



DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING



Fall 2006

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From the Chair

This past year has been a particularly significant year for the ECE Department. It is highlighted by the ABET (Accreditation Board for Engineering and Technology) accreditation visit, hiring new faculty, exciting research, and recognition of achievements by both students and faculty.

We began this year with the ABET accreditation visit which was very successful. The department received accreditation for both our Electrical Engineering and Computer Engineering programs. The ABET visitors praised, in particular our excellent lab base programs, the senior design element, the Nerd Girls projects as well as the dedication of the faculty to the students' education. The

department continues to nurture and enhance the undergraduate experience for our students. At the same time, we are placing increased emphasis on the research program for both undergraduate and graduate students. Highlights of some of these efforts are presented throughout this newsletter.

We are particularly excited with the addition of two new senior faculty members, Dr. Jeff Hopwood and Dr. Eric Miller who come to Tufts with distinguished research careers and outstanding records of quality teaching. Please see the articles on Jeff and Eric which follow. In addition to contributing to the undergraduate program, Jeff will expand our graduate pro-



Professor Joe Noonan

gram in microelectronics while Eric concentrates on digital signal and image processing. The department's graduate efforts will be concentrated on microelectronics, communications and signal processing with particular emphasis on interdisciplinary work in such fields as biomedical engineering and medical research. Jeff and Eric directly support these objectives.

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Nerd Girls Team at Thacher Island

The Nerd Girls Team Hits the Islands!

On July 8, 2006, Dr. Karen Panetta and Electrical and Computer engineering students from the Nerd Girls team spent the day on Thacher Island, off the coast of Rockport, MA, installing a solar beacon for the North Tower. Thacher Island is a historic landmark and is the last operating twin lighthouse in the U.S. The students have spent over a year designing this renewable energy system and working with the Thacher Island Association to bring the "Twin Lights" back to life.

At approximately 8:40 PM that evening, the North Tower light, which was dark for over a year, came to life when the system came on-line.

ECE students Valery Thompson, Sumi Nadkarni, RaeAnne Dietz, Marianne Stark, and Mechanical Engineering student Joanne Rucker installed the new solar energy system. Tufts Alumni and team consultants, Matthew Heller and Allison Bedwinek

(Continued on page 7)

Congratulations to our graduate students who recently completed their Ph.D. dissertations, M.S. theses, and M.S. projects in 2006!

Ph.D. Dissertation

Brian Gregory Swahn Advisor: Soha Hassoun
"FinFETs: Thermal Modeling, Analysis, and Circuit Design"

M.S. Theses

Adil Bahadoor Advisor: Mohammed Afsar
"Frequency Spectra for the Complex Permittivity and Permeability of Magnetic Powders and U-type Ferrites"

Mi Lin Advisor: Mohammed Afsar
"Microwave Cavity Perturbation Measurements of Complex Dielectric Permittivity and Complex Magnetic Permeability"

M.S. Projects

Samer Ashkouri Advisor: Chornng Hwa Chang
"DEAF alert System(P.A.S)"

Adil Bahadoor Advisor: Mohammed Afsar
"Frequency Spectra for the Complex Permittivity and Permeability of Magnetic Powders and U-type Ferrites"

Christopher Bowen Advisor: Joseph Noonan
"Edge Detection Using the Parametric Slant-Hadamard and Parametric Slantlet Wavelet Transforms and How Each Compares To Standard Techniques"

Lindsey Brock Advisor: Joseph Noonan
"2-D Peak Detection Algorithm"

Nathan Brown Advisor: Joseph Noonan
"Image Restoration through Iterative Deconvolution"

Kurt Bruch Advisor: Denis Fermental
"Brushless DC Motor Communication Techniques and Analysis"

Dr. Jeffrey A. Hopwood Joins the ECE Faculty

Dr. Jeff Hopwood is joining the Tufts ECE faculty this year and will lead the department's research and educational goals in the area of microelectronics. His research in plasma applications provides a unique educational opportunity for Tufts students.



Plasma, the fourth state of matter, is used to produce most of the world's artificial light and is critical to manufacturing microelectronic chips. Jeff Hopwood began research in plasma physics and plasma applications at Michigan State University, where he received a Ph.D. in Electrical Engineering in 1990. After a post-doctoral appointment at IBM's T. J. Watson Research Center, he joined Northeastern University in 1993. As a strong proponent of combining research and teaching, he was awarded the NSF CAREER Award in 1997, along with the inaugural teaching award from the College of Engineering (1997), and the Northeastern University Excellence in Teaching Award (2000). He

was named a Distinguished Research Fellow in 2004 and promoted to the rank of Professor in 2006. In addition to investigating novel approaches for producing microelectronics, he is a leader in the area of microplasmas, which are most commonly used in plasma televisions. Professor Hopwood joins the ECE Department at Tufts University in 2006. In the future, he plans to exploit the unique properties of plasma to solve problems in microelectronics, biocompatible surface modification, environmental sensors, and sustainable energy.



Halligan Hall, home of the ECE Department

Lincoln Laboratory Internship Program

The ECE Department initiated an internship program for students at Lincoln Laboratories. Through this program selected students perform their senior design projects during the summer after the junior year and the fall of their senior year. This past year four students; Torre Bydlon, Raymond Chang, Judson Porter, and Nevin McConnell were involved in this program and their projects concerned radar detection and tracking algorithms.

Lincoln Laboratories was very pleased with the results and the students. The program is continuing this next year and Kyle Bradbury, Jason Jong, and Stephanie Mayer are the students selected to participate.

Dr. Eric Miller Joins ECE Department

Eric Miller comes to Tufts ECE Department having developed a cross-disciplinary research program aimed at tackling problems of image formation and signal processing in areas ranging from cancer screening using diffusive optical sensing to unexploded ordnance remediation and landmine using electromagnetic induction and ground penetrating radar technologies. Dr. Miller received the SB, SM, and PhD in Electrical Engineering and Computer Science from MIT in 1990, 1992, and 1994 respectively. Since 1994, he has been on the faculty of the Electrical and Computer Engineering Department at Northeastern University where he was promoted to the rank of Professor in July 2006. Dr. Miller was the recipient of a National Science Foundation CAREER award in 1996 and the Northeastern College of Engineering Excellence in Research Award in 2002. While at MIT he was elected to the Tau Beta Pi, Phi Beta Kappa

and Eta Kappa Nu honor societies. Dr. Miller has served as an Associate

Editor for the **IEEE Transactions on Image Processing** from 1998-2002 and is currently in that same role at the **IEEE Transactions on Geoscience and Remote Sensing**. Prof. Miller will be joining the Electrical and Computer Engineering Department at Tufts starting in 2007. He is looking forward to the many collaborative opportunities at Tufts to continue and expand his research in physics-based image formation and inverse problems especially in the medical and environmental application areas.



Electrical Engineering Graduate School Alumni Michael Tzannes Receives Outstanding Career Achievement Award

Each year, the Graduate School of Arts and Sciences (GSAS) and the School of Engineering bestows a graduate alumni award for Outstanding Career Achievement. The Outstanding Career Achievement Award is given to a Tufts Graduate School of Arts and Sciences or School of Engineering graduate alumnus/a who has, with the help of his/her Tufts graduate education, excelled in his/her career of choice. In 2005, Electrical engineering alumnus Michael Tzannes, G'90, received the Outstanding Career Achievement Award for his work as the CEO of Aware, a worldwide leader in the development and marketing of intellectual property

for broadband communications. Headquartered in Bedford, Massachusetts, Aware powers over 20 million chipsets in operation around the world. When asked what current engineering undergraduate and graduate students could learn from the professional achievements of Michael Tzannes, his former adviser and current electrical and computer engineering chair professor Joseph Noonan said, "There is of course some luck involved, but having strong skills and a willingness to take chances like Michael has is generally critical for success."

Congratulations to our graduate students who recently completed their Ph.D. dissertations, M.S. theses, and M.S. projects in 2006!

M.S. Projects

- | | |
|--|--------------------------|
| James Caccese
"Data & Acquisition Systems Using a Motorola HC12 Processor" | Advisor: Karen Panetta |
| Laura Grout
"Battery System Characterization and Design for the Nerd Girls Solar Car" | Advisor: Karen Panetta |
| Brett Ingersoll
"FR Circuit Design" | Advisor: Mohammed Afsar |
| Mathew Magpayo
"Range-Free Sensor Localization Simulations with ROCRSSI-based Algorithms" | Advisor: Chong Hwa Chang |
| Gregory McCloskey
"Design and Simulation of Patch Antennas based Sierpinski Carpet Geometries" | Advisor: Paul McCormack |
| David Ries
"Coding of Iterative Signal Retoration Algorithms" | Advisor: Joseph Noonan |
| Zachary Rimkunas
"Cancellation of Acoustic Noise Using the LMS Algorithm" | Advisor: Douglas Preis |
| Adam Rowell
"Detecting and Classifying Interictal Epileptic EEG Spikes using Wavelets" | Advisor: Joseph Noonan |
| Robert Wangai
"DEAF Alert System (P.A.S)" | Advisor: Chong Hwa Chang |
| John Wilkinson
"A Real Time Implementation of a Minimum Relative Entropy spectrum Enhancement Technique" | Advisor: Joseph Noonan |
| Adam Wilson
"Levitation of a Steel Ball Bearing Using an Electromagnetic Coil and a Feedback Control System" | Advisor: Denis Fermental |

("From the Chair..." Continued from page 1)

Additionally, during this past year the faculty and students of the ECE dept have received a number of awards and recognitions. The ECE department would like to congratulate Dr. Karen Panetta for her appointment as the IEEE Women in Engineering Director for 2007 and being elected to the Executive board of the IEEE Boston Section. A number of other awards and recognition are also noted in this newsletter. This is, indeed, an exciting time for the members of the ECE Department and the faculty pledges to continue to strive for excellence in teaching and research. I hope you will enjoy reading this newsletter, which serves to bring you up to date on the department. Please do not hesitate to contact me with any questions or comments on the Department.

DEPARTMENT RESEARCH

Afsar's Labs Decipher Properties of Materials at High Frequencies

The High Frequency Materials Measurement and Information Center (HFMMIC) at Tufts University's Electrical and Computer Engineering Department enters its 19th year of excellence with a very exciting future. An active team of professors, doctors, graduate and undergraduate students contribute over 20 conference and journal publications annually to the scientific community making the group one of the most active research teams in the university.



Professor Mohammed Afsar

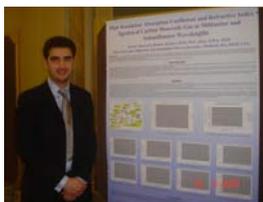
The HFMMIC specializes in obtaining dielectric and magnetic properties of gaseous, liquid, solid, and powder materials at high frequencies. The center is home to some of the most advanced and precise equipment in the world. Over 20 different techniques and instruments provide data for almost all types of samples from 2 GHz to 20,000 GHz. A sample preparation facility has just been added to the center.

Recently, the HFMMIC team has been focusing on interdisciplinary research through joint ventures with several departments and organizations. High frequency breast tissue examinations performed in collaboration with the New England Medical Center have yielded positive results for potential cancer detection applications. An environmental study has been completed analyzing the rotational transition lines of pollutant gases such as Carbon Monoxide at different pressures and has provided insight into the behavior of pollutant gases. Most importantly this work, published in the August 2006 issue of IEEE Transactions on Instrumentation and Measurement, shows that varying the pressure of a pollutant gas only effects its relative spectral amplitude. Another accomplishment was

the development of a magneto-optical approach to separate the dielectric and magnetic effects in ferrites while simultaneously determining the complex permittivity and permeability of materials at the millimeter wave range. A broadband millimeter wave investigation in diluted and non-diluted barium and strontium ferrites successfully demonstrated the correlation between ferromagnetic resonance, specific gravity, and the electromagnetic properties.

The HFMMIC team spent much of the last academic year working on several projects supported by the Department of Homeland Security and US Army to enhance our nation's security. The team successfully proposed and developed a method to identify and detect biological and chemical hazards at personnel checkpoints and in postal mail.

The extensive research conducted by group members (Professor and Advisor: Mohammad Afsar; Research Associates: Mahmut Obol, Konstantin Korolev; Graduate Students: Nawaf AlMoayed, Shu Chen, Usman Khan, Mi Lin, Lakshmi Subraminian; Undergraduate Students: Nicholas Nguyen, Joshua Kupersmidt, Megan Duane, David Guen, Derrick Hwu, Lora Lingrey, Sean McCooey, Kim Nguyen, Baris Piyade, Dino Sijamic) was published and presented in several international conferences and journals such as the European



Graduate Student Nawaf AlMoayed

Microwave Conference, Infrared and Terahertz Conference, International Magnetics Conference, Annual American Physical Society Meeting, International Microwave Symposium, IEEE Transactions on Microwave Theory and Techniques, Magnetics, Instrumentation and Measurement, Journal of Applied Physics, and Microwave and Optical Let-

ters.

More information on our lab and a full list of publications can be found at

www.eecs.tufts.edu/mm-smm/



Undergraduate Students Nicholas Nguyen and Sean McCooey Working in the Lab

Students Advance in Design Competition

A student design team from Tufts Nanoscale Circuits and Systems Lab led by Dr. Sameer

Sonkusale was one of five from around the country selected to continue in the second phase of an engineering design competition organized by the Semiconductor Research Corp. and the semicon-



ductor Industry Association. The contest focuses on integrated circuit System-on-a-Chip (SoC) design, a process by which one integrated circuit becomes a complete hardware and software system. This exercise "challenges engineering students across the country to create innovative designs while working on all aspects of the extremely complex chip and design and manufacturing process," said Larry Sumney, president and chief executive officer of Semiconductor Research Corp. of North Carolina. "The winning teams, selected by industry judges, have demonstrated the capability to meet and overcome the most difficult aspects of today's SoC design environment." Tufts was one of the five teams in the second phase of the competition.

DEPARTMENT RESEARCH

Professor Noonan's Epilepsy Research Continues



ECE Chair, Professor Joe Noonan, has thirty-five years experience in the areas of digital signal processing, probabilistic modeling, and statistical communication theory.

His general research activities concern optimal detection and estimation of signals in noise. Specific applications include channel modeling, spectral and image estimation, time varying systems and medical applications. The three major programs his team of students are currently investigating are Epilepsy prediction, wireless channel modeling, and improved images for low resolution CCD applications.

First, with regards to Epilepsy research, we have substantially improved the ability to predict seizure paths which cannot be detected by visual examination of the Electroencephalogram (EEG) data. We have also developed an algorithm to identify and classify two difficult epileptic EEG spikes, Rolandic and generalized, with much greater accuracy than existing techniques. These results have been submitted for Journal publication and have been presented at three neurological conferences. This

work looks very promising for aiding in the treatment of epilepsy.

In a second effort, on a project supported by BAE Systems, we have developed a new technique for channel estimation to improve space-time diversity coding. Finally, with the recent prevalence of low resolution CCDs such as those found in cell phones, we are developing an algorithm using information theory, to be applied to low resolution text images to yield improved quality by post processing of the data.

Learn more about ECE research at:
<http://www.ece.tufts.edu/research/>

Professor Chang Develops Wireless Networks for Home Healthcare

This has been a busy year for Prof. C. Hwa Chang. He chaired the senior faculty search committee for the year of 2005-2006, with Dr. Hopmood and Dr. Miller chosen from more than 100 applications.

Prof. Chang's research group, with Zhong Zou and Na Wang leading the effort, established a wireless sensor network infrastructure in which users are able to



Professor Hwa Chang

login to the network to do their experiments. The research group expects to eventually add more sensors to the network. Of special note; Jason Waterman's submission,

entitled "Real-Time Traffic Monitor and Reporting," has been selected as one of the two Bronze (Third) prize winners of the 2006 International Open Source Embedded Software Competition (IOSESC 2006).

This summer Professor Chang secured a donation of 15 development kits from Alterna for digital system design lab. The students in digital system design can now learn both Xilinx and Alterna FPGA (Field Programmable Date Array) including both software and hardware. Xilinx and ALtera are two leading designers and manufacturers of PLD (Programmable Logic Devices).

Professor Chang is developing a new course on "Wireless Home for Healthcare". Baby boomers, those who were born between 1946 and 1964, are expected to live longer than any generation before them. There are about 78.2 million of them which is

roughly a quarter of the US population [<http://www.semissourian.com/story/1151661.html>]. They will need a lot of medical care resources in the near future. In order to provide affordable and comfortable healthcare, projects like Digital Home [<http://www.intel.com/research>] will be an important part of our medical care system. In this project, homes are equipped with wireless sensor networks and wireless and wired communication devices, to reduce costs and provided better care to the elderly. With the help of Jason Waterman, Zhong Zou (both Master candidates), and a medical doctor from MGH (Massachusetts General Hospital), Professor Chang wrote a proposal on "Wireless Networks for Home Healthcare Applications" to NSF (National Science Foundation). He will be developing an undergraduate course for this subject. More equipment will be purchased for students to set up a home healthcare environment and learn the related technology and home healthcare issues.

New Multi-disciplinary Research in Biomimetic Robots

Prof. Joyner has recently begun a new multidisciplinary research collaboration with faculty in Biomedical Engineering, Biology, Mechanical Engineering, and Electrical&Computer Engineering to investigate the science and engineering of a new class of soft-bodied biomimetic robots, incorporating biomaterials, neuromechanical controllers, and evolutionary concepts. Professor Joyner is leading research efforts to develop ultra low-power, analog and mixed-signal integrated circuits for embedded control and designing an optical wireless communications infrastructure for navigation and data transfer in a distributed robotic sensor network. Through funding

provided by the Biomedical Research Experiences for Engineering Majors (BREEM) summer internship program at Tufts University, Prof. Joyner is currently co-advising an undergraduate student and developing a low-power control system to drive a prototype robot. This study highlights the biomimetic design considerations of a soft bodied robot relative to the emulation of *Manduca Sexta* motor control. The replication of *Manduca* kinematics within a robot would allow for a maximal degree of freedom in confined spaces. The benefit of this property could be seen in endoscopy; while today endoscopy relies largely on rigid devices, the freedom of

movement found in a soft bodied robot would strengthen endoscopic diagnostics.



Subsequent phases of this collaborative project will involve investigating the application of this new biomimetic robotic technology to sensor networks for harsh environments and non-conventional terrains where human mobility and perception are major challenges. Free-space optical communication is the most attractive technology over RF communication for small, energy-constrained sensor nodes because optical

Dr. Ron Lasser's Senior Design Course

Besides teaching a course on engineering entrepreneurship and working with the Nerd Girls solar car project, Ron developed the departments highly successful senior design project course.

The senior design project EE 97 and EE 98 had thirteen student teams covering a multitude of projects: computer vision and robotics; radar enhancement and telemetry data processing for convoy detection; children's learning toys, one to detect the Earth's magnetic field demonstrating Faraday's Law and a second to teach robotics programming; image processing enhancement; biomedical measurements



of cells; renewable energy; a self-balancing device; electronic energy measurements for a solar car dashboard; a CMOS camera on a chip; digital audio compression; and an exercise database

network and measurement system. The class learned about the design process by studying methods used in industry for product design, design for manufacturabil-

ity, integration and system testing, and understanding risk and how to manage it. A final poster session displayed their work and project outcomes.

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The Gomez Multimedia Laboratory Update:

The Gomez Multimedia Laboratory is still the only interdisciplinary media lab in the country, where individuals from engineering and the arts work together creating new forms of communication and media presentations.



We are excited that this lab has also been instrumental in conducting innovative biomedical research. Dr. Panetta and her students are analyzing voice signals from throat cancer patients to develop computer chips that will allow these patients to regain their natural sounding speech.

The “Animations for Technical Communications” course has also been upgraded now that there are new computers and software in the lab. This enables us to teach students current technology that Media and Entertainment companies seek in their new hire candidates. We are beginning to see our graduates’ secure prestigious positions in this very competitive business. Ian Kezsbom, one of our graduates is now the Assistant Editor for the television series, “BattleStar Galactica”. Ian has also worked for Producer Sean Penn and done work on the popular television series, “Alias”. Additionally, Jenny Chowdhury, an ECE Alum, has been featured on NPR for her Popularity Dialer Project, which was recently used for advertising the movie “Snakes on a Plane”. Another media lab Alum, Micheal White, is working in the U.K. for the B.B.C.

Students in the “Animations for Technical Communications” class have a “real client” to serve during the course. This year’s client was the FBI. Students created media presentations to train FBI agents and the public on white collar crime and chemical attacks. Students researched about internet scams called “Phishing”, where criminals imitate well-known websites in an attempt to get victims to provide their financial information. Another project taught the difference between virus and bacteria and how they are reproduced. Finally, students investigated and created a media tutorial on what Anthrax is and did analogies to express how dangerous Anthrax was in tiny quantities. Millions of Anthrax spores can fit on the head of a common pin. 1 Teaspoon of this material can wipe out life in 20 city blocks. The students enjoyed their projects and presented their work to the Boston FBI Director and several Agents.

2005 Tufts Graduate Research Fair Presentations

- Nawaf Almoayed – *High Resolution Absorption Coefficient and Refractive Index Spectra of Carbon Monoxide Gas at Millimeter and Sub-millimeter Wavelengths.*
- Shu Chen – *Accurate Measurement System for Low Loss Materials.*
- Usman Khan – *Identification and Detection of Biological/Chemical Threats using Dispersive Fourier Transform Spectroscopy.*
- Mi Lin – *Dielectric & Magnetic Characteristics Measurement of Ferrites & Composite Materials in Microwave Frequency Range.*
- Almir Davis – *Low-Power Wireless Network Processor.*
- Yong Zhang – *Low-Power Wireless Network Processor.*
- Francine Lalooses – *Recovery of Target Tracking in Wildlife.*
- Hengky Susanto – *Recovery of Target Tracking in Wildlife.*
- Na Wang – *The Wireless Sensor Network Infrastructure.*
- Zhong Zou – *The Wireless Sensor Network Infrastructure.*
- Zhong Zou – *Localization of Wireless Sensor Nodes.*
- Matt Magpayo – *Localization of Wireless Sensor Nodes.*
- Marc Weintraub – *Low Power Wireless Showcase Monitoring System*
- Prabahan Basu – *Error Bond for Maximum Entropy Estimates*
- Cedric Vigil – *CHAOS in Communications*
- Ethan Danahy – *Non-Linear Algorithms for Noise Removal from Medical Signals Using the Logical Transform*
- Jon Chow – *An Active Pixel Sensor Based Camera-On-Chip*
- Wing Siu – *An Active Pixel Sensor Based Camera-On-Chip*
- Milan Daphtary – *Broadband Dielectric Spectroscopy using CMOS Integrated Sensor IC*
- Eric Evans – *Integration of Physiological Monitors to Increase Response Time in an Acute Care Setting*

(“Nerd Girls...” Continued from page 1)

were also on-hand at this exciting event. The team was joined by Rick Colombo, an ECE adjunct Professor who has also been working with the ECE team for the past year. The Nerd Girl team will be featured on ElleGirl.com this fall. The fashion magazine is producing a series of stories on the members of the team.

More information about the Nerd Girls can be found at:
www.nerdgirls.org



Team of Nerd Girls in the Thacher Island Light House

Department of Electrical and Computer Engineering Mission Statement

The mission of the Department of Electrical and Computer Engineering is to provide our students with educational experiences which give them a sound basis for professional practice, advanced education, and lifelong learning. At its core is the goal that students learn the fundamental principles of electrical and computer engineering and master engineering methods to solve challenging and diverse problems. Further, the department strives to have each student develop the leadership and communications skills necessary to relate these solutions to both technical and non-technical communities. The faculty is dedicated to accomplishing this mission through the integration of teaching and research.



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The department is always seeking industry relationships. If your company is looking to sponsor graduate fellowships, interested in internships, or career opportunities please contact Joe Noonan at jnoonan@ece.tufts.edu.