The 2016-2017 academic year brought much growth and success for the Tufts Electrical and Computer Engineering Department.

Under the leadership of Dean Jianmin Qu and Professor Karen Panetta, Dean of Graduate Education, 14 master's degrees and two doctoral degrees were awarded to ECE students at the School of Engineering Graduate Programs Ceremony on May 20. The next day, we celebrated those new graduates again, along with 17 newly minted graduates from our electrical engineering bachelor's program and another eight from our computer engineering program.

Despite our small size, Tufts' ECE students and alumni continue to be recognized for their contributions. This year four of our undergraduates were honored with academic prizes including: Andrew Bourhis, E17 (Lieutenant Commander R.J. Manning Memorial Prize), Jorge Anton Garcia, E17 (Prize Scholarship of the Class of 1882), Ryan Gill, E17 (Benjamin G. Brown Scholarship), and Danielle Skufca, E18 (Frederick Melvin Ellis Prize). Four of our seniors were also on the winning team at the 2017 $100K New Ventures Competition, Tufts' annual startup pitch contest. Jorge Anton Garcia, E17, Erika Marmol, E17, Jessica Morales, E17, Terence Tufuor, E17, and computer science major Andre Newland, E17, formed team Tarsier and won the top prize in the Healthcare/Life Science category with an accurate and accessible headset that can aid in the diagnosis and monitoring of glaucoma.

Accomplishments continue among our graduate students and alumni. At the 50th anniversary IEEE Asilomar Conference on Signals Systems and Computers, Ph.D. candidate Sam Safavi, advised by Associate Professor Usman Khan, won first place for best paper in the Networks category as well as the third-place prize for best overall conference paper for "A Distributed Range-Based Algorithm for Localization in Mobile Networks." Finally, the department was proud to learn that electrical engineering double-jumbo John Heffernan, E81, EG84, received the Presidential Award for Excellence in Mathematics and Science Teaching.

At the faculty level, we congratulate Usman Khan and Shuchin Aeron, who were both granted tenure and promoted to associate professor. Both joined the Tufts ECE department within six months of each other in 2011-2012. With their expertise in control and estimation (Khan) and signal processing and machine learning (Aeron), we are all looking forward to many years of fruitful collaboration with both professors. Beyond Medford, our faculty has assumed leadership positions across a range of professional organizations. Associate Professor Valencia Joyner Koomson was Technical Program chair for the 60th IEEE International Midwest Symposium on Circuits and Systems which was hosted on our campus in August 2017, while Associate Professor Tom Vandervelde has been elected chair of the Optics for Energy Technical Group for the Optical Society of America (OSA). Associate Professor Usman Khan has been named an associate editor for IEEE Control Systems Letters, and Associate Professor Shuchin Aeron was the lead guest editor for the recent special IEEE Transactions on Computational Imaging issue devoted to computational imaging in the earth sciences. Finally, Professor Karen Panetta continues to be a prominent national advocate for STEM education and STEM diversity, including an appearance with the Wall Street Journal’s Tech News Briefing podcast in late December, 2016, where she outlined the importance of computer science education for young children. She recently spoke with TechRepublic in April regarding her efforts in helping women with STEM degrees re-enter the workforce by mentoring college students during their capstone design experience.

We are proud of the many accomplishments of our talented faculty, students, and staff, and look forward to another successful year ahead.

Enjoy the remainder of this report,
Eric Miller, Professor and Chair
Faculty News

Associate Professor Mark Hempstead discusses the exciting momentum at Tufts Computer Architecture Lab

Can you tell us about your current research and supported projects?
I design computing solutions that are more energy-efficient than existing computing platforms. Because decisions about all components of a computing device—from the application software, to the operating system, circuit design, and architecture—affect energy consumption, my current set of research projects spans across hardware and software, from the design of energy-efficient circuits and microprocessor architecture, to next generation Internet of Things (IoT) devices.

For the past few years, we have been studying the power consumption of Android smartphones under the Power-Agile Project, which was funded by the National Science Foundation. We have developed new metrics and techniques to dynamically manage the power consumption of multiple components on a smartphone in response to changing application demands. This project highlights the interdisciplinary nature of my research and the wide range of skills necessary to tackle issues of power consumption. For example, my students and I collaborated with researchers in operating systems to modify the Android operating system; we have taken experimental measurements of smartphone power consumption; and we collaborated with industry on models of smartphone memory and microprocessors.

Can you elaborate on any recent grants or awards? Do they tie into your current research efforts?
I’m halfway through a project, funded by the NSF CAREER program, to study many-accelerator architectures in order to combat Dark Silicon. Basically, designers of microprocessors have noticed that power consumption is increasing so much that, while we can run processors faster than ever before, it is not possible to adequately cool computers to sustain that processor speed; thus, some parts of the processor need to run slowly or even be powered off, leaving parts of the silicon chip dark. Since we can’t demand more from our processors, we need to find ways to compute more with less.

One solution is to use application-specific circuits (hardware accelerators) that compute specific tasks 10-100 times more efficiently than a standard processor. My group is developing new methods to discover which software tasks to accelerate by measuring the software and finding similarities between software applications. These methods will help designers build more efficient hardware. In addition, the security of our computing devices is an increasing concern, so, as part of this project, we are looking to see if the computing of many accelerators raises any additional security concerns. The NSF CAREER program specifically aims to support researchers early in their careers who, besides having a strong research program, have a commitment to education and learning. In my opinion, this is a perfect description of what it means to be a Tufts faculty member.
What is your approach for balancing research, teaching, and advising roles at the university?

I personally find that my efforts in teaching and research are mutually beneficial. In class, I often find myself sharing things that I have learned at technical conferences with students; I especially like helping students to understand how innovations and open questions in the research community will affect their future careers. I’ve also found that teaching can lead to new research areas and projects. For example, last year I developed a new course on the Internet of Things with Professor Soha Hassoun in the Computer Science department. While it is a lot of work developing a course in a new area that does not yet have a definitive textbook, it motivates me to learn along with the students and discover some new research questions.

How does your research impact society? Are there any examples of real-world applications?

Computing touches all aspects of society. Many people interact with multiple computing devices in a single day and more often than not, these devices are battery-powered. The capacity of batteries is improving at a slower rate than the demand for computing—which is evident whenever you see a crowd of people and devices around an outlet in a coffee shop, hotel lobby, or airport. Most of my research projects focus on improving energy efficiency, which would allow users of devices such as smartphones to get more done with the same battery. That would both save energy and make it easier for users to rely on battery-powered devices in remote areas.

Any closing remarks about the future of your research interests? Where are you headed in the Computer Engineering/Architecture field?

It’s an exciting time to be a computer architect! The expanding need for energy-efficient computing and the technical challenges of manufacturing microprocessors mean that computer architects must get creative. Over the next few years, I will continue to expand my efforts to improve the energy efficiency of computing devices by developing new design techniques that leverage both hardware and software. I’m constantly talking with other Tufts faculty to discover new applications for computing that need efficient solutions and new materials for computing that my group could incorporate into computing devices.

I’m very excited to build a Tufts Computer Engineering program that can train students for these future challenges. Professor Eric Miller and the ECE department envision curriculum changes, new faculty, and relations with industry that reflect the unique position of computing engineering as a field—one located between hardware and software, and electrical engineering and computer science—to impact society.

Quick Notes

Associate Professor Tom Vandervelde was elevated to the rank of Senior Member of the IEEE, an honor held by fewer than eight percent of more than 415,000 members of this professional society.

He was elected chair of the Optics for Energy Technical Group for the Optical Society of America (OSA). His three-year term began in January 2017.

He also gave the keynote address at the 2017 Optics Society of America (OSA) IONS conference in Paris, France, on the topic of optics for energy.

Associate Professor Shuchin Aeron was granted tenure and was promoted to the rank of associate professor.

He was invited to participate in the fourth Arab-American Frontiers of Science, Engineering, and Medicine symposium, hosted by the Masdar Institute of Science Technology on its campus in Abu Dhabi.

In addition, he was named lead guest editor for a special issue of *IEEE Transactions on Computational Imaging*. Professor and Chair Eric Miller was a fellow guest editor on the issue. This achievement highlighted Tufts faculty members’ longstanding expertise in the area of imaging and image formation.

Associate Professor Usman Khan was granted tenure and was promoted to the rank of associate professor.

He also was elected to serve as a member of the BigData Special Interest Group within the IEEE Signal Processing Society.

Professor of the Practice Ron Lasser received the 2017 Henry and Madeline Fischer Award. Awarded annually to one faculty member in the School of Engineering, the award recognizes teaching excellence and dedication to inspiring and motivating students.

Professor of the Practice Brian Tracey received a Teaching with Technology Award for 2017. Nominated by students, the award recognizes instructors who use technology in new and inventive ways in the classroom.
Research Highlights

Associate Professor Valencia Joyner Koomson received a National Science Foundation grant to design, develop, and implement a new class of optoelectronic devices. The project is the first to use biometal-electroluminescence as a tool in biological research and to monitor/modulate electric activity of brain cellular systems. The research will contribute to neural technologies as a bridge between basic- and clinical-research, using a combination of tools and principles from biology, medicine, engineering, and material science.

Professor Sameer Sonkusale received a $1 million grant from the Office of Naval Research to build biomedical microdevices to investigate the gut microbiome. The project is a collaboration between Sonkusale, Associate Professor Qiaobing Xu, BME, and Assistant Professor Jimmy Crott, HNRCA.

Associate Professor Tom Vandervelde received a $470,000 ONR DURIP award to purchase a new IR ellipsometer system and to upgrade existing equipment. His research will continue to characterize material with light from 170nm to 20 microns, with sample temperatures from 80K to 600C.

Professor and Chair Eric Miller received Tufts Collaborates funding to develop a hybrid engineered cornea model with innervation and integrated electronics for pain modeling, working with Assistant Professor Brian Timko, BME.

Professor Aleksandar Stankovic received a $200,000 award from the National Science Foundation to pursue collaborative research involving differential geometry for model verification in energy systems. The project has the potential to result in economic, environmental, and resilience benefits by enabling more precise operation of future electricity markets and control in actual power plants and customer sites.

Chip-sized, high-speed terahertz modulator raises possibility of faster data transmission

Tufts University engineers have invented a chip-sized, high-speed modulator that operates at terahertz (THz) frequencies and at room temperature at low voltages without consuming DC power. The discovery could help fill the “THz gap” that is limiting development of new and more powerful wireless devices that could transmit data at significantly higher speeds than currently possible.

Measurements show the modulation cutoff frequency of the new device exceeded 14 gigahertz and has the potential to work above 1 THz, according to a paper published online in Scientific Reports. By contrast, cellular networks occupy bands that are much lower on the spectrum where the amount of data that can be transmitted is limited.

The device works through the interaction of confined THz waves in a novel slot waveguide with tunable, two-dimensional electron gas. The prototype device operated within the frequency band of 0.22-0.325 THz, which was chosen because it corresponded to available experimental facilities. The researchers say the device would work within other bands as well.

Although there is significant interest in using the THz band of the electromagnetic spectrum, which would enable the wireless transmission of data at speeds significantly faster than conventional technology, the band has been underutilized in part because of a lack of compact, on-chip components, such as modulators, transmitters, and receivers.

“This is a very promising device that can operate at terahertz frequencies, is miniaturized using mainstream semiconductor foundry, and is in the same form factor as current communication devices. It’s only one building block, but it could help to start filling the THz gap,” said corresponding author Sameer Sonkusale of Tufts Nao Lab and the Department of Electrical and Computer Engineering.

(P.K. Sing and S. Sonkusale, “High Speed Terahertz Modulator on the Chip Based on Tunable Terahertz Slot Waveguide,” Scientific Reports, published online Jan. 19, 2017. DOI: 10.1038/SREP40933.)
Professor and Dean of Graduate Education Karen Panetta continues to develop impressive new research, contribute to interdisciplinary projects, and sustain a strong academic presence at Tufts University.

Recently, Professor Panetta was awarded a United States Army Research Office (ARO) grant supporting her image processing and data science research, which analyzes eye tracking video to help cognitive scientists better understand an individual’s cognitive load and capacity for reasoning. This work also investigates how individuals approach and solve problems.

Analyzing eye tracking video doesn’t come without difficulties. Manually processing the extensive eye movement and sound data is time prohibitive, prone to human error, and doesn’t correlate the images to the audio of a person “thinking out loud.” The lack of automatic sound conversion solutions designed specifically for concurrent analysis with video data limits possibilities for exploring prosodic dimensions of speech. As such, prosody has only limited potential to serve as a substrate of composite measures for identifying states of confusion or high mental workload.

Professor Panetta’s Vision & Sensing System Laboratory developed a proof-of-concept algorithm for automating object recognition and characterization in large-scale video data. The system analyzes gaze-overlaid videos to identify and characterize the object the participant is looking at, along with other verbal clues to help better understand an individual’s cognitive state.

In addition to her research, Professor Panetta also collaborates with Jumbos for Jumbos: Tufts Elephant Conservation Alliance as part of the Tufts Institute for Human-Animal Interaction. As the first engineer to join the team, she works on the project with Tufts veterinarians, anthropologists, and faculty to develop novel methods for combating poaching, diagnosing and monitoring elephant health, and training park rangers with new technology.

Dedicated to bringing high-quality education to all students, Professor Panetta, Associate Professor Tom Vanderswalde, and Associate Professor Valencia Joyner Koomson were awarded a $1 million dollar NSF grant to help support low income students who wish to continue to graduate school after completing their undergraduate studies. The first FAST-TRAC scholarships were awarded in June 2017, and the cohort will now build upon their research training and mentorship experiences in the fall of 2017. The FAST-TRAC scholarships bring awareness to Tufts’ combined Bachelor of Science – Masters of Science program, allowing students the opportunity to complete two degrees in just five years. The scholarships provide financial, academic, and social support to economically disadvantaged students who embark on the five-year track.

Finally, Professor Panetta remains a strong presence in the electrical engineering community and was appointed Editor-in-Chief of IEEE Women in Engineering magazine, winning two APEX awards for Publication Excellence. She was also named the Associate Editor of the IEEE Transactions on Systems, Man, and Cybernetics journal. Lastly, Professor Panetta serves on the Board of Governors for both the IEEE Eta Kappa Nu society and the IEEE Systems, Man, and Cybernetics society.
At the 50th anniversary IEEE Asilomar Conference on Signals Systems, and Computers, Ph.D. candidate Sam Safavi won first place for the best paper in the Networks track, as well as the third-place prize for best paper of the entire conference. Advised by Associate Professor Usman Khan, Safavi wrote his paper on “A Distributed Range-Based Algorithm for Localization in Mobile Networks.”

Noel Hwang, E17, and Logan Garbarini, E18 were on a team of Tufts undergraduates that won first prize in the MakeMIT hackathon. Their team, Sphnx, developed a battery-operated sensor system to track a cyclist’s posture.

Lisa Fantini, E18, was named a 2017 Tufts summer scholar. She worked with Associate Professor Tom Vandervelde to study “Characterization of Thermophotovoltaic Cells.”

With Associate Professor Valencia Joyner Koomson, Professor Mohammed Afsar, and master’s student Tinghao Liang, senior Brian O’Keefe, E17, published the paper “Characterization of nanostructure ferrite material on gallium nitride on SiC substrate for millimeter wave integrated circuit” in American Institute of Physics Advances.

Tarsier won first place in the healthcare and life science category during the competition. Their headset system aims to eliminate several layers of glaucoma testing bias and give medical professionals higher quality data to make more informed decisions about their patients.

The students pitched their product as a replacement for the current visual field test; a machine where patients click a button when they see a dot of light at various sizes and brightness. The headset would minimize user error and begin tracking eye movements. The team researched basics of structured light, human eye simulations, Purkinje images, and Active IR (infra-red) light for eye detection and tracking during the creation process.

Tarsier is focused on reaching a wider range of audiences, specifically those at higher risk of glaucoma. They believe that no one should have to compromise their medical care, especially when it comes to their sight.

“A large part of our success is because of both the innovative approach for this device and our group dynamic. Everyone is committed, curious, and willing to go the extra mile, which makes all the difference when working on an open-ended problem,” Marmol said.
for glaucoma testing

At the beginning of their senior year, the team members embarked on their final capstone project, an Electrical Computer Engineering senior design class. Working for months, the team formed a camaraderie and passion for their project, causing Lasser to encourage the team to discuss a viable business model and focus on the impact for the future of glaucoma testing.

Anton-Garcia looks forward to their upcoming year pursuing their labor of love. He said, “We are going to continue doing what got us here: putting in a lot of hours of work, asking advice of people who have done this before, and being in constant contact with physicians, technicians, and patients who will be using the product.”

Defying gravity with an inverted pendulum

Summer scholar Anu Gamage, E18, spent her summer developing an inverted pendulum that could continue collecting accurate measurements and balancing itself in the case of a cyberattack.

Simply put, a pendulum is a weight suspended from a frictionless pivot. The common example is the swinging weight of a grandfather clock. When the clock’s pendulum is lifted to the side and dropped, a restoring force — due to gravity — accelerates it back toward its equilibrium position. An inverted pendulum, meanwhile, is precisely what it sounds like: a pendulum turned on its head. With its center of mass lying above its pivot point, an inverted pendulum cannot rely upon gravity to return it to its equilibrium position. In fact, gravity works against it.

Gamage gives the example of a childhood game with a pencil. “If you’re trying to balance a pencil on your hand, you have to constantly move your hand to apply force to balance it,” she says. The more complex inverted pendulums found in robotics systems typically have in-built sensors that allow the pendulum system to provide the appropriate amount of force to balance itself. What happens, though, when there’s a bug in the software?

Gamage’s plan is to separate the pendulum system from its sensor. A backup external sensor would allow the pendulum system to continue collecting accurate measurements and balancing itself in the case of a cyberattack or a bug that took down its internal sensor. Her project for the summer had three main stages. Step one was to build an actual inverted pendulum, collaborating with mechanical engineering major Chandler Coble to design and assemble the pendulum in Bray Laboratory. Gamage, meanwhile, also set up the sensors, microcontrollers, and motors necessary to control the system.

The second stage of the project was working with faculty advisor Associate Professor Usman Khan to develop mathematical models that could describe and predict the system’s behavior. For that stage, Gamage used the traditional method of an internal sensor as she figured out algorithms to control the pendulum. Her final step would be to build an external sensor, which was a camera system, to capture a running visual feed of the pendulum’s motion and process those images to get the data needed to control it.

Gamage will continue her project through at least the fall semester. She is currently finishing the second stage (working out the algorithms to control her inverted pendulum using an internal sensor) before moving on to using an external camera to control it. The pendulum currently can balance for small deviations, like if the pendulum is a few degrees off from a vertical line. Ideally, Gamage says, the pendulum will be robust for larger disturbances of tens of degrees.

It’s no small task, but Gamage — the incoming president of the Tufts IEEE student chapter as well as the newly elected treasurer for the Tufts Robotics Club — is up to the challenge.
Re-imagining music for an immersive, interactive listening experience

Can you imagine experiencing music in a three-dimensional sound space?

Tufts University seniors Joseph Cirone, E17, Kayla Neis, E17, and Gregory Warns, E17, set out to develop a new audio algorithm that would be used in virtual reality (VR) applications to create an immersive, interactive listening experience.

As a collaborative project for their senior Electrical and Computer Engineering capstone project, the team sought to develop a technology with the potential to substantially change the music industry. The project, sponsored by Bose Corporation, captured how virtual reality equipment can be utilized for future capabilities.

“We have been listening to music in stereo since the late 60s and it took many years to change from mono. Now with virtual reality, we no longer need things to be static. Our music listening experience can be controlled by user movements and we can even place sounds in a 3D location,” Cirone says.

Bose Corporation’s Alexander Coleman, an electrical engineer, began working with Cirone in the summer of 2016. Cirone became familiar with techniques to create realistic audio for virtual reality applications, including a technique called Head Related Transfer Functions (HRTF’s). Coleman then mentored the team during the school year, providing unique experiences including a tour of Bose’s facility and demos of VR equipment currently in production. Coleman went on to receive a mentorship award for his dedication to the team at the Electrical and Computer Engineering Awards Ceremony.

Using HRTF’s and the inertial measurement unit (IMU) method, the students were able to track head movement, an integral part of how humans localize sound, and create a spatial environment. IMU’s generally contain an accelerometer, a gyroscope, and a compass. The data from all three sensors can be combined to determine the position of the head. HRTF’s are used to enhance the spatialization for music by capturing local sound and externalizing it to perceive distance.

By adding HRTF’s to the project’s audio processing chain, the team could make music sound as if the user was hearing it externally, instead of coming from inside the ears.

“Being able to isolate different tracks and follow different instruments could completely change how society listens to and thinks of music,” said Neis.

Cirone, Neis, and Warns will be pursuing different avenues after graduating Tufts. However, the project may continue to grow thanks to interest from Bose Corporation and future seniors. Due to the project’s multidisciplinary appeal, student researchers and musicians alike feel strongly about the advancements of 3D spatial spaces. With the potential for musicians to test a new VR platform as well as the user’s ability to experience music in different environments, these seniors are pushing the boundaries of the virtual reality landscape.
Published Papers

Associate Professor Valencia Joyner Koomson and collaborators published “Dimming and Modulation for VLC-enabled Lighting” in a new edited volume called *Optical Wireless Communications – An Emerging Technology*.


Associate Professor Usman Khan and Chenguang Xi, EG17, published the paper “DEXTRA: A Fast Algorithm for Optimization Over Directed Graphs” in *IEEE Transactions on Automatic Control*.

Working with collaborators from the University of New Mexico and Resselaer Polytechnic Institute, Associate Professor Valencia Joyner Koomson, Ph.D. candidate Yun Miao, and Ali Mirvakili, EG14, published “A 6-m OOK VLC Link Using CMOS-compatible PN Photodiode and Commercially Available Red LED” in *IEEE Photonics Technology Letters*.

Associate Professor Valencia Joyner Koomson, Chirag Sthalekar, EG15, and Ph.D. candidate Yun Miao published “Optical characterization of tissue phantoms using a silicon integrated fNIRS system-on-chip” in *IEEE Transactions on Biomedical Circuits and Systems*.

Professor Sameer Sonkusale published the article “The next frontier in medical sensing: Threads coated in nanomaterials” in *The Conversation*. The article expanded on the advantages of embedding sensor functions into threads.

Associate Professor Tom Vandervelde and Ph.D. candidate Nicole Pfester published “Selective emitters for thermophotovoltaic applications” in *Physica Status Solidi A*.


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Graduate Student Highlights: Qianwen Wan

Qianwen (Wendy) Wan is a fourth year doctoral student working with Professor and Dean of Graduate Studies, Karen Panetta. Wan’s research focuses on eye movements’ deployment, prosody analysis, and underlying cognitive states prediction. Currently, she is collaborating with the Department of Psychology and the Center for Applied Brain and Cognitive Science. They aim to develop an image processing framework for analysis underlying cognitive status based on mobile eye tracking data and recorded sound data collected from participants seated in a laboratory setting as well as outdoor environments.

Wan works closely with Professor Panetta to achieve her research and career goals. She remembers that writing her first conference paper was a daunting experience. Professor Panetta provided insight and technical writing mentorship during the entire process. The conference paper was successfully published, marking a milestone for Wan.

“Working with [Professor Panetta] will be one of the best memories in my entire life. She is not only my research and academic mentor; she is also the mentor of my life,” she says.

Wan completed her master’s thesis and delivered several conference presentations under the same supportive mentorship. As an international student far away from family, Wan felt Professor Panetta was a key factor in adjusting to the new culture and environment, and relieved some of her homesickness. The best advice she received was to believe in herself, and she took it to heart.

Currently, Wan is focusing on completing her Ph.D. and continuing her research, which she hopes will have a significant impact on society in the future. Ultimately, her goal is to provide a human machine for monitoring, characterizing, and predicting individual and small team performance. For example, a real-life application could monitor a deployed soldier during a field mission while his commanding officer tracks his cognitive status based on collected data.

Because completing a Ph.D. is challenging work, Wan still enjoys spending her personal time outdoors, especially skiing.
Our Graduates

Doctor of Philosophy in Electrical Engineering:

Chenguang Xi (February 2017)  
Dissertation: Distributed Optimization Algorithms in Large-Scale Directed Networks  
Advisor: Associate Professor Usman Khan

Zemin Zhang (February 2017)  
Dissertation: A Novel Algebraic Framework for Processing Multidimensional Data: Theory and Application  
Advisor: Associate Professor Shuchin Aeron

Master of Science in Electrical Engineering:

Roza Bayrak (August 2016)  
Advisor: Professor Sameer Sonkusale

Alex Daniels  
Advisor: Associate Professor Mark Hempstead

Maria De Paolis Kaluza (August 2016)  
Advisor: Professor Eric Miller

Stephen Dennison  
Advisor: Professor Jeffrey Hopwood

Brian Herdeg (February, 2017)  
Advisor: Professor Mohammed Afsar

Arik Landsman  
Advisor: Professor Mohammed Afsar

Tinghao Liang (February 2017)  
Advisor: Professor Mohammed Afsar

Jason Morrow (February 2017)  
Advisor: Professor Eric Miller

Meera Punjiya (August 2016)  
Advisor: Professor Sameer Sonkusale

Christopher Sacca  
Advisor: Associate Professor Usman Khan

Steven Santos  
Advisor: Associate Professor Usman Khan

Michele Viani  
Advisor: Professor Mohammed Afsar

Gang Wang (August 2016)  
Advisor: Professor Aleksandar Stankovic

Tara Watson  
Advisor: Associate Professor Mark Hempstead

Bachelor of Science in Electrical Engineering:

Andrew Bourhis  
Ethan Chan  
Adam Chapman  
Joseph Cirone  
Arlo Clarke  
Andac Demir  
Ryan Gill  
Noel Hwang  
John Mei Jin Koh  
Trevor LeDoyt  
Ryan Maponga  
Michaela Nies  
Brian O’Keefe  
Kenneth Postigo  
Terence Tufuor  
Gregory Warns  
Sadie Woolf  
Jeffrey Wu  
Peter Wu

Bachelor of Science in Computer Engineering:

Saurav Acharya  
Oghenebefgo Ahia  
Jorge Anton Garcia  
Aaron Bowen  
Uyen Diep  
Erika Marmol  
Jessica Morales  
Tomer Shapira
ECE at a Glance

2016 - 2017

Degrees Awarded

- Ph.D.: 2
- M.S.: 14
- B.S.E.E.: 19
- B.S.C.E.: 8

Enrollments

- Total: 208
- B.S.E.E.: 66
- B.S.C.E.: 36
- M.S.: 55
- Ph.D.: 51

Research Expenditures

- Total: $3,317,654.90
- Direct: $2,549,742.02
- Indirect: $767,912.88

Publications

- 46 faculty published papers
A wireless device that would help secure vehicles and garage doors against replay attacks

Every year, students in Professor of the Practice Ron Lasser’s Senior Design Project class produce capstone projects. By the end of the year, the teams develop prototypes and technical notes on their work. In the process, students learn firsthand about innovative technologies and the design process, and they practice management, communication, and life skills that will serve them far beyond the Tufts campus.

Last year, senior teams worked on capstone projects that ranged from a drink tampering detection device to an autonomous search and rescue UAV. Alex Goldschmidt, Jake Hellman, and Alexander Yared came up with the idea for a wireless device that would add an extra layer of encryption to keyless entry systems. The device, which the team called Wireless Security for Keyless-entry (WiSK), would secure garage doors and vehicles against wireless attackers.

WiSK was designed to receive the wireless command, add an encrypted timestamp, and then transmit the message to a receiver that would make sure the message should be accepted. This added level of security would deter replay attacks, which car and garage doors manufactured prior to 2014 are particularly susceptible to.

After graduating from Tufts, Goldschmidt, Hellman, and Yared have continued to work on WiSK, and they recently filed for a provisional patent.
## Our Faculty

### DEPARTMENT CHAIR AND PROFESSOR

**Eric Miller**  
*Ph.D., Massachusetts Institute of Technology*  
Physics-based signal and image processing and inverse problems

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### PROFESSORS

- **Mohammed Nurul Afsar**  
  *Ph.D., University of London*  
  Precision microwave, millimeter, submillimeter, terahertz, infrared wave; solid, liquid and gaseous state physics, spectroscopy

- **Shuchin Aeron**  
  *Ph.D., Boston University*  
  Statistical Signal Processing (SSP), inverse problems, compressed sensing, information theory, convex optimization, machine learning

- **Valencia Joyner Koomson**  
  *Ph.D., University of Cambridge*  
  Design of silicon-based mixed-mode VLSI systems (analog, digital, RF, optical), analog signal processing

- **Douglas Preis**  
  *Ph.D., Utah State University*  
  Signal analysis, digital signal processing, audio engineering, electromagnetic theory

- **Jeffrey Hopwood**  
  *Ph.D., Michigan State University*  
  Microwave circuit design for microplasma generation, microplasma-based environmental sensors and other microsystem applications

- **Sameer Sonkusale**  
  *Ph.D., University of Pennsylvania*  
  Integrated circuits for sensors and instrumentation, nanoelectrochemical systems on silicon, CMOS image sensors for scientific imaging

- **Mark Hempstead**  
  *Ph.D., Harvard University*  
  Computer architecture, computer systems, power-aware computing, embedded systems, mobile computing

- **Mai Vu**  
  *Ph.D., Stanford University*  
  Network communications and signal processing

- **Usman Khan**  
  *Ph.D., Carnegie Mellon University*  
  Robotics, sensing in the context of distributed estimation and control algorithms, distributed, iterative algorithms in random environment

- **Tom Vandervelde**  
  *Ph.D., University of Virginia*  
  Interaction of light with matter, physics of nanostructures (semiconductor photonics and electronics) and interfaces

- **Karen Panetta**  
  *Ph.D., Northeastern University*  
  Image and signal processing for security and medical applications, modeling and simulation, multimedia

- **Aleksandar Stanković**  
  *Ph.D., Massachusetts Institute of Technology*  
  Analytical and experimental work involving modeling, control, and estimation in electric energy processing

- **Ronald Lasser**  
  *Ph.D., Carnegie Mellon University*  
  Digital image processing, computer animation, swarm robotics, innovation, engineering method and design

- **Brian Tracey**  
  *Ph.D., Massachusetts Institute of Technology*  
  Imaging techniques and image processing, computational acoustics and acoustical signal processing, biomedical signal processing and medical device development

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### ASSOCIATE PROFESSORS

- **Chong Hwa Chang**  
  *Ph.D., Drexel University*  
  Computer architecture, parallel processing, computer networking, hardware description languages, and programmable logic design

- **Karen Panetta**  
  *Ph.D., Northeastern University*  
  Image and signal processing for security and medical applications, modeling and simulation, multimedia

- **Sameer Sonkusale**  
  *Ph.D., University of Pennsylvania*  
  Integrated circuits for sensors and instrumentation, nanoelectrochemical systems on silicon, CMOS image sensors for scientific imaging

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