# Electrical Engineering Department

CAPT Robert J. Voigt, USN
Chair

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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 the faculty and the 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 Office of Naval Research (ONR), Naval Research Laboratory (NRL), the Naval Surface Warfare Center (NSWC), the Johns Hopkins University Applied Physics Laboratory (JHU/APL), the National Security Agency (NSA), the Advanced Technology Institute (AFI), the Army Research Laboratory (ARL) and from within the 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 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, study of radio frequency identification principles and applications, development of optical local area networking protocols, biometric signal processing including partial iris recognition and design and implementation of advanced mathematical algorithms on field programmable gate array hardware. This faculty and midshipmen 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

### Office of Naval Research (ONR) National Naval Responsibility Electric Ship Integration Initiative

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

The researchers are involved in a multi-institutional research project with both pedagogical and fundamental research deliverables. At the U.S. Naval Academy, year two focused on establishing the hardware and software infrastructure for an automation laboratory and creating a project or test bed that would link the automation and power system laboratories. In addition, work was completed on several student projects including a ES495 report entitled "Militarizing Commercial Automation for Integrated Power System Warship Command and Control" by Midshipman Alexis Wise and "Assessment of Linear Computer Simulations of Shipboard Nonlinear Integrated Power System" by Midshipman Ryan Corcoran. The next phase of the research is to establish a ship-wide automation strategy for controlling the ship power, cooling, and mechanical system. Control philosophies will be evaluated using detailed and reduced-order system models programmed in ACSL of the Naval Combat Survivability (NCS) test bed located at Purdue University. The strategy will ultimately be extended to an architecture more representative of what is being proposed for DDX and future surface naval combatants. Finally, work will continue on the development of an automation short course to be taught at the Naval Academy. The work product will ultimately serve to create a permanent course at USNA and a monograph that can be used by the relevant automation/power system community.

## Advanced Shipboard Electrical Control and Monitoring

Researcher: Associate Professor John G. Ciezki
Sponsor: Imagine One Ltd.

The purpose of this research work was to investigate the practicality and application of power factor correction (PFC) onboard the USS John Kennedy (CV-67). The goal was to assess whether PFC in conjunction with lowering load demand could eliminate the requirement of installing a seventh engine shipboard. The principal investigator researched the availability of PFC units commercially and considered issues such as shock hardening, cost, weight, volume, and distributing the location among the various ship load centers. In addition, the PI considered other issues such as power quality and the impact on the PFC units of being situated near large Variable Speed Drive (VSD) loads. The conclusion of this preliminary study was that to correct the power system from 0.82pf to 0.95pf would require at least six capacitor banks at a cost of approximately $1.5M and would require three 12 foot by 12 foot rooms (or equivalent) with a weight impact of between 12-18 long ton. Each unit would require fire suppression and monitoring equipment and represents a significant difference between terrestrial and fleet application of PFC. The end conclusion was that PFC was NOT recommended for use on CV-67 due to the cost, protection, and power quality issues. It was later determined that CV-67 would be decommissioned before power demand issues would require the seventh engine to be installed.

## Center for Biometric Signal Processing

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

The research group is investigating 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. Several databases of iris images are being built/collected to use in algorithm testing. The goal of the Director of the Biometric Signal Processing Laboratory includes finding funding to ensure that the laboratory has state-of-the-art equipment and extending collaborations to include partnerships with industry, government labs, and other academic institutions.

## Continued Development of MEMS Microwave Switches

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

Microelectromechanical relays offer many potential advantages over solid-state switches for routing microwave signals, and 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 AY01-02, the APL switch was redesigned so that it would operate at a lower actuation voltage. In AY02-03 the device was 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. In AY03-04 issues with packaging these devices were explored and an alternative switch that uses lateral actuation was developed. In AY04-05 the temperature sensitivity of these devices was investigated and design rules were determined to avoid switch distortion. This project was also the basis for the dielectric charging experiment undertaken by a Bowman Scholar Program student.

## New Iris Recognition Algorithms

Researcher: Assistant Professor Robert W. Ives
Sponsors: Central Intelligence Agency (CIA) and Intelligence Technology Innovation Center ITIC)

This research project has a single major objective: to develop new iris recognition algorithms. Within this major goal, there are several related objectives, including: (1) Creating an iris database. (2) Compare some leading iris recognition algorithms using a standard set of raw iris images. (3) Developing new computationally efficient matching algorithms and compare their performance to leading algorithms. This research money will primarily support a postdoctoral research fellow, and part of the funding will pay for advertising for the position. This research will involve human subject testing and is covered under an approved Institutional Research Board (IRB) proposal.

## New Approaches to Iris Identification

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

A novel approach to iris recognition is proposed in this research. 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. We are supported by our research laboratory, which currently contains state-of-the-art equipment that allows us to collect and analyze iris scans using LG IrisAccess systems and powerful PCs. This research will involve human subject testing and is covered under an approved Institutional Research Board (IRB) proposal. There is a US Patent Pending on the algorithm developed.

## Biometric Signal Processing at the USNA

Researchers: Assistant Professor Robert W. Ives, Professor Delores M. Etter,
Dr. Eliza Du, ONR Post-doctoral Fellow, CDR Thaddeus B. Welch, USN, and LT Robert C. Schultz, USN
Sponsor: National Security Agency (NSA)

This research is a follow-on to a FY04 project. For FY05, this research project has two objectives: (1) to develop a multi-modal biometric collection station that can capture iris, face, fingerprint and voice; and (2) to provide equipment support for midshipman research projects in biometrics. Using a multi-modal biometric approach, the accuracy rate of a biometric system should be noticeably improved. Once these multi-modal biometric samples are captured, the challenge of data (or sensor) fusion must be addressed: how to combine the information from several sensors in order to perform recognition. The collection of this data is a first step in the process of developing an algorithm for sensor fusion. Midshipman research projects include Trident Scholar projects, senior design projects, and projects that form part of the EE488c Biometric Signal Processing course. The Naval Academy's Biometric Signal Processing Laboratory contains state-of-the-art equipment to support these goals.

## 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 attempting 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 predict the steady-state behavior of SBS 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 multichip substrate structure. The technique, using poled polymers, will permit electrical and optical interlayers to be formed simultaneously, thus allowing buried optical waveguide and electrical signal lines on the same MCM-D.

Another technique used is one that employs 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 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.

## Evaluation of Water-Cooled Heat Sinks

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

This ARL project involved designing and developing a test fixture for evaluating a liquid cooled microchannel heat sink and a pole-arrayed heat sink. Thermal analysis was conducted using a finite element analysis approach and the simulation results were compared to experimental data. Along the way, a novel approach for determining the thermal parameters using a Fourier approach was demonstrated. This work resulted in two separate IEEE conference publications.

## Calibration of an IR Camera

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

This project explored the calibration of an infrared camera system for use in high voltage, high power circuit applications. The work involved establishing calibration procedures, methodology, and circuits. A comparison of using different spray coatings to provide uniform emissivity was conducted. This work resulted in one IEEE conference publication.

### Development and Evaluation of a Wireless Network for Airborne Optical Weapons

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

In this summer, a wireless network with 5 nodes was configured and tested with satisfactory results. Each network-node consisted of a miniature Spread Spectrum Transceiver (XECOM's, XE900SL10) operating at 902-928 MHz frequency range, with transmitted power level of 10 mW of and receiver sensitivity of -100dBm.

The network was intended for distributed measurement and control application and it was tested with 32 k bps serial ASCII baseband data. Each node used an "AT" command format and the data were encapsulated by the XE900SL10's communication controller. Single error correction was also performed by the by this controller. Point-to point and point-to multipoint network topologies were used with one master node and with 4 remote nodes. To prevent packet collisions between network nodes, the XE900SL10 uses a Carrier Sense Multiple Access protocol at each network transceiver.

### Design of a Silicon Carbide (SiC) RF Limiter

Researcher: Assistant Professor James D. Zuber
Sponsor: CAPT A.F. Haggerty, NAVSEA PEO IWS 2.0

The goal of this project is to provide technical support for high power RF and microwave subsystem investigations at JHU/APL in support of advanced phased-array (PA) radar systems development tasks sponsored by the NAVSEA PEO IWS 2.0; specifically, to support development of advanced semiconductors related to the development of future PA 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 PA radar systems for Theater Air and Ballistic Missile Defense. This work will continue for the remainder of FY04 and throughout FY05.

Recent work on this project has focused on 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.

## Independent Research

### Characterization of the Energy Released During Short Circuiting of Branch Circuit Wiring and Appliance Cords

Researcher: Professor Richard L. Martin

When residential electric circuits are short circuited by a sharp metal edge cutting through the wiring insulation, the energy dissipated is expected to be limited by the tripping characteristics of the protective devices for those circuits. Use of the CurrentxTime characteristic curves for residential circuit breakers appears to lead to unrealistic values for the energy dissipated at the short circuit. In some cases, the short circuit is cleared before the circuit breaker reaches its trip level, and in other cases, much of the energy appears to be dissipated in the wiring itself. Whether the load on the circuit is pure resistive or reactive also appears to affect the energy dissipated at the short circuit. A special circuit breaker panel, with branch circuits protected by replaceable breakers, has been configured and various tests and measurements are being performed.

# Midshipmen Research Projects

## USNA Gate Control Using RF-Tag Technology

Researchers: Midshipman 1/C Christopher M. Bingham, USN and Midshipman 1/C John A. Topolski, USN
Adviser: Visiting Professor James F. Ziegler
Sponsor: Symbol Technologies Inc.

This project investigated improving the Naval Academy gate security by attaching small RF-ID tags to the ID cards of people with authorized access to the Academy. As people drive or walk towards the Academy gate, an antenna activated the RF-tag and read its ID number. This was then cross-checked with the database of authorized people for entry. Beside the gate guard was an LCD monitor that brought up a picture of the person and the automobile identification, even before they reached the guard. The guard could then glance at the display to see if any limiting comments had been placed in the file for that person or car. By matching the person's image to the person in the car, the guard could verify that the ID was being carried by the correct person.

Initial project design led to testing on Electrical Engineering Department 1/C Midshipmen in a laboratory environment. The system worked well, with the ID card being read while still in a person's pocket. The detection/ID success was about 90%. Future work ('06) will increase the antenna power, making the system more reliable. Full testing in Rickover Hall corridors will be planned for all Electrical Engineering Department majors.

## Electrical Power System for MIDSTAR

Researcher: Midshipman 1/C Aaron D. Cox, USN
Advisers: Associate Professor Louiza Sellami and Associate Research Professor Billy R. Smith, Jr.
Sponsor: U.S. Air Force

The project dealt with the design of the electrical power system (EPS) for MidSTAR-1 satellite. The main purpose of the EPS is to collect, store, and distribute power to the satellite vital systems, which are the Command and Data Handling (CD&H) and the Main Communications System (ICSat, and CFTP) for two years. Its secondary mission is to support additional USNA and Goddard Space Flight Center experiments for two years.

To meet the Primary mission requirements, the EPS must deliver at a minimum, 27W average power during normal operations. The maximum power used is 57W during communication transmissions but when averaged over the course of the orbit, it falls within 27W. To incorporate a safety factor, the power system is required to provide 30W of power. This covers the most stringent power demands.

1. Provide vital systems (CD&H, Main Comms, and ICSat (receivers only)) 20 W in a standby mode and 27 W average power in a transmit mode to fulfill basic life requirements.
2. Provide the CFTP payload with 5 W in a normal operational mode and 0.5 W in standby mode.
3. Provide experimental payloads power as available during normal satellite operations.
4. Power system must have an end-of-life permanent kill switch to disconnect the batteries from the solar array.

## Using Non-Orthogonal Iris Images for Iris Recognition

Researcher: Midshipman 2/C Ruth M. Gaunt, USN
Advisers: Assistant Professor Robert W. Ives and Professor Delores M. Etter

This research investigated the use of non-orthogonal iris patterns for iris recognition. Identifying individuals from partial iris images taken from off-axis angles will aide in the solution to the larger problem of covert iris recognition. Midshipman 1/C Bonney's 2004-2005 Trident Scholar Program project involved developing an algorithm to extract partial iris patterns from an image of an eye taken from an off-axis angle with a near-infrared camera. This research continues his project. It involves determining the maximum angle that an iris can be off-axis from the camera lens and still be used to positively identify an individual. A database of iris images that are taken from a variety of off-axis angles will be created using a near-infrared camera. An algorithm will then be developed to use these images to positively identify new iris images that are presented at off-axis angles to the camera lens. Iris recognition is a highly effective biometric with a cooperative user trying to gain access to secure systems and information. However, it is not currently used in a covert identification system. The research involved in this project will aid in the solution to this problem by developing a way to take the extracted iris patterns in an off-axis iris image and use them to positively identify individuals.

## Motion Follower Part of an Avatar-Based Visual Monitoring System

Researcher: Midshipman 1/C Christopher N. Hinson, USN
Advisers: Professor Delores M. Etter and Assistant Professor Robert W. Ives

The purpose of this project was to create an algorithm that can read in images from a live video feed, then determine if and where motion exists in these images. Motion is detected by comparing the difference between successive frames, and applying a threshold to create a binary representation of the difference. Binary morphology is then used to remove noise and other variations too small to be considered a true moving object. If motion is detected, the algorithm finds the center of mass of the motion and records this information for visual representation in a graphical user interface (GUI), and for passing on to a related senior design project. The GUI provides a visual record of the live video feed and the frame-to-frame difference image, along with the center of motion. This project is combined with Midn Harp's project to create an avatar-based visual monitoring system that gave the appearance of a facial image on the computer screen following motion around a room. A live demonstration was provided.

## TLM Modeling of Human Lung

Researcher: Midshipman 2/C Andrew Hornfeck
Adviser: CAPT Joseph C. McGowan, USNR
Sponsor: Office of Naval Research (ONR)

Transmission Line Matrix modeling is applied to the study of human lung. A model will be constructed in 2-d incorporating flexible boundaries and the capacity to simulate physiological perfusion and diffusion of oxygen.

## Smart Search Iris Recognition

Researcher: Midshipman 1/C John P. Horwath, USN
Advisers: Assistant Professor Robert W. Ives and Professor Delores M. Etter

There are currently a few iris detection and recognition algorithms commercially available to government and private sectors. In enrollment, these algorithms detect and map the features of the iris into a template or iris code, and store it in a database. In recognition, when an individual presents his or her eye to the camera, the algorithm also maps this iris and compares it to all of those stored in the database. If a close enough match is made, the individual is positively identified. Another approach to iris recognition is presented in this research. The idea behind this algorithm is that an individual's iris contains a number of unique characteristics different from another's iris. These characteristics are determined and extracted manually off-line to create a template for those individuals deemed "enrollees." These templates are then used in recognition instead of the entire map of the iris. Thus, this system can best be utilized as a precursor to a commercial iris recognition system to limit the scope of the search in

identification. The images used in this research were collected at the United States Naval Academy using the LGIris 3000 near-infrared camera system.

## Voice Recognition Algorithm for Laboratory Access

Researcher: Midshipman 1/C Michael G. Mathis, USN
Advisers: Professor Delores M. Etter, Major Alfredo Dubois, USMC
and Assistant Professor Thomas E. Salem

This project attempted to distinguish between three different human voices, two male voices and one female voice in order to allow access to a laboratory. Voice samples from the three subjects were collected, with at least 15 samples of selected words from each subject. Analysis of the voice samples began in the time domain using power and zero crossing metrics. Further analysis used the frequency domain to determine the pitch frequency and the frequencies of the first two formant frequencies. The algorithms were implemented using MATLAB®. When the software determined that access should be granted, a set of tones were sent through the speaker to cause the door to the laboratory to unlock.

## Evaluation of the Reliability of Joint Strike Fighter Avionics

Researchers: Midshipman 1/C Nathan J. Peck, USN and Midshipman 1/C Benjamin A. Scheideman, USN
Adviser: Visiting Professor James F. Ziegler
Sponsor: United Technologies Inc.

This project measured the reliability of avionics for the Joint Strike Fighter (JSF) as designed by United Technologies. The avionics can be quite sensitive to radiation from cosmic rays at flight altitudes. This is believed to be the most important limitation on the avionics reliability.

United Technologies provided Midshipmen Peck and Scheideman with memory chips used in the prototype fly-by-wire avionics for the JSF. The Midshipmen developed complex electronic interfaces to interrogate the chip while it was remotely run within a radiation beam. This simulated the natural radiation environment, but at a greatly speeded up time frame.

The semiconductor memories were successfully tested at NIST. The chips were quite "hard," i.e. resistant to upset from radiation. The results were communicated to United Technologies for integration into their overall reliability calculations.

## Measuring and Minimizing Dielectric Charge Effects of RF MEMS Capacitive Shunt Switches to Improve Reliability

Researcher: Midshipman 1/C John S. Schultz, USN
Adviser: Assistant Professor Samara L. Firebaugh
Sponsors: The Johns Hopkins University/Applied Physics Laboratory (JHU/APL)
and the Bowman Scholar Program

Microelectromechanical (MEM) switches for microwave signals offer many advantages over solid-state devices, including greater linearity and isolation and less insertion loss. In particular, capacitive shunt switches operate at high frequencies (> 10GHz) and draw little power. Such switches consist of a coplanar waveguide, with a bridge connecting the outer ground planes and spanning the signal line, which has been coated by a thin dielectric layer. When a large DC voltage is applied between the ground plane and the signal line, an electrostatic force is generated which brings the bridge in contact with the dielectric layer, creating a high-frequency short circuit to ground, and blocking signal transmission. The lifetime and reliability of such switches is currently limited by charging within the dielectric layer. The objective is this project was to establish a sensitive and quantitative method to measure this phenomenon, and to suggest techniques by which charging effects might be minimized.

## Microelectromechanical (MEM) Thermal Device Operation and Control For the MidSTAR I Satellite Program

Researcher: Midshipman 1/C John S. Schultz, USN
Adviser: Assistant Professor Samara L. Firebaugh
Sponsors: The Johns Hopkins University/Applied Physics Laboratory (JHU/APL)
and the Bowman Scholar Program

The traditional approach to spacecraft thermal control involves large radiators connected to the spacecraft by heat pipes, large and bulky thermostat controlled louver structures which allow controlling heat loss of the radiators, and power-hungry heaters which maintain the satellites operating temperature on a low offset temperature given by the radiator area. These approaches do not work anymore for small satellites below 20 kg, so-called nanosats and picosats. These satellites with their low thermal capacitance are vulnerable to rapid temperature fluctuations. Therefore, thermal control becomes important, but the limitations on mass and electrical (battery) power require new approaches. One possible approach is to coat the satellite radiators with a variable emissivity coating (VEC) that can be used to actively vary the heat rejection of the satellite in response to variations in the thermal load and environmental conditions. Such systems have been built and tested using microelectromechanical systems (MEMS). MEMS are well suited to small spacecraft; they are lightweight, low power, and relatively inexpensive to fabricate. This project focused on the integration of such systems aboard the Naval Academy satellite, MIDSTAR-1. For this mission, the devices were not used to actively cool the satellite, but instead were included as a payload to test and validate their operation. Integration of these devices with the satellite included the design and construction of a control and communications interface to the device, as well as the design of the physical package.

## Evaluation of Effects of Building Materials on Electronic Reliability

Researcher: Midshipman 1/C Jack L. Shis, USN
Adviser: Visiting Professor James F. Ziegler
Sponsor: The Johns Hopkins/Applied Physics Laboratory (JHU/APL)

In 2004, Midshipmen V. Scott and R. Mistry conducted experiments on the sea level neutron flux. They found that aboard ships, the ambient neutron flux was 2x greater than outside in the air. They explained this remarkable effect as due to "multiplicity" interactions between the incident high energy neutrons and the steel in the ship. This effect has created significant interest because it indicates that buildings, rather than shield electronics from ambient radiation, may indeed cause more radiation and hence make electronics less reliable.

Midshipman Shis attempted to broaden the understanding of this effect by measuring the ambient radiation inside various types of building. He built complex detectors which could discriminate between energetic charged particles and energetic neutrons.

## Hands-Free Phone Dialer

Researcher: Midshipman 1/C Addison T. Tafel, USN
Advisers: Professor Delores M. Etter and Assistant Professor Robert W. Ives

This report contains the results of a senior design project to build a "hands-free phone dialer." The purpose of this project was to analyze voice signals using MATLAB® in order to produce an algorithm that allowed a user to dial a telephone without using his or her hands; the developed algorithm determines which number the user spoke. This was achieved by using voiced/unvoiced characteristics of the signal, the power and the length of the signal. Samples of a speaker reciting the words: "one", "two", "three", "four", "five", "six", "seven", "eight", "nine", "zero", and "oh" were recorded into a database. MATLAB® programs were written to analyze the features of these voice signals and to determine the best way to differentiate which numbers were spoken. Results were presented that included the number of voice samples (spoken numbers) that were correctly and incorrectly decoded.

# Trident Scholar Projects

## Non-Orthogonal Iris Segmentation

Researcher: Midshipman 1/C Bradford L. Bonney
Advisers: Professor Delores M. Etter and Assistant Professor Robert W. Ives
Sponsors: Office of Naval Research (ONR) and Bowman Scholar Program

The goal of this project was to isolate the iris in a non-orthogonal, digital image of the human eye. A non-orthogonal image is an image where the eye is not looking directly at the camera. The iris – the colored part of the eye – is a unique biometric identifier. Much like a fingerprint, an iris pattern differs significantly between individuals (including identical twins), and an analysis of these patterns can lead to accurate personal identification.

Presently, iris recognition algorithms are used in commercial and research systems, and these systems are becoming widespread in government and industry for logical security and access control. These systems currently require a cooperative user to interact with image acquisition devices. The iris recognition algorithms assume these captured iris images are normal, or orthogonal, to the sensing devices, and therefore search for circular patterns in the image. Off-angle, or non-orthogonal, images of irises cannot currently be used for identification because the iris appears elliptical; commercial algorithms cannot isolate the elliptical iris in order to start the identification process.

This research expanded the functionality of iris recognition technology by developing a set of new algorithms to isolate the iris in a non-orthogonal state within a digital image. The algorithmic approach for development was to first isolate the pupil, the dark circular portion in the center of the eye. The pupil was isolated using the bit-plane processing. The pupil appeared as a large homogenous area surrounded by insignificant noise, which allowed for easy definition of the pupil-iris boundary. Next, the limbic boundary (the outer edge of the iris) was determined in the cardinal directions, and an ellipse was calculated that incorporated those points. Circular patterns were never assumed during boundary calculations.

After all boundaries were calculated, an "iris mask" was created. The mask was used to identify pixels in the image that contained the iris data, the only pixels of value for the identification of an individual. The functionality of the algorithm was tested using an in-house database collected at the United States Naval Academy. Images that were both orthogonal and non-orthogonal in nature were used to collect quantitative results.

## A Network Interface Card for a Bidirectional Wavelength Division Multiplexed Fiber Optic Local Area Network

Researcher: Midshipman 1/C Joshua W. Wort, USN
Advisers: Associate Professor R. Brian Jenkins and CAPT Robert J. Voigt, USN
Sponsor: Office of Naval Research (ONR)

The purpose of this project was to design and implement the control logic for a network interface card (NIC) for a local area network. The NIC implements the medium access control (MAC) layer of the network, and can use various physical layer topologies.

In this network, each node is connected to other nodes via two optical transmitters and two receivers, with each transmitter and receiver on a given node operating on a different wavelength than the other. The design of control logic of this network is described using four state machines: one for receiver function, one for transmitter function, one for the interface to the host, and one central controller used to make routing decisions. The four state machines are synthesized in hardware in a field programmable gate array (FPGA) and interface with blocks of random access memory (RAM) where status information and data packets are stored.

The control logic uses routing information to control transmitter selection and make switching decisions. It also manages contention at each node for transmitters by prioritizing data packets. Because switching is performed on the NIC, the network control is distributed vice centralized on a switch or hub. This architecture, coupled with high data rate transceivers on each NIC, results in high network throughput and low latency. The predicted maximum aggregate throughput using this NIC on this network is fifty gigabits per second.

The physical layer of the network uses dense wavelength division multiplexing (DWDM) on a single optical fiber ring to implement an eight node ShuffleNet network topology. Organizing the nodes in a ShuffleNet topology minimizes the number of hops between nodes for a given data packet. This DWDM ShuffleNet has been tested and is capable of supporting error-free data rates of up to 10 Gbps. This illustrates a theoretical maximum aggregate throughput of 160 Gbps for this network.

# Midshipmen Design Projects

### RF Tags for USNA Gate Control

Researchers: Midshipman 1/C Christopher M. Bingham, USN and Midshipman 1/C John A Topolski, USN
Advisers: Visiting Professor James F. Ziegler and Commander John S. Rice, USN

### SAE Car Team

Researcher: Midshipman 1/C Dane A. Brown, USN
Adviser: Commander Leonard J. Hamilton, USN

### "Solarsplash" Power Systems: Speed Control and Electrical Monitoring System

Researchers: Midshipman 1/C Charles N. Cuddy, USN, Midshipman 1/C Thomas E. Driscoll, USN and Midshipman 1/C John S. Schultz, USN
Advisers: Assistant Professor Samara L. Firebaugh and Lieutenant Nathan S. Shenck, USN

### Terminal Guidance for a UAV

Researcher: Midshipman 1/C John J. Creegan, USN
Advisers: Assistant Professor James D. Zuber and Major Dean A. Ebert, USMC

### Modeling the Naval Academy Data Network in OPNET

Researchers: Midshipman 1/C John J. Creegan, USN, and Midshipman 1/C Johathan M. Gilliom, USN
Adviser: Captain Robert J. Voigt, USN

### FIRST Robotics

Researcher: Midshipman 1/C Graig T. Diefenderfer, USN and Midshipman 1/C Mary T. Stringer, USN
Advisers: Lieutenant Aaron M. Still, USN, and Assistant Adjunct Professor Curran Wooten

### USNA Satellite: RAFT1 Data Processing Tool

Researcher: Midshipman 1/C Thomas J. Dill, USN
Advisers: Commander Robert Bruninga, USN (ret) and Major Charles A. Hulme, USMC

### Automated Paintball Gun

Researcher: Midshipman 1/C Brad W. Dubil, USN
Advisers: Associate Professor John G. Ciezki and Assistant Professor Thomas E. Salem

### Networking of Two Original Nintendo Systems; Controller Interface; USB Interface; Network Design

Researchers: Midshipman 1/C Douglas W. Fitzpartick, USN, Midshipman 1/C David M. Jakubek, USN and Midshipman 1/C William M. Vuillet, USN
Adviser: Captain Robert J. Voigt, USN

### Coil Gun

Researcher: Midshipman 1/C Jonathan M. Gilliom, USN
Advisers: Associate Professor John G. Ciezki and Assistant Professor Thomas E. Salem

## Avatar Based Visual Monitoring System
Researcher: Midshipman 1/C Brian J. Harp, USN
Advisers: Professor Delores M. Etter and Dr. Eliza Du, ONR Post-doctoral Fellow

## Iris Recognition with Smart Search
Researcher: Midshipman 1/C John P. Horwath, USN
Advisers: Professor Delores M. Etter and Assistant Professor Robert W. Ives

## Motion Follower
Researcher: Midshipman 1/C Christopher L. Hinson, USN
Advisers: Professor Delores M. Etter and Assistant Professor Robert W. Ives

## Telemetry for a Chesapeake Bay Drifting Buoy
Researcher: Midshipman 1/C Caleb J. Humberd, USN
Advisers: Commander Charles B. Cameron, USN, and Commander Robert Bruninga, USN (ret)

## Remotely Controlled Presentation Timer
Researcher: Midshipman 1/C Tyler F. Spring, USN
Advisers: Commander Charles B. Cameron, USN, and Captain Walter N. Currier, USMC

## Musical Instrument Tuner
Researcher: Midshipman 1/C Allison A. Maas, USN
Advisers: Captain Robert J. Voigt, USN, and Lieutenant Bryan T. Burke, USN

## Voice Recognition Algorithm for Laboratory Access
Researcher: Midshipman 1/C Michael G. Mathis, USN
Advisers: Professor Delores M. Etter and Major Alfredo DuBois, USMC

## Door and/or Locker Automated Surveillance
Researcher: Midshipman 1/C Christopher S. McClean, USN
Advisers: Lieutenant Robert C. Shultz, USN, and Dr. Eliza Du, ONR Post-doctoral Fellow

## Motion Detection Enhancement with Edge Detection
Researcher: Midshipman 1/C Eric J. Mikowski, USN
Advisers: Dr. Eliza Du, ONR Post-doctoral Fellow and Lieutenant Robert C. Shultz, USN

## Remotely Controlled Presentation Timer
Researcher: Midshipman 1/C Tyler F. Spring, USN and Midshipman 1/C Daniel Oh, USN
Advisers: Commander Charles B. Cameron, USN, and Captain Walter N. Currier, USMC

## Electronic Reliability of JSF Avionics
Researcher: Midshipman 1/C Nathan J. Peck, USN and Midshipman 1/C Benjamin A. Scheideman, USN
Advisers: Visiting Professor James F. Ziegler and Associate Professor David S. Harding

## Voltage Conditioning for the MIDSTAR Satellite
Researcher: Midshipman 1/C Christopher M. Schuster, USN
Advisers: Associate Professor Louiza Sellami and Major Robert J. Nash, USMC

## Nuclear Monitoring: The Ship Effect
Researcher: Midshipman 1/C Jack L. Shis, USN
Advisers: Visiting Professor James F. Ziegler and Associate Professor David S. Harding

**Fingerprint Recognition Algorithm**
Researcher: Midshipman 1/C Anthony C. Silvestrini, USN
Advisers: Assistant Professor Robert W. Ives and Lieutenant Robert C. Schultz, USN

**Hands-Free Phone Dialer**
Researcher: Midshipman 1/C Addison T. Tafel, USN
Advisers: Professor Delores M. Etter and Assistant Professor Robert W. Ives

# Professional Publications

# Journal (Refereed) Manuscripts

CAMERON, Charles B., Commander, USN, Rodriguez, Rosa Nivea, Padgett, Nathan, Waluschka, Eugene, and Kizhner, Semion, "Optical Ray Tracing Using Parallel Processors", *Institute of Electrical and Electronics Engineers (IEEE) Transactions on Instrumentation and Measurement*, Vol. 54, No. 1, February 2005, pp. 87-97.

> One of the instruments on the sun-synchronous Terra (EOS AM) and Aqua (EOS PM) spacecraft, the Moderate Resolution Spectroradiometer (MODIS), obtains calibration data once during every orbit. Observations of the sun permit corrections to observations of the earth during the ensuing orbit. Although the instrument was designed to receive uniform sunlight over the entire surface of its detector, the sunlight was in fact not uniform. While this did not adversely affect the calibration, it nonetheless implied a lack of understanding of how the optical system really functioned. To learn what was wrong, NASA used an optical ray-tracing program on a DEC Alpha computer. The results correlated well with the observations made by the instrument itself, but it took nearly two weeks to complete the computer simulation, a discouragingly long time. This paper describes the algorithm and its implementation in a system with multiple digital signal processor (DSP) chips operating in parallel. Timing data show a highly linear relationship between the number of DSPs present and the speed of the computation. Administrative overhead is negligible compared to the time taken to compute ray trajectories. This implies that many more than just four DSPs could be harnessed before administrative overhead would begin to be significant.

FIREBAUGH, Samara L., Assistant Professor, Charles, H. K. Jr., Edwards, R. L. Keeney, A. C. and Wilderson, S. F., "Fabrication and Characterization of a Capacitive Microwave Micromachined Shunt Switch," *Journal of Vacuum Science and Technology A*, July/August 2004.

> The design and fabrication of a capacitive shunt switch is described. The switch is based on a bridge structure that can be modulated using electrostatic actuation. The switch has two states: when the bridge is up the signal passes through with less than 0.1 dB insertion loss. When the switch is down, the signal is attenuated by 15-20 dB at 20 GHz. The residual stress of the bridge material was critical to the operation of these switches. This stress was tightly controlled by varying the temperature of the plating bath. Different bridge widths and shapes are compared. "Bowtie" shaped bridges are demonstrated to have increased insertion loss and similar isolation when compared to straight bridges. These devices were observed to be sensitive to packaging stress, resulting in more than a doubling of the actuation voltage. This work also describes the development of a test fixture that facilitates standard microwave connections for testing the devices without a probe station. The test fixture was observed to have an insertion loss of less than 3 dB up to 20 GHz.

FIREBAUGH, Samara L., Assistant Professor, Charles, H. K. Jr., Edwards, R. L. Keeney, A. C. and Wilderson, S. F., "Optical Deflection Measurement for Characterization of Microelectromechanical Systems (MEMS)," *Institute of Electrical and Electronics Engineers (IEEE) Transactions on Instrumentation and Measurement*, August 2004.

> Nonintrusive measurement of small out-of-plane motions of microscale structures is critical to the development of microelectromechanical systems (MEMS). This paper presents a low-cost deflection measurement system for MEMS structures based on a fiber optic displacement sensor. The system is demonstrated in the characterization of a microwave switch. The deflection system had a demonstrated sensitivity of 290 ± 32 μV/nm over a deflection range of 100 μm. The calibration and linearity of the system is described, and the static and dynamic performance is compared to more elaborate systems.

IVES, Robert W., Assistant Professor, DU, Yingzi, ONR Post-doctoral Fellow, ETTER, Delores M., Professor, and WELCH, Thaddeus B., Commander, USN, "A Multidisciplinary Approach to Biometrics," *Institute of Electrical and Electronics Engineers (IEEE) Transactions on Education*, (in press).

> Biometrics is an emerging field of technology using unique and measurable physical, biological, or behavioral characteristics that can be processed to identify a person. It is a multidisciplinary subject that integrates engineering, statistics, mathematics, computing, psychology, and policy. The need for biometrics can be found in governments, in the military, and in commercial applications. The Electrical Engineering Department at the U.S. Naval Academy has introduced a biometric signal processing course for senior-level undergraduate students and has developed a biometrics lab to support this course. In this paper, the authors present the course content, the newly developed biometric signal processing lab, and the interactive learning process of the biometric course. They discuss some of the challenges that were encountered in implementing the course and how they were overcome. They also provide some feedback from the course assessment.

MCGOWAN, Joseph C., Captain, USN, and Wallace, Sharon K., "Synergy of a Combined Near-Infrared Spectroscopy and Blood Oxygenation Level–Dependent Functional Activation Study", *American Journal of Neuroradiol*, Volume 25, 2004, pp. 1127-1128.

> Genetic diseases affecting the brain typically have widespread lesions that require global correction. Lysosomal storage diseases are good candidates for central nervous system gene therapy, because active enzyme from genetically corrected cells can be secreted and taken up by surrounding diseased cells, and only small amounts of enzyme (<5% of normal) are required to reverse storage lesions. Injection of gene transfer vectors into multiple sites in the mouse brain has been shown to mediate widespread reversal of storage lesions in several disease models. To study a brain closer in size to the human brain, we evaluated the extent of storage correction mediated by a limited number of adeno-associated virus vector injections in the cat model of human alpha-mannosidosis. The treated cats showed remarkable improvements in clinical neurological signs and in brain myelination assessed by quantitative magnetic resonance imaging. Postmortem examination showed that storage lesions were greatly reduced throughout the brain, even though gene transfer was limited to the areas surrounding the injection tracks. The data demonstrate that widespread improvement of neuropathology in a large mammalian brain can be achieved using multiple injection sites during one operation and suggest that this could be an effective treatment for the central nervous system component of human lysosomal enzyme deficiencies.

Osiander, R., FIREBAUGH, Samara L., Assistant Professor, Champion, J. L., Farrar, D.M., Darrin, A., "Microelectromechanical Devices for Satellite Thermal Control", *Institute of Electrical and Electronics Engineers (IEEE) Sensors Journal*, August 2004.

> Future space missions will include constellations of spacecraft, including nano- and pico-satellites, where adaptive thermal control systems will be needed that fit the constraints of space applications with limited power and mass budgets. A microelectromechanical systems (MEMS) solution has been developed that will vary the emissivity on the surface of the small satellite radiator. The system is based on louver thermal controllers, where shutters are mechanically positioned to modulate the effective radiator surface area. This system consists of MEMS arrays of gold-coated sliding shutters, fabricated with the Sandia Ultra-planar, Multi-level MEMS Technology (SUMMiT™) fabrication process, which utilizes multi-layer polycrystalline silicon surface micromachining. The shutters can be operated independently to allow digital control of the effective emissivity. This first demonstrator technology is limited in the possible emittance range to a 40% change. Early prototypes of MEMS louvers that open away from the structure have shown the capability of a much wider dynamic range. The first generation of this active thermal management system will be demonstrated on NASA's New Millennium Program ST-5 spacecraft. With the opportunity to validate the MEMS thermal control technology in space on ST-5, lightweight low power MEMS radiators offer a possibility for flexible thermal control on future nano-satellites.

# Conference Proceedings

Ashton, R. W. and CIEZKI, John G., Associate Professor, "Efficiency and EMI Comparisons between Prototyped 8kW Hard and Soft Switched Buck Choppers," Applied Power Electronics Conference 2005, Austin, TX, 8-10 March 2005.

> Rapid reconfiguration makes power electronics-based DC distribution systems attractive for systems that must be highly dependable. For systems at high power levels, the development of high-performance dc-dc converters is essential. In an attempt to assess efficiency, EMI, size and complexity, the authors have simulated, prototyped, and evaluated similar hard-switched and soft-switched 8kW buck converters.

BONNEY, Bradford L., Midshipman 1/C, USN, IVES, Robert W., Assistant Professor, ETTER, Delores M., Professor, and DU, Yingzi, ONR Post-doctoral Fellow, "Iris Pattern Extraction Using Bit-Plane Analysis", Institute of Electrical and Electronics Engineers (IEEE) 38th Annual Asilomar Conference on Signals, Systems, and Computers, Vol. I, pp. 582-586, November 2004.

> Iris recognition has been shown to be very accurate for human identification. In this paper, we develop a technique for iris pattern extraction utilizing the least significant bit-plane: the least significant bit of every pixel in the image. Through binary morphology applied to the bit-plane, the pupillay boundary of the iris is determined. The limbic boundary is identified by evaluating the standard deviation of the image intensity along the vertical and horizontal axes. Because our extraction approach restricts localization techniques to evaluating only bitplanes and standard deviations, iris pattern extraction is not dependent on circular edge detection. This allows for an expanded functionality of iris identification technology by no longer requiring a frontal view, which leads to the potential for off-angle iris recognition technology. Initial results show that it is possible to fit a close elliptical approximation to an iris pattern by using only bit-planes and standard deviations for iris localization.

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.

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, ONR Post-doctoral Fellow, BONNNEY, Bradford L.,Midshipman 1/C, USN, IVES, Robert W., Assistant Professor, ETTER, Delores, M., Professor, and SCHULTZ, Robert C., Lieutenant, USN, "Analysis of Partial Iris Recognition using a 1D Approach," Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Vol. II, pp. 961-964, March 2005.

Iris recognition has been shown to be very accurate for human identification. In this paper, we investigate the performance of the use of a partial iris for recognition. A partial iris identification system based on a one-dimensional approach to iris identification is developed. The experiment results shows that a more distinguishable and individually unique signal is found in the inner rings of the iris. The results also show that it is possible to use only a portion of the iris for human identification

DU, Yingzi, ONR Post-doctoral Fellow, IVES, Robert W., Assistant Professor, SCHULTZ, Robert C., Lieutenant, USN, and ETTER, Delores, M., Professor, "Analysis of Partial Iris Recognition," Proceedings of the SPIE Defense, Vol. 5779, pp. 31-40, March 2005.

In this paper, we investigate the accuracy of using a partial iris image for identification and determine which portion of the iris has the most distinguishable patterns. Moreover, we compare these results with the results of Du *et. al.* using the CASIA database. The experimental results show that it is challenging but feasible to use only a partial iris image for human identification.

DU, Yingzi, ONR Post-doctoral Fellow, IVES, Robert W., Assistant Professor, ETTER, Delores M., Professor, and WELCH, Thaddeus B., Commander, USN, "A New Approach to Iris Pattern Recognition", Proceedings of the SPIE, Vol. 5612, pp. 104-116, December 2004.

An iris identification algorithm is proposed based on adaptive thresholding. The iris images are processed fully in the spatial domain using the distinct features (patterns) of the iris. A simple adaptive thresholding method is used to segment these patterns from the rest of an iris image. This method could possibly be utilized for partial iris recognition since it relaxes the requirement of using a majority of the iris to produce an iris template to compare with the database. In addition, the simple thresholding scheme can improve the computational efficiency of the algorithm. Preliminary results have shown that the method is very effective. However, further testing and improvements are envisioned.

DU, Yingzi, ONR Post-doctoral Fellow, WELCH, Thaddeus B., Commander, USN, IVES, Robert W., Assistant Professor, and ETTER, Delores M., Professor, "Robust Algorithms for Iris Recognition," Proceedings of NATO Workshop on Enhancing Information Systems Security Through Biometrics, October 2004.

The iris is one of the most stable biometric features for use in human identification and verification. The iris patterns are unique to each person. Even for the same person, the left eye is unique from the right eye. Compared with other biometric recognition techniques such as face and fingerprint recognition, iris recognition is more reliable. This paper will introduce different iris algorithms.

DU, Yingzi, ONR Post-doctoral Fellow, IVES, Robert W., Assistant Professor, ETTER, Delores M., Professor, and WELCH, Thaddeus B., Commander, USN, "A New Approach to Iris Pattern Recognition", Proceedings of the SPIE European Symposium on Optics/Photonics in Defense and Security, October 2004.

Using an individual's iris pattern, voice, facial characteristics or fingerprints for identification enables a high degree of certainty of a person's identity, especially when used together. This form of identifying people can be used in a variety of applications, including allowing physical access to secure sites, making financial transactions, allowing access to networked computers, or identifying a terrorist in a public place. Due to the potential for research that this relatively new field holds, and its importance to homeland defense, we have built a new Biometric Signal Processing Laboratory, and developed a new course in biometric signal processing.

This course was designed for seniors in the electrical engineering major so that they could become familiar with the basis for these new technologies. The course was organized to give the students some background in image processing, from which the identification algorithms are formulated, and had them design simple identification algorithms. The students were exposed to state-of-the-art commercial equipment, including iris scan, fingerprint and facial recognition hardware and software. The course was comprised of three lecture hours and two lab hours each week. We discuss the topics that were covered, the equipment in the lab that supported each topic, the projects that the students performed, field trips, guest lecturers and related senior design projects.

FIREBAUGH, Samara L., Assistant Professor, JENKINS, R. Brian, Associate Professor, and CIEZKI, John G., Associate Professor, "A Comprehensive Laboratory Design Project for Teaching Advanced Circuit Analysis," Proceedings of the 2004 ASEE Annual Conference and Exposition, Salt Lake City, UT, 20-23 June 2004.

This paper describes a design project for sophomores who are learning advanced circuit concepts related to frequency response. The objective of the design project is to design a row or column detector for a touch-tone keypad. The project is conducted in small groups of two to three students. Each group designs and builds a detector for a single row that will produce a logical "high" when a button from that row or column is pressed and a logical "low" otherwise. The project is focused on the design of the filter stages, using both Laplace analysis and convolution to demonstrate an understanding of the frequency response of circuits. The students must not only design, build and test their filters, but also model and analyze the circuit using MATLAB®. Elements of the project, such as the design of an individual filter stage or the use of MATLAB® to perform convolution, are integrated into laboratory exercises during the semester. The digital portion of the design connects this course with the introductory digital logic course that the students take concurrently. This project also introduces students to peak detectors and comparators, which relates the course to the electronics course the students will take in the following semester.

FIREBAUGH, Samara L., Assistant Professor, SALEM, Thomas E., Assistant Professor, ETTER, Delores M., Professor, SHENCK, Nathan S., Lieutenant USN, and VOIGT, Robert J., Captain, USN, "A 'Hands-On' Module to Introduce Freshmen to Electrical Engineering," Proceedings of the 2005 ASEE Annual Conference and Exposition, Salt Lake City, UT, 12-15 June 2005.

Freshman engineering courses are being widely implemented so that students can make an informed decision about their major. Module-based approaches that trade depth for the sake of breadth are often used to present each of the varied disciplines separately. Electrical engineering, an abstract and mathematically intense discipline, is particularly challenging to distill into a few hours. This paper describes a four-hour electrical engineering module that examines the role of electrical engineering in the manipulation of audio signals, developed for a new introductory engineering course at the United States Naval Academy.

In the first hour, students were given a short presentation on biometrics (signals that can be used to identify a person) and participated in demonstrations of iris, face, and fingerprint recognition systems. They then completed a laboratory experiment in which they analyzed plots of speech (audio) signals, measured pitch

frequencies, and identified male and female voices using that information. During the following hour, after a brief overview of A/D and D/A conversion, the students captured their own voices and viewed the quantized voice signals as oscilloscope images. They used a Matlab script to manipulate the sampling rate and quantization and to play back the modified signals, illustrating aurally the effects of changing these parameters.

The last two hours of the module were spent on a small electronics project involving a "light organ." This discrete circuit consists of a microphone, an amplifier, and a series of band pass filters tuned to different frequency ranges. The filters drive LEDs that flash with an audio signal. Circuit boards were prefabricated with all components except for the band pass filter resistors in place. The students engaged in the design process by first identifying the desired frequency ranges for their filters using function generators and speakers, and then choosing resistor values using an Excel spreadsheet programmed with the filter's design equations. Finally, the students soldered their resistors into place and tested their circuits.

Thus, within four hours, the students were exposed to digital systems, digital signal processing, electronics, frequency response and communications - all tied around the central and concrete theme of audio signals.

IVES, Robert W., Assistant Professor, BONNEY, Bradford L., Midshipman 1/C, USN, and ETTER, Delores M., Professor, "Effect of Image Compression on Iris Recognition," 22nd IEEE Instrumentation and Measurement Technology Conference, Ottawa, Canada, May 2005.

Iris recognition is a proven, accurate means to identify people. Commercial iris recognition systems are currently employed to allow passengers in some airports to be rapidly processed through security, to allow access to secure areas, and for secure access to computer networks. With the growing employment of iris recognition systems and associated research to support this, the need for large databases of iris images is growing. If required storage space is not adequate for these images, compression is an alternative. It allows a reduction in the space needed to store these iris images, although it may be at a cost in some amount of information lost in the process. This paper investigates the effects of image compression on iris recognition. Compression is performed using JPEG2000, and the iris recognition algorithm used is based on several methods, including the Daugman algorithm.

IVES, Robert W., Assistant Professor, DU, Yingzi, ONR Post-doctoral Fellow and WELCH, Thaddeus B., Commander, USN, "Biometrics High School Outreach: Summer Seminar and Internships at the U.S. Naval Academy", Biometric Consortium Conference, September 2004.

The summer seminar focused primarily on academics, with each student attending eight 90-minute workshops of their choosing. Some of the workshop topics included modern computing, physics, seamanship and various disciplines of engineering, including electrical engineering. It was within this latter area that high school students were introduced to biometrics.

MECHTEL, Deborah M., Associate Professor and VOIGT, Robert J., Captain, USN, "Minimizing the Pain and Maximizing the Gain of Assessment", Proceedings Frontiers in Education 34th Annual Conference, TG3-7-TG3-11, October 2004.

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.

Morrow, M.G., Wright, C. H. G. and WELCH, Thaddeus B., Commander, USN, "ENHANCING THE TMS320C6713 DSK FOR DSP EDUCATION", Proceedings of the 2005 ASEE Annual Conference and Symposium, (Portland, Oregon), June 2005.

The introduction of the Texas Instruments TMS320C6713 DSP Starter Kit (DSK) brought a much more capable, stable, and robust DSP development environment to DSP education. However, while the DSK had many improvements over the TMS320C6711 DSK, it did not include any way to transfer data to and from the host computer except through the debugger interface, which is extremely limited in bandwidth and requires that the TI software tools be available. This means that the existing suite of winDSK6 demonstration tools cannot be run on the 6713 DSK, denying educators a valuable teaching and classroom demonstration resource. Also, there is no way to interface an application on the host PC directly to the DSK, limiting the abilities of students to create stand-alone, interactive projects using the DSK. To solve this problem, the authors have created an interface to the TMS320C6713 DSK that uses the Host Port Interface (HPI) to provide both a means for a PC host application to boot software onto the DSK, and to permit the transfer of data between the DSK and the host PC application. A software package makes it possible for students to create stand-alone Windows applications that communicate directly with the DSK. In addition to parallel port communication, the interface provides USB, RS-232, and digital input/output ports as user selectable resources available to the DSK software. This paper discusses the specific capabilities of the hardware and software interface, summarizes the software applications and library calls available, and relates our experiences in using all of it. The presentation will include a demonstration of the capabilities and uses of this interface. The authors freely distribute the software components of the interface for educational use.

SALEM, Thomas E., Assistant Professor, Bayne, Stephen and Porschet, Don, U.S. Army Research Laboratory, and Chen, E., Halfmoon Power Technologies, LLC, "Thermal Performance of Water-Cooled Heat Sinks", 20th Annual IEEE Applied Power Electronics Conference and Exposition, March 2005, pages 129-133.

As power electronic applications continue to switch higher levels of voltage and current in smaller-sized component packages, the resulting increase in power density requires efficient thermal management. This paper compares the thermal performance for operating a MOSFET on a water-cooled pole-arrayed heat sink versus a novel water-cooled microchannel heat sink.

SALEM, Thomas E., Assistant Professor, Bayne, Stephen and Porschet, Don, U.S. Army Research Laboratory, "Thermal Performance of Water-Cooled Heat Sinks: A Comparison of Two Different Designs", Semiconductor Thermal Measurement, Modeling, and Management Symposium, 2005 IEEE Conference, March 2005, pages 264-269.

As power electronic applications continue to switch higher levels of voltage and current in smaller-sized component packages, the resulting increase in power density requires efficient thermal management. This paper compares the thermal performance for operating a MOSFET on a water-cooled pole-arrayed heat sink versus a novel water-cooled microchannel heat sink. Details are presented on an innovative technique for determining the thermal capacitance modeling parameter for the heat sinks from experimental data.

SALEM, Thomas E., Assistant Professor, Ibitayo, Dimeji, U.S. Army Research Laboratory, "Calibration of an Infrared Camera for Thermal Characterization of High Voltage Power Electronic Components", 2005 Institute of Electrical and Electronics Engineers (IEEE) instrumentation and Measurement Technology Conference Proceedings, Vol. II, 17-19 May 2005.

Thermal performance of power electronic components is a limiting factor on the power density and design of high voltage high power systems. Therefore, accurate assessment and characterization on the thermal capabilities of these components is critical for the development and design of high density power applications. This paper presents a methodology for calibrating an infrared camera system for use in characterizing high voltage power electronic components.

SCHULTZ, JOHN S., Midshipman 1/C, USN, FIREBAUGH, Samara L., Assistant Professor, Charles, H. K., Jr., Edwards, R. L., Keeney A. C., and Wilderson, S. F., "Dielectric Charge Measurement in Capacitive Microwave Shunt Switches", 2005 IEEE Instrumentation and Measurement Technology Conference, Ottawa, Ontario, Canada, 17-19 May 2005.

Microelectromechanical Systems (MEMS) electrostatic switches offer several advantages over solid-state switches in high frequency applications. MEMS switches operate at near-zero power consumption and provide very high isolation in the off state with very low insertion loss in the on state. The use of MEMS electrostatic switches in phased array radars and satellite communications is of particular interest because of their advantages over solid-state devices. However, the performance of these switches may be limited by lifetime and power handling issues. One lifetime limiting effect in capacitive shunt switches is the excessive buildup of charge in the dielectric layer between the bridge and the transmission line. This dielectric charging is the primary cause of unreliability in the MEMS capacitive shunt switches.

Published methods of characterizing dielectric charging include capacitance-voltage measurements, lifetime measurements, and a non-contact measurement based on the symmetry of the force-drive voltage relationship. One issue with capacitance-voltage measurement of charging is that the method itself causes dielectric charging, and therefore the experiment must be done rapidly to avoid excessive data corruption. Lifetime measurement only provides a qualitative measurement of the dielectric charging. In contrast, the non-contact measurement, implemented by Reid *et al.* gives a quantitative value of charge in the dielectric. The method involves determining the DC voltage generated by the charge present in the dielectric layer. The electrostatic force on the bridge should be a function of the absolute value of the applied voltage. This implies that in the absence of trapped charge the response of the bridge to positive excursions in voltage should be identical to the response to negative excursions in voltage. Trapped charge, however, disrupts the symmetry of this operation. Specifically, in this method a microwave frequency, mixed with a triangle wave drive signal, is passed through a capacitive shunt switch. The drive signal is kept below the pull-in voltage in order to prevent contact between the bridge and the dielectric. The output of the switch is then passed through a mixer where the LO frequency is the original signal frequency. The output of the mixer is analyzed on an oscilloscope. Any offset caused by dielectric charging will result in an asymmetric signal shown by the oscilloscope. The drive signal is offset in order to make the signal viewed on the oscilloscope symmetrical and the voltage-offset value is proportional to the sheet charge trapped in the dielectric.

The devices we are testing are capacitive shunt switches with an electroplated gold bridge formed by surface micromachining. The bridges are about 1.5 μm thick, 200 μm long, and have widths of 25 μm, 50 μm, and 100 μm. The bridges are suspended about 2 μm above the substrate. Underneath the bridges there is a sputtered silicon nitride dielectric layer which is 113 nm thick. The fabrication method and test results for these bridges have been presented elsewhere. We first verified this dielectric charging method by repeating the measurements described by Reid *et al.* One concern was that the method, like the capacitance-voltage measurement method, might cause additional dielectric charging in the device under test; however our measurements have proved that this is not the case. Now that the reproducibility of the method has been demonstrated, we have applied this method to determine if there is a way to remove charge trapped in the dielectric. The first removal methods we investigated were the use of heat and ionized air. We have successfully reproduced the measurement, and have demonstrated that the method does not

cause further charging by monitoring the voltage-offset value as a function of bias amplitude and time, where we found no variation. We are currently applying the method to quantify the affects of heat, actuation voltage and geometry on dielectric charging. The results of this work could significantly increase lifetimes in capacitive shunt switches.

SCHUSTER, Christopher M., Midshipman 1/C, USN, BEASLEY, Matthew A., Midshipman 1/C, USN, FIREBAUGH, Samara L., Assistant Professor, Osiander, R., and Farrar, D., "Temperature Characterization System and Communication Interface for Microelectromechanical Thermal Switches for the MidSTAR Satellite Program", 2005 Institute of Electrical and Electronics Engineers (IEEE) Instrumentation and Measurement Technology Conference, Ottawa, Ontario, Canada, 17-19 May 2005.

The Midshipman Space Technology Applications Research (MidSTAR) Program is a small satellite project involving midshipman at the United States Naval Academy, created to support reduced-scale space experimentation, and sponsored by the Department of Defense Space Test Program. The launch window is set for September of 2006 out of Cape Canaveral aboard a Lockheed-Martin Atlas V rocket. Orbit of the satellite is determined by the requirements of the experiments and by visibility to the ground station at the United States Naval Academy in Annapolis, Maryland. The MidSTAR satellite is octagonal in shape, measuring 32.2" long, 21.2" high and 21.2" wide. The electrical power is generated by 16 triple-junction Gallium Arsenide solar panels, one on each side of the satellite, arranged in two parallel arrays of eight panels connected in series. These solar panels mounted on the skin of the craft provide the power for communications with the ground control stations, critical operations, and mounted experiments. Internal to the craft are shelves to house the control systems and experiments. Space is also allotted for the individual experiments on the skin of the craft.

One of the payloads is the exterior-mounted Microelectromechanical System (MEMS) Thermal Control Device (TCD). MEMS incorporate multiple levels of design, including interaction with the environment, to accomplish essential functions at a smaller material and spatial cost. These characteristics are desirable for smaller scale satellites, which are referred to as nano- and picosatellites. These satellites have a low thermal capacitance, which makes them vulnerable to rapid temperature fluctuations. This particular device serves to show the benefits of thermal control for such satellites via the use of a variable emissive coating (VEC) [2]. The variation is achieved by using an electrostatic device to control conductivity of an emissive surface with a radiator. It is comprised of a gold membrane that is supported by SU-8 polymer columns.. This suspended foil design is a new approach to previous MEMS arrays that use shutter systems and louvers to achieve a similar goal.

This electrostatic MEMS for thermal control is slated for onboard testing on the MidSTAR satellite, and as a result needs a robust test platform to accurately actuate and evaluate its capabilities. The test platform must operate the device, read the temperature, and communicate the findings to the satellite. This paper presents a manner to effectively test and incorporate the MEMS TCD in a modular and cost-effective fashion independent of the command and data-handling (C&DH) unit.

Wang, H., Pekarek S., Fahimi, B., ZIVI, Edwin L., Jr., Associate Professor (Weapons and Systems Engineering Department), 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, Aachen, Germany, June 2004.

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.

WELCH, Thaddeus B., Commander, USN, Wright, C.H.G. and Morrow, M.G., "Reach Out and DSP Someone!" Proceedings of the 2004 ASEE Annual Conference and Symposium, Salt Lake City, UT, June 2004.

In recent years, more and more students have been designing and implementing small systems using real-time DSP hardware. Given the decreasing cost and the increasing capability of DSP starter kits (DSKs) and evaluation modules (EVMs), these projects are being used by greater numbers of educators as a valuable pedagogical tool. Currently, the ability to easily control a number of electrical loads totaling several hundred watts using DSKs or EVMs does not readily exist. Yet DSP control of significant electrical loads can add depth and interest to many student projects. This paper will discuss the design, construction, and use of a very compact, dual-tone multiple-frequency (DTMF) based decoder and power switching device.

These devices have been successfully and enthusiastically used by a number of undergraduate and graduate students to allow their DSP algorithms to control their world, or to put it another way, to Reach Out and DSP Someone!

WELCH, Thaddeus B., Commander, USN, Wright, C.H.G., and Morrow, M.G., "Experiences in Offering a DSP-based Communications Laboratory", Proceedings of the 2004 Digital Signal Processing Workshop and Signal Processing Education Workshop, Taos, NM, August 2004.

Most courses that include a hardware laboratory component are constrained by the need for realism without making the individual exercises insurmountable. This paper discusses a number of analog signal processing components that make possible the interfacing of analog systems to a variety of input/output boards specifically designed for use with Texas Instruments' TMS320C6x DSKs. These components and boards have been used in a number of undergraduate and graduate courses to facilitate the laboratory exercises and the design projects that routinely come from these laboratory-based courses.

WELCH, Thaddeus, B., Commander, USN, T. B. Welch, Wright, C.H.G. and Morrow, M.G., "Caller ID: An Opportunity To Teach DSP-based Demodulation", Proceedings of the 2005 IEEE International Conference on Acoustics, Speech and Signal Processing, Philadelphia, PA, March 2005.

This paper discusses one of our real-time DSP course's most popular projects, demodulating a telephone's caller ID signal. We will describe the use of a modified telephone coupler to allow students to access to caller ID signal and then discuss a number of the DSP methods and techniques that are required to successfully demodulate, decode, and display the caller ID information. This project has been exceedingly well received by both our undergraduate and graduate students and represents a DSP-based solution to a real world communications problem that every student has seen in use. This project involves almost every aspect of realtime signal processing implementation, but is not so overwhelming in scope that it cannot be completed in a reasonable amount of time.

WELCH, Thaddeus B., Commander, USN, Wright, C.H.G., and Morrow, M.G., "Caller ID: A Project To Reinforce An Understanding Of DSP-based Demodulation", Proceedings of the 2005 ASEE Annual Conference and Symposium, Portland, OR, June 2005.

This paper discusses one of the most popular projects in our real-time DSP course: demodulating a telephone's caller ID signal. We will describe the use of a modified telephone coupler to allow students to access the caller ID signal and then discuss a number of the DSP methods and techniques that are required to successfully demodulate, decode, and display the caller ID information. This project has been exceedingly well received by both our undergraduate and graduate students and represents a DSP-based solution to a real world communications problem that every student has seen in use. This project involves almost every aspect of real-time signal processing implementation, but is not so overwhelming in scope that it cannot be completed in a reasonable amount of time.

WELCH, Thaddeus B., Commander, USN, and Kubichek, R., "The Incredible Hulk and Other Techniques for Teaching Waveform Demodulation", Proceedings of the 2005 ASEE Annual Conference and Symposium, Portland, OR, June 2005.

The University of Wyoming has introduced a 2 contact hour undergraduate/graduate course entitled, "Communications Measurement Laboratory." This new course was designed to reinforce student knowledge of their course work in signals and systems, digital and analog communication systems, and digital signal processing. The primary course objectives were to familiarize students with vector signal analysis and develop a thorough understanding of I and Q-based demodulation techniques. This paper provides an overview of this course and describes student projects that utilize a vector signal analyzer (VSA) to detect, localize, and record decimated I and Q data as would be available at the output of an intermediate frequency (IF) analog-to-digital converter (ADC) stage of a software defined radio (SDR).

# Books and Monographs

ETTER, Delores M., Professor, Engineering Problem Solving with C, Third Edition, Prentice-Hall Publishing Co., 2005.

This text provides an introduction to engineering problem solving using the ANSI C programming language. It offers an extensive variety of real-world problem solving applications to solve a diverse range of problems from areas including electrical, computer, mechanical, civil, chemical, and environmental engineering and computer science. The text uses a consistent 5-step methodology for solving scientific and engineering problems.

ZIEGLER, James F., Visiting Professor, and Puchner, Helmut, "The Reliability of Modern Electronic Memories – History, Problems and Trends", Cypress Inc., San Jose, CA, 285 pages, (2005).

The reliability of modern integrated circuits (ICs) depends mostly on their resistance to ambient radiation, especially neutrons. This fact has been known for 30 years, but only in the last decade has it been made clear that sensitivity to radiation is the overwhelming cause of poor reliability, and efforts to understand and mitigate these effects have been initiated by all semiconductor manufacturers.

This book traces the history of industrial incidents about radiation effects on IC devices, with emphasis to the large economic impact it has made on various companies. The effects of radiation on current ICs is reviewed with estimates of the fail rates of various IC designs. Chapters discuss the techniques which can evaluate IC reliability, and how circuit changes can remarkably change the degree of sensitivity of ICs to radiation. Finally, methods are presented for containing the impact of poor IC reliability by system architecture or redundancy.

ZIEGLER, James F., Visiting Professor, "Ion Implantation – Science and Technology", Ion Implantation Press, Annapolis, 717 pages, (2004).

Ion implantation is the single most important process in making integrated circuits (ICs). It is also the largest tool (about the size of a garage), the most expensive (typically ~$4M), and the most dangerous (containing nuclear radiation, high voltages (>100 kV), toxic materials and vacuums).

A review is made of the history of ion implantation. Various aspects of the technology are discussed from both theoretical and experimental viewpoints. The limitations of current ion implanters are reviewed, with emphasis on the trade-offs in emphasis by the various commercial machines now offered. Finally, the future of ion implantation development is suggested, with emphasis on new modern devices and how they will be made using current and next-generation ion implanters.

# Book Chapters

DU, Yingzi, ONR Post-doctoral Fellow, IVES, Robert W., Assistant Professor, and ETTER, Delores M., "Iris Recognition," The Electrical Engineering Handbook, 3rd Edition, Boca Raton, FL: CRC Press, 2005, in press.

> The iris provides one of the most stable biometric signals for use in identification, with a distinctive texture that is formed before birth and remains constant throughout life unless there is an injure to the eye. The striations, filaments, and rings that make up the iris pattern are very unique to each person, and the left eye is unique from the right eye. Because of its uniqueness to an individual, an iris can provide identification with very high confidence even with large databases. Compared with other biometric features such as face and fingerprint, iris patterns are more stable and reliable. Iris recognition systems are non-invasive, but require a cooperative subject.

# Technical Reports

ZUBER, James D., Assistant Professor and Kopp, Bruce A., "Silicon Carbide PIN Diode Limiter for Radar Receiver Protection", JHU-APL Report A2F04-U-0-008, June 8, 2004, 46 pages including theoretical development and numerical calculations. (Sponsored by NAVSEA PEO IWS 2.0)

> 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.

# Presentations at Professional Meetings and Conferences

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, 20-25 June 2004.

CIEZKI, John G., Associate Professor, "Efficiency and EMI Comparisons between Prototyped 8kW Hard and Soft Switched Buck Choppers", Applied Power Electronics Conference 2005, Austin, TX, 8-10 March 2005.

CIEZKI, John G., Associate Professor, "Systems Engineering and Automation", ESRDC Workshop, Tallahassee, FL, 23-26 May 2005.

DU, Yingzi, ONR Post-doctoral Fellow, IVES, Robert W., Assistant Professor, ETTER, Delores, M., Professor, and WELCH, Thaddeus B., "A New Approach to Iris Pattern Recognition", Proceedings of the SPIE European Symposium on Optics/Photonics in Defense and Security, London, UK, October 2004.

DU, Yingzi, ONR Post-doctoral Fellow, "Biometrics High School Outreach: Summer Seminar and Internships at the U.S. Naval Academy", Biometric Consortium Conference, Crystal City, VA, September 2004.

DU, Yingzi, ONR Post-doctoral Fellow, "Analysis of Partial Iris Recognition using a 1D Approach", IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Philadelphia, PA, March 2005.

DU, Yingzi, ONR Post-doctoral Fellow, "One-Dimensional Iris Recognition", University of Maryland, Baltimore County, Baltimore, MD, April 2005.

DU, Yingzi, ONR Post-doctoral Fellow, "A Wonderful World of Digital Image Processing", Embry-Riddle Aeronautical University, Prescott, AZ, February 2005.

DU, Yingzi, ONR Post-doctoral Fellow, "Introduction to Biometrics", East Carolina University, Greensville, NC, March 2005

DU, Yingzi, ONR Post-doctoral Fellow, "1D Iris Recognition and Its Application to Partial Iris Identification", Oregon State University, Corvallis, OR, March 2005

DU, Yingzi, ONR Post-doctoral Fellow, "1D Iris Recognition and Its Application to Partial Iris Identification", Indiana University - Purdue University, Indianapolis, IN, March 2005.

DU, Yingzi, ONR Post-doctoral Fellow, "1D Iris Recognition and Its Application to Partial Iris Identification", University of Nebraska, Lincoln, NE, March 2005.

ETTER, Delores M., Professor, "Biometrics: The Promises and the Challenges", The International Society for Optical Engineering, Research Conference, Orlando, FL, 28 March 2005. (Keynote speaker)

ETTER, Delores M., Professor, "Defense Science Board Report on Identification Technologies," Office of the Secretary of Defense (OSD) Briefings, October 2004 (Sega), October 2004 (Wynne), November 2004 (Haave), November 2004 (Brown), December 2004 (Behling), and May 2005 (Lauber).

ETTER, Delores M., Professor, "Defense Science Board Review of Improvised Explosive Devices (IED) Blitz Program", Office of the Secretary of Defense (OSD) Briefings, November 2004.

ETTER, Delores M., Professor, "Defense Science Board Task Force on Role of 'Director of Defense Research Engineering' (DDR&E)", April 2005.

ETTER, Delores M., Professor, "Biometrics Laboratory Presentation/Demonstrations", National Association of Electrical Engineering Chairs, 17 August 2004.

ETTER, Delores M., Professor, "Biometrics Laboratory Presentation/Demonstrations", Critical Infrastructure Protection Subcommittee, North American Electric Reliability Council, 9 December 2004.

ETTER, Delores M., Professor, "Biometrics Laboratory Presentation/Demonstrations", National Security Agency, 18 January 2005.

ETTER, Delores M., Professor, "Biometrics Laboratory Presentation/Demonstrations", Office of Naval Research, 28 January 2005.

ETTER, Delores M., Professor, "Biometrics Laboratory Presentation/Demonstrations", National Academy of Science Committee on Biometrics, 8 June 2005.

FIREBAUGH, Samara L., Assistant Professor, JENKINS, R. Brian, Associate Professor, and CIEZKI, John G., Associate Professor, "A Comprehensive Laboratory Design Project for Teaching Advanced Circuit Analysis", 2004 ASEE Annual Conference and Exposition, Poster Presentation, Session 1532, Salt Lake City, UT, 20-23 June 2004.

FIREBAUGH, Samara L, Assistant Professor, SALEM, Thomas D., Assistant Professor, ETTER, Delores M., SHENCK, Nathan S. Lieutenant, USN, and VOIGT, Robert J., Captain, USN, "A 'Hands-On' Module to Introduce Freshmen to Electrical Engineering", 2005 ASEE Annual Conference and Exposition, Salt Lake City, UT, 12-15 June 2005.

IVES, Robert W., Assistant Professor, "Iris Research at the U.S. Naval Academy", 2005 U.S. Interagency Information Exchange on Biometrics, McLean, VA, May 2005.

IVES, Robert W., Assistant Professor, Guidry, A., 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., Professor, DU, Yingzi, ONR Post-doctoral Fellow, and WELLCH, Thaddeus B., Commander, USN, "Biometrics High School Outreach: Summer Seminar and Internships at the U.S. Naval Academy", Biometric Consortium Conference, Crystal City, VA, September 2004.

IVES, Robert W., Assistant Professor, ETTER, Delores, M., Professor, DU, Eliza, ONR Post-doctoral Fellow, and WELCH, Thaddeus B., Commander, USN, "Development of an Undergraduate Course in Biometric Signal Processing,", 2004 Annual American Society for Engineering Educators (ASEE), Conference and Symposium, Session 2632, Salt Lake City, UT, June 2004.

MCGOWAN, Joseph C., Captain, USNR, "Fast Spin Echo", 13th Scientific Meeting of the International Society of Magnetic Resonance in Medicine, Miami, FL, 10 May 2005.

MCGOWAN, Joseph C., Captain, USNR, Lecture Series on "Magnetic Resonance (MR) Physics", National Naval Medical Center, Bethesda, MD, October 2004 – May 2005.

MECHTEL, Deborah M., Associate Professor, "Minimizing the Pain and Maximizing the Gain of Assessment", 2004 Institute of Electrical and Electronics Engineers (IEEE), Frontiers in Education Conference (FIE), Savannah, GA, 21 October 2004.

MECHTEL, Deborah M., Associate Professor, "Technological Literacy at the United States Naval Academy", Improving the Technological Literacy of Undergraduates and Engineering as a Liberal Art, National Academy of Engineering, Washington, D.C., 18 April 2005.

Morrow, M.G., WELCH, Thaddeus B., Commander, USN, and Wright, C.H.G., "Opening New Doors: Enhanced Educational Opportunities with the TMS320C6713 DSK", 2005 Texas Instruments Developer's Conference, Houston, TX, February 2005.

SALEM, Thomas E., Assistant Professor, "Thermal Performance of Water-Cooled Heat Sinks," Institute of Electrical and Electronics Engineers (IEEE) Applied Power Electronics Conference, 6-10 March 2005.

SALEM, Thomas E., Assistant Professor, "Thermal Performance of Water-Cooled Heat Sinks: A Comparison of Two Different Designs," Institute of Electrical and Electronics Engineers (IEEE) Semiconductor Thermal Measurement, Modeling, and Management Symposium, 15-17 March 2005.

SALEM, Thomas E., Assistant Professor, "A 'Hands-On' Module to Introduce Freshmen to Electrical Engineering," American Society for Engineering Educators (ASEE), Annual Conference and Exposition, 12-15 June 2005.

SCHUSTER, Christopher M., Midshipman 1/C, USN, BEASLEY, Matthew A., Midshipman 1/C, USN, FIREBAUGH, Samara L., Assistant Professor, Osiander, R. and Farrar, D., "Temperature Characterization System and Communication Interface for Microelectromechanical Thermal Switches for the MidSTAR Satellite Program", 2005 IEEE Instrumentation and Measurement Technology Conference, Ottawa, Ontario, Canada, 17-19 May 2005.

SCHULTZ, John S., Midshipman 1/C, USN, FIREBAUGH, Samara L., Assistant Professor, Charles, H. K., Jr., Edwards, R. L., Keeney, A. C. and Wilderson, S. F., "Dielectric Charge Measurement in Capacitive Microwave Shunt Switches", 2005 IEEE Instrumentation and Measurement Technology Conference, Ottawa, Ontario, Canada, 17-19 May 2005.

VOIGT, Robert J., Captain, USN, "Academic and Professional Instruction Using OPNET", OPNETWORK 2004, September 2004. (Invited speaker and panelist)

WELCH, Thaddeus B., Commander, USN, "Reach Out and DSP Someone!", 2004 American Society for Engineering Educators (ASEE) Annual Conference and Symposium, Salt Lake City, UT, June 2004.

WELCH, Thaddeus B., Commander, USN, "Experiences in Offering a DSP-based Communications Laboratory", 2004 Digital Signal Processing Workshop and Signal Processing Education Workshop, Taos, NM, August 2004.

WELCH, Thaddeus B., Commander, USN, "Implementing Spectrally Efficient Digital Transmitters Using DSPs", University of Wyoming Electrical and Computer Engineering (ECE) Graduate Seminar, Laramie, WY, October 2004.

WELCH, Thaddeus B., Commander, USN, "Caller ID: An Opportunity To Teach DSP-based Demodulation", 2005 Institute of Electrical and Electronics Engineers (IEEE) International Conference on Acoustics, Speech and Signal Processing, Philadelphia, PA, March 2005.

WELCH, Thaddeus B., Commander, USN, "Caller ID: A Project To Reinforce An Understanding Of DSP-based Demodulation", 2005 American Society for Engineering Educators (ASEE) Annual Conference and Symposium, Portland, OR, June 2005.

WELCH, Thaddeus B., Commander, USN, "The Incredible Hulk and Other Techniques for Teaching Waveform Demodulation", 2005 American Society for Engineering Educators (ASEE) Annual Conference and Symposium, Portland, OR, June 2005.

WORT, Joshua W., Midshipman 1/C, JENKINS, R. Brian, Associate Professor, and VOIGT, Robert J., Captain, USN, "A Network Interface Card for a Bidirectional Wavelength Division Multiplexed Fiber Optic Local Area Network", 19th National Conference on Undergraduate Research (NCUR), Lexington, VA, April 2005.

ZIEGLER, James F., Visiting Professor, "The Ship Effect – Enhancement of Ambient Neutron Flux by Surrounding Materials", Institute of Electrical and Electronics Engineers (IEEE) Conference on Nuclear Science and Radiation Effects, Monterey, CA, 21 July 2004.

ZIEGLER, James F., Visiting Professor, "The Effects of Cosmic Rays on Modern Integrated Circuits", Institute of Electrical and Electronics Engineers (IEEE) Conference on Advanced Computer Architecture, San Francisco, CA, 19 March 2005.

ZIEGLER, James F., Visiting Professor, "The Effects of Cosmic Rays on Modern Integrated Circuits", Department of Defense/Defense Threat Reduction Agency (DTRA) Classified Workshop, Cypress, CA, 17 May 2005.

ZUBER, James D., Assistant Professor, "Silicon Carbide PIN Diode Limiter for Radar Receiver Protection", JHU-APL, Radar Systems Development Review, 7 October 2004.