Electrical Engineering Department

CAPT Robert J. Voigt, USN
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 it ultimately improves the effectiveness of the academic environment by encouraging a modern and relevant curriculum.

Funding for our research comes from the Office of Naval Research (ONR), the Naval Research Laboratory (NRL), the Naval Surface Warfare Center (NSWC), the Johns Hopkins University Applied Physics Laboratory (JHU/APL), the Armed Forces Communications Electronics Association (AFCEA), the National Security Agency (NSA), Harvard University, the Advanced Technology Institute (ATI), Cypress Semiconductor, Medtronics Corporation, the U.S. Air Force (USAF), the Army Research Laboratory (ARL), and from within the U.S. Naval Academy.

Research topics supported during the past year included an initiative in control and reconfiguration of shipboard electric power systems, distributed control of shipboard systems, stability of shipboard electric power systems, various aspects of digital signal processing (including image and video processing, adaptive DSP, and reconstruction of periodic SONAR signals), development of micro-electro-mechanical microwave switches and thermal control devices, packaging of microwave and optical components, design of wireless sensor system/power nodes, near earth RF propagation, high power vacuum electronics, electronic reliability, operation and control of buck converters, electronics for detection of nuclear materials by a UAV and micro-dosimetry of space radiation, study of the "ship effect" on nuclear radiation, optical calibration of TLD readers, development of ad hoc networking protocols, biometric signal processing, and software defined radio. This faculty and midshipman 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

National Naval Responsibility Electric Ship Integration Initiative

Researchers: Assistant Professor Edwin L. Zivi (Weapons and Systems Engineering Department)
and Associate Professor John G. Ciezki
Sponsor: Advanced Technology Institute (ATI) and Office of Naval Research (ONR)

This research supports the U.S. Navy's push towards the development of an Electric Warship. The investigators are part of a collaborative effort that includes faculty from MIT, Purdue University, and University of Missouri at Rolla. The effort specifically involves the integration of research, analyses, software and hardware tools, monographs, and curricula to support multidisciplinary ship design, power system analysis, and automation engineering. The Naval Academy's technical thrust is in the area of automation engineering. Initial efforts focused on the development of an automation laboratory and the structuring of an undergraduate course in automation.

Distributed Control of Shipboard Systems Technical Support

Researcher: Associate Professor John G. Ciezki
Sponsor: Office of Naval Research (ONR)

This project supports efforts to develop intelligent distributed load management schemes for a naval warship operating with a power electronics-based power distribution system. This effort is specifically concerned with power systems and shipboard domains.

Biometric Signal Processing

Researchers: Professor Delores M. Etter, Assistant Professor Robert W. Ives,
CDR Thaddeus B. Welch, III, USN and Dr. Eliza Du, ONR Post-doctoral Fellow
Sponsors: National Security Agency (NSA) and Office of Naval Research (ONR)

This project investigated a number of techniques for iris recognition. An architectural framework to test and compare algorithms has been developed. This framework outlines the different components to the algorithms - image preprocessing, pattern identification/coding, and pattern matching - and guides the development of a MATLAB simulation model. The project also includes building and collecting several databases of iris images to use in algorithm testing.

Continued Development of MEMS Microwave Switches

Researcher: Assistant Professor Samara L. Firebaugh
Sponsor: The Johns Hopkins University /Applied Physics Laboratory (JHU/APL)

Microelectromechanical (MEM) relays offer many potential advantages over solid-state switches for routing microwave signals, and they could facilitate active aperture phased array systems (like the Aegis system) on small vehicles such as missiles or airplanes. They have much lower insertion loss, behave linearly over a wide operation range, and require little power for operation. In previous work, the APL switch was redesigned, fabricated, packaged and tested. The performance of the new switches met expectations, with an actuation voltage of less than 40 V, insertion loss less than 0.2 dB, and isolation of greater than 20 db at 20GHz. Further issues were explored with packaging these devices and an alternative switch that uses lateral actuation was developed.

Modeling for Miniature Photoacoustic Chemical Sensors Using Microelectromechanical (MEMS) Structures

Researcher: Assistant Professor Samara L. Firebaugh
Sponsor: Army Research Laboratory (ARL)

Photoacoustic spectroscopy is a useful monitoring technique that is well suited for trace gas detection. The technique also possesses favorable detection characteristics when the system dimensions are scaled to a micro-system design. Piezoelectric microelectromechanical systems and chemical and biological sensing were incorporated into a monolithic MEMS photoacoustic trace gas detector. Modeling is an important part of this effort.

Sparse Aperture Array Image Compression

Researcher: Assistant Professor Robert W. Ives
Sponsor: Naval Research Laboratory (NRL)

This project attempted to apply lossless and near-lossless image compression to multi-spectral sparse aperture array imagery. A team lead by the Naval Research Laboratory is developing a satellite system that would combine sixteen video cameras in an array such that the lower resolution camera outputs could be combined to yield an improved system resolution. Unfortunately, the resolution sought and the size/frame rate of the sixteen video camera outputs would produce a digital data stream on the order of Gbits/sec.

To reduce the bandwidth of transmission, the idea of data compression was tested on some of the preliminary imagery created by a ground-based prototype of the system. Several means of compression were tested, including JPEG, JPEG-2000, SPIHT and other modern image compression algorithms, including an algorithm derived by the investigator. The best results were achieved with JPEG-2000, although no video compression algorithm (*e.g.,* MPEG-2 or MPEG-4) was attempted. This project (testing compression) was completed during the summer of 2003.

New Approaches to Iris Recognition

Researchers: Assistant Professor Robert W. Ives and CDR Thaddeus B. Welch, III, USN
Sponsor: National Security Agency (NSA)

This project is in progress. The interest lies in pursuing several new ideas related to iris identification. One of these approaches to iris pattern recognition uses Parzen windows in the spatial domain (as opposed to the wavelet used by Daugman and others). The Parzen window is a non-parametric multi-scale statistical model, which is computed directly from the sample; there is no search for parameters. To reduce the noise and illumination influence in an iris image, some type of smoothing of the data was necessary. Curve fitting was used rather than simple smoothing to more accurately approximate the underlying trends in the iris data. This technique includes three stages: preprocessing, pattern extraction, and pattern identification. Preprocessing locates the various components of the iris boundary. In particular, the need is to find the limbic (outer) boundary of the iris, the pupillary (inner) boundary of the iris, and the eyelids, and then generates the iris mask that eliminates these non-iris parts. In the pattern extraction stage, the Parzen window is used to capture the iris patterns. This technique also uses curve fitting to identify the non-iris pattern areas as well as iris patterns. The plan is to classify the iris patterns into categories, which will form an identification code to be stored in a database for future matching. The pattern identification stage includes a circular match to existing databases. In this way, the new algorithm for iris pattern recognition will be translation, rotation, and scale invariant.

Another approach is to use a partial iris image for identification. The first step was to make a database of partial iris images from existing databases. This allows for the performance of analyses on the data before expanding the technique to include the collection of the partial iris. This method may also include the three-stage analysis described above. With a partial iris image, identification may result in several good matches, as opposed to one best match. The advantage of this technique is that it could use iris images collected from side views and from various angles. This would allow more images to be successfully processed, and would also allow collections from non-cooperative subjects. There is also interest in developing "smart" iris searches through databases. This technique would require the determination of characteristics stored with the iris and used to narrow the scope of the identification process. These characteristics might include color and unique patterns within the iris.

Steady-State Analysis of Stimulated Brillouin Scattering in Optical Fiber

Researcher: Associate Professor R. Brian Jenkins
Sponsor: The Johns Hopkins University Applied Physics Laboratory (JHU/APL)

This project focuses on the analysis and numerical modeling of Stimulated Brillouin Scattering (SBS) in optical fiber in the steady-state regime. The research is in support of ongoing experiments at the Johns Hopkins University Applied Physics Laboratory that attempt to optically extract a high-speed digital clock from a stream of data (at arbitrary data rates of 10-40Gb/s). SBS is the fiber nonlinearity with the lowest threshold power in many systems. SBS is a nonlinear interaction between three waves, a forward-propagating optical pump, a backward-propagating optical Stokes wave (downshifted 11GHz from the pump), and an acoustic wave (at 11GHz) that leads to material density fluctuations (in the index of refraction). Optical pump energy is scattered off the grating in the direction of the Stokes wave. Hence SBS often causes strong fluctuations in energy levels, leading to signal degradation in many fiber optic systems. SBS can also be used productively for amplifiers, sensors, and clock recovery. The goal of this project has been to understand the steady-state characteristics of the SBS process, with emphasis on the spontaneous growth of noise due to SBS. Analytical and numerical models were developed that accurately predicted the steady-state behavior of SBS as observed in the laboratory.

Advanced Packaging Applications

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

Wide bandwidth applications have driven the demand for optical waveguides and other components for the processing and transmission of information. Polymers are attractive materials for optical waveguides at both the chip and substrate levels because of their desirable electrical and optical properties as well as their ease of processing. Techniques are being developed to simultaneously use polyimide as both a dielectric layer and an optical waveguide in the same multi-chip substrate

structure. One technique, using poled polymers, permits electrical and optical interlayers to be formed simultaneously, thus allowing buried optical waveguide and electrical signal lines on the same Multi-Chip Module-Dielectric (MCM-D).

Work continues on a noninvasive, laser-based instrument to probe 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. Electric field measurements and mappings can be useful in diagnosing module performance, locating sites of circuit shorts and opens, and determining the efficacy of field containment structures. The detection of electric fields in polyimide with buried circuit elements in multiple layers characteristic of MCM-D structures is being studied. Test systems of two dielectric layers with one metal interlayer are also being studied.

The details of the poling and processing operations along with the mechanical, thermal, electrical, optical and electro-optic properties for both lightguide and dielectric layer applications are being examined.

Test Fixtures for SiC Power Electronic Components

Researcher: Assistant Professor Thomas E. Salem
Sponsor: Naval Research Laboratory (NRL)

Work was completed on two separate test fixtures for evaluating SiC power electronic components for the Naval Research Laboratory. One fixture provided for high voltage transient reverse recovery characterization of SiC diodes. Another fixture provided the capability for high voltage high current pulse testing of SiC diodes.

Evaluation of Micro-channel Heat Sink

Researcher: Assistant Professor Thomas E. Salem
Sponsor: Army Research Laboratory (ARL)

Work has begun at the Army Research Laboratory on designing and developing a test fixture for evaluating a liquid cooled micro-channel heat sink. A three-phase power inverter is being designed and fabricated utilizing IGBT H-bridges packaged on individual heat sinks. The heat sinks are mounted on a block manifold and connected to a pump system capable of supplying either heated or chilled water. Thermal analysis is underway to evaluate the efficacy of the micro-channel system.

Development and Evaluation of Real-Time DSP Systems and Programs Used in Airborne Optical Weapons

Researcher: Professor Antal A. Sarkady
Sponsor: Naval Research Laboratory (NRL)

Several FFT based MATLAB and C programs were developed, timed and tested. The programs were used with SHARC ADSP 21060 DSP hardware, and they are intended for future airborne optical weapons.

Design of a Silicon Carbide RF Limiter

Researcher: Assistant Professor James D. Zuber
Sponsor: The Johns Hopkins University /Applied Physics Lab (JHU/APL)

The purpose of this research is to provide technical support for high power RF and microwave subsystem investigations at JHU/APL in support of advanced radar systems development tasks sponsored by the PEO IWS 2.0; specifically, to support development of advanced semiconductors related to the development of future RADAR and communications systems. Development areas include the analysis and assessment of technical issues for wide bandgap (WBG) semiconductors, including silicon carbide (SiC), gallium nitride (GaN) devices and novel gallium arsenide (GaAs) devices. JHU/APL is providing technical expertise and leadership for system engineering, design, development, and system integration efforts

leading to the development and fielding of Cobra Judy Replacement and next-generation radar systems for Theater Air and Ballistic Missile Defense. This work will be a multi-year effort.

Recent effort on this project has targeted the design of a solid-state RF diode limiter that can protect the sensitive receiver of a phased array radar from any inadvertent high power RF signals that may be passed from the duplexer. Silicon and GaAs do not handle the power levels and temperatures that may arise from very high RF power levels, so there is some interest in the feasibility of developing a silicon carbide diode to perform the intended function. Thus far, some analysis has been conducted and a design approach has been developed for review by JHU/APL leaders.

Independent Research

Mixed-Frequency Operation of Cascaded DC Buck Converters

Researcher: Assistant Professor Thomas E. Salem

As the U.S. Navy transitions towards the all-electric warship, the need exists for research and further understanding of the design, operation, and control of largely distributed DC power systems. Within such a system, many types and levels of power conversion will be required. Traditionally, these converters are designed to produce a well-regulated output within necessary specifications.

This project approaches the overall power conversion process with a cascaded arrangement in which the first converter's output requirements are relaxed allowing for the possibility of lower power loss within the converter at the expense of output voltage ripple, which the second converter cleans up.

Combined Feedforward and Feedback Control of a Buck Converter

Researcher: Assistant Professor Thomas E. Salem

In conjunction with the aforementioned research on cascaded Buck converters, this project examines the efficacy of combining both feedforward and feedback control techniques for a Buck converter. Feedforward control of a Buck converter facilitates a stable output via control action on the converter due to fluctuations on the input voltage. Feedback control enables control action to occur based upon measurement and evaluation of the output and usually presumes a stable input voltage source. Combined, these techniques should yield a robust controller for the Buck converter capable of meeting the goals of the cascaded approach.

Midshipman Research Course Projects

Electronic Reliability and Integrated Circuit Processing

Researchers: Midshipman 1/C Kevin J. Behm, USN, Midshipman 1/C Stephan T. Koev, USN,
Midshipman 1/C Rajesh J. Mistry, USN and Midshipman 1/C Vance D. Scott, USN
Adviser: Visiting Professor James F. Ziegler

Electronic Reliability: The head of product reliability at Texas Instruments has said, "Failures in digital electronics from radiation, especially cosmic rays, is the single most important component of electronic reliability. It is more important than all other problems put together." (2002) The vice president of Cypress Semiconductor recently stated the same sentiment, saying "With the vast inter-leaving of electronic information, the spontaneous changing of a single bit, leading to the crash of a system, leads to widespread waves of problems. It is the most important problem in IC (integrated circuit) reliability." (2004)

The researchers on this project attacked this problem from two directions in 2003-2004. Midshipmen Scott and Mistry pursued their project by measuring the cosmic ray radiation in various locations, to evaluate the effects of building materials on the localized flux of radiation. Using the same instrumentation, they also evaluated the "Ship Effect" that prevented the Coast Guard from screening inbound ships for nuclear weapons of mass destruction (WMD). Their work

showed, for the first time, how massive steel ships emit a similar neutron spectrum to nuclear WMD, but that there were enough significant differences to allow a special detector to be built to isolate a signature of nuclear WMD.

Midshipmen Koev and Behm collaborated with the prime contractor of the Joint Strike Fighter avionics package, United Technologies, to evaluate the effects of cosmic ray radiation at aircraft altitudes on the current avionics package. By running special tests, these researchers found that one critical memory chip was remarkably sensitive to thermal neutrons, thus limiting the reliability of the avionics package to less than 200 flight-hours. This unreliability was considered unacceptable, and the avionics is currently being redesigned. This work won the "Hagee Prize" for excellence in electrical engineering design.

Fast Implementation of the Hilbert-Huang Transform

Researcher: Midshipman 1/C Brandon R. Monaghan, USN
Advisers: CDR Charles B. Cameron, USN, and Professor Antal A. Sarkady
Sponsor: Bowman Scholar Program (BSP)

The Hilbert-Huang Transform (HHT) is a recently developed algorithm for analyzing non-stationary, non-periodic waveforms. It uses cubic splines to estimate the upper and lower envelopes of a time-series. The method uses their mean as if it was the mean of the underlying data and subtracts this synthetic mean from the data. The process is applied repetitively until a well-behaved, so-called, intrinsic-mode function (IMF) results. This IMF is then subtracted from the original data leaving a new time series. The process is repeated until a monotonic waveform is left. The collection of IMF functions gathered by this means is then processed using a Hilbert Transform to get frequency as a function of time for each IMF.

In this research, several means of reducing the large number of calculations required in order to reduce the time required were investigated. Measurements suggested that certain parts of the computation (among the most computationally intensive) can achieve a 30% reduction in time through these techniques. Unfortunately, there are some anomalies in the results these irregularities have not yet been explored fully. Thus, the Hilbert Transform was never implemented so the HHT in turn has not been fully implemented.

Trident Scholar Projects

Development of a Microelectromechanical System for Small Satellite Thermal Control (Trident Report # 321)

Researcher: Midshipman 1/C Matthew A. Beasley, USN
Adviser: Assistant Professor Samara L. Firebaugh
Sponsors: The Johns Hopkins University /Applied Physics Laboratory (JHU/APL), Office of Naval Research (ONR), and the Bowman Scholar Program (BSP)

Trends in space technology require future satellites to be smaller and cheaper than their contemporary counterparts. This new direction requires a similar evolution in thermal control. Previous techniques such as heat pipes and conventional radiators have large masses themselves and are also not scaleable to fit these smaller designs. Microelectromechanical Systems (MEMS) offer unique advantages in mass and scalability. By coating a satellite with thousands of MEMS devices, thermal control can respond to variations in thermal capacity.

This project describes a variable radiator that controls the heat conduction between the satellite and an emissive surface layer. Supporting the gold membrane are posts made of the polymer, SU-8. SU-8 has a low thermal conductivity, and therefore insulates the satellite when the device is off. Beneath the SU-8 posts is a thin layer of silicon nitride and the silicon substrate itself. The substrate would then be fixed to the exterior of the satellite. These devices were designed to operate at a voltage of 20 to 24V, which is the bus voltage for many satellites in production today. Actual voltages from 18 to 30V have been achieved with the devices.

The electromechanical and thermal properties of the device were modeled. These models provided insight into the design dimensions that dominated the voltage and power characteristics as well as the thermal heat flow. The devices were tested for both their thermal and electrostatic properties. The modeling predictions were found to be accurate for the

required device voltages. With the insight gained from modeling and testing, a new design was made offering greater thermal performance while maintaining low operating voltages. This design incorporated different materials allowing easier device fabrication and higher wafer yields. It also used different physical dimensions to improve thermal performance.

Finally, this project involved the packaging of this device for flight on the MIDSTAR I satellite. The groundwork has been laid for its flight into space in 2006 through a package redesign specific to this device. The Interface Control Document outlining hardware interfaces, power specifications, and satellite orientation has been completed.

A Bidirectional Wavelength Multiplexed Fiber Ring Network (Trident Report # 324)

Researcher: Midshipman 1/C Adam S. Fisher, USN
Advisers: Associate Professor R. Brian Jenkins and CAPT Robert J. Voigt, USN
Sponsors: Office of Naval Research (ONR) and the Bowman Scholar Program (BSP)

There is much untapped potential in the use of fiber optic technology. Its advantages, including greater bandwidth and higher data rates, are currently used most effectively in large-scale network backbones. While used to connect continents and cities, optical fiber still has yet to be widely integrated into small-scale applications, such as local area networks.

The aim of this research project was to build a working eight-node optical fiber ring network that functions as a precursor to a local area network. The network used four wavelength division multiplexed (WDM) frequency channels and eight bidirectional add-drop multiplexers to route mixed types of data signals (digital and analog) between the individual nodes.

In WDM communications, information is transmitted on multiple optical frequencies. In this project, each frequency channel was routed to different nodes in a bidirectional manner. This minimized the number of nodes, on average, that a message must encounter in order to reach its destination. Eight add-drop multiplexers (ADM), one for each node, performed the routing function. The novel aspect of the ADMs used in this network was the ability to propagate information on multiple wavelengths in both directions. Each ADM added (dropped) two wavelengths to (from) the ring network. The bidirectional capability was achieved using thin film filter technology, in which filtered wavelengths are reflected in a direction opposite that of the transmitted wavelengths.

The entire eight node network has been implemented. In addition to successful operation, the network performs reliably. Specifically, the bit error rate (BER) measurements for sending digital information through the network were more than low enough to guarantee reliable communication. Similar tests were completed with analog and quadrature amplitude modulation (QAM) signals and yielded comparable results.

This project has the potential to further harness the benefits of optical fiber. ADMs with bidirectional capability permitted the implementation of the proposed fiber ring network. This network serves as an example that complex network connectivities can be implemented at the LAN level while maintaining a relatively simple all-optical infrastructure. As a result, ships, campuses, office buildings, even whole neighborhoods have the potential to be connected with the high bandwidth associated with fiber optic networks.

Midshipmen Design Projects

Laser Pointer Transmitter/Receiver

Researcher: Midshipman 1/C Lee Jared Allen, USN
Advisers: Professor Antal A. Sarkady and Associate Professor R. Brian Jenkins

Infra-red Influenced Gun Turret

Researcher: Midshipman 1/C Wade C. Barnes, USN
Advisers: Commander Charles B. Cameron, USN, and Lieutenant William C. Pritchett, USN

Motion Simulation Seat
Researcher: Midshipman 1/C Don Edward Barber, Jr., USN
Advisers: Associate Professor David S. Harding and Lieutenant Ann C. Chamberlain, USN

Instrumentation to Test the Avionics of the Joint Strike Fighter
Researcher: Midshipman 1/C Kevin J. Behm, USN
Advisers: Visiting Professor James F. Ziegler and Professor Antal A. Sarkady

Swimming Pool Lap Counter/Timer
Researcher: Midshipman 1/C Bryan M. Blair, USN
Advisers: Captain Joseph C. McGowan, USNR, and Professor Richard L. Martin

Quarter Mile Corvette Drag Race Simulator
Researcher: Midshipman 1/C Justin J. Braune, USN
Advisers: Commander Charles B. Cameron, USN, and Assistant Professor Thomas E. Salem

Real Time Caller ID Display
Researcher: Midshipman 1/C Christopher K. Brown, USN
Advisers: Commander Thaddeus B. Welch, III, USN, and Professor Delores M. Etter

Jessica: The Avatar with the Plan - A Voice Recognition Project
Researcher: Midshipman 1/C Jason E. Burkett, USN
Advisers: Professor Delores M. Etter and Commander David D. Pierce, USN

Ultra Low Energy Electronics for USNA-II Satellite Experiments
Researcher: Midshipman 1/C Matthew O. Caylor, USN
Advisers: Visiting Professor James F. Ziegler and Professor Antal A. Sarkady

Path Following Car
Researcher: Midshipman 1/C Robert D. Fannon IV, USN
Advisers: Commander Charles B. Cameron, USN, and Lieutenant Jesko M. Hagee, USN

SolarSplash 2004
Researchers: Midshipman 1/C Natalie R. Frantz,
Midshipman 1/C Jeffrey R. Roberts, Jr., USN and Midshipman 1/C Anthony W. Sisti, USN
Advisers: Lieutenant Nathan S. Shenck, USN, and Assistant Professor Samara L. Firebaugh

Iris Scan Security System
Researcher: Midshipman 1/C Anthony J. Guidry, USN
Advisers: Professor Delores M. Etter and Assistant Professor Robert W. Ives

Digital Alarm Clock Using the PIC Processor
Researcher: Midshipman 1/C Christopher D. Holland, USN
Advisers: Commander Charles B. Cameron, USN, and Major Dean A. Ebert, USMC

Swim Tracker 2004
Researcher: Midshipman 1/C Christopher G. Hopkins, USN
Advisers: Professor Antal A. Sarkady and Captain Walter N. Currier, USMC

Infra-red Transmitter/Receiver
Researcher: Midshipman 1/C Christopher S. Hurt, USN
Advisers: Associate Professor David S. Harding and Professor Richard L. Martin

Electric Bike Generator
Researcher: Midshipman 1/C Kenji Igawa, USN
Advisers: Professor Richard L. Martin and Lieutenant Jesko M. Hagee, USN

Instrumentation to Test the Avionics of the Joint Strike Fighter
Researcher: Midshipman 1/C Stephan T. Koev, USN
Advisers: Visiting Professor James F. Ziegler and Commander Charles B. Cameron, USN

PIC Based Battery Tester
Researcher: Midshipman 1/C Arpad P. Korossy, USN
Advisers: Captain Robert J. Voigt, USN, and Professor Richard L. Martin

Bluetooth Network Interfacing
Researcher: Midshipman 1/C Ian S. LaSpina, USN
Advisers: Professor Antal A. Sarkady and Commander Charles B. Cameron, USN

Sound Seeking Racecar
Researcher: Midshipman 1/C Michael A. Lilleberg, USN
Advisers: Professor Richard L. Martin and Commander David D. Pierce, USN

Microphone Array and Tracking
Researcher: Midshipman 1/C Patrick M. Lobner, USN
Advisers: Professor Delores M. Etter and Assistant Professor Robert W. Ives

Measurement of Spectrum of Neutrons at Terrestrial Locations
Researcher: Midshipman 1/C Rajesh J. Mistry, USN
Advisers: Visiting Professor James F. Ziegler and Professor Martin E. Nelson

Building a 32 Bit IEEE Floating Point Multiplier
Researcher: Midshipman 1/C Brandon R. Monaghan, USN
Advisers: Commander Charles B. Cameron, USN, and Professor Antal A. Sarkady

Active DC Motor Control Module
Researchers: Midshipman 1/C James P. Murray, USN and Midshipman 1/C Susatorn Phetgad, USN
Advisers: Associate Professor John G. Ciezki and Assistant Professor Thomas E. Salem

FM Transmitter - Beaming MP3s to Standard FM Radio
Researcher: Midshipman 1/C Nathan L. Neihoff, USN
Advisers: Commander Thaddeus B. Welch, III, USN and Captain Alfredo DuBois, USMC

Secured Access System Using Voice Recognition Technology
Researcher: Midshipman 1/C Mitchell A. Newton, USN
Advisers: Professor Delores M. Etter and Assistant Professor Robert W. Ives

Voice Scrambler/Descrambler using LPC
Researcher: Midshipman 1/C James R. Sanguinetti, USN
Advisers: Professor Delores M. Etter and Associate Professor Louiza Sellami

Measurement of Spectrum of Neutrons at Terrestrial Locations
Researcher: Midshipman 1/C Vance D. Scott, USN
Advisers: Visiting Professor James F. Ziegler and Professor Martin E. Nelson

Wind Generator
Researcher: Midshipman 1/C Alexander A. Singh, USN
Advisers: Assistant Professor James D. Zuber and Lieutenant Nathan S. Shenck, USN

MEMs Implemented Tactile Display
Researcher: Midshipman 1/C James E. Smith, Jr., USN and Midshipman 1/C John D. Roth, USN
Advisers: Assistant Professor Samara L. Firebaugh and Captain Alfredo DuBois, USMC

Sound Sequence Assistor
Researcher: Midshipman 1/C Justin B. Smith, USN
Advisers: Commander Charles B. Cameron, USN, and Professor Delores M. Etter

FIRST Robot
Researchers: Midshipman 1/C Michael Q. Tremel, USN and Midshipman 1/C Rainel A. Nunez, USN
Advisers: Lieutenant Aaron M. Still, USN, and Dr. Ellen C. Wooten

Electric Bike Generator
Researcher: Midshipman 1/C Kevan T. Young, USN
Advisers: Lieutenant Nathan S. Shenck, USN, and Associate Professor John G. Ciezki

Professional Publications

Journal (Refereed) Manuscripts

DIRK, John D., (Trident Scholar, Class of 2002), NELSON, Martin E., Professor, (Mechanical Engineering Department), ZIEGLER, James F., Visiting Professor, Thompson, A., and Zabel, T.H., "Terrestrial Thermal Neutrons," *Institute of Electrical and Electronics Engineers (IEEE) Transactions on. Nuclear Science*, Vol. 50, pp. 2060-2064 (2003).

> Thermal neutrons are the end product of cosmic rays, which bombard the earth. They are the source of significant soft errors in some memory products. The flux of thermal neutrons at sea level has never been well known – existing papers have a range of more than 30x for the flux. This paper described extensive calibration of standard thermal neutron detectors and the protocol for precise measurement of ambient sea level neutrons. Measurements were made at 52 locations within 100 miles of the U.S. Naval Academy, and this paper established the sea level flux of thermal neutrons with a precision of 2x.

DU, Yingzi**,** Assistant Research Professor, Chang, C.I, Ren, H., D'Amico, F.M., and Jensen, J., "A New Hyperspectral Discrimination Measure for Spectral Characterization," *Optical Engineering,* Vol. 43, No. 8, pp. 1777-1786, 2004.

> Spectral angle mapper (SAM) has been widely used in multispectral and hyperspectral image analysis to measure spectral similarity between substance signatures for material identification. It was shown that the SAM was essentially the Euclidean distance when the spectral angle was relatively small. Most recently, a stochastic measure, called spectral information divergence (SID) was suggested to model the spectrum of a hyperspectral image pixel as a probability distribution so that spectral variations among spectral bands can be captured more effectively in a stochastic manner. This paper develops a new hyperspectral spectral discrimination measure, which combines the SID and the SAM into a mixed measure. The spectral discriminability of such a mixed measure was greatly enhanced by multiplying spectral ability of both measures. In order to demonstrate its utility, a comparative study was conducted among the (SID, SAM)-mixed measure, the SID and the SAM. These experimental results have shown that the discriminatory ability of the (SID, SAM)-mixed measure can be significantly improved over the SID and SAM.

DU, Yingzi, Assistant Research Professor, Chang, C.I, and Thouin, "An Unsupervised Approach to Color Video Thresholding," *Optical Engineering,* Vol. 43, No. 2, pp. 282-289 (2004).

Thresholding of video images is a great challenge because of their low spatial resolution and complex background. We investigate the issue of thresholding these images by reducing the number of colors to improve automated text detection and recognition. We develop an unsupervised approach to video images, which can be considered as an RGB color thresholding method. It applies a gray-level thresholding method to a video image in the (R, G, B) color space to produce a single threshold value for each domain. The three (R, G, B)-generated values will be subsequently processed by an effective unsupervised clustering algorithm that is based on a between-class/within-class criterion suggested by Otsu's method. Since thresholding methods designed for document images may not work effectively for video images in many applications, our proposed RGB color thresholding method has shown to be particularly effective in improvement on text detection and recognition, because it can reduce the background complexity while retaining the important text character pixels. Experiments also show that thresholding video images is far more difficult than thresholding document images, and the RGB color thresholding presented performs significantly better than simple histogram-based methods, which generally do not produce satisfactory results.

NELSON, Martin E., Professor (Mechanical Engineering Department), DORMO, Jeffrey, (Trident Scholar, Class of 2003), JENKINS, R. Brian, Associate Professor, and St. John, T., "Comparison of Calibration Light Sources for Use in a Commercial TLD Reader," *Health Physics*, Vol. 84, June 2003, p. S168.

The U.S. Navy currently uses scintillations from a radioactive C14 source for periodic calibration of its TLD readers. It would be preferable to use a non-radioactive reference light source. However, these sources currently produce unacceptable variations in the light output due to ambient temperature changes and the TLD heating process. To solve this problem, a temperature isolation box was designed and built to keep the output of the reference light source constant. The light source is stabilized using a thermoelectric (TE) cooler to maintain the box at a constant temperature. The TE cooler heats or cools the box based on a feedback signal pro vided by a thermistor. The system has been designed to maintain the temperature of the box to within one degree of 25 C for a period of one month. The isolation box has been placed externally to a Bicron model 3500 TLD reader and employs a fiber optic cable to transmit the reference light source to the reader's photomultiplier tube. The system has been evaluated by varying the ambient temperature between 10 C and 40 C and using a data acquisition system, that simultaneously records both the isolation box temperature and ambient temperature with time. While the system meets most operational requirements, further improvements in instrumentation could be made for the light source power output, thereby reducing system complexity.

Wright, C.H.G., WELCH, Thaddeus B., III, Commander, USN, ETTER, Delores M., Professor, and Morrow, M. G., "Teaching DSP: Bridging the Gap from Theory to Real-time Hardware," *American Society of Electrical Engineers (ASEE) Computer Education Journal, Vol. XIII, pp. 14-26, July 2003.*

Many digital signal processing (DSP) topics are difficult for undergraduates to internalize, but studies have shown that demonstrations and laboratory experiences can facilitate the process. In the past, many barriers prevented including real-time DSP hardware in an undergraduate curriculum. This paper describes a pedagogical model the authors have developed which includes theory, demos, lab exercises, and real-time DSP experience using MATLAB, C, and real-time DSP hardware that overcomes the barriers. This model has been very successful.

ZIEGLER, James F., Visiting Professor, "SRIM-2003," *Nuclear Instructions and Methods*, Vol. 219-220, pp. 1027-1036 (2004).

SRIM is a software package that calculates the Stopping and Range of Ions in Matter (SRIM). It is available from the website SRIM.org, and is downloaded about 14,000 times/year. The software tutorials are used in courses in more than 80 universities, and it is a scientific citation in about 600 publications each year. The software is updated about every five years, and SRIM-2003 is a publication describing the most recent version.

Conference Proceedings

BEASLEY, Matthew A., Midshipman 1/C, USN, FIREBAUGH, Samara L., Assistant Professor, Edwards, R. L., Keeney, A. C., and Osiander, R., "Microfabricated Thermal Switch for Emittance Control," *Space Technology and Applications International Forum-STAIF 2004*, American Institute of Physics Press, edited by M. S. El-Genk, pp. 119-125, 2004.

The trend to smaller satellites with limited resources in weight and power requires a new approach to thermal control to replace heaters with emittance-controlled radiators. There are a number of approaches to variable emittance radiators such as variable emittance coatings or louvers. This paper describes an actively controlled radiator based on a Microelectromechanical (MEMS) thermal switch. The switch operates by electrostatically switching a high emittance membrane in and out of contact with the substrate. The radiator is covered with an array of large numbers of these switches, which allows an almost digital control of the apparent emittance of the radiator. The thermal and electromechanical design of the MEMS device is discussed. A proof-of-concept design has been fabricated and tested that uses a gold membrane suspended on polymer posts. In the open position, actuation voltage range from 8 to 25 volts; this was consistent with our electromechanical model for the devices.

BEASLEY, Matthew A., Midshipman 1/C, USN, FIREBAUGH, Samara L., Assistant Professor, Edwards, R. L., Keeney, A.C., and Osiander, R., "Design and Packaging for a Microelectromechanical Thermal Switch Radiator," *Proceedings of ITHERM 2004*, pp. 629-634, June 2004.

Smaller satellites will require low-power, lightweight thermal control. This paper describes a technology based on a thermal switch which controls the conductivity between the radiator and a highly-emissive surface. The device is going to be tested aboard MIDSTAR 1, a small satellite that is being designed and built by students at the United States Naval Academy. This paper presents a discussion of the device design, and a detailed thermal analysis that shows how the power dissipation for the device relates to design parameters. The package and testing procedure are also described.

BEASLEY, Matthew A., Midshipman 1/C, USN, FIREBAUGH, Samara L., Assistant Professor, Edwards, R. L., Keeney, A. C., and Osiander, R., S, "Thermal Switch for Spacecraft Thermal Control," MEMS/MOEMS Components and Their Applications, edited by Siegfried W. Janson and Albert K. Henning, *Proceedings of the SPIE,* Vol. 5344, pp. 98-105, 2004.

Small satellites with their low thermal capacitance are vulnerable to rapid temperature fluctuations. Therefore, thermal control becomes important, but the limitations on mass and electrical power require new approaches. Possible solutions to actively vary the heat rejection of the satellite in response to variations in the thermal load and environmental condition are the use of a variable emissivity coating (VEC), micro-machined shutters and louvers, or thermal switches. An elegant way to radiate heat is to switch the thermal contact between the emitting surface and the radiator electrostatically. This paper describes the design and fabrication of an active radiator for satellite thermal control based on such a micro electromechanical (MEMS) thermal switch. The switch operates by electrostatically moving a high emissivity surface layer in and out of contact with the radiator. The electromechanical model and material considerations for the thermal design of the MEMS device are discussed. The design utilizes a highly thermal conductive gold membrane supported by low-conductance SU-8 posts. The fabrication process is described. Measured actuation voltages were consistent with the electrostatic model, ranging from 8 to 25 volts.

CIEZKI, John G., Associate Professor, and Ashton, R. W., "Optimal Design of a Soft-Switching DC-DC Converter for a Prototype DC Distribution System," *Power Electronics Specialist Conference 2004*, Aachen, Germany, June 2004. (CD-ROM)

The U.S. Navy is actively exploring power electronics-based distribution architectures to enhance the fight-thru capability of future surface combatant power systems. In one such dc distribution topology, 1000V/800V dc-dc converters provide isolation and step-down voltage regulation. Adoption of such a system is slowed by the high development cost of the power converters and weight, volume, and thermal management concerns. A soft-switching or resonant converter circuit is one approach to tackling the packaging and thermal management issues. In this paper, the authors reported on the design, fabrication, optimization, and testing of a reduced-scale soft-switching buck dc-dc converter.

DU Yingzi, Assistant Research Professor, IVES, Robert W., Assistant Professor, ETTER, Delores M., Professor, and WELCH, Thaddeus B., III, Commander, USN, "Biometric Signal Processing Laboratory," *Institute of Electrical and Electronics Engineers* (*IEEE) International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Vol. 5, pp. 1025-1028, May 2004.

Biometric systems verify a person's identity based on unique physical attributes. Biometric technologies are becoming the foundation of an extensive array of highly secure identification and personal verification solutions. It is a broad subject, which integrates image processing, digital signal processing, statistics, mathematics, computing, psychology and legislation. To enable the average undergraduate to understand and internalize the biometric theories and technologies, we have developed a biometric signal processing laboratory at the U.S. Naval Academy. This paper describes the model of the lab, introduces the key biometric equipment, and overviews our lab activities.

DU, Yingzi, Assistant Research Professor, IVES, Robert W., Assistant Professor, ETTER, Delores M., Professor, WELCH, Thaddeus B., III, Commander, USN, and Chang, C.I, "One Dimensional Approach to Iris Identification," *Proceedings of the International Society for Optical Engineering* (*SPIE),* Vol. 5404, pp. 237-247, April, 2004.

A novel approach to iris recognition is proposed in this paper. It differs from traditional iris recognition systems in that it generates a one-dimensional iris signature that is translation, rotation, illumination and scale invariant. The *Du* Measurement was used as a matching mechanism, and this approach generates the most probable matches instead of only the best match. The merit of this method is that it allows users to enroll with or to identify poor quality iris images that would be rejected by other methods. In this way, the users could potentially identify an iris image by another level of analysis. Another merit of this approach is that this method could potentially improve iris identification efficiency. In our approach, the system only needs to store a one-dimensional signal, and in the matching process, no circular rotation is needed. This means that the matching speed could be much faster.

FIREBAUGH, Samara L., Assistant Professor, Charles, Jr., H. K., Edwards, R. L., Keeney, A. C., and Wilderson, S. F., "Packaging Considerations for Micro-electro-mechanical Switches," *Proceedings of the 54th Electronic Components and Technology Conference*, pp. 862-868, June 2004.

Micro-electro-mechanical switches for microwave signals offer better isolation, insertion loss and linearity than their solid-state counterparts. However, system issues such as the packaging and power handling of such switches require examination. The contribution of this work is to address the essential link between the laboratory development of microfabricated MEMS switches and application. In previous work, we developed a shunt switch based on an electrostatically actuated bridge suspended over a coplanar waveguide. The bridge is connected to the ground plane of the waveguide. When there is no DC voltage applied, the bridge is sufficiently distant from the signal line to allow the signal to pass through relatively unimpeded. However, when a large DC voltage is applied between the signal line and the ground plane the bridge pulls down towards the signal line, which has a thin dielectric layer to prevent DC contact while creating a high-frequency short circuit. This causes the signal to reflect back towards the source, blocking transmission. In probe station tests, these switches had an insertion loss of less than 0.1 dB and an isolation of 15-20 dB at 20 GHz. These bridge-based switches were observed to be sensitive to package stresses. The pull-in voltage was observed to change from about 35 volts to greater than 80 volts between testing on the probe station and testing the packaged die. The change in pull-in voltage is due to a difference in tensile stress when the die is affixed onto the base plate of the fixture. The bridge-based switch design is particularly prone to packaging stress due to the manner in which the bridge supports mechanically couple to the substrate. This problem can be addressed by the use of a more compliant adhesive and a thicker base plate, however a more elegant solution is to change the switch structure to make it less sensitive to packaging and handling stresses. This led to the development of a switch that moves laterally to the wafer surface instead of orthogonally. The lateral switches are in a series configuration. They consist of a micro-strip line broken into three sections. The center section is moved in and out of contact with the end sections by electrostatic or thermal actuation. Lateral electrostatic actuation is achieved through the use of a comb drive. A second set of devices uses differential thermal expansion for actuation. We have chosen to implement the lateral design with metal MUMPs, a standardized micro-fabrication process available from MEMSCAP, which is more readily transferred to industry.

IVES, Robert W. Assistant Professor, ETTER, Delores M., Professor, and WELCH, Thaddeus B., III, Commander, USN, "Speckle Reduction of SAR Imagery Using Homomorphic Processing and Predictive Filtering," *Proceedings of the 37th Asilomar Conference on Signals, Systems and Computers*, Monterey, CA, pp. 216-220, November 2003.

This paper describes a method of reducing the speckle in a SAR image using a variation of homomorphic processing. In a SAR image, speckle is typically characterized as multiplicative noise such that traditional means of additive noise reduction may not perform well. In homomorphic processing, a signal is first passed through a logarithmic function, which would tranform any multiplicative components (such as speckle noise) into additive components in the logarithmic domain. At this point, any additive noise reduction technique may be used for denoising. Here, we incorporate predictive filtering into the homomorphic process as a means to reduce the speckle.

MECHTEL, Deborah M., Associate Professor, and VOIGT, Robert J., Captain, USN, "Minimizing the Pain and Maximizing the Gain of Assessment," *2004 Institute of Electrical and Electronics Engineers (IEEE) Frontiers in Education Conference (FIE)*, 2004. (CD-ROM)

This paper presents a snap shot of the evolving, flexible assessment process used in the Electrical Engineering Department at the United States Naval Academy. The assessment process was initiated to meet the new accreditation requirements for engineering programs required by the Accreditation Board for Engineering and Technology (ABET). To circumvent becoming process centered and maintain faculty support, efforts are continuously focused on program improvement. To simplify the implementation of the assessment process, ideas were borrowed from other programs and workshops and modified to fit the department's mission and culture. When the assessment process didn't clearly return results that supported program improvement, it was modified. This paper will describe the optimization of the assessment process, including faculty buy-in, document creation and process efficiency. Key course and program level assessment tools are included and their use justified.

Pellegrino, P.M., Polcawich, R. G., and FIREBAUGH, Samara L., Assistant Professor, "Miniature Photoacoustic Chemical Sensor Using Microelectromechanical Structures," *Proceedings of the SPIE Defense and Security Symposium,* Orlando, FL, pp. 42-53, April 2004.

Photoacoustic spectroscopy is a useful monitoring technique that is well suited for trace gas detection. The technique also possesses favorable detection characteristics when the system dimensions are scaled to a microsystem design. The objective of the present work is to incorporate two strengths of the Army Research Laboratory (ARL), piezoelectric Microelectromechanical systems (MEMS) and chemical and biological sensing into a monolithic MEMS photoacoustic trace gas sensor. A miniaturized macro-cell design was studied as a means to examine performance and design issues as the photoacoustic is scaled to a dimension approaching the MEMS level. Performance of the macro-cell was tested using standard organo-phosphate nerve gas simulants, Dimethyl methyl phosphonate (DMMP) and Diisoproply methyl phosphonate (DIMP). MEMS work centered on fabrication of a multi-layer cell subsystem to be incorporated in the full photoacoustic device. Preliminary results were very positive for the macro-cell sensitivity (ppb levels) and specificity indicating that the scaled cell maintains sensitivity. Several bonding schemes for a three-dimension MEMS photoacoustic cavity were investigated with initial results of a low temperature AuSn bond proving most feasible.

Wang, H, Pekarek, S., Fahimi, B., ZIVI, Edwin L., Assistant Professor, and CIEZKI, John G., Associate Professor "Improvement of Fault Tolerance in AC Motor Drives Using a Digital Delta-Hysteresis Modulation Scheme," *Power Electronics Specialist Conference 2004*, Aachen, Germany, June 2004. (CD-ROM)

In this paper, a novel Digital Delta-Hysteresis Regulation (DDHR) scheme is proposed that allows motor drive systems to maintain relatively accurate control of phase currents in the event of the loss of all phase current sensors. Within the scheme, line currents are reconstructed using knowledge of the DC-link current and switching states. The generation of switching signals is based upon traditional Delta-Hysteresis Regulation (DHR). However, modifications are made to DHR to ensure that the DC-link current always contains sufficient information to reconstruct phase currents. Experimental results obtained from a vector-controlled induction machine are used to show that there is a relatively small difference between the performance of the pre- and post-fault systems.

Books

ETTER, Delores M., Professor, "Engineering Problem Solving with C," 3rd Edition, Prentice-Hall Publishing Co.

This new edition of this textbook was completed during the 2003-2004 academic year, and will be published during the summer of 2004 with a 2005 copyright.

ZIEGLER, James F., Visiting Professor, and Puchner, H., "Soft Error Rates – History, Trends and Challenges," Cypress Company, San Jose, CA (2004).

Electronic reliability used to be described in terms of the mean time to failure of electronic components. With the digital age, a new kind of reliability limitation has emerged: the generation of soft fails, or errors in electronic logic or memory. Currently, it is widely stated that soft errors are the most significant limit on electronic reliability, and it is more important than all other mechanisms combined. This book reviews the discovery of soft errors from the earliest computers (1948), and the slow and very expensive realization by industry that this problem was a dominate effect that could cripple modern interleaved electronics. The book reviews the various causes of soft fails, and shows how the rate of errors can be estimated depending on the electronics used and the site of installation. It also reviews ways to modify integrated circuits to minimize soft fails. Finally, it discusses the impact on soft fails on complex networks and also on implantable devices (*e.g.,* pacemakers).

ZIEGLER, James F., Visiting Professor (editor), "Ion Implantation – Science and Technology," Ion Beam Press, (2004).

Ion implantation is the most widely used process to introduce doping into semiconductor devices. More than 98% of all modern electronics have been subjected to ion implantation. This book reviews the scientific background to ion implantation, and also shows the wide variety of applications for which the process is used. This book is a textbook, which is used in dozens of university Electrical Engineering courses.

ZIEGLER, James F., Visiting Professor, "Ion Implantation: Science and Technology", 8th Edition, Ion Implantation Technology Co. (2003).

Technical Reports

Silicon Carbide PIN Diode Limiter for Radar Receiver Protection

Researcher: Assistant Professor James D. Zuber
Sponsor: The Johns Hopkins University / Applied Physics Laboratory (JHU-APL)

Transmitter and receiver damage can occur if an antenna is exposed to an excessive amount of RF energy. Existing RADARs such as SPY-1 and future RADARs for self and ballistic missile defense (BMD) can create such excessive power levels. Damage can also be caused by reflections of transmitted energy. A properly designed duplexer can help protect the transmitter and receiver from damage. The power handling capacity of the duplexer is set primarily by the power handling capability of its limiter. Typically, phased array antennas use silicon (Si) PIN diode limiters, since they are compatible with the packaging and assembly techniques used to produce transmit/receive (T/R) modules. The ultimate power handling capacity of an RF limiter device is determined by both the PIN diode design and its packaging. Typically, a switch can be used to limit such unwanted power flow. A shunt-mounted switch performs this limiting function by introducing an impedance mismatch (switch closed) in the transmission line. The mismatch results in most of the power being reflected back to the antenna. During normal receive mode, the impedance mismatch is removed (switch opened) to allow power to flow to the receiver.

SiC PIN diodes can provide significant performance advantages for RF limiter applications as compared to Si. These advantages are based on three key factors: reduced intrinsic layer resistance, higher thermal conductivity, and wider energy bandgap. First, the SiC device can be designed with a relatively smaller intrinsic width, which means less resistance when conducting. This reduced resistance translates directly into much better isolation (i.e., as a shunt diode it does a better job of reflecting incident power when forward biased). Secondly, for the smaller amount of power that is dissipated in the diode, the relatively larger thermal conductivity of SiC enables a greater capacity of heat removal. Thirdly, the large SiC energy bandgap allows diodes to function electronically at higher temperatures without experiencing thermal runaway. These three combined factors enable SiC diodes to handle power dissipation many times that of Si.

Defense Science Board Task Force Reports

ETTER, Delores M., Professor (co-author), "Unexploded Ordinance," Defense Science Board Task Force Report (November 2003).

This study addressed two key questions relative unexploded ordnance (UXO). First, can advanced technology help reduce the very high cost of UXO cleanup at former and current test and training sites, and second, can advanced technology help minimize the environmental impact of future live-fire munitions training. The report summarizes our responses to both questions.

ETTER, Delores M., Professor (co-author), "Missile Defense, Phase III: Modeling and Simulation," Defense Science Board Task Force Report (March 2004).

This study assessed five specific areas involving modeling and simulation for the missile defense program: the scope of the modeling and simulation effort, the appropriateness of tthe level of fidelity, the impact of communication on the end-to-end models, the approaches to the validity of simulation, and additional opportunities for M&S contributions.

ETTER, Delores M., Professor (co-author), "Future Strategic Strike Forces," Defense Science Board Task Force Report (February 2004).

This study looks to the 30-year future with the objective of providing the president with a broad range of strike options to protect the United States and our forces abroad, assure friends and allies of our future commitment, and deal with future adversaries on terms favorable to the United States. The Task Force identified currently planned systems that will still be relevant and recommended new systems for development.

Presentations at Professional Meetings and Conferences

BEASLEY, Matthew A., Midshipman 1/C, USN, and FIREBAUGH, Samara L., Assistant Professor, "MEMS Thermal Switch for Spacecraft Thermal Control," SPIE Photonics West, San Jose, CA, 24-29 January 2004.

BEASLEY, Matthew A., Midshipman 1/C, USN, FIREBAUGH, Samara L., Assistant Professor, Edwards, R.L., Keeney, A.C., and Osiander, R., "Micro-fabricated Thermal Switch for Emittance Control," Space Technology and Applications International Forum-STAIF 2004, Melville, NY, 8-11 February 2004.

BEASLEY, Matthew A., Midshipman 1/C, USN, FIREBAUGH, Samara L., Assistant Professor, Edwards, R.L., Keeney, A.C., and Osiander, R., "Design and Packaging for a Micro-electromechanical Thermal Switch Radiator," ITHERM 2004, Las Vegas, NV, 1-4 June 2004.

CIEZKI, John G., Associate Professor, "The Development of a Power Engineering Concentration," 33rd ASEE/IEEE Frontiers in Education (FIE) Conference, Boulder, CO, November 2003.

CIEZKI, John G., Associate Professor, "Optimal Design of a Soft-Switching DC-DC Converter for a Prototype DC

Distribution System," Power Electronics Specialist Conference 2004, Aachen, Germany, June 2004.

CIEZKI, John G., Associate Professor, and McCoy, T., "Systems Engineering and Automation Task Overview," ESAC Annual Review, St. Louis, MO, 21-23 July 2003.

DU, Yingzi, Assistant Research Professor, IVES, Robert W., Assistant Professor, ETTER, Delores M., Professor, and WELCH, Thaddeus B., III, Commander, USN, "A One-Dimensional Approach to Iris Recognition," 2004 SPIE Defense and Security Symposium, Orlando, FL, April 2004.

DU, Yingzi, Assistant Research Professor, IVES, Robert W., Assistant Professor, ETTER, Delores M., Professor, and WELCH, Thaddeus B., III, Commander, USN, "Biometric Signal Processing Laboratory," 2004 Institute of Electrical and Electronics Engineers (IEEE) International Conference on Acoustics, Speech and Signal Processing (ICASSP), Montreal, Canada, May 2004.

DU, Yingzi, Assistant Research Professor, "Introduction to Biometrics," University of Maryland, Baltimore County (UMBC), Baltimore, MD, November 2003.

ETTER, Delores M., Professor, "Biometrics: The Promises and the Challenges," The Biometric Consortium Conference, 23 September 2003. (Keynote speaker)

ETTER, Delores M., Professor, "The Promises and Challenges of Biometrics," University of Maryland Graduate Student Research Conference, 23 April 2004. (Keynote speaker)

ETTER, Delores M., Professor, "Defense Science Board Report on Unexploded Ordinance," Office of the Secretary of Defense (OSD) Briefings: 10 July 2003, 30 July 2003, 9 October 2003, 18 December 2003; Congressional Staff Briefing, 6 February 2004. (Guest speaker)

ETTER, Delores M., Professor, "Importance of Scientists and Engineers to Our Country," FIRST Robotics Chesapeake Regional Conference, 20 March 2004. (Guest speaker)

ETTER, Delores M., Professor, "Future Needs for the Department of Defense (DoD) in Modeling and Simulation," General Dynamics Executive Board, 30 April 2004. (Guest speaker)

ETTER, Delores M., Professor, "National Security Panel," National Nanotechnology Initiative Workshop on Societal Implications of Nanoscience and Nanotechnology, 10 November 2003. (Moderator/speaker)

ETTER, Delores M., Professor, "The Role of Science in the Art of War," Science and the Congress Project, American Chemical Society, 19 February 2004. (Moderator/speaker)

FIREBAUGH, Samara, L., Assistant Professor, Charles, Jr., H. K., Edwards, R.L., Keeney, A.C., and Wilderson, S.F., "Packaging Considerations for Micro-electromechanical Switches," ECTC2004: The 54th Electronic Components and Technology Conference, Las Vegas, NV, 1-4 June 2004.

FIREBAUGH, Samara L., Assistant Professor, Pellegrino, P.M., and Polcawich, R. G., "Miniaturized Photoacoustic Spectroscopy for Chemical Warfare Defense," International Conference on Advanced Technologies for Homeland Security, Storrs, CT, 25-26 September 2004.

FIREBAUGH, Samara L., Assistant Professor, Charles, Jr., H.K., Edwards, R.L., Keeney, A.C., and Wilderson, S.F., "Fabrication and Characterization of a Capacitive Micro-machined Shunt Switch," American Vacuum Society 50th International Symposium, Baltimore, MD, 2-4 November 2004.

FISHER, Adam S., Midshipman 1/C, USN, JENKINS, R. Brian, Associate Professor, and VOIGT, Robert J., Captain, USN, "A Bidirectional Wavelength Multiplexed Fiber Ring Network," National Conference on Undergraduate Research

(NCUR), Indianapolis, IN, April 2004.

IVES, Robert W., Assistant Professor, ETTER, Delores M., Professor, DU, Yingzi, Assistant Research Professor, and WELCH, Thaddeus B., III, Commander, USN, "Development of an Undergraduate Course in Biometric Signal Processing," Proceedings of the 2004 Annual American Society of Electrical Engineers (ASEE) Conference and Symposium, Session 2632, Salt Lake City, UT, July 2004.

IVES, Robert W., Assistant Professor, GUIDRY, Anthony J., Midshipman 1/C, USN, and ETTER, Delores M., Professor, "Iris Recognition using Histogram Analysis," 38th Asilomar Conference on Signals, Systems and Computers, Monterey, CA, November 2004.

IVES, Robert W., Assistant Professor, ETTER, Delores M., DU, Yingzi, Assistant Research Professor, and WELCH, Thaddeus B., III, Commander, USN, "Biometrics High School Outreach: Summer Seminar and Internships at the U.S. Naval Academy," 2004 Biometrics Consortium Symposium, Crystal City, VA, September 2004.

IVES, Robert W., Assistant Professor, ETTER, Delores M., Professor, and WELCH, Thaddeus B., III, Commander, USN, "Speckle Reduction of SAR Imagery Using Homomorphic Processing and Predictive Filtering," Proceedings of the 37th Asilomar Conference on Signals, Systems and Computers, Monterey, CA, November 2003.

IVES, Robert W., Assistant Professor, "Biometrics at the U.S. Naval Academy," Meeting of the Society of American Military Engineers, Annapolis, MD, 20 November 2003.

NELSON, Martin E., Professor (Mechanical Engineering Department), DORMO, Jeffrey, (Trident Scholar, Class of 2003), JENKINS, R. Brian, Associate Professor, and St. John, T., "Comparison of Calibration Light Sources for Use in a Commercial TLD Reader," 48th Annual Meeting of the Health Physics Society, San Diego, CA, July 2003.

Pellegrino, P.M., Polcawich, R.G., and FIREBAUGH, Samara L., Assistant Professor, "Miniature Photo-acoustic Chemical Sensor Using Micro-electromechanical Structures," SPIE Defense and Security Symposium, Orlando, FL, 12-16 April 2004.

SALEM, Thomas E., Assistant Professor, and CIEZKI, John G., Associate Professor, "An Assessment of Power Engineering Education," 2003 American Society for Engineering Education Annual Conference & Exposition, Nashville, TN, June 2003.

SALEM, Thomas E., Assistant Professor, and CIEZKI, John G., Associate Professor, "The Development of a Power Engineering Concentration," Institute of Electrical and Electronics Engineers (IEEE) Frontiers in Education Conference, Boulder, CO, November 2003.

SALEM, Thomas E., Assistant Professor, and VOIGT, Robert, CAPT USN, "A Three-Pronged Approach to Student Learning: Integrating Theory, Simulation, and Physical Experiments," Institute of Electrical and Electronics Engineers (IEEE) Frontiers in Education Conference, Boulder, CO, November 2003.

Smith, J.E., Roth, J.D., and FIREBAUGH, Samara L., Assistant Professor, "MEMS Tactile Actuators for Pilot Orientation Systems," 2004 MEMS Alliance Symposium on MEMS in Homeland Security, Defense and Aerospace Applications, Laurel, MD, 29-30 March 2004.

VOIGT, Robert J., Captain, USN, IVES, Robert W., Assistant Professor, and HAGEE, Jesko M., Lieutenant, USN, "Modified Studio Lab-Classroom Used to Teach Electrical and Computer Engineering to Non Engineers," 2003 ASEE Annual Conference and Exposition, Nashville, TN, June 2003.

WELCH, Thaddeus B., III, Commander, USN, Wright, C. H. G., and Morrow, Michael G., "Reach Out and DSP Someone!," 2004 ASEE Annual Conference and Exposition, Salt Lake City, UT, June 2004.

WELCH, Thaddeus B., III, Commander, USN, Wright, C.H.G., and Morrow, M.G., "Using DSP Hardware to Control Your

World," 2004 IEEE International Conference on Acoustics, Speech and Signal Processing, Montreal, Canada, May 2004.

WELCH, Thaddeus B., III, Commander, USN, "Vector Signal Analyzer (VSA)," COMSOC, Baltimore, MD, February 2003.

WELCH, Thaddeus B., III, Commander, USN, Morrow, M.G., Wright, C.H.G., and IVES, Robert W., Assistant Professor, "CommDSK: a Tool for Teaching Modem Design and Analysis," ASEE Annual Conference, Nashville, TN, June 2003.

Wright, C.H.G., WELCH, Thaddeus B., III, Commander, USN, and Morrow, M.G., "An Inexpensive Method to Teach Hands-on Digital Communications," IEEE/ASEE Frontiers in Education Annual Conference, Boulder, CO, November 2003.

ZIEGLER, James F., Visiting Professor, "The Stopping and Range of Ions in Matter," 12th International Conference on Ion Beam Analysis, Albuquerque, NM, 23 July 2003. (Invited talk)

ZIEGLER, James F., Visiting Professor, "The Effects of Cosmic Rays on Electronics," Cypress Semiconductor Co., San Jose, CA, 24 June 2004. (Invited talk)