

Department of Electrical Engineering and Computer Science



***COL Andre Sayles
Professor and Head of the Department of
Electrical Engineering and Computer Science***

The mission of the Department of Electrical Engineering and Computer Science is to educate cadets to be Army officers who understand, develop, and exploit current and future technologies. We ensure that our highly productive research programs support our curriculum, enhance the professional development of both cadets and faculty, and contribute to the fields of science and engineering important to the Department of Defense. Our 50 faculty members have superb qualifications in computer science, electrical engineering, information systems engineering, and information technology. The Photonics Research Center and the Information Technology and Operations Center have an outstanding track record of finding research opportunities that best support our mission, establishing funding programs, and then inviting faculty to support the project of choice with no overhead requirements or administrative burdens. This approach to department research has resulted in 100% faculty participation and up to 100 publications and presentations in a given year. At the same time, we are making a difference throughout the Defense community as well as in the Federal Government. Of particular note are our contributions to smart pixel technologies, optical and oversampled analog to digital conversion, image processing, information assurance, science and engineering education, diversity, officer education needs in network-centric warfare, information technology, advanced technology classrooms, high speed communications, fiber optics, and the science and engineering underpinning numerous Army battlefield and automation systems. The quality of our scholarship and service is recognized by peers nationally and internationally.

Through the efforts of the Information Technology and Operations Center, USMA continues to maintain its designation as a Center of Academic Excellence in Information Assurance Education by the National Security Agency (NSA). The Military Academy was the first-ever undergraduate institution to be so designated. For the second year, the USMA cadet team won the NSA Information Assurance Director's Trophy. This prestigious trophy is awarded to the Service Academy that wins the annual Cyber Defense Exercise. The Information Technology and Operations Center also continues to serve as the lead agency for the Annual IEEE Information Assurance Workshop, which brings together over 100 representatives from academia, industry and the federal government. The electrical engineering and computer science efforts in the Photonics Research Center continue to be singled out for excellence during reviews by outside agencies. Faculty members received several awards for excellence over the past year, while the teaching programs worked hard in completing an excellent accreditation visit.

Fourth Annual IEEE Information Assurance Workshop

**LTC Dan Ragsdale, Dr. John James, LTC John Surdu, MAJ Scott Lathrop,
MAJ Ron Dodge, COL Clark Ray**

**Sponsors: IEEE Systems, Man, and Cybernetics (SMC) Society and the
National Security Agency (NSA)**

The Department of Electrical Engineering and Computer Science, with support from the National Security Agency, has initiated a national-level series of workshops to provide a forum for discussion of information-assurance-related issues and publication of information-assurance-related research. The workshop provides a niche for those researchers, managers and businesses that are especially interested in military aspects of information assurance. The EE&CS Information Technology and Operations Center has played a key role in establishing the workshop as a popular venue for discussion and publication of research results concerning emerging technologies that can affect the security of defense-related computer networks.

The workshop proceedings have been published on compact disk and selected papers from the 2000 workshop have appeared in a special issue of the IEEE SMC Society journal. The next workshop will be held 18-20 June 2003 at West Point.

Proceedings of the Third Annual IEEE SMC Information Assurance Workshop, June 17-19 2002, West Point, NY, ISBN: 0-7803-9850-5.

Classroom XXI

MAJ Edward Mattison

Sponsor: TRADOC

Provide technical expertise and maintain the test-bed laboratory for the TRADOC multimedia classroom of the 21st Century. Evaluate and recommend proposed technologies. Perform

government test and acceptance of Classroom XXI implementations and conduct courseware development training. Objectives include:

- Determine benefits and limitations of student computer management tools.
- Evaluate collaborative tools and other methods to enhance student learning.
- Evaluate and test hardware, software, and audio-visual equipment for possible use in future Classroom XXI implementations.
- Assess knowledge/learning management systems to enhance school administrator ability to conduct soldier Human Capital Management.

Cyber Defense Exercise 2001
Mr. Wayne Schepens

Sponsor: Public Key Infrastructure Program Office, National Security Agency

The inter-academy Cyber Defense Exercise (CDX) is a hands-on, competitive real-life learning experience initiated and implemented by faculty and cadets assigned to the US Military Academy, with funding and direction provided by the National Security Agency. The concept of "defending the network" was derived to evaluate cadet skills and the effectiveness of the Information Assurance (IA) education invoked at West Point. The CDX served as the final project for senior-level Computer Science majors enrolled in the IA course. The US Air Force Academy, US Military Academy, and Naval Postgraduate School accepted the challenge to compete in 2001.

A combined team of analysts from the National Security Agency, 92nd Aggressor Squadron, US Air Force, and the Land Information Warfare Activity, US Army, served as the Red Team. Remote access was provided from a laboratory in Elkridge, MD to each participating school's Cyber Defense Network (CDN) via a Virtual Private Network configured to provide authentication and encryption of all traffic. The team verified the student's efforts to provide security to the CDN while ensuring the predetermined services and applications were available with a baseline set of network resources and operating systems provided by the DoD Public Key Infrastructure Program Management Office. The Red Team then, based on predetermined assessment criteria, designated the school with the strongest information assurance posture the winner of the exercise.

W. J. Schepens, D. W. Welch, and D. J. Ragsdale "A Lesson in Cyber Defence," *Defence Systems International: Critical Information Systems*, June 2002.

D. W. Welch, D. J. Ragsdale, and W. Schepens "Training for Information Assurance," *IEEE Computer*, 2002

Dismounted Warrior Palmtop Forward Observer System
LTC Buck Surdu

Sponsor: Program Manager, Effects and Fires Command and Control System

The purpose of this project is to construct a prototype Hand-held Terminal Unit (HTU) using off-the-shelf hardware and Open Systems software. Since no COTS hardware is available to act as an HTU, the focus of this project is on the software so that when hardware is available, the system can be quickly constructed. Objectives include:

- Identify the best open standards for software and hardware.
- Construct prototype hardware link between a COTS palmtop device and SINCGARS radio.
- Build a completely platform and architecture independent HTU replacement prototype.

Accepted: J. Surdu, K. Alford, G. Yu, W. Herrington, and C. Maranich. "Platform Independent Tactical Data Entry Devices" to *CrossTalk: The Journal of Defense Software Engineering*.

Presented: J. Surdu, K. Alford, F. Mabry, J. Rhyne, S. Patton, E. Hand, and F. Sperl, "XML Implementation of Variable Message Format in Army C4I Systems." *Software Technology Conference*, Salt Lake City, UT, 28 April - 2 May 2002.

Presented: E. Watson, Z. Miller, A. Peplinski, A. Adas, and J. Surdu, "A Wireless Data Entry Device for Forward Observers." *Software Technology Conference*, Salt Lake City, UT, 28 April - 2 May 2002. *Cadet Paper!*

Analysis and Classification of Multispectral Imagery
LTC Dan Ragsdale

Sponsor: US Army Topographic Engineering Center (TEC)

Compare the effectiveness of machine learning methods, geostatistical methods, and traditional human (parametric) methods in the extraction and classification of terrain features using various sources of data. Research objectives include:

- Select the best combinations of different bands from the hyperspectral image.
- Apply both a backpropagation neural network and competitive network using Learning Vector Quantization (LVQ) to evaluate classification
- Assess the impact of ancillary information, such as a digital elevation model.

Intrusion Detection and Response
LTC Curt Carver and LTC Dan Ragsdale

Sponsor: Information Assurance Directorate, Director of Information Systems for Command Control, Communications, and Computers (DISC4)

The purpose of this research is to investigate and apply intelligent methods and Agent-based approaches to provide adaptive intrusion detection and intrusion response. The objectives of this research are:

- Investigate data reduction methods to possibly find key variables in the data set.
- Apply and assess the accuracy of several types of neural networks regarding the classification of intrusive behavior.
- Develop appropriate metrics and tolerance levels associated with the operation of a given classification system.
- Assess the risk associated with malicious intrusive behavior versus the resources and time consumed by given classification systems

Trafficability Analysis

LTC Surdu

Sponsor: US Army Topographic Engineering Center

Design and implementation of a prototype system to determine military trafficability of terrain under a variety of weather conditions. The system must take into account weather, soil type, slope, vegetation, and cultural features, as well as other information

Research objectives include:

- Investigating the viability of a rule-based expert system for this prototype
- Determining the most effective method of displaying the resulting trafficability analysis.

Accepted: J. Sullivan, M. Rabkowski-Dudak, C. Gates, N. Colvin, and J. Surdu, "A Trafficability Analysis Engine Using Artificial Intelligence." *Software Technology Conference*, Salt Lake City, UT, 28 April - 2 May 2002. *Cadet Paper!*

Information Assurance Curriculum Development

LTC Daniel Ragsdale

Sponsor: National Science Foundation (NSF)

Our nation's economy and our military are becoming increasingly dependent on information systems. Assuring the confidentiality, integrity, and availability of these systems is a national

security issue. A significant effort is being expended to develop information assurance curriculum for use in undergraduate programs. Objectives include:

- Develop consistent IA curriculum criteria for all undergraduate universities to employ
- Share advances in IA education with other universities as well as industry by facilitating technology transfer
- Work with the NSA and other organizations to continue to expand cadet and faculty internships
- Ensure IA education is conducted employing a multi-disciplinary approach
- Identifying means for those universities resource bound to influence IA into existing curriculum

W. J. Schepens, D. W. Welch, and D. J. Ragsdale "A Lesson in Cyber Defence," *Defence Systems International: Critical Information Systems*, June 2002.

D. W. Welch, D. J. Ragsdale, and W. Schepens "Training for Information Assurance," *IEEE Computer*, 2002

D. W. Welch, M. S. Thibodeaux, D. J. Ragsdale, "A Framework for Due Diligence in Information Assurance Education," *Journal of Computer Education*, Jan. 2002

Land Warrior Network Simulation **LTC John Surdu and MAJ Fernando Maymi**

Sponsor: Program Manager, Soldier Systems

PM Soldier Systems has been developing the Land Warrior system of systems for the integration of infantry soldier combat capabilities into a war fighting system optimized for close combat. Once Land Warrior infantry squad and platoon soldiers are equipped with a variety of subsystems, the soldiers will need to be networked together to facilitate situational awareness and command and control. In this project, we are building a network simulation of the proposed system as a baseline. Once this is done, we will conduct experiments to determine the sensitivity of the system to interruption and degradation. In addition, we will be able to use this model to help determine whether new technologies, protocols, or organizations will have any effect on the overall system.

Accepted: F. Maymi, J. Surdu, A. Hall, R. Beltramini, "Modeling the Wireless Network Architecture of Land Warrior" to *Winter Simulation Conference*, San Diego, CA, 8-11 December 2002.

A. Hall, J. Surdu, F. Maymi, A. Deb., and K. Freberg. "Modeling the Communications Capabilities of the Infantry Soldier" to *Communication Networks And Distributed Systems Modeling And Simulation Conference (CNDS 2002)*, San Antonio, TX, 27-31 January 2002.

Information Assurance Vulnerability Alert (IAVA) Compliance
Mr. Schepens

Sponsor: National Security Agency (NSA)

The Information Assurance Vulnerability Alert (IAVA) program was instituted by the Department of Defense (DoD) in 1998 to provide positive control of vulnerability notifications and corresponding corrective actions within the DoD. In accordance with this program, whenever a critical vulnerability that poses an immediate threat to DoD is identified, an alert has been issued to major commands for dissemination. The alerts include corrective action to be taken to eliminate or mitigate the vulnerability. Because of the immediate threat associated with the vulnerabilities identified in IAVAs, compliance with the directed corrective action is of paramount concern to DoD leadership. An automated tool that checks for compliance would be especially useful for this purpose. This tool would be especially useful for local system administrators to check their own compliance.

The "Nessus" Project provides powerful, secure, and easy to use remote security scanning capability. It is already being used by organizations throughout the DoD and it is ideally suited for the construction of an IAVA compliance tool. The benefits of Nessus are that it is free, reliable, and has a modular architecture. As new vulnerabilities are identified, new "plugins" can be written to determine if the vulnerabilities exist on any of the system in a particular network. The research goals for this project are:

- Gain a thorough understanding of IAVA process
- Gain a thorough understanding the capability provided by the Nessus remote security scanning system.
- Develop simple and complex plugins using the Nessus Attack Scripting Language (NASL) to determine compliance with issued IAVAs.
- Identify any security vulnerabilities that the use of Nessus might introduce.
- Preparation of user documentation
- Preparation of a paper for submission to the National Conference on Undergraduate Research

Photonics Research Center Projects

The following Department of Electrical Engineering and Computer Science projects are described in the Photonics Research Center section:

Photonic Analog-to-Digital Conversion and Image Processing Using Neural Networks and Smart Pixel Technology

LTC(P) Barry L. Shoop, Ph.D., COL Eugene K. Ressler, Ph.D., Dr. Thomas D. Wagner, Dr. Jean R. S. Blair, LTC David A. Nash, Ph.D., MAJ(P) Robert W. Sadowski, Ph.D., COL Glen P. Dudevoir, Ph.D., COL Andre H. Sayles, Ph.D., Dr. Wenli Huang, LTC George Nowak, Ph.D.,
Dr. Pankaj K. Das, University of California at San Diego, La Jolla, California
Dr. Joseph N. Mait, Dr. George Simonis, U.S. Army Research Laboratory, Adelphi, MD
Sponsors: U.S. Army Research Office and Defense Advanced Research Projects Agency

Photonic Analog-to-Digital Conversion Using Spatial Oversampling and Spectral Noise Shaping

LTC(P) Barry L. Shoop, Ph.D., COL Eugene K. Ressler, Ph.D., MAJ(P) Robert W. Sadowski, Ph.D., COL Glen P. Dudevoir, Ph.D., COL Andre H. Sayles, Ph.D., LTC George Nowak, Ph.D.,
Dr. Pankaj K. Das, University of California at San Diego, La Jolla, California
Sponsor: Defense Advanced Research Projects Agency and Army Research Office

Mixed Signal Applications of Smart Pixel Technology

MAJ(P) Robert W. Sadowski, LTC(P) Barry L. Shoop, COL Glen P. Dudevoir, COL Andre H. Sayles, LTC Brian Gollsneider and Dr. Wenli Huang
Dr. Pankaj K. Das, University of California at San Diego, La Jolla, California
Dr. George Simonis, US Army Research Laboratory
Dr. Daniel M. Litynski, University of Western Michigan
Sponsor: Defense Advanced Research Projects Agency and Army Research Office

Extensions of the Error Diffusion Neural Network: Partitioning and Multigrid

LTC David A. Nash, COL Eugene K. Ressler, Dr. Jean R. S. Blair
LTC(P) Barry L. Shoop, Dr. Thomas D. Wagner
Dr. Pankaj K. Das, University of California at San Diego, La Jolla, California
Sponsor: Defense Advanced Research Projects Agency and Army Research Office

Biologically Motivated Analog-to-Digital Conversion

COL Eugene K. Ressler and LTC(P) Barry L. Shoop, Dr. Jean R. S. Blair
Dr. Pankaj K. Das, University of California at San Diego, La Jolla, California
Sponsor: Defense Advanced Research Projects Agency and Army Research Office

Army Transformation: The Educational Imperative

LTC(P) Barry L. Shoop
Sponsor: Army Research Office (ARO)

The Uniformed Army Scientist and Engineer (UAS&E)

LTC(P) Barry L. Shoop
Sponsor: Army Material Command (AMC) and Army Research Office (ARO)

Additional Department Research Papers

B. Goda, J. McDonald, R. Kraft : 'SiGe HBT BiCMOS FPGAs,' FPGA 2001 Proceedings, August 11-13, 2001, Dublin Ireland. pp. 59-69.

W. Huang, M. Xu, F. Jain, "1.55 μ m InGaAs-InP Quantum Wire Optical Modulators: Optimization of Wire Width to Maximize Absorption and Index of Refraction Changes due to Excitonic Transitions," International Journal of Infrared and Millimeter Waves, Vol. 22, July 2001.

W. Huang and F. Jain, "Integrated InGaAs-InP Quantum Wire Lasers and Stark Effect Modulators for 1.55 μ m Applications," in proceedings of SPIE's Photonics West Conference, San Jose Convention Center, San Jose, California 19-25 January, 2002.

C. Phillips, S. Demurjian, T.C. Ting, "Security Engineering for Roles and Resources in a Distributed Environment", in Proc. of the 3rd Annual Information Systems Security Engineering Conference, Orlando, March 2002.

C. Phillips, T.C. Ting, S. Demurjian, "Information Sharing in Dynamic Coalitions", in Proc. of the 7th ACM Symposium on Access Control Models and Technologies (SACMAT 2002), Monterey, CA, June 2002.

C. Phillips, S. Demurjian, T.C. Ting, "Toward Information Assurance in Dynamic Coalitions", in Proc. of the 3rd IEEE Information Assurance Workshop, USMA, West Point, NY, June 2002.

Conference Presentations

K. Alford, G. Conti, D. Cushen, E. Ressler, W. Turmel and D. Welch; "A Two Edged Sword: Computing at West Point;" Making History: West Point at 200 Years Conference; March 2002.

C. Carver, J. Surdu, J. Hill, D. Ragsdale, S. Lathrop, T. Presby, "Military Academy Attack/Defense Network," 3rd Annual IEEE Information Assurance Workshop, West Point, NY, 17-19 June 2002.

K Huggins, T. Flowers, J. Hill, and J. Surdu, "Conceptual Level Anticipatory Planning," *Advanced Simulation Technology Conference*, San Diego, CA, 14-18 April 2002, pp. 87-92.

C. K. Ray, "IT Curriculum Evolution at USMA," Joint Service Academy Computing Conference, March 2002, US Military Academy.

J. Surdu and J.M.D. Hill. "Simulations in Commands Posts of the Future" to *Advanced Simulation Technology Conference*, San Diego, CA, 14-18 April 2002, pp. 77-86.

J. Surdu and G. Conti; "Join the Cyber Corps;" IEEE Information Assurance Workshop; Poster Session; June 2002.

Cadet papers at the National Conference on Undergraduate Research, University of Wisconsin Whitewater, 25-27 April 2002.

1. "Palmtop Computer Assisted Wargaming," Gabriel Wolfe, Jeston Morris, Abraham Skellenger, and Daniel Todd, Faculty Advisor: Surdu
2. "Land Warrior Network Simulation," Nicholas Clark and Simon Kim, Faculty Advisor: Surdu
3. "Wireless Data Entry Device for Forward Observers," Zachariah Miller, Erica Watson, Allen Peplinski, and Alison Adas, Faculty Advisor: Surdu
4. "Using Wireless PDA's for Inventory Management," David Gowel, Jonathon Kalaher, Robert Schneider, and Jacob White, Faculty Advisor: Huggins
5. "Cadet Calendar Program," James Garnett and Betty Simbert, Faculty Advisor: Surdu
6. "NESSUS: A Security Threat Analysis of one Automated Security Tool," Niel Lofland, Faculty Advisor: Ragsdale
7. "A Trafficability Analysis Engine Using Artificial Intelligence," Jeff Sullivan, Marek Rudak, Christopher Gates, and Nathan Colvin, Faculty Advisor: Surdu
8. "Study in Forensic Email Recovery and Normalization," Julie Dixon, Alexis Marks, Ryan Renken, Lukasz Slominski, and Erin Springsteen, Faculty Advisor: Lathrop
9. "Securing Personal Digital Assistants and Sensitive Information in a Military Environment," Jerrod Fussnecker and William Wright, Faculty Advisor: Lathrop
10. "Gate Guard Security Identification System," Joseph Sequin, Kurt Reyes, and Joseph Quinn, Faculty Advisor: Surdu