellectance and school success were each significantly positively correlated with class standing. Implications of these findings for understanding personality correlates of success in military leadership are discussed.

LALL, R., HOLMES, E.K., Bongar, B., JOHNSON, W. B., Jain, V. K., and Mittauer, M. W. "Efficacy of the MCMI-II in Discriminating Mental Health Patients With and Without Suicidal Ideation." Military Psychology, 11(1999).

Forty-two mental health clinic patients with suicidal ideation and 89 patients without suicidal ideation were administered the Millon Clinical Multiaxial Inventory-Two (MCMI-II: Millon, 1987). All participants were active duty military personnel. Fifteen MCMI-II scale elevations were significantly different between the two groups. Two discriminant analyses, the first utilizing all 25 MCMI-II scales, and the second with only the 13 MCMI-II personality scales, produced correct classification rates of 80.92% and 75.57% respectively. Six of seven MCMI-II "suicide" items significantly differentiated suicidal ideation and non-suicidal ideation groups. Results of this study offer initial support for the utility of the MCMI-II as a potential screening device for suicidal ideation.

LUCAS, George R. Jr., Associate Professor, "Charles Hartshorne: The Last or the First," The Personalist Forum, 14/2 (Fall, 1998), 83 - 107.

Keynote address for the 100th Birthday celebration of Professor Charles Hartshorne, University of Chicago emeritus, and University of Texas - Austin. Recounts the major intellectual achievements of America's most eminent philosopher of religion in the 20th century, and attempts to develop a historical context for estimating Hartshorne's work.

LUCAS, George R. Jr., Associate Professor, "Morality and Cross Cultural Traditions in the Philosophy of Robert C. Neville," in Frankenberry, et alia, eds, Re-Thinking Neville (Albany, NY: State University of New York Press, 1999).

Gives an account of the grounding of Neville's moral theory in the traditions of Confucian and neo-Confucian philosophy, arguing that the American philosophical idiom from which Neville also draws, is equally sufficient to develop the communitarian insights he advocates.

NIELSEN, S. L., Johnson, *W. B.* (Assistant Professor), & Ridley, C. R. (2000). Religiously sensitive Rational Emotive Behavior Therapy: Theory, techniques and brief excerpts from a case. Professional Psychology: Research and Practice, 31 21-28.

Rational Emotive Behavior Therapy's (REBT's) methods for fostering change, such as disputation of irrational beliefs, are similar to the kinds of activities one might expect to encounter in many organized religions. REBT also bears a strong theoretical affinity with some religions because of its preferred therapeutic goal of helping clients examine and change their beliefs. Furthermore, the formal religious tenets and traditions to which many clients adhere will usually include doctrinal material which is highly congruent with REBT's theory of change. Such belief-oriented material might be enlisted during REBT to help religious clients evaluate and change their self-defeating, irrational beliefs. A case integrating religious belief with REBT is presented. Finally, we conclude with a brief summary of preliminary outcome research regarding the efficacy of this approach.

Presentations

DONOVAN, Aine, Assistant Professor. "Raising moral Children," Annual Conference of Pace University (NYC) Ethics Center, February 1999.

DONOVAN, Aine, Assistant Professor. "The Military Community as a Force in Late-Adolescent Moral Development," presentation at the Annual Conference of the Association of Moral Education, November 1998.

DONOVAN, Aine, Assistant Professor. "Valuation and the Conditions Necessary for Inculcation," presentation at the World Congress of Philosophy, August 1998.

DWYER, Susan, Assistant Professor. "Moral Motivation," University of Maryland, Baltimore County, December 1998.

DWYER, Susan, Assistant Professor. "Moral Motivation," Johns Hopkins University, January 1999.

DWYER, Susan, Assistant Professor. "Evil and Moral Competence: What Psycopaths Can Teach Us," Conference on The Problem of Evil, Association for the Advancement of Philosophy and Psychiatry, Washington, DC, May 1999.

DWYER, Susan, Assistant Professor, "Reconciliation

for Realists" Conference on the Dilemmas of Reconciliation, Calgary, Alberta, Canada, June 2-6, 1999.

HOLMES, Elizabeth B., Captain, USN and Professor, "Gender Differences in Communication", Pacific Fleet Admirals/Commanders Conference, 1 March 1999.

HOLMES, Elizabeth B., Captain, USN and Professor, "Eating Disorders and College Athletes," American College Health Association, San Diego, CA, 5 June 1998.

HOLMES, Elizabeth B., Captain USN and Professor, "Emotional Intelligence," Surgeon Generals Conference, Norfolk, VA, 23 September 1998.

Huwe, J. M., Fallow, A., JOHNSON, W. Brad, Lall, R., & Holmes, E. K. (1999, August). Mentoring among Flag officers: A Survey of Retired Admirals. Poster session presented at the annual meeting of the American Psychological Association, Boston.

JOHNSON, David E., "Gandhi and Tutu: two moral pioneers in the 20" Century." A talk delivered to the Annapolis Rotary Club, Annapolis, MD, January 20, 2000.

JOHNSON, David E., "Truth, Justice and Conciliation," a paper delivered to Concerned Philosophers for Peace, Radford, VA, 22 October 1999.

JOHNSON, David E., Professor. "Should the Military Fight the War on Drugs?" Twentieth World Congress of Philosophy, Boston MA, 16 August 1998.

JOHNSON, David E., Professor. "Should the Military Fight the War on Drugs?" 11th Annual Conference of Concerned Philosophers for Peace, Washington, DC, October 3, 1998

JOHNSON, David E., Professor. "Don't Learn War Anymore." Proceedings of the Truxal Seminars, 1998-1999, Arnold MD.

JOHNSON, David E., Professor. "What is the Truth Worth? South Africa's Truth and Reconciliation Commission." The Ethical Culture Society of Baltimore, May 9, 1999.

JOHNSON, W. Brad, *(2000,* April). Clinical Mlications of Rational Emotive Behavior TherVA. Invited lecture presented to the Psychology and Psychiatry faculty at the National Naval Medical Center, Bethesda, MD.

JOHNSON, W. Brad, *(2000,* May). Brief and elegant psychothewy for the *2 1'* CeqW: A Rational Emotive Behavior TherVy Primer. Invited Professional Workshop to be presented at Pine Rest Medical Center, Grand Rapids, MI.

JOHNSON, W. Brad, Assistant Professor. "Rational Emotive Assessment with Religious Clients," at Symposium conducted at the annual meeting of the Association for the Advancement of Behavior Therapy, Washington, DC, November 1998.

Clark, R. A., Harden, S. L., and JOHNSON, W. Brad, Assistant Professor. "Mentor Relationships in Clinical Psychology Doctoral Training: A National Survey of Recent Graduates." Symposium conducted at the annual meeting of the American Psychological Association, San Francisco, CA, August 1998.

JOHNSON, W. Brad, Assistant Professor, DiGiuseppe, R., and Ulven, J. "Albert Ellis as Mentor: Results of a National Survey." Symposium conducted at the annual meeting of the American Psychological Association, San Francisco, CA, August 1998.

Thomas, J., Bufford, R. K., JOHNSON, W. Brad, Assistant Professor, and Ecklund, K. "Effects of Prtherapy Disclosure of Personal Values." Poster session presented at the annual meeting of the American Psychological Association, San Francisco, CA, August1998.

JOHNSON, W. Brad, Assistant Professor, Carmichael, K., Fallow, A., Fallow, G., Geca, M,. Huwe, J., Lucas, J., and Zorich, L. "Mentor-Protege Relationships in

the Seasons of a Psychology Career." Symposium presented at the annual meeting of the Oregon Psychological Association, Lincoln City, OR, April 1999.

LUCAS, George R., Associate Professor, and LEE, J. Scott. "Using General Education Reform for Institutional Improvement," FIPSE Project Directors' Annual Meeting, Washington DC (OCT 9, 1999).

Presentation of preliminary results of the study of 65 higher education institutions nationwide drawn from all four Carnegie categories. Case studies and examples illustrate how gen ed reform is often part of an overall institutional strategy to combat crisis, recruit students, retain faculty, and restore a sense of mission sufficient to complete and excel in a highly competitive academic market.

Nielsen, S. L., JOHNSON, W. Brad, & Robb, H. B. (1999, November). Rational Emotive Behavior Therapy for Religious Clients. Continuing Education Workshop presented at the annual meeting of the Association for the Advancement of Behavior Therapy, Toronto, Ontario.

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Publications

WERKING, Richard H., Professor, *ed.,Change and Continuity in Librarianship: Approaching the Twenty-First Century*. Proceedings of the 40th Annual Military Librarians Workshop, 20-22 November 1996, Annapolis, MD (Washington, D.C., 1998).

Presentations

CREIGHTON, Alice S., Head, Special Collections and Archives, "Using the Academy to Teach the Research Paper," at Educating our Nation's Leaders: A Conference for the Federal Service Academies. West Point, NY, 8-9 April 1999.

HENNESSY, Ruth M., Head, Electronic Resources Program, "Developing Students' Research Skills," at Educating our Nation's Leaders: A Conference for the Federal Service Academies, West Point, NY, 8-9 April 1999.

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