Seniors Design Communication Interoperability System

ECE 492 Senior Project Team after a successful project demonstration.

T he difficulty of intercommunication among first responders has been brought into the public eye by tragedies such as the terrorist attacks on the World Trade Center and the Pentagon and disaster response efforts such as those following Hurricane Katrina. Law enforcement, fire departments, emergency medical services, and other groups and agencies often need to communicate with each other in emergencies and in daily operations. The communication devices these agencies use are not normally compatible with other agencies' equipment because the devices use different technologies and operate at different frequencies.

Thirteen senior electronic and computer engineering students designed, built, and tested a prototype system that provides communication interoperability between at least eight voice communication technologies. The students were given a statement of work, a set of system require-ments, and a fixed budget at the beginning of the spring semester. During the semester, the students managed themselves, developed the system architecture, designed eight custom printed circuit boards, wrote system software, and integrated their custom hardware and software with several purchased items into a working prototype system that met all system requirements. Formal design reviews were conducted periodically using outside reviewers from industry. The course was taught by **Bill Jemison** and **Jeff Gum**.

The system supports wireless and wire line communication technologies such as UHF and VHF radio, voice over Internet protocol (VoIP), and cellular telephony. The system digitizes baseband analog audio and routes the audio via a field-programmable gate array. The system is configurable via a graphical user interface written in Java to support up to four user-defined talk groups with a two-level priority scheme. It is enclosed in a standard 19-inch equipment rack and includes battery backup and fault localization and error reporting to the line replaceable unit level. ∎

Lafayette Engineering Hosts Northeast Bioengineering Conference

T he 32nd Northeast Bioengineering Conference was held on the Lafayette campus on April 1 and 2. The conference was organized by four faculty members in the engineering division: **Javad Tavakoli** of chemical engineering, **Ismail Jouny** and **Yih-Choung Yu** of electrical and computer engineering, and **Erol Ulucakli** of mechanical engineering. More than 150 people from academia and the biomedical industry visited Lafayette to participate in the event. Activities during the one-and-a-half-day conference included speeches, paper presentations in podium and poster formats, and student paper contests.

Three internationally recognized experts were invited to give keynote speeches related to the conference theme, artificial organs. Mohamad Sawan, a professor at Ecole Polytechnique de Montréal, Canada, and the Canadian Research Chair in Smart Medical Devices, addressed vari-ous methods that can be used to design reliable microsystems dedicated to build smart medical devices such as sensors and microstimulateurs in his speech "The Pursuit of Sight Restoration for the Blind by Intracortical Microstimulation." Deger Tunc, retired global senior research manager of Stryker Orthopaedics, discussed bioabsorbable PLLA cages for lumbar interbody fusion. The presentation demonstrated his suc-cessful experience of developing bioabsorbable polymers in orthopedic research. James Antaki, a bioengineer from Carnegie Mellon University, shared the history, challenges, and recent accomplishments in the field of ventricular assist device design. He also demonstrated how modern engineering techniques could be employed to develop the next-generation heart-assist devices.

One hundred nine technical papers were presented in 12 podium sessions and two poster sessions. The papers provided a broad spectrum of employing various engineering disciplines in bioengineering and biotechnology applications. The conference also included a competition for students who presented papers. The competition's four categories were based on the participants' levels (graduate and undergraduate) and the presentation formats (podium and poster). Three winners were selected from each category, judged by experts in the related fields from both industry and academia. ∎

Mission:

Our mission is to be one of the nation's premier undergraduate ECE departments. We are dedicated to providing students a thorough technical preparation, the continuous development of professional awareness, and a heightened sense of social responsibility.

This mission statement leads to three major goals:

(1) to bring together students of high ability and a faculty composed of teacher-scholars in the major fields of electrical and computer engineering for the purpose of learning through study, inquiry, discourse, and discovery—our people.

(2) to maintain a continuous evolution of curriculum, pedagogical practices, and resources to educate students in the guiding principles of the engineering profession and the best practices in both electrical and computer engineering—our program.

(3) to create an interactive environment between students and faculty which fosters a dedication to learning and an appreciation of both the history and future of the discipline—our learning environment.

OBJECTIVES
Graduates will have the ability to:
- educate themselves continually;
- adapt to changing job assignments/challenges;
- function in a team and provide leadership;
- apply their engineering education in solving a broad range of problems;
- be involved in professional/public/community service;
- excel in their chosen area of professional activity;
- communicate in a mature and effective manner, and
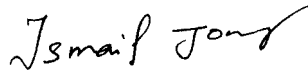- appreciate business enterprise, technology management, and social and legal issues.

PROGRAM OUTCOMES
Upon graduation, students will:
- value life-long learning and understand contemporary issues;
- function in a multidisciplinary team;
- analyze data and communicate results;
- solve broad-based engineering problems in a socially conscious and ethical manner;
- be able to design, simulate, build, and test both complex analog and digital circuits;
- use mathematical technique and science knowledge to model and analyze communication and control systems;
- use modern engineering hardware and software tools;
- be able to formulate an engineering problem and solve it by creating, debugging, and testing a team-based solution;
- understand microscopic material properties and how they are used to develop modern electronic devices.

From the Department Head

I am pleased to have the opportunity to share with colleagues, alums, friends, and future Lafayette students the fourth edition of this newsletter. The 2005-06 academic year has been a banner year for electrical and computer engineering, with six successful honors theses and an impressive and fully functional senior design project that amazed not only our colleagues in the engineering division but also our security and safety officers, who saw the value of intercommunications using multiplatform devices. Briefly said, our seniors demonstrated how first responders using various wireless systems, telephone, cellular systems, voice over IP, and other technologies can communicate with one another in an emergency. The system is functional, demonstrable, and will be presented at a national meeting on telecommunications. I am extremely proud of our students and their accomplishments, and I wish them continued success and perseverance.

Ismail Jouny

Ismail I. Jouny
Charles A. Dana Professor of Electrical and Computer Engineering

Lodato '06 Explores Ways to Fight Computer Hackers

Mark Lodato '06 knows that breaking codes isn't just for hacking into computers; it's also for protecting them.

Under the guidance of **Ismail Jouny**, Dana Professor and head of electrical and computer engineering, Lodato explored the vulnerabilities in computer server codes for his honors thesis to improve security against hackers.

Lodato won the Delaware Valley Engineers Week Council Student Paper Contest in the junior/senior category for work on his thesis. The goal of his work is to explore ways to undermine the security of different networks without physically breaking in.

He used a "timing attack" that was published in a journal a few years ago to find holes in certain networks and fix them in a proactive approach.

"When you go to a web site that begins with https:// and you see a padlock icon, your computer is protecting your data through SSL [Secure Sockets Layer]," Lodato says. "SSL uses RSA [a public-key encryption technology developed by RSA Data Security, Inc.], which in turn uses a secret piece of information, or a key, that only the server knows." He studied attacks on RSA that would compromise SSL in some cases, specifically, when the attacker "makes a series of timing measurements and uses them to deduce the server's secret key."

Lodato says that most secure sites are protected from the timing attack he used. For research purposes however, he used it against a server that didn't have the protection to see how long it took to determine the RSA key that would allow him to compromise the security.

"For one of the experiments I used a server that was in the same room as the computer I was using," he says. "I was able to attain the code rather quickly. It took longer for a server that was housed in another building."

Mark is working for the Department of Defense. ■

Seniors Present Research at National Conferences

Five senior electrical and computer engineering majors presented their research at national conferences this year; they also published their papers in their respective conference proceedings.

Mark Lodato '06 published and presented his paper "A Practical Timing Attack on RSA Over a LAN" at the SPIE Defense & Security Symposium April 18-20 in Orlando, Fla. For his honors thesis, he explored the vulnerabilities in computer server codes to improve security against hackers. Mark's paper won the Delaware Valley Engineers Week Council Student Paper Contest in the junior/senior category for work on his thesis. Mark also placed third at the IEEE Region 2 contest held at Drexel University.

John Kolba '06 presented his paper "Analysis of Subbanding Techniques in Blind Source Separation" at the SPIE Defense & Security Symposium. In his senior honors thesis, Kolba worked with a set of signal processing techniques called blind source separation to determine which method is most effective at finding sources of mixed signals. He also published and presented "Blind Source Separation in Tumor Detection in Mammograms" at the 32nd annual Northeast Bioengineering Conference April 1-2 hosted by Lafayette.

Josh Porter '06 presented his paper "Pressure Flow Modeling of a Rotary Ventricular Assist Device" at the Northeast Bioengineering Conference, where he won first place for undergraduate student oral presentation. His EXCEL Scholars research dealt with rotary heart assist devices. Porter was also scheduled to present "Mathematical Modeling of a Ventricular Suction Induced by a Rotary Ventricular Assist Device" at the 2006 American Control Conference in Minneapolis. Josh won first place at the IEEE

Josh Porter '06 is helping design a mock circulatory system as an EXCEL scholar with Yih-Choung Yu.

Morton Student contest held at the University of Scranton.

Also at the Northeast Bioengineering Conference, **Simon Mushi '06** presented his paper "Evaluation of a Simple Cardiovascular Model with Short-Term Baroreflex," winning first place for undergraduate student poster presentation. Mushi also was scheduled to present at the American Control Conference. Simon placed first at the IEEE Region 2 paper contest held at Drexel University.

JoAnna Vetreno '06 presented her paper "Nonlinear Time Domain Model of a Phase-Locked Loop for Phase Noise Prediction" at the 20th annual National Conference on Undergraduate Research April 6-8. She also presented "Time Domain Noise Modeling to Predict Phase-Locked Loop Performance" at the 16th annual MPRG/Virginia Tech Symposium on Wireless Personal Communications June 7-9 in Blacksburg, Va. Vetreno researched phase noise in advanced electronics. ∎

Loh '04 Awarded Tau Beta Pi Fellowship

Matthew **Loh '04** of Singapore, an Electrical & Computer Engineering graduate, has been awarded a graduate fellowship from Tau Beta Pi, the national engineering honor society, for the 2006-07 academic year. Loh will enter Columbia University this coming fall to pursue a M.S./Ph.D. in electrical engineering. Tau Beta Pi Fellowships are awarded on the basis of high scholarship, campus leadership and service, and promise of future contributions to the engineering profession.

Loh is currently serving in the Singapore Army, fulfilling his National Service obligation. He looks forward to returning to the United

States where he has been accepted at many prestigious graduate schools.

During his time at Lafayette, Loh participated in the EXCEL Scholars program and was awarded the Finley W. and Ethelwyne H. Smith Electronic Engineering Prize. He was president of the Pennsylvania Epsilon chapter of Tau Beta Pi, and a member of the student chapter of the Institute of Electrical and Electronics Engineers, the Pi Mu Epsilon honor society, College Choir, Madrigal Singers, Lafayette Christian Fellowship, History Club, International Students Association, and the Dry Surfers, a living group of students with an interest in technology and substance-free living. ∎

Electrical and Computer Engineering
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Kolba '06 Studies Signal Processing Techniques

The work **John Kolba '06** conducted for his senior honors thesis could some day be used to perfect hearing aid technology or help the U.S. government improve radar transmissions.

Kolba worked with a set of signal processing techniques called blind source separation (BSS) to determine which method is most effective at finding sources of mixed signals. **Ismail Jouny**, Dana Professor and head of electrical and computer engineering, was his thesis adviser.

"BSS is a way of taking data from several sources with a series of sensors and processing it to find out what information came from what source," Kolba explains. "In the case of audio, different speakers comprise the different sources, and the BSS processing determines which sounds came from each speaker."

His research included comparing full band BSS, subband BSS, and wavelet-based subband BSS. In full band BSS, Kolba processed the signal all at once. For standard subbanding, he split the signal into equal pieces of the frequency spectrum, performed BSS on each piece, and added the results. With wavelet-based subbanding, he split the signal into smaller and smaller pieces and added those results together.

"With this process, I am hoping to find which one of the methods is more effective so we'll be able to process the different signals more efficiently," he says. "That could have applications in the science of hearing aids and also in eavesdropping techniques along the lines of espionage."

Later in the year, Kolba used BSS on images. "An image is thought of as a two-dimensional object, but in the process of rearranging the signals, you turn the image into a long, one-dimensional object, reprocess it through the separation techniques, and then recombine the image into

John Kolba '06 is researching blind source separation under the direction of Ismail Jouny.

two dimensions," he explains. Understanding signal sources in a video image is a helpful defense tool.

John is pursuing graduate studies at Duke University. ■

Class of 2006

- **Student-focused teaching and mentoring by an exceptionally qualified faculty, committed to each student's success.**

- **A challenging, broad-based academic curriculum that offers strong programs in the liberal arts, sciences, and engineering.**

- **A small college environment with large college resources.**

- **A friendly residential community offering an exciting social life with a broad spectrum of extracurricular activities.**

Electrical and computer engineering graduates in the Class of 2006 have found jobs with the following employers: Department of Defense, Johnson & Johnson, IBM Business Consulting, Lockheed Martin, Goldman Sachs & Co., ViaSat Comsat Labs, PPL, Viecore, and CSC Consulting.

Five students are attending the following graduate schools: John Hopkins University, Princeton University, North Carolina State University, Duke University, and University of Virginia. ■

"Lafayette is classified as one of the nation's most academically competitive colleges and is committed to providing the best possible undergraduate education in the liberal arts, sciences, and engineering for men and women who can benefit from the Lafayette Experience." —*Peterson's Four-Year Colleges*
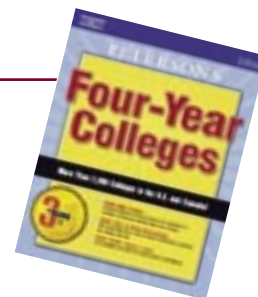
To keep up to date on department news, visit the home page on the College's web site (www.lafayette.edu). Choose "academics," then "departments and majors," then "electrical and computer engineering."