



# DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING



*Fall 2005*

Dept. Welcomes New Faculty Member	2
ECE Grad Wins Prestigious Award	2
Prof. Afsar's Labs Decipher Properties of Materials at High Frequencies	4
Professor Noonan's Research Has Applications to Treat Epilepsy	5
WiseNET Endeavors to Prevent Terrorist Attacks	5
ECE & Chemistry Collaborate on Medical Applications	5

## From the Chair

Welcome to the inaugural issue of our newsletter! The department intends to bring you news about ground breaking research and the ongoing process creating unparalleled engineers. Our department has experienced some administrative and logistical challenges from the unification with and subsequent division from the Department of Computer Science in the past ten years. The latest changes have given us the opportunity to search for talented new faculty members. In addition, ECE will be conducting research in a new location at 200 Boston Avenue where two of our faculty members will set up the new Clean Room and Fabrication Facility. The Ana-

log and Mixed Signal Circuit research will be the focus in the new research location.

Truly our greatest strengths lie in our students. The enrollment in our two degree programs, namely Electrical Engineering and the Computer Engineering, is on the rise. Last year the department graduated 77 seniors, a 64% increase from our 2000 figures. We are focusing our efforts to increase our graduate enrollment and enrich the quality of graduate research. Our grad students are publishing and presenting papers in record numbers. The high caliber of our engineering graduates is no secret to the professional world. Compa-



**Professor Mohammed Afsar**

nies such as Raytheon and BAE Systems employ large numbers of Tufts engineers.

Our traditional research areas such as simulation, multimedia, signal processing, Communications, Microwave, Millimeter Wave and Terahertz Material Characterization, Wavelets, Smart Windows and Control Electronics have generated over twenty Conference and Journal papers this

*(Continued on page 6)*



NerdGirls and Anne E.B. with Tufts University President Lawrence Bacow

## Nerd Girls Defy Stereotypes

Tufts University has female engineers who have danced in the Nutcracker ballet, sang at the Apollo Theater, are award-winning pianists, and nationally ranked athletes. These well-rounded women are on a quest to show the world that females can be successful in the world of science and engineering without being con-

finied to the stigmas associated with that type of career.

The mission of their program is to show a wide audience of young women and young men how successful these students are as they work together to design and construct an engineering system. The project will

*(Continued on page 3)*

Congratulations to our graduate students who recently completed their Ph.D. dissertations, M.S. theses, and M.S. projects in 2005!

### Ph.D. Dissertation

**Erica Heffer** Advisor: Sergio Fantini  
"Frequently-Domain Optical Mammography for Detection & Oximetry of Breast Tumors"

### M.S. Theses

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

**Jared Burdin** Advisor: Chong Hwa Chang  
"The Benefit of Multiple Input, Multiple Output Communications to Wireless Sensor Networks"

### M.S. Projects

**Anthony Arous** Advisor: Chong Hwa Chang  
"A Server for Wireless Golf Course Management System"

**Jamal Bnari** Advisor: Chong Hwa Chang  
"FPGA Simulation of a High-Speed Telephone Switch over Cable Network for Voice and IP Traffic"

**David Botha** Advisor: Chong Hwa Chang  
"OPNET Simulation of a High-Speed Telephone Switch over Cable Network for Voice and IP Traffic"

**Joseph Brassard** Advisor: Chong Hwa Chang  
"Distance Measurement and Display Using a PDA"

**Kimberlee Chang** Advisor: Joseph Noonan  
"A Feature-Aided MTI Algorithm"

**Robert Chirwa** Advisor: Joseph Noonan  
"Wavelet Applications to Image Processing"

**Michael Creamer** Advisor: Joseph Noonan  
"Base Station Cellular Breathing in a CDMA Environment"

## Department Welcomes New Faculty Member

The department is proud to announce the arrival of our newest faculty member, Valencia Joyner.



Dr. Joyner received bachelor of science and masters of engineering degrees in electrical engineering from the Massachusetts Institute of Technology in 1998 and 1999, respectively. She was awarded a Marshall Scholarship in 1999 to pursue a doctoral degree in Great Britain at the University of Cambridge.

In November 2003, she completed a Ph.D. degree in electrical engineering with a research focus on the design of high-frequency integrated circuits for wireless networks based on optical transmission.

She is a Marshall Scholar, Intel Foundation Scholar and a National Science Foundation Graduate Research Fellow. She was recently with the University of Southern Cali-

fornia's Information Sciences Institute in Arlington, VA as a Senior Computer/Electronics Engineer. She has also held an adjunct faculty position at Howard University. Her research interests are in integrated circuit design, electronic systems for space applications, sensors and wireless sensor networks.

This fall Dr. Joyner is teaching one section of Introduction to Electrical Engineering. In addition to her professional achievements, Dr. Joyner is an accomplished gospel choir singer and enjoys traveling.



Halligan Hall, home of the ECE Department

## ECE Grad Wins Prestigious Award

2005 ECE Graduate Lakshmi "Punchi" Subramanian has won the Young Scientist Award from the International Union of Radio Science. Punchi is joined by two students from Stanford and Cornell as the only U.S. recipients of the award. She will attend the international conference this October in India.





Professor Karen Panetta (far right) and Torre Bydlon (center) showcase Anne E.B. to children at All-Wheels Festival where NerdGirls took first place

(*"Nerd Girls"* continued from page 1)

showcase the young women's talents, diverse backgrounds and engineering skills. The team will build an energy efficient automobile and will drive it down the East coast, visiting local communities along the way and sharing their experiences with K-12 educators and students.

Despite efforts to attract women to engineering and science careers, these technical fields still remain elusive and do not appeal to young girls. While workshops and dedicated outreach efforts in K-12 continue to target this invisible barrier by introducing young girls to the workplace and to special math and science projects, the negative perception of women engineers and scientists is compounded by the "egghead" stereotype associated with engineering and science in general. Engineers and scientists are typically known as "geeks" or "nerds" and are considered lacking in social skills and non-

technical interests.

The Tufts University Nerd Girls Engineering team began its year with a first place win at the All-Wheels Festival at the Larz Anderson Museum for the "Best renewable energy vehicle exhibit". Over 10,000 visitors attended the festival and voted the Nerd Girls team as their favorite exhibit. As the team enters its fourth year, they have expanded their research to include renewable energy systems for Thacher Island, a historic landmark off the coast of Rockport, MA.

Thacher Island is the last operating twin light house in the nation. The team has designed new solar systems to provide the lights within the tower, power for the septic systems and charging systems for the electric vehicle used to haul supplies on the island. This year, the team will include civil engineers to develop water filtration systems for the island's only source of fresh water, a 30 million gallon cistern built in the 1700's and will develop solar power systems for the septic pump and electricity for the two historic

**Congratulations to our graduate students who recently completed their Ph.D. dissertations, M.S. theses, and M.S. projects in 2005!**

### M.S. Projects

- |   |                            |
|---|----------------------------|
| <b>Nathan Egan</b><br>"Controller Design Used to Levitate an Object using Ultrasonic Detection"   | Advisor: Denis Fermental   |
| <b>Shayan Haque</b><br>"Digital Video Processing"   | Advisor: Robert Gonsalves  |
| <b>Yasumichi Iwamoto</b><br>"Distance Measurement and Display using a PDA"  | Advisor: Chornng Hwa Chang |
| <b>Richard Johnson</b><br>"Kalman Filtering"  | Advisor: Mohammed Afsar    |
| <b>Rachid Mzaouakk</b><br>"Characterizing Relays for High Speed Applications"   | Advisor: Mohammed Afsar    |
| <b>Stuart Peloquin</b><br>"Interface and Management of Wireless Communication between PDAs and a Server"  | Advisor: Chornng Hwa Chang |
| <b>Natalia Perova</b><br>"A Wireless Sensor Network for Pong Water Temperature Monitoring"  | Advisor: Chornng Hwa Chang |
| <b>Eduart Pulaha</b><br>"A Code Division Multiple Access Communications Link Simulator"   | Advisor: Chornng Hwa Chang |
| <b>Nattakarn Suwanvisan</b><br>"Complex Permittivity Measurement of Low, Medium, and High Loss Liquids Using Waveguide Transmission Line Technique" | Advisor: Mohammed Afsar    |
| <b>Sonal Thaker</b><br>"Cerebral Measurements of Hemoglobin Concentration and Oxygen Saturation Using Near-Infrared Spectroscopy in Human Neonates" | Advisor: Van Toi Vo        |
| <b>Arvind Vidyarthi</b><br>"Wave Pipelining for Interconnect"   | Advisor: Soha Hassoun      |

houses on the island.

Dr. Karen Panetta, ECE professor and Nerd Girls advisor, says, "The Nerd Girls project is truly an interdisciplinary project open to all disciplines of engineering and science. The Thacher Island project gives the team the opportunity to serve a community, and have their work have an immediate impact on the island while considering the safety of its wildlife in-

habitants." She adds, "How many engineering students get the opportunity to do their research on an island?"

This year's project leader is Torre Bydlon, an Electrical Engineering senior. Torre designed solar panels for the team's newest vehicle as a junior and was awarded a Lincoln Laboratories fellowship this past summer.

# DEPARTMENT RESEARCH

## Afsar's Labs Decipher Properties of Materials at High Frequencies

The Millimeter and Submillimeter Waves Laboratory was founded in 1987 at Tufts University's Department of Electrical Engineering. The laboratory's fundamental mission is to apply advanced technology and science to develop millimeter and submillimeter wave elements and state of the art measurement techniques for precision measurement of electromagnetic properties of electronic and magnetic materials at these frequencies.

The High Frequency Materials Measurement and Information Center headed by Professor Mohammed Afsar is home to some of the most advanced measurement and instrumentation techniques in the world. With over 200 publications, the Center has a history and reputation of contributing to engineering technology and advancements.

Dispersive Fourier Transform Spectroscopy (DFTS) is one of the many techniques at the facility that can provide the dielectric properties of liquid, solid, and gaseous specimens from 60-3,000 GHz. Using a two-beam polarizing interferometer, data is recorded in the spatial-time domain and frequency transformed to yield the dielectric properties as a function of frequency. Highly sensitive equip-

ment, such as Silicon bolometers / detectors, are set up through cryogenic transfers to ensure 4 Kelvin operating conditions.

Recently, the DFTS setup has been modified to enable testing of environmental and biological samples such as blood and animal tissue. The Center has completed testing and published results on ground water contaminants such as dioxane and biological fixatives such as 10% formalin. The Center hopes to become the world's largest database on the dielectric properties of materials at high frequencies.

Some recent publications include "Complex Permittivity Measurements of Dielectric and Semiconductors at Millimeter Waves with High Power Sources", "Measurement of Broadband Dielectric Properties of 10% Formalin and 1,4 Dioxane using Dispersive Fourier Transform Spectroscopy", and "An Improved 60GHz Open Resonator System for Accurate Measurement of Dielectric Permittivity." A full list of publications can be found at [www.eecs.tufts.edu/mm-smm](http://www.eecs.tufts.edu/mm-smm)



Usman Khan working in Prof. Afsar's Lab

### Undergraduate Participation

Participation in advanced research labs is not limited to graduate students. Dino Sijamic and Josh Kupersmidt are two undergraduate students working in Prof. Afsar's lab in the field of system automation. Their major project for the summer is upgrading outdated PC hardware and software in the lab. Dino and Josh made certain that the old data were archived and that older hardware could adequately communicate with newer technology in the lab in order to ensure future reliability. Most of the old equipment in the lab, having little to no documentation, required various troubleshooting techniques to bring up to date.

Says Josh Kupersmidt about the summer research, "It's a lot of fun learning what kind of research your professors are occupied with. Working in the lab really lets you see the depth of research opportunities available and how important some of the work can be."

Dino Sijamic adds, "I've learned a lot about systems automation during my time in the lab over the summer. Being here has taught me a lot about the real world uses for all the computer theory we learn in classes."



(Top, L-R) Usman Khan, Mi Lin, Dino Sijamic, David Guen, Konstantin Korolev, Yong Wang, Professor Afsar, (Bottom L-R) Josh Kupersmidt, Shu Chen, Nicholas Nguyen, Kim Nguyen, Megan Duane, Nattakarn Suwanvisan

## DEPARTMENT RESEARCH

### Professor Noonan's Research Has Applications to Treat Epilepsy

Somerville native, three-time Tufts graduate, and ECE professor Joe Noonan has thirty-five years experience in the areas of digital signal processing, probabilistic and statistical modeling and statistical communications theory. His primary research activities concern the application of statistical communication theory and digital signal processing to the problems of optimal detection and estimation of signals in noise. Specific application areas include Channel Modeling (Blind Equalization), Spectral Estimation, Image Enhancement, Deconvolution, Time Varying System Modeling, and Radar Signal Processing.

Professor Noonan is continuing his research with the assistance of several talented ECE students. The research group works on problems of signal processing and communications with applications to

optimal detection and estimation of signals in noise. Two major programs are currently underway.

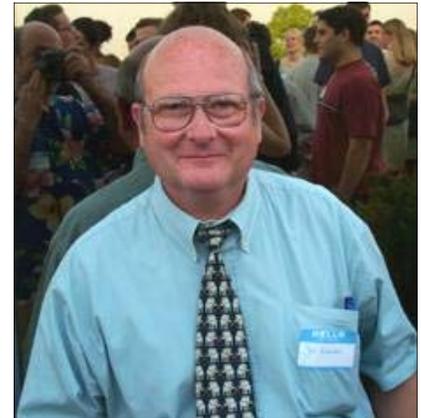
#### Communication Channel Modeling

BAE Systems is supporting Ph.D. student Prabhakar Basu in this effort. The objective is the development of faster and more accurate channel estimation to implement space-time diversity coding.

#### Modeling and Classification of Epileptic Transients in Electroencephalograms (EEGs)

In cooperation with a pediatric neurologist we are developing wavelet based models for the modeling and classification of epileptic transients. Initial results are encouraging in predicting seizure paths which cannot be detected by visual examination of the EEG data and in the classification of various types of epilepsies. Initial results have been

presented at an international neurology conference and this work is continuing. It is believed that this work will potentially aid in the treatment of epilepsy. Recently, master students Chen Wu, Sumugam Balachandran and Adam Rowell have been working on this research.



Professor Joe Noonan

### WiseNET Works to Prevent Terrorist Attacks

WiseNET (Wireless Integrated Sensor Network) is a research project focused on developing improved wireless sensor networks in order to detect potential chemical or biological terror agents.

The project consists of developing a long-life reliable wireless network for environmental monitoring and bio-chemical-defense. The development includes high-fidelity CMOS Molecular Sensor, lower energy transceiver and CPU, and QoS and energy aware routing protocols. The sensor, transceiver, the CPU and the routing protocol design are being developed in parallel for final network deployment.



Professor Hwa Chang

The project's final goal is to integrate the sensor, transceiver, and the CPU on a sin-

gle sensor card, and using the routing protocol to connect all the sensor cards into a wireless sensor network.

This project is led by Prof. Hwa Chang with the assistance of Prof. Sameer Sonkusale and graduate students Almir Davis, Na Wang, and Yong Zhang.

With recent advances in mobile sensor networks, sensor networks are now being used in wildlife environments. Sensor networks are utilized in wildlife to track animals. The discoveries that have been made through such efforts include animal behavior and lifestyles. One of the most significant reasons why wildlife tracking research has escalated is for the protection of humans and animals in the food chain. Wildlife tracking can also be used to protect endangered species. Francine Lalooses and Hengky Susanto, both Ph.D. students, analyze related work being done and describe how to track mobile sensor nodes. They present an optimized recovery algorithm to track animals when they cannot be found

and provide supporting documentation to show that their proposed algorithm is effective in performing a quick recovery and extending the network lifetime.

Besides Sensor Networks, Prof. Chang is also interested in RFID (Radio Frequency Identification) research. He is talking with Oaks Systems, MIT researchers and Microsoft in a possible collaboration for intelligent mobile data storage, processing and communication.

### ECE & Chemistry Collaborate on Medical Applications

The benefits of the semiconductor Integrated Circuit (IC) technology has already fueled the digital revolution and has created a huge impact on the way we work, live and play. The Nanoscale Circuits and Systems lab was founded with the vision to use advances in semiconductor technology in other areas of sciences

(Continued on page 6)

## 2004 Tufts Graduate Research Fair Presentations by MM-SMM lab members

Nawaf Almoayed – *High Resolution Dispersive Fourier Transform Spectrometry of Gases*

Adil Bahadoor – *Complex Permittivity and Permeability of Barium and Strontium Ferrite Powders in X, Ku, and K Band Ranges*

Usman Khan – *Millimeter and Submillimeter Wave Broadband Dielectric Measurements of Biological Liquids and Solvents*

Lakshmi Subramanian – *Complex Dielectric Measurements of Materials at Q-Band, V-Band, and W-Band Frequencies with High Power Sources*

(“From the Chair” continued from page 1)

year. Our papers and presentations were included in conferences such as IEEE InterMag and Magnetic Materials and Measurement Conference, in California;

International Ferrite Conferences in Nagoya, Japan; IEEE Instrumentation and Measurement Conference in Ottawa, Canada; American Physical Society Meeting; IEEE International Microwave Symposium in Long Beach, CA; URSI

General Assembly in New Delhi; and European Microwave Conference in Paris.

I am happy to report that the department is now in receipt of a large grant from the U.S. Navy in addition to our long time support from the U.S. Army. The new research contract involves the determination of unique resonance or signatures from microwave to terahertz frequency of common materials such as sugar, salt, flour, yeast, starch powder, and baking soda. Our Navy grant has allowed us to promote more undergraduate research opportunities. Nine sophomores were involved on grant-related projects this summer. This group of undergraduates is known as Team Research First One (RF-1). The team expects to present papers at international conferences next summer.

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

(“ECE & Chemistry...” continued from page 5)

and engineering. The lab aims to harness the increased levels of integration available in today’s CMOS technology to develop better sensors and instrumentations for chemical and medical diagnostic applications.

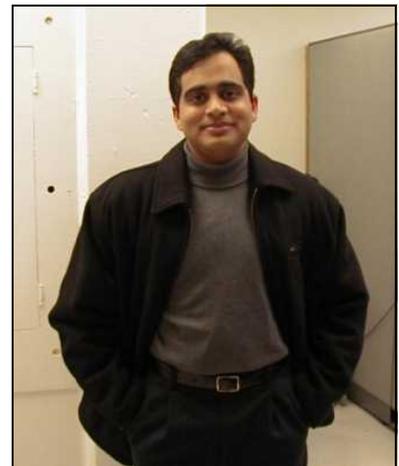
One such project is the development of the first-ever micro-electro-optical array interface in collaboration with Prof. David Walt of Chemistry. Walt’s group at Tufts has pioneered a way to fill metal in the capillary arrays of an optical fiber creating a dense array of electrodes that can be used for dual transduction capabilities – optical and electrical. Dual transduction using a dense microelectrode array will open doors for enhanced sensing applications in medicine and healthcare. For example, it could be used to observe either an electrical, or optical response of, the neuro-chemical reactions in the brain at the synaptic level. This was unachievable in the past. The main requirement for such application is to individually address each electrode in the microelectrode array. The Nanoscale Circuits and Systems Lab is

developing a complementary microelectrode array in silicon chip with built-in potentiostat and addressing logic to satisfy this requirement. The microchip will be vertically integrated with the fiber bundle to provide an integrated micro-electro-optical array on a single CMOS chip. This application shows how CMOS technology can be harnessed to further advances in the area of chemical diagnostics.

Other projects undertaken at the lab include a development of an advanced broadband dielectric spectroscopy front-end for portable chemical sensors and fluctuation enhanced sensing front-end for improved sensitivity in chemical and biological sensing. Both these projects provide techniques to improve selectivity and sensitivity from existing commercial sensors by using advanced signal processing techniques implemented on a single chip in low cost CMOS technology.

The lab takes great pride in providing resources for an integrated teaching and research experience to undergraduate and graduate students. Undergraduate

students are heavily involved in the core research activities of the lab. Matthew Toia and Loren Brichter were sophomores when they started working on an SRC sponsored design challenge which also includes three graduate students. The SRC design challenge was to create a CMOS camera on chip for smart visual surveillance in hazardous environments. The project is currently in its design phase and anticipates completion by the year end.



Professor Sameer Sonkusale

## What are RF-1 sophomores saying about lab opportunities for undergraduates?



While working in the Millimeter-Submillimeter Wave Labs, I have been studying the various techniques of studying the dielectric properties of samples. I have learned two techniques that use a network analyzer to obtain results, and another technique that uses the dispersive Fourier transform spectrometer, which can find results at much higher frequencies. It has been a fantastic opportunity to get to work with faculty and graduate students, using methods and techniques I learned in the classroom and being able to apply to real life engineering.

**Megan Duane, E'07**

My knowledge of waves and permittivity and permeability learned from basic engineering and physics courses allowed me to quickly pick up the work currently done in the lab, and also improve these methods. Through working everyday and further research, I have learned much more about waves, optics, and dielectric properties, and calculation techniques. Being able to apply what I have learned at such an early stage in my education has definitely given me a better perspective on the power of my studies and research.

**Nick Nguyen, E'07**



I worked with a team of doctors, professors, graduate students, and fellow undergraduates on projects funded by the Army and Navy and some of our own developing ideas. I learned how to operate the different machines used for testing all of our samples and I also learned how to process the collected data using numerous computer programs. Also, the research gave me the opportunity to apply some of the things I have been learning in the classroom and to continue to develop my technical knowledge in the field of electrical engineering.

**Sean McCooey, E'07**



The machine I became most familiar with was the Agilent Network Analyzer, utilizing both the waveguide and cavity technique to collect data. I learned how to calibrate and collect data from the network analyzer as well as process the data to give results that actually mean something. Overall, my time as a member of the research team has been a great experience and should help me prepare for future opportunities in the electrical engineering field.

**David Guen, E'07**



## Faculty Contact Information

Name	Title	Room	Phone	E-mail
Mohammed Afsar	Professor/Chair	Halligan 218	617-627-3129	mohammed.afsar@tufts.edu
Chong Hwa Chang	Associate Professor	Halligan 131	617-627-5178	hchang@ece.tufts.edu
Denis Ferment	Associate Professor	Halligan 242/225	617-627-5250	dferment@ece.tufts.edu
Valencia Joyner	Assistant Professor	Halligan 210	617-627-3217	vjoyner@ece.tufts.edu
Paul McCormack	Faculty Lecturer	Halligan Ext. 011	617-627-4977	mccormack@ece.tufts.edu
Joseph Noonan	Professor	Halligan 216	617-627-2490	jnoonan@ece.tufts.edu
Karen Panetta	Associate Professor	Halligan 236	617-627-5976	karen@ece.tufts.edu
Douglas Preis	Professor	Halligan 222	617-627-2492	dpreis@ece.tufts.edu
Sameer Sonkusale	Assistant Professor	Halligan 231A	617-627-5113	sameer@ece.tufts.edu

# 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.*



TUFTS UNIVERSITY  
DEPARTMENT OF ELECTRICAL AND  
COMPUTER ENGINEERING



Department Office:  
Halligan Hall, Room 101  
161 College Avenue  
Medford, MA 02155

Phone: 617-627-3217  
Fax: 617-627-3220  
E-mail: [ylandry@ece.tufts.edu](mailto:ylandry@ece.tufts.edu)

---

[WWW.ECE.TUFTS.EDU](http://WWW.ECE.TUFTS.EDU)

---