Tufts UNIVERSITY
School of Engineering

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

In this Issue:

Letter from the Chair

Professor Jeff Hopwood

Not so long ago, university research and teaching were considered completely separate functions. But today more and more undergraduate students want to work alongside professors and graduate students to solve our most challenging engineering problems. At Tufts we value the integration of classroom teaching and research experience. For example, last summer ECE had a record number of students win Tufts' prestigious Summer Scholars competition. You can learn about their experiences on page 4. There is also an impressive sampling of research papers that were presented and published by undergraduates on page 6. In addition to research here on campus, many undergraduates and graduate students have expanded their educational experience by working as interns for local research laboratories such as MIT Lincoln Laboratory and Mitre Corporation. Creating opportunities for students to expand and enrich their education through hands-on laboratory work is a priority for us, and I am happy to report that this effort is bearing fruit.

We are pleased to welcome Dr. Thomas Vandervelde to the ECE faculty. Professor Vandervelde is an expert in photovoltaic and thermophotovoltaic devices, and he is one of four faculty who were recently hired to grow the thrust area of sustainable energy within the School of Engineering. Professor Vandervelde holds the Adams Endowed Chair, an honor made possible by the generosity of the John A. Adams (EE'39) family. Learn more about his work on page 3.

Another exciting development is the creation of the Howell Endowed Chair in Electrical Engineering. This new Endowed Chair is made possible through the historical generosity of Frank Doble (EE'11). The position is named in honor of Professor Alvin H. Howell who served

(continued on page 7)

2008 Faculty and Staff, L-R: Yvette Landry, Hwa Chang, Jeff Hopwood, George Preble, Ron Lasser, Mary Lou Vigilante, Sameer Sonkusale, Joe Noonan, Karen Panetta, Denis Fermental and Valencia Joyner. Not pictured: Mohammed Afsar, Eric Miller, Doug Preis, Tom Vandervelde.

Professors Fermental and Lasser Receive University Teaching Awards

The Department is very proud of our two faculty members who were honored with University-wide awards this year.

Denis Fermental was awarded the 2009 Seymour Simches Award. This honor recognizes his outstanding and sustained record of teaching and advising Tufts engineering students for more than 100 semesters!

Professor of the Practice Ron Lasser was chosen by last year's senior class to receive the 2009 Henry and Madeline Fischer Award for teaching excellence. Ron is the driving force behind the creation of a strong, relevant senior design course by applying his years of experience in engineering leadership to the ECE undergraduate curriculum. Congratulations to Ron for having such a positive impact on many of our students.

Congratulations to our graduate students who completed their Ph.D. dissertations, M.S. theses, and M.S. projects in 2008 and 2009!

Ph.D. Dissertation

Nawaf Almoayed Advisor: M.Afsar
"High Resolution Spectroscopy of Environment Hazardous Gases at Millimeter Wavelengths"

Shu Chen Advisor: M. Afsar
"Design of a 250 Msample/sec 6-bit Flash A/D Converter Utilizing Chopping on AMI 0.5 um CMOS Process"

Usman Khan Advisor: M. Afsar
"Millimeter Wave and Terahertz Dielectic Properties of Biological Materials"

Na Wang Advisor: C.H. Chang
"Probabilistic Flow-based Spreading Geographic Routing for Wireless Sensor Networks"

M.S. Theses

Jian Guo Advisor: S. Sonkusale
"CMOS Image Sensors for Scientific Imaging Application and Implementation of Portable Electronic Nose"

Raonaak Kabir Advisor: K. Panetta
"Investigation into the enhancement of alarynegeal speech using electrolarynx"

Krenar Komoni Advisor: M. Asfar
"Fundamental performance limits and Scaling of CMOS passive Double balanced (FET-Quad) Mixer"

James Kotwal Advisor: J. Noonan
"The modified Logistic map & its application to cryptography"

Shahan Nercessian Advisor: K. Panetta
"A New Class of Edge Detection Algorithms with Performance Measure"

James Pringle Advisor: J. Hopwood
"Feedback Controlled RF Source for Microplasma Production"

Sadaf Qazi Advisor: K. Panetta
"Median based principal component analysis for edge detection on color images using partial derivatives of boolean functions and a New correlated color similarity measure"

Nicholas Rotker Advisor: J. Noonan
"Cursive Text Detection Using the MIM Algorithm"

Michael Trakimas Advisor: S. Sonkusale
"A 0.5V Bulk-Input OTA with Improved Common-Mode Feedback for Low-Frequency Filtering Applications"

Leah Uftring Advisor: E. Miller
"A Multiple Target Tracker for Nonlinear Rotational Object Motion Using Range and Range-Rate Measurements"

Mapping the Mind

Professor
Eric Miller

A wiring diagram of the nervous system is a requirement if we are to learn how the brain functions.

However, mapping the connectivity of neurons is an exceptionally difficult problem requiring fundamental advances in a range of disciplines including microbiology, microscopy, electrical engineering and computer science. This is precisely the objective of Connectome, a project led by Harvard Professors Jeff Lichtman (Molecular and Cellular Biology) and Clay Reid (Neurobiology) which brings together an interdisciplinary, multi-institutional team of researchers to address the many and varied aspects of this important problem. Over the past year, Prof. Eric Miller of the ECE Department at Tufts, in collaboration with his graduate student, Amelio Vazquez-Reina (Computer Science), have joined the Connectome team to focus on problems of image segmentation.

The Connectome project makes use of high-resolution electron microscopy data stacks to ascertain the structure of the neurons in a volume of brain tissue. A small portion

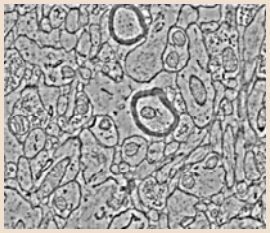


Figure 1: Small portion of electron microscopy

of a "slice" in one of these stacks is shown in Figure 1. Technically, the problem we face is one of image segmentation where we seek to determine the boundaries of the cells in each of these images and, ultimately, link the results together across a data stack in order to obtain the full, 3D geometry of all neurons. As seen in Figure 1, even the single image problem is exceptionally challenging. Not only are the individual cells tightly packed, but a variety of sub-cellular structures are present in addition to the cell walls, making automated analysis of these images rather difficult.

In the past year, Mr. Vazquez-Reina, Prof. Miller and Prof. Hanspeter Pfister of Harvard's School of Engineering and Applied Sciences have begun to address the image segmentation problem discussed above. Building on methods in the area of mathematical curve evolution, they have developed a new approach to so-called multi-phase level set segmentation procedures. The project's approach constructs mathematical elastic forces between curves to encourage the formation of ribbon-like structures. In the context of the Connectome problem, one side of the ribbon represents the inside of a cell wall while the other side of the ribbon encircles the outside of the wall. An example of this "Active Ribbon" approach is shown in Figure 2 where an initial estimate of the

ECE Welcomes Prof. Tom Vandervelde

The Electrical and Computer Engineering Department is pleased to welcome Thomas Vandervelde to its faculty. Tom earned a Ph.D. in Physics in 2004 from the University of Virginia, where he studied electronic materials in the laboratory of ECE Professor John C. Bean. He taught in the Physics and Engineering Department of Washington and Lee University before joining Professor Milton Feng's High Speed Integrated Circuits Laboratory at the University of Illinois in 2005. In 2007 he became a Research Assistant Professor at the Center for High Technology Materials in the ECE Department at the University of New Mexico.

Professor Tom Vandervelde

Dr. Vandervelde's current research interests focus on the development and characterization of novel electronic materials for efficient solar cells and infrared detectors. Particular areas of specialization include *Heterojunction Engineering for Monolithic Integration of High-Efficiency Multijunction Solar Cells on Silicon Substrates* and *Quantum-Dot-Enhanced Photovoltaic Cells.* He chaired the session on "Detectors and Solar Cells" at the 2007 NAMBE conference and is the recipient of numerous fellowships including the Intelligence Community Postdoctoral Research Fellowship. His ancillary interests in device fabrication, optoelectronics, imaging, and terahertz electronics align with current strengths in the School of Engineering and we are looking forward to productive collaborations.

Recruiting talent like Tom Vandervelde is becoming extremely competitive among the nation's top universities. We were fortunate that a generous gift from the John A. Adams (EE'39) estate this year made it possible to name Professor Vandervelde the inaugural *John A. and Dorothy M. Adams Faculty Development Professor.* When asked why he decided to join Tufts, Professor Vandervelde responded that commitment to a strong educational program moved Tufts ahead of other top research universities.

M.S. Theses, *continued*

Jason Waterman Advisor: C.H. Chang
"Design for Low Power Opportunistic Wireless Computation"

Oyku Yildiz Advisor: K. Panetta
"Image Processing Algorithms for Security Applications"

Yicong Zhou Advisor: K. Panetta
"Multimedia encyption with different security levels using recursive sequences"

Selected M.S. Projects

Robert Bishop Advisor: S. Sonkusale "Design of a 250 Msample/sec 6-bit Flash A/D Converter Utilizing Chopping on AMI 0.5 um CMOS Process"

Bradley Blanchard Adivsor: D. Fermental
"Portable Vibration Shaker Using Response Estimation Control"

Lixiang Vincent Bu Advisor: J. Hopwood
"Microstrip split-ring Resonater Microplasma Design"

Matthew Dorsch Advisor: E. Miller
"A Prototype of a Stereo Vision Based Virtual Modeling Application"

Abhimanyu Gosain Advisor: C.H. Chang
"Delay Tolerant Networking in Wireless Sensor Networks"

Jaina Morgan Advisor: J. Noonan
"A New Anomaly Detection Algorithm"

Wayne Mueller Advisor: D. Preis
"Design of Casual Digital Hilbert Transformers"

Carl Rodrigues Advisor: C.H. Chang
"Automated Test Equipment Improvement"

Istvan Rodriguez Advisor: J. Hopwood
"CPW to MMIC Transition"

Krishna Tej Varanasi Advisor: D. Preis Bandwidth Enhancement Techniques in CMOS

Scott Vasquez Advisor: M. Afsar "Computer Aided Design of a 2.4GHz RF Tranceiver Front-End for ISM Band Wireless Communication"

Mapping the Mind *(continued)*

contours is displayed along with the intermediate and final results of the process. The technique has been shown to be more accurate than existing methods for segmentation of these types of images. This work was presented at the prestigious Computer Vision and Pattern Recognition meeting (4% acceptance rate) in June 2009. The full paper can be found at the SciWeavers web site.

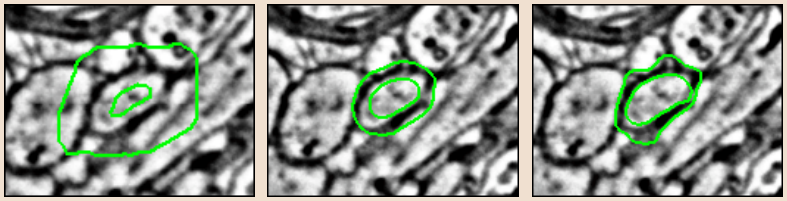


Figure 2: Active ribbon processing approach. Left: Initial contours. Middle: Midway through the processing. Right: Final estimate of

2008 Undergraduate Summer Scholars

At Tufts, we value undergraduate research and this summer many undergraduate students performed research in our department. 2008 Tufts Summer Scholars were Atiyah Ahsan (E10), Victor Hwang (E10), Pavan Nyama (E09), and Niraj Shrestha (E10). Joshua Levinson (E09) was also able to perform research thanks to a Summer Scholars fellowship from the dean's office and David Tilton (E09) worked for Prof. Afsar through grant funding from the US Army.

Under the guidance of Prof. Jeff Hopwood, Atiyah Ahsan completed her project on "Atmospheric Pressure Plasma Research." She investigated the use of a microstrip split-ring resonator — miniature circuits powered by microwaves — to create inexpensive cold atmospheric pressure plasma. Her breakthrough was to generate two plasmas concurrently from a single power source – a configuration that was believed to be unstable until now. Plasma, the fourth state of matter, is currently used in commercial applications such as integrated circuit fabrication and lighting. Ahsan's results hold promise for the future of plasma production. If many such micro-plasmas can function in parallel, it may be possible to reduce the high production costs for processes that use plasma, including solar cells, which would benefit society with low cost renewable energy.

Victor Hwang worked on a Biomedical Imaging project with Prof. Eric Miller. Hwang sought to create algorithms and software that would remove noise and find edges in images of collagen fibers in order to assess biological tissue regeneration. This software assists the research being conducted by Professor Irene Georgakoudi on limb regeneration in mice and may one day be applicable to human medicine. Hwang feels his summer research has been useful in his coursework this year. He says, "After completing this project, I have seen these topics come up in a majority of my classes, especially Linear Systems. Having learned it on my own previously has been a huge help in understanding the formal theory."

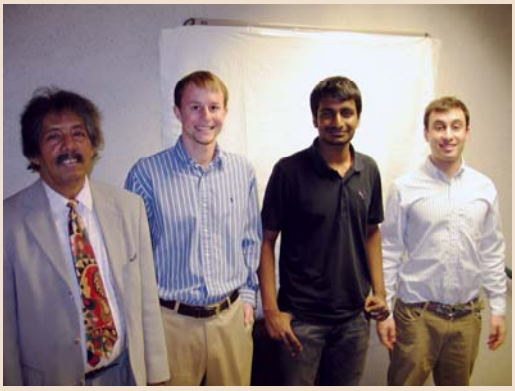
With Prof. Sameer Sonkusale, Niraj Shrestha undertook research aimed to detect AC wall outlets using an image sensor built on a moving robot. The CMOS Camera on Chip project involved simplifying the image processing task through geometric pattern recognition. The sensor could efficiently find AC-outlets by identifying the unique rectangular and circular shape patterns.

Joshua Levinson's research on shape-memory alloys (SMAs) contributed to an on-going investigation into soft-bodied robots called The Tufts Chembot Project. This work was begun in 2007 by Prof. Sonkusale and Prof. Joyner. The soft-bodied robot's movement is a major component in its creation; the SMAs are similar to small springs that contract and expand in a similar motion to that of a caterpillar. Since the contraction and expansion of the SMAs is temperature regulated, the project needed an electronic system to control the electrical current used to heat the springs, which Levinson created. The researchers involved with the Tufts Chembot Project, and eventually the greater robotics community, will benefit from Levinson's contribution.

For the United States Army, David Tilton researched potential stealth technologies using magnetic powders. Each powder was tested in a specially constructed quasi-optical transmittance and reflectance spectrometer energized by a number of high power *backward wave oscillators* – a device that produces tunable millimeter wave energy over a broad frequency range (30 GHz to 120 GHz). The experiment determined the transmission and reflection of waves by the powders; these basic scientific data indicate how effectively a powder can mask an object from being identified by radar. He has also worked on a novel concept of microwave isolator design that features ferrite or magnetic samples coated with uniformly spaced strips of metal wires to obtain negative permittivity and permeability at certain desirable frequencies, a new phenomenon achievable by this metamaterial. His work led to submission of two journal papers now in revision form.

Dr. Valencia Joyner sponsored the research of another Summer Scholar, Pavan Nyama, in Power Efficient Visible Light Communication. Nyama developed a system to study the feasibility of sending digital information to and from computers by encoding the data in room lighting. One day this method could replace wireless networks by optical networks that use a building's light fixtures.

We are delighted that so many of our undergraduates are interested in working side-by-side with professors in the lab. The students get to apply the principles learned in the classroom while experiencing graduate level research. All wish to express their thanks to the sponsors of their research, especially the Summer Scholars program.



Prof. Mohammed Afsar with ECE Summer Scholars

Learn more about ECE research:

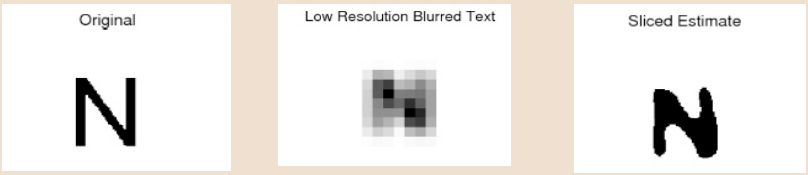
http://www.ece.tufts.edu/research/

Releasing the Innovation and Leadership Inside

The *Releasing the Innovation and Leadership Inside* series presents three successful entrepreneurial engineers to participate in a Q&A session with students. In the past, the series has included, David Birnbach, CEO of Vaultus Mobil Technologies; Jon Hirschtick, Founder, SolidWorks; Charlie Neckyfarow, Vice President of Engineering, Textron Systems; and Helmi Ozguc, Founder, Maven Networks. The program consists of two-parts: twenty questions, asked by Professor Lasser to the guest, which allow the students to learn about the guest's background and experience since college graduation. This is followed by an unrehearsed Q&A by students. The series is being videotaped for posting to the High Tech Innovation web site during this coming academic year, allowing future students to learn from the experiences of these highly successful engineers.

Professor Noonan Makes it all Clear

Recovering clean images from distorted and fuzzy images and estimating text from badly corrupted documents are applications of a new patent developed by Prof. Noonan and his post-doctoral researcher Prabahan Basu. This work is a result of Prof. Noonan's research on applying the concepts from Information Theory to the problems of detection and estimation of signals in the presence of noise. This new approach may be implemented as a special purpose software algorithm within a larger system or as a stand alone unit. The image is first digitized and then the information is recovered using the new mathematical estimation technique. The work was undertaken in an effort to address the problem of recovering information from severely damaged documents. In the example below, the original letter N (*left*) is badly blurred due to low resolution scanning or damage to a hard-copy document (*center*). After applying the algorithm to the blurred image, a much improved image is recovered (*right*). The approach shows improved performance over existing methods.



Pioneering New Ideas at the Boundaries of Disciplines

Professor Sonkusale

The Nanoscale Integrated Sensors and Circuits Laboratory (nicknamed "Nanolab") is at the frontier of research activities that transcend traditional disciplinary boundaries. The lab, led by Dr Sonkusale, consists of eight graduate and three undergraduate students in the Advanced Technology Laboratory on Boston Avenue. Taking a truly interdisciplinary approach, lab members apply core research expertise in microelectronics to unconventional and emerging problems in biology, chemistry, applied physics and biomedical sciences. In the 2008-2009 academic year, the laboratory invented a novel way to perform electrochemical spectroscopy on a tiny chip of silicon. This idea harnesses traditional metal layers as working electrodes for electrochemical reactions. Built-in transistors facilitate readout and signal processing. This project has far-reaching impact in portable sensors for chemical and biological sensing, fuel cells for energy to biomedical implants for measuring neurotransmitters. The research was conducted with Professors David Walt and Christopher LaFratta (Tufts Chemistry Dept.). The idea to apply mature microelectronics technology to problem solving in highly unconventional areas is key to a high impact research program at Tufts University. Nanolab is also engaged in developing a single chip magnetic biosensor in collaboration with Dr. Edward Goldberg of Sackler School for early warning and detection device for infectious diseases. This idea borrows concepts from physics of Brownian motion of magnetic nanoparticles, and the effect of the hydrodynamic size on its susceptibility. Measurement of the susceptibility using a custom low-cost magnetic susceptometer developed at Nanolab has shown encouraging results in bringing this novel sensing paradigm to reality. The laboratory is also at the center of the soft-bodied robots program, funded by the Department of Defense, in developing flexible and soft integrated circuits for control and communication of tiny robots. This unconventional research enterprise is an interdisciplinary effort led by Dr. Kaplan in Biomedical Engineering and Dr. Trimmer in Biology, and boasts a team of ten faculty members from different disciplines working on a common theme to advance science and engineering of soft biomaterials for various applications.

The Nanolab group provides integrated educational experience for undergraduate students by hosting summer scholars for the past five years. More than ten students have completed their senior design projects at Nanolab, providing an ideal platform for graduating students to work on practical and high impact problems facing the world today.

Professor Fermental Delivers 2009 Last Lecture

Prof. Fermental

ECE's own Associate Professor, Denis Fermental, along with the Political Science Chair, Professor Robert Devine, delivered the 2009 Last Lecture on Wednesday April 8, 2009 at the Alumni Lounge. Each professor centered their remarks around the question, "If you knew this was the last lecture you would ever give, what would you share with students and colleagues?" – a question that allows us insight into his personal story and constructive advice.

After having received the greatest number of nominations by the senior class, Fermental proudly took the stand as first speaker. Quoting Thomas Edison and Alexander Graham Bell, he touched upon ways of motivating students to be more open-minded. Fermental then went on to his personal story and how he fell upon teaching accidentally. His early career path ranged from teaching courses on radar in Germany to assisting in a projects involving photographing the Soviet Union from high-flying balloons. He focused on the predestined path of his career and how, despite his earlier intentions, he had found his calling as a professor.

The Last Lecture is based on a speech Randy Pausch, a computer science professor at Carnegie Mellon, gave in September 2006. The speech called "Achieving your Childhood Dreams" was Pausch's last lecture before dying from terminal illness. Since then the last lecture has become a popular tradition at many universities in which student-elected professors deliver a similar style speech. The Last Lecture is the opportunity for Tufts faculty to reflect on their life journeys and demonstrate their value to the Tufts community.

Tufts Undergraduate Publications

Aaron Greenblatt, Karen Panetta and Sos Agaian, "Border Crossing Detection and Tracking through Localized Image Processing." Proceedings 2008 IEEE Homeland Security Technologies Conference, Waltham, MA, 12-15 May, 2008.

Roanaak Kabir, **Aaron Greenblatt**, Karen Panetta, Sos Agaian, "Enhancement of Alaryngeal Speech using spectral subtraction method based on cosine transforms and minimum statistics," submitted to IEEE International Conference on Machine Learning and Cybernetics, Kunming, China, 12-15 July, 2008.

Aaron Greenblatt, Karen Panetta, and Sos Agaian, "Restoration of Semi-Transparent Blotches in Damaged Texts, Manuscripts, and Images Through Localized, Logarithmic Image Enhancement," in Proc. IEEE Communications, Control, and Signal Processing, Malta, Mar, 2008, pp. 484-489.

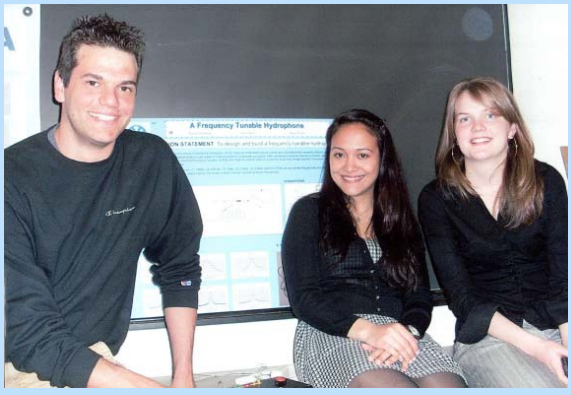
Aaron Greenblatt, Karen Panetta, and Sos Agaian, "Restoration of Images Damaged by Semi-Transparent Water Blotches using Localized Image Enhancement," in Proc. SPIE Defense and Security Conference, Orlando, FL, Mar, 2008.

Aaron Greenblatt, Sos Agaian, Karen Panetta, "Localized, Logarithmic image enhancement for use in color restoration of semi-transparent blotches," submitted to IEEE International Conference on Image Processing, San Diego, CA, Oct 12-15, 2008.

Nawaf N. Almoayed, **Baris C. Piyade**, and Mohammed N. Afsar, "High-Resolution Absorption Coefficient and Refractive Index Spectra of Common Pollutant Gases at Millimeter and THz Wavelengths," *SPIE Conference Proceedings* vol. 6772, September 2007.

Baris C. Piyade, Usman Khan, and Mohammed N. Afsar, "Polarization Effects on the Millimeter Wave Dielectric Properties of Pesticide," *IEEE Instrumentation and Measurement Technology Conference*, 12-15 May, 2008.

Baris C. Piyade, Mohammed N. Afsar, "Transmittance and Dielectric Permittivity Measurement of Pesticide at Milimeter Wave," *European Microwave Conference,* accepted for publication in October 2008.



Members of the Class of 2008

Professor Panetta Elected IEEE Fellow

Professor
Karen Panetta

Congratulations to Professor Karen Panetta, who was elected Fellow of the Institute of Electrical and Electronics Engineers (IEEE) in 2008. Professor Panetta was cited "for leadership in engineering education and curriculum development to attract, retain, and advance women in engineering." We are very proud of Professor Panetta as only 0.1% of the IEEE membership may be given the honor of Fellow each year.

Professor Panetta is also the IEEE Women in Engineering Chair. She has been traveling around the world this year in support of the organization's mission to "inspire, engage, encourage, and empower IEEE women worldwide." As part of the Women in Engineering outreach, several Tufts' alums from Professor Panetta's Nerd Girls program appeared with her on NBC's Today Show on July 18, 2008. They encouraged other young women to pursue engineering careers while maintaining their diverse outside interests.

ECE'S "Morning Wonder" Retires

Marylou Vigilante began her retirement on December 31, 2008 after 23 years of dedicated service to the ECE Department and to the University. Known as our "morning wonder," she was an asset to the department and will be truly missed! Marylou joined ECE in June 1985. Over the years she witnessed the department grow and evolve. She never failed to show up every morning with a big smile and a cheery disposition, ready to help anyone who walked into the office. She also became known for her festive holiday spirit. Marylou showed extraordinary willingness to tackle new tasks and adapt her work to the department's needs. We wish Marylou the best of luck as she and her husband Fred enjoy their grandchildren and frequent trips to Foxwoods. "May the slots be with you!"

Letter from the Chair

(continued from pg. 1)

as EE department chair from 1941 to 1970 and was instrumental in the growth of the Doble Company. Our international search for a renowned researcher and educator is coming to a close, and we hope to announce the new Howell Endowed Professor during the summer of 2009.

The department is also proud to have another of its faculty honored by becoming a Fellow of the IEEE. Professor Karen Panetta was given this distinction "for leadership in engineering education and curriculum development to attract, retain, and advance women in engineering." Congratulations Karen! Last, but not least, both Professors Fermental and Lasser received teaching awards this year. This is an exciting time of growth in the ECE department, and I am pleased that the faculty and students are obtaining distinction for excellence in teaching and research.

ECE Office Welcomes New Staff Member

Renee Simonetti

Following Marylou Vigilante's retirement in December, the Department welcomed new Staff Assistant Renee Simonetti in January 2009. Renee comes to Tufts Medford Campus after working at Tufts Medical School on Harrison Avenue in Boston for the past several years. In the past, Renee has held positions in public relations and marketing communications. Renee's goal for the department is to bring some light humor to each and every day.

Halligan Hall, home of the ECE Department

Recent Faculty Grants

C. Hwa Chang, PI. “CitiSense” (BBN)

C. Hwa Chang, PI. “Elite Project” (National Science Council, Taiwan)

Jeff Hopwood, PI. “Instabilities in nonthermal atmospheric pressure plasma” (DOE)

Jeff Hopwood, PI. “Nanoparticle Detection Using Microplasma” (NSF)

Jeff Hopwood, PI. “Microplasma Research” (Agilent Foundation)

Jeff Hopwood, PI. “Cold Plasma Thin Film Deposition of Photovoltaic Materials on Commodity Substrates” (Wittich Fund)

Valencia Joyner, PI. “Collaborative Research: 3D Integrated Imaging Receivers for Free-Space Optical MIMO” (NSF)

Valencia Joyner, PI. “BRIGE: Multi-spectral, High-frequency Image Sensors for Frequency-Domain Biomedical Imaging” (NSF)

Eric Miller, PI. “Multi-Modal and Shape-Based Inverse Methods for the Characterization of DNAPL Source Zone Architecture” (NSF)

Eric Miller, PI. “Harvard IIC Support” (Harvard IIS)

Eric Miller, PI. “Multi-modal detection of HIFU lesions” (NIH)

Eric Miller, Tufts PI (in collaboration with Northeastern University). “Awareness and Limitation of Explosives-Related” (DHS)

Karen Panetta, PI. “Liquid Detection” (Analogics)

Karen Panetta, CO-PI with Ronald Lasser. “Mathworks Nerd Girls” (MathWorks)

Karen Panetta, CO-PI with Ronald Lasser. “Textron Scholars for Nerd Girls” (Textron Defense Systems)

Karen Panetta, PI. “Verizon Nerd Girls” (Verizon)

Sameer Sonkusale, CO-PI. “Bio-mimitic Technologies for Soft-Body Robots” (Keck Foundation)

Sameer Sonkusale, PI. “Development of RF CMOS Receiver for Ultra-Low Power Applications” (MIT Lincoln Labs/DOD)

Sameer Sonkusale, PI. “Mixed-Signal VLSI Interface for High Aspect Ratio Optical/Electrochemical Hybrid Sensor Array” (Catalyst Foundation)

Sameer Sonkusale, PI. “Ultra Low Power Transceivers for Biomedical Implants” (Marshall Grant / Tufts Faculty Research Award)

Sameer Sonkusale, PI. “Draper fellowship on Sigma Delta Converters” (Draper Labs)

Sameer Sonkusale, PI. “Programmable Mixers” (Bitwave Semiconductors)

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