BOSTON UNIVERSITY

Department of Electrical & Computer Engineering

2014 - 2015 ANNUAL REPORT

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
Annual Report 2014-2015

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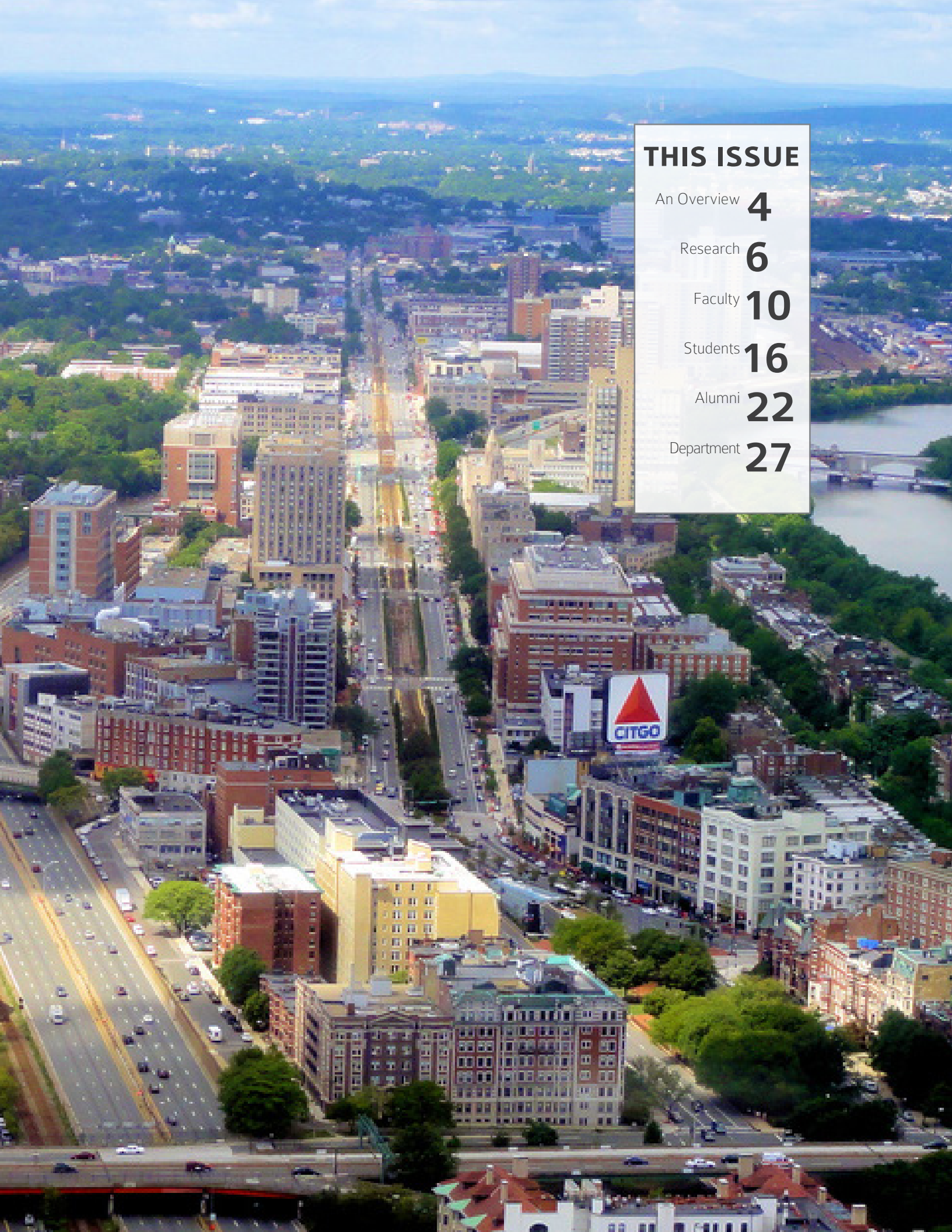


THIS ISSUE

Dean Kenneth R. Lutchen announced the appointment of W. Clem Karl (ECE, BME, SE) as the new chair of the Electrical and Computer Engineering Department, effective January. "He is a world-renowned researcher in his discipline, leader in the the professional community and an outstanding educator," said Lutchen. "He will provide extraordinary and visionary leadership to the department as the College embarks on its continuous commitment to growth in excellence."

MESSAGE FROM THE CHAIRMAN

Welcome to the Annual Report of the Boston University Department of Electrical and Computer Engineering! On the following pages you will find a summary of the accomplishments of the department and its 53 faculty over the 2014-2015 academic year. Enrollments are strong and growing with our new Masters specializations in Data Analytics, Cybersecurity and Robotics. Department grant revenue has grown by 23% over the last decade. Our campus wide initiatives in Data Science and Systems Neuroscience offer exciting future prospects.

I encourage you to check out how Yannis Paschalidis is using big data to improve health care on page 6. Read how Doug Densmore is creating a "Bio-Design Automation" system for synthetic biology by extending VLSI design methods on page 8. Or how Selim Unlu is combating Ebola using photonic sensors on page 9. These are just a few of the exciting research developments that happened last year.

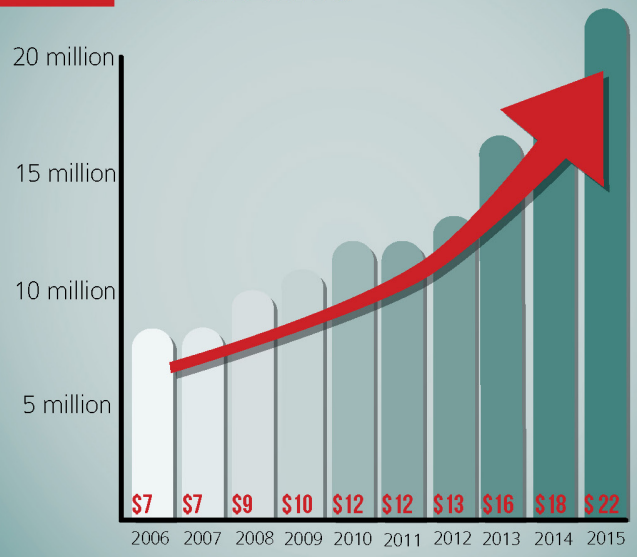
See how our students are becoming Societal Engineers and winning awards in the process on page 16. The startup company founded by a group of our juniors won the MIT Enterprise Forum's entrepreneurial business pitch competition. Our Senior Design program is a true jewel, including a team which won first place in the Intel-Cornell Cup last year. And this excellence continues in our graduate program with a graduate research team who won 2nd place in the IBM/IEEE Smarter Planet Competition.

The Department of Electrical and Computer Engineering is committed to a continued tradition of growth and excellence, building on our strong foundation to create a bright future. I invite you to visit the department to take a closer look at our programs, faculty and accomplishments. I look forward to seeing you on campus!

W. Clem Karl

23% GROWTH RATE over 10 years

RESEARCH FUNDING



STUDENTS ENROLLED

- 329 Bachelor of Science
- 98 Master of Science
- 121 Master of Engineering
- 103 Doctor of Philosophy

PUBLICATIONS

- 7 Books
- 12 Book Chapters
- 139 Journal Articles
- 112 Conference Papers
- 67 Invited Lectures
- 7 Patents & Patent Disclosures

FACULTY HONORS

- 1 Nobel Prize Winner
- 14 IEEE Fellows
- 3 National Academy Members
- 8 Other Society Fellows
- 2 Former IEEE Society Presidents
- 13 NFS CAREER Award Winners

DEGREES AWARDED

- 78 Bachelor of Science
- 54 Master of Science
- 59 Master of Engineering
- 11 Doctor of Philosophy

32% M.S. PROGRAM GROWTH RATE over 1 year

SPOTLIGHT

RESEARCH

Photo by Rick Davis, published in Synapse 2013, Vol. 1, "Additional Telemetry Rooms Will Expand Heart Monitoring Capacity."

BIG DATA & IMPROVING HEALTH CARE

DATA SCIENTIST AND PHYSICIAN TEAM UP TO REDUCE PREVENTABLE HOSPITALIZATIONS

YANNIS PASCHALIDIS, a data scientist, has built a career on making things run smoothly and efficiently—transportation systems, communication networks, supply chains, sensor networks—and now he's taking on perhaps his most ambitious challenge yet: the US health care system.

It all started about three years ago. Paschalidis, a professor and Distinguished Faculty Fellow at Boston University's College of Engineering (ENG), read in a study by the US Department of Health and Human Service's Agency for Healthcare Research and Quality (AHRQ) that in 2006, the US spent about $30.8 billion on hospitalizations that could have been prevented through better patient care, healthier patient behavior or improved ambulatory services.

"I was reading a lot of things about the sorry state of the health care system in the US and how inefficient it is, and I thought it's an opportunity to do something," said Paschalidis, who also directs BU's Center for Information & Systems Engineering. "I thought people like me that have a quantitative, more optimization-oriented background could contribute something."

And so, having never worked in medicine before, Paschalidis teamed up with William G. Adams, a Boston Medical Center (BMC) physician and BU School of Medicine professor of pediatrics. With a team of graduate students and nearly $2 million from the National Science Foundation, the two set out to build a piece of software that could automatically flag patients at increased risk for medical emergencies by using data from their electronic health records (EHRs). They decided to start with heart disease, which alone cost the US more than $9.5 billion in preventable hospitalizations in 2006, according to the AHRQ study.
In this project, hospital patients are the systems. The challenge for Paschalidis was understanding how to properly use medical data and how to incorporate this kind of software in an actual hospital. That's where Adams came in.

Fortunately, EHRs offer plenty of data—test results, diagnoses, prescriptions, emergency room (ER) visits, previous hospitalizations, demographic information. It's far too much for doctors and nurses to comb through manually, but enough to feed an algorithm that automatically processes the information and flags at-risk patients. The software works by sifting through records of patients who were previously hospitalized and learning which risk factor—a certain number of chest complaints or an unusual level of a particular enzyme in the heart, for example—might have been red flags. The algorithm then uses those red flags to warn of future hospitalizations.

A pediatrician and medical informatician (someone who uses information technology to improve health care), Adams has spent the past 20 years thinking about how to use data from EHRs to improve patients' health outcomes, especially among families in Boston's urban

communities. He's also one of the lead scientists at BU's Clinical & Translational Science Institute (CTSI), one of 60 such sites across the country that aim to accelerate medical advances by encouraging researchers in disparate fields to collaborate on medical research.

The researchers remove any identifying information from the EHRs using open-source software from a National Institutes of Health-funded center at Harvard University called i2b2 (Informatics for Integrating Biology & the Bedside).

"In medicine, we're constantly trying to balance between something that's concerning and something that might be a false positive," Adams said. In many cases, however, the recommendations that would come of a false positive—healthy eating, exercise, an extra check-in with the doctor, extra visits from a nurse—could still benefit the patient. And, Paschalidis said, preventing hospital visits that each cost thousands of dollars is worth the occasional unnecessary checkup that only costs a couple hundred dollars.

Adams and Paschalidis published their findings about the machine learning software's success in predicting heart-related hospitalizations in March 2015 in the International Journal of Medical Informatics. Their co-authors included VENKATESH SALIGRAMA, an ENG professor of electrical and systems engineering; WUYANG DAI and THEODORA BRISIMI, PhD students working with Paschalidis; and Theofanie Mela, a cardiologist at Massachusetts General Hospital.

"If coupled with preventive interventions, our methods have the potential to prevent a significant number of hospitalizations by identifying patients at greatest risk and enhancing their patient care before they are hospitalized," the researchers wrote in the study. "This can lead to better patient care, but also to substantial health care cost savings. In particular, if even a small fraction of the $30.8 billion spent annually on preventable hospitalizations can be realized in savings, this would offer significant results."
In the coming year, Paschalidis and Adams will be interviewing doctors, trying to figure out how best to put this kind of predictive software to work in an actual hospital.

"I'm confident that it will work," Paschalidis said. "The issue is, what is the best way of incorporating something like that in the practice? Will the doctors use it or ignore it?"

Down the road, Paschalidis said, it might also be possible to use data from wearable technologies in addition to EHR data. The data is there, he said; it's just a matter of getting access to it.

"We carry these smartphones and now these smart watches and all of these fitness trackers and other devices that know much more than the hospital knows about our state of health," he said. "You now have a much richer record about the patient, and the richer the record is, the better prediction you can make."

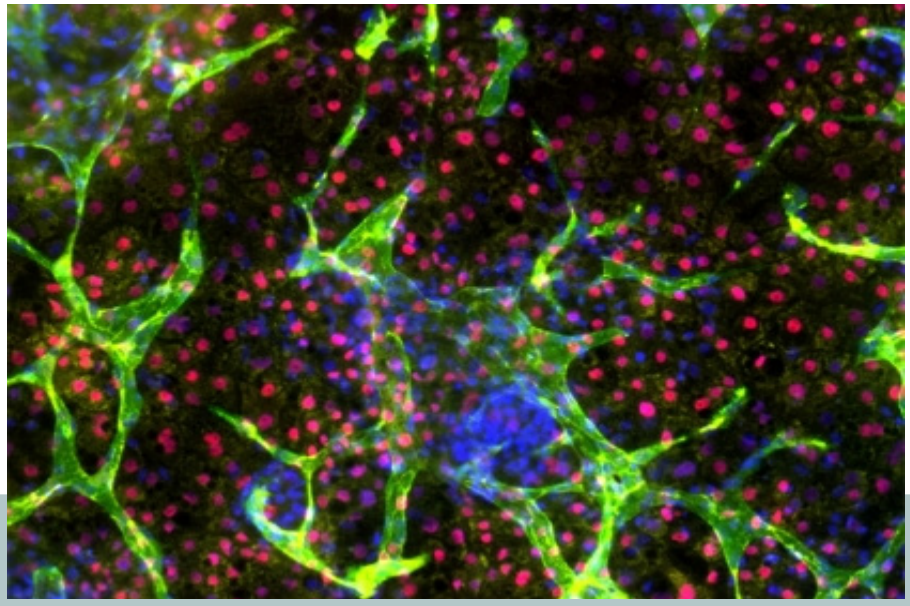
By Suzanne Jacobs, *BU Research*

DESIGNING AN INTELLIGENT URBAN ECOSYSTEM

Boston could benefit from "smart" traffic lights moving traffic efficiently, safer bike paths and other improved services that BU aims to develop through a new online platform. Photo by Rob Colonna

Professor Christos Cassandras (ECE, SE) is researching "smart" traffic lights capable of sensing when there's no cross-street traffic and staying green for motorists on a main thoroughfare. His research is part of Smart-city Cloud-based Open Platform and Ecosystem (SCOPE), a effort funded by a three-year, $850,00 grant from the NSF with the goal of developing cloud computing-based services and products to solve urban problems.

By Mark Dwortzan



Liver-like tissue formation in human-induced pluripotent stem cells. The research team's robotic approach to engineering living cells could lead to technologies that transform human stem cells into tissues and organs for transplantation or drug design. Image courtesy of the Weiss Lab, MIT

A ROBOTIC APPROACH TO LIVING CELLS

Researchers have long sought to enable collections of living cells to perform desired tasks that range from decontaminating waterways to growing tissue in the lab, but their efforts have largely relied on trial and error. Now a team of scientists and engineers led by Boston University is developing a more systematic approach through a deft combination of synthetic biology and micro-robotics.

Supported by a National Science Foundation (NSF) five-year, $4.5 million Cyber-Physical Systems Program (CPS) Frontier grant, the researchers aim to engineer bacterial or mammalian cells to exhibit specified behaviors and direct a fleet of micro-robots to corral the engineered cells into working together to perform desired tasks.

Drawing on experts in control theory, computer science, synthetic biology, robotics and design automation, the team includes Professor CALIN BELTA (ME, ECE, SE), the lead principal investigator and Associate Professor DOUGLAS DENSMORE (ECE, BME, Bioinformatics) from the BU College of Engineering, University of Pennsylvania Professor Vijay Kumar, MIT Professor Ron Weiss, who directs the Institute's Synthetic Biology Center and members of SRI International.

"We came up with the idea of bringing robotics in to control in a smart way the emergence of desired behavior patterns among collections of engineered cells," said Belta, who will develop algorithms to catalyze such behavior. "Our ultimate goal is to automate the entire process, from engineering individual cells to controlling their global behavior, so that any user could submit requests from the desktop."

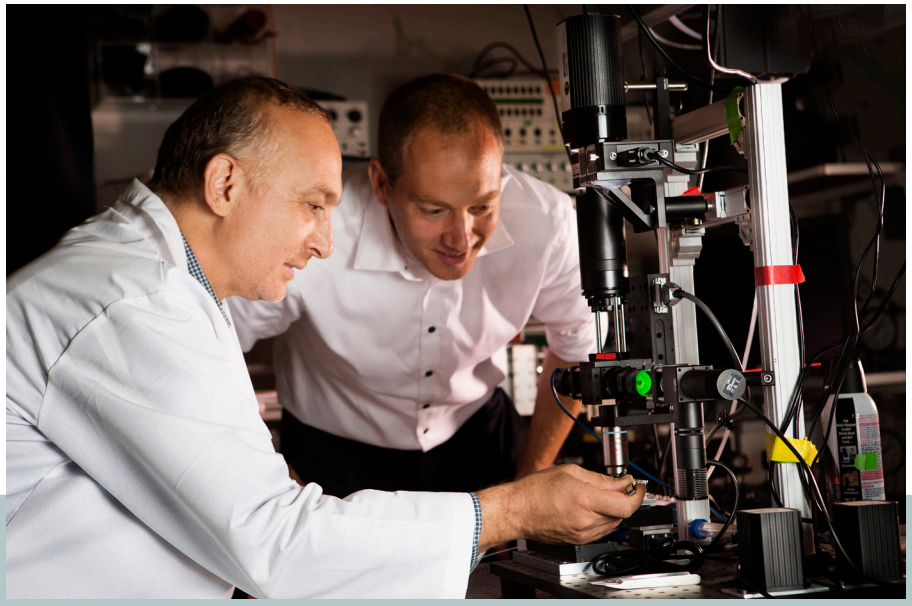
If successful, the research could yield new insights in developmental biology, lead to greater standardization and automation in synthetic biology and enable a diverse set of applications. These range from nanoscale robots that can manipulate objects at the micron (one-millionth of a meter) level to chip-scale technologies that transform stem cells into tissues and organs for human transplantation or drug design.

The team's first main challenge is to advance a synthetic biology platform—what it calls a Bio-Design Automation (BDA) workflow system—that can predictably engineer cells to sense their environment, make decisions and communicate with neighboring cells. To produce such "smart cells," Densmore will use and enhance software he's developed to specify, design and assemble gene networks (also known as gene circuits) with desired functions and insert them in living cells.

The second challenge is to design micron-scale, mobile robots that can affect cells' interactions so that they ultimately bring about a specified global behavior. Composed of organic and inorganic material and controlled by magnetic fields and light, each micro-robot interacts and communicates with individual cells at specified locations and times, implementing control strategies needed to achieve the desired global behavior. For example, the micro-robots could be controlled to optimize tissue formation from stem cells by triggering desired chemical reactions within the cells.

Finally, the researchers will test how well the micro-robots are able to direct the emergent, global behavior of collections of engineered bacterial cells and mammalian cells. They'll attempt to form Turing patterns—dots and patches of varying sizes—in E. coli and hamster ovarian cells and liver tissue from human stem cells. In the process, they will employ a magnetic manipulation system developed by SRI to control multiple robots with sub-millimeter precision.

By Mark Dwortzan



Ebola, Marburg and Lassa antibodies on the SP-IRIS surface capture nanoparticles corresponding to these viruses if present in a blood serum sample. The device then identifies and counts each virus particle based on its size. Image courtesy of Steve Prue.

CONTAINING EBOLA WITH NANOTECHNOLOGY

The US Centers for Disease Control and Prevention reports 1.4 million people in Guinea, Liberia, and Sierra Leone have been infected with the Ebola virus. 70 percent of people infected with the virus die.

One of the big problems hindering containment of Ebola is the cost and difficulty of diagnosing the disease when a patient is first seen. Conventional fluorescent label-based virus detection methods require expensive lab equipment, significant sample preparation, transport and processing times and extensive training to use. One potential solution may come from researchers at the College of Engineering and the School of Medicine, who have spent the past five years advancing a rapid, label-free, chip-scale photonic device that can provide affordable, simple and accurate on-site detection. The device could be used to diagnose Ebola and other hemorrhagic fever diseases in resource-limited countries.

The first demonstration of the concept, described in the American Chemical Society journal Nano Letters in 2010 and developed by Professor SELIM ÜNLÜ's (ECE, BME, MSE) research group in collaboration with Professor BENNETT GOLDBERG (Physics, BME, ECE), showed the ability to pinpoint and size single H1N1 virus particles. Now, after four years of refining the instrumentation in collaboration with Associate Professor John Connor (MED) and other hemorrhagic fever disease researchers at the University of Texas Medical Branch, the team has demonstrated the simultaneous detection of multiple viruses in blood serum samples—including viruses genetically modified to mimic the behavior of Ebola and the Marburg virus.

Mentioned in *Forbes* magazine as a potentially game-changing technology for the containment of Ebola, the device identifies individual viruses based on size variations due to distinct genome lengths and other factors. Funded by the National Institutes of Health, the research is showcased in ACS Nano.

"Others have developed different label-free systems, but none have been nearly as successful in detecting nanoscale viral particles in complex media," said Ünlü, referring to typical biological samples in which a mix of viruses, bacteria and proteins may be present. "Leveraging expertise in optical biosensors and hemorrhagic fever diseases, our collaborative research effort has produced a highly sensitive device with the potential to perform rapid diagnostics in clinical settings."

Whereas conventional methods can require up to an hour for sample preparation and two hours or more for processing, the current Boston University prototype requires little to no sample preparation time and delivers answers in about an hour.

"By minimizing sample preparation and handling, our system can reduce potential exposure to healthcare workers," said Connor. "And by looking for multiple viruses at the same time, patients can be diagnosed much more effectively."

The shoebox-sized prototype diagnostic device, known as the Single Particle Interferometric Reflectance Imaging Sensor (SP-IRIS), detects pathogens by shining light from multi-color LED sources on viral nanoparticles bound to the sensor surface by a coating of virus-specific antibodies. Interference of light reflected from the surface is modified by the presence of the particles, producing a distinct signal that reveals the size and shape of each particle. The sensor surface is very large and can capture the telltale responses of up to a million nanoparticles.

By Mark Dwortzan

SPOTLIGHT FACULTY

MOUSTAKAS NAMED DISTINGUISHED PROFESSOR OF PHOTONICS & OPTOELECTRONICS

Boston University Provost Jean Morrison has named Professor THEODORE MOUSTAKAS (ECE, MSE, Physics) as the inaugural Distinguished Professor of Photonics and Optoelectronics, the College of Engineering's first fully funded, named, endowed professorship. Intended to honor and support a BU faculty member with outstanding achievements in research, teaching and service in the fields of photonics and optoelectronics, the professorship will be jointly funded by the College of Engineering, the Boston University Office of the Provost and the BU Photonics Center.

Upon Moustakas' retirement, the professorship will be renamed as the Theodore Moustakas Professorship of Photonics and Optoelectronics.The College has begun an unprecedented international search for a senior faculty member in this area of engineering science who will be selected as the inaugural holder of the Moustakas Professorship.

"I am very pleased that Boston University named me as the inaugural Distinguished Professor of Photonics and Optoelectronics," said Moustakas, who has developed a wide range of novel optoelectronic materials and devices ranging from diamond thin films to nitride semiconductors. "Photonics and optoelectronics form the backbone of today's information technology, and the College of Engineering and the BU Photonics Center are world leaders in both domains. The establishment of this Distinguished Professorship will help the University in maintaining its leadership role in these areas."

Since Moustakas joined BU in 1987, the primary focus of his research has been the development of nitride semiconductors for high-performance optoelectronic devices covering the spectral region from the deep ultraviolet (UV) to terahertz. Such devices include light-emitting diodes (LEDs), photo-detectors and solar cells. He is well known for the development of the nucleation steps for the growth of blue/green LEDs, widely used in flat panel displays on smartphones and televisions as well as for general illumination. He has also developed highly-efficient, deep UV LEDs, which are expected to provide environmentally friendly water and air purification as well as food sterilization and various medical applications.

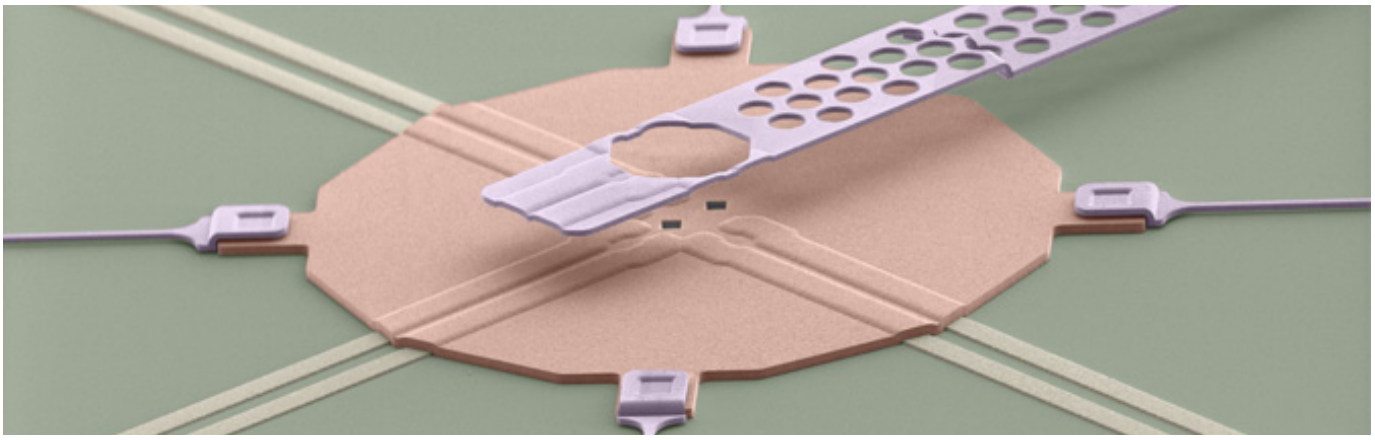
Moustakas has had a significant impact on his field through 31 US patents, hundreds of invited talks, 350 journal papers, eight co-edited books and more than 11,000 citations in research literature. Selected as the 2010 Molecular Beam Epitaxy (MBE) Innovator Award winner, he has been named a Fellow of the American Physical Society, Electrochemical Society, National Academy of Inventors and IEEE. Intellectual property resulting from his work has been licensed to a number of companies, including major manufacturers and users of blue LEDs and lasers. Moustakas is the co-founder of RayVio Corp., a venture-backed company that makes UV LEDs.

A professor of electrical and computer engineering since 1987, professor of physics since 1991, and the current associate head of the Division of Materials Science & Engineering, Moustakas helped in putting the MSE Division on the national map. He was the 2011 College of Engineering Distinguished Scholar Lecturer and winner of Boston University's 2013 Innovator of the Year award.

Moustakas took a lead role in propelling the ECE Department's PhD program into the nation's top-ranked programs and establishing BU as a national center of photonics research.

Prior to joining the BU faculty, Moustakas worked at Harvard University as a research fellow and Exxon Corporate Research Laboratories as a senior scientist. He received a BS in Physics from Aristotle University (Greece) and a PhD in Solid State Science and Engineering from Columbia University.

By Mark Dwortzan



Professor David Bishop (ECE, Physics, MSE) and collaborators at BU and Bell Laboratories have developed a low-cost, microelectromechanical system (MEMS)-based method that directs atoms onto a surface through tiny holes in silicon plates that move with nanometer precision.

MAKING NANO-MANUFACTURING VIABLE

BU researchers envision massproducing high-speed nanoscale devices ranging from integrated circuits to biosensors, but their aspirations have been hampered by a persistent inability to precisely manipulate nanomaterials to build reliable, functional products at a reasonable cost. In a nutshell, the key challenge has been to pattern extremely small materials at exact locations in a repeatable manner over relatively large surfaces all within a very short timeframe. Current nanomanufacturing processes are likely to become wasteful and/or expensive if applied on a commercial scale, potentially costing orders of magnitude more than the value of the devices or systems they're designed to build.

"Absent major breakthroughs in nanomanufacturing, the current trend in smartphones, laptops, PCs and other electronic devices toward smaller, faster, better and cheaper models may grind to a halt," said MSE Division Head and Professor DAVID BISHOP (ECE, Physics, MSE). But Bishop is confident that with sufficient investment, nanomanufacturing can evolve from a laboratory technology to one capable of generating commercial products on a massive scale within the next decade or two. In the cover story of the December 2014 edition of *Physics Today*, he and coauthor MATTHIAS IMBODEN, an ECE postdoc, explore three potential pathways—each requiring further research to overcome current limitations—to the high-speed, low-cost and scalable manufacture of devices with nanoscale features.

The first and primary avenue that nanomanufacturing researchers are pursuing is resist-based nanolithography, a nanoscale version of photolithography, commonly used today in the manufacture of semiconductor devices. In conventional photolithography, manufacturers pass light through a mask, which transfers the pattern of the mask (holes and traces of different shapes and sizes) to an intermediate photoresist layer, which, in turn, transfers it to a target device layer beneath it.

In nanolithography, the features or holes in the mask are on the order of one-billionth of a meter, resulting in similar-sized features on the manufactured device layer. To achieve deep nanoscale features—those sized below 100 nanometers—will require replacing visible light with something that has much shorter wavelengths, such as x-rays, which are hard to produce and focus, or electron beams, which now take a prohibitively long time to get the job done.

The second approach is nanoimprinting or nanostamping, a process akin to using a nanoscale rubber stamp. Capable of making identical copies of nanoscale features on a device layer, nanoimprinting could be ideal for manufacturing memory chips and magnetic displays. It works very well for single-layer systems in the lab, but has challenges ensuring that multiple layers of an integrated circuit or other nanomanufactured device will line up correctly.

The third strategy is to apply a direct writing technique, controlling the placement of atoms with nanoscale precision. An example of this is dip-pen lithography, which deploys atoms at precise locations on a device surface just as a ballpoint pen's inkball deposits ink on a piece of paper. Dip-pen lithography works with a variety of materials, but it's a slow, serial process, akin to writing out a newspaper with a pen.

"This is not a one-size-fits-all proposition," Bishop said. "One technique will probably not end up 'the winner,' but they'll all have regions of optimal applicability. Nanomanufacturers of the future may place different technologies on a chip that can be activated at different times to achieve different purposes."

By Mark Dwortzan

IEEE BEST PAPER AWARD

2,820 papers were submitted to the 2014 IEEE International Conference on Image Processing. 1,219 were accepted. 9 were honored as finalists, and two received top accolades. Boston University Professor VIVEK GOYAL (ECE) and the co-authors of "Computational 3D and Reflectivity Imaging with High Photon Efficiency" received the Best Paper Award.

The conference, held October 27-30 in Paris, draws the world's leading image and video processing engineers and scientists. Sponsored by IEEE Signal Processing Society, it is a premier forum for research in theoretical, experimental and applied image and video processing.

Assistant Professor Goyal co-authored the paper with his Ph.D. students Dongeek Shin (MIT) and Ahmed Kirmani (MIT), along with MIT Professor Jeffrey H. Shapiro. It proposed the field's most efficient imaging methodology in terms of the number of detected photons, besting the efficiency of "first-photon imaging" research also published by Goyal's team in early 2014.

The primary difference between these leading photon-efficient schemes relates to the pixel acquisition time. The new model simplifies the signal collecting process by applying similar theory and algorithms, but with deterministic acquisition durations.

By Gabriella McNevin

RECOGNITION

NATIONAL ACADEMY OF ENGINEERING SIMON RAMO FOUNDERS AWARD

Robert A. Brown
BU President and Professor

Brown received the NAE's Simon Ramo Founders Award in Washington, D.C. The award confers a commemorative medal on recipients whose achievements better society.

PROFESSOR OF THE YEAR

Alshaykh Osama
Adjunct Professor

ALSHAYKH OSAMA is CEO of NxTec. He was CTO of Packetvideo Corporation, Scientist at Rockwell and Visiting Researcher at University of California, Berkeley. Osama received a Ph.D in Electrical and Computer Engineering from Georgia Institute of Technology in 1996. He received the Fulbright Scholarship and served as Associate Editor for *IEEE Transactions on Circuits and Systems for Video Technology*. He has served as a consultant, board member and advisor for several companies and groups.

NASA EARLY CAREER AWARD

Jonathan Klamkin
Assistant Professor

KLAMKIN (ECE, MSE) is one of seven university researchers nationwide to receive the 2014 NASA Early Career Faculty Award. The recognition honors early career faculty focused on space technology that address critical needs in the US space program.

BILL BRIGHT MEMORIAL LECTURE

Mark Horenstein
Professor

In April in England, HORENSTEIN (ECE) delivered the Bill Bright Memorial Lecture at Electrostatics 2015, a quadrennial conference organized by the Institute of Physics.

INAUGURAL DISTINGUISHED PROFESSORS OF ENGINEERING SELIM ÜNLÜ & CHRISTOS CASSANDRAS

ÜNLÜ'S research is concerned with the development of photonic materials, devices and systems focused on the design, processing, characterization and modeling of semiconductor optoelectronic devices and high-resolution imaging and spectroscopy of semiconductor and biological materials.

The author of 163 peer-reviewed journal articles and an IEEE Fellow, he has served as editor-in-chief of the IEEE Journal of Quantum Electronics and as former chair of Photodetectors and Imaging, founding chair of Nanophotonics and current chair of Biophotonics technical committees for the IEEE Photonics Society. His awards include the IEEE Lasers and Electro-optics Society Distinguished Lecturer, the Photonics Society Distinguished Lecturer, the Australian Research Council Nanotechnology Network Distinguished Lecturer, the Turkish Scientific Foundation Science Award, the National Science Foundation CAREER and Office of Naval Research Young Investigator Awards.

At the College, Ünlü has served as the Associate Dean for Research and Graduate Programs and is now the Associate Dean for Research and Technology Development.

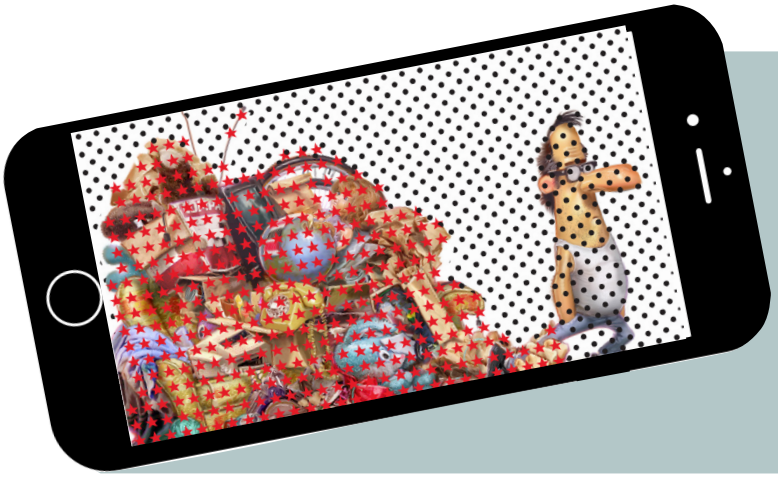
By Mark Dwortzen

CASSANDRAS' research centers on discrete event and hybrid systems, cooperative control, stochastic optimization and computer simulation, with applications to computer and sensor networks, manufacturing systems and transportation systems.

The author of more than 350 peer-reviewed journal articles, proceedings, and five books, Cassandras is a Fellow of the IEEE and IFAC. He has served as the president, vice president for publications and member of the board of governors of the IEEE Control Systems Society, and on the board of directors of the American Automatic Control Council. His awards include the IEEE Control Systems Technology Award, the Distinguished Member Award of the IEEE Control Systems Society, the Harold Chestnut Prize, the IEEE Distinguished Lecturer Award, a prize for the IBM/IEEE Smarter Planet Challenge competition, a Lilly Fellowship and a Kern Fellowship. A chair or plenary/keynote speaker at several conferences and guest editor of many technical journal issues, he has served as editor-in-chief (1998-2009) and earlier as editor of the IEEE Transactions on Automatic Control, and is the senior editor for the Journal of Control and Decision. He has worked extensively with industrial organizations on various systems integration and simulation projects. At the College of Engineering, Cassandras is Head of the Systems Engineering Division, a co-founder of the Center for Information and Systems Engineering, and was a Distinguished Lecturer.

By Mark Dwortzen

In March, US News & World Report published an article presenting Professor Christos Cassandras (ECE, SE) as a leader in academia at the forefront of a trend in graduate programs to bring student innovations to the marketplace.



With Dean's Catalyst Award funding, Professor Janusz Konrad (ECE) and Associate Professor Jordana Muroff (SSW) plan to develop an objective, automatic, image-based, real-time hoarding assessment algorithm running on a smartphone or tablet. Early result of automatic detection of clutter (red stars denote clutter; blue circles denote non-clutter). The severity of hoarding disorder is judged based on clutter. Graphic by Gabriella McNevin

AUTOMATING BEHAVIORAL & HEALTH CARE ASSESSMENTS

The College of Engineering has funded four new projects through the Dean's Catalyst Award (DCA) grant program. ENG and collaborating faculty will receive $40,000 per project to develop their technologies.

Professor JANUSZ KONRAD (ECE) and Associate Professor Jordana Muroff (SSW) will explore ways to automate the assessment of hoarding, a complex psychiatric disorder and public health problem characterized by persistent difficulty and distress associated with discarding of possessions. Current assessment methods of hoarding are subjective and time-consuming, as they require patients and/or clinicians to complete questionnaires or select images.

To overcome these drawbacks, Konrad and Muroff plan to develop an objective, automatic, image-based, real-time hoarding assessment algorithm running on a smartphone or tablet. Such technology could enable cost-effective, precisely-targeted mental healthcare for hoarding disorder patients.

By Mark Dwortzan

EFFECTIVE NEW APPROACH TO PHOTON DETECTION

Professor ENRICO BELLOTTI (ECE, MSE) won the Boston University Office of Technology Development (OTD) Ignition Award for research in "high sensitivity optical detectors in light starved applications. "The purpose of the Ignition Award is to help launch promising new technologies into the marketplace. Bellotti credits graduate students ADAM WICHMAN and BEN PINKIE for being driving forces in taking a fresh approach to Bellotti's mission.

The award will help develop an infrared detector prototype advanced by Belotti and based on a novel architecture invented by Wichman that overcomes deficiencies of existing technologies.

The team's invention will lead to more sensitive infrared detectors that can operate using less power and at higher temperatures, thereby eliminating the need for certain cooling devices required by the current generation of infrared cameras. This advance may enable novel applications, especially for portable devices where weight and power consumption are at a premium.

Ignition Award recipients participate in a program that supports further research and enables investigators to develop and position technology to be well-received by potential consumers. According to the OTD, "Ignition Awards help bring new technologies to a mature enough state where they can be licensed, spun off as a new venture or create a new, non-profit social enterprise."

Bellotti has pursued research on infrared detectors for more than a decade; he won an NSF Early Career Award in 2005 for his work on the physics of avalanche photon detectors.

By Gabriella McNevin

PAVLIDIS WINS IEEE DISTINGUISHED EDUCATOR AWARD

Professor DIMITRIS PAVLIDIS (ECE) received the 2015 Distinguished Educator Award from the IEEE Microwave Theory and Techniques Society (MTT-S). The award recognizes an individual who has achieved outstanding success in the field of microwave engineering and science as an educator, mentor, and role model for microwave engineers and engineering students. The award consists of a recognition plaque, a certificate and an honorarium of $2,500. Pavlidis was conferred at the IEEE International Microwave Symposium the week of 17-22 May 2015 in Phoenix, Arizona.

Pavlidis has pursued microwave research while remaining active in both academia and the microwave engineering industry. He boasts citation in more than 550 publications, and his work with semiconductor devices and circuits has had an extraordinary impact on high-speed, high-frequency and photonic applications.

Early in Pavlidis' career, he recognized the importance of mentoring engineering students, and in improving microwave engineering academic programs. In 1989 he introduced the first comprehensive Microwave Monolithic Integrated Circuits (MMIC) course, of many, that would be taught around the world. The MMIC course (IEEE Trans. on Education, 1989) was followed by courses covering design, processing and characterization of high frequency components; also, microwave and millimeter-wave circuits and devices. The courses have been well received by students, because they are structured to shed light on the fundamental principles of each topic, and simultaneously provide information on cutting-edge applications.

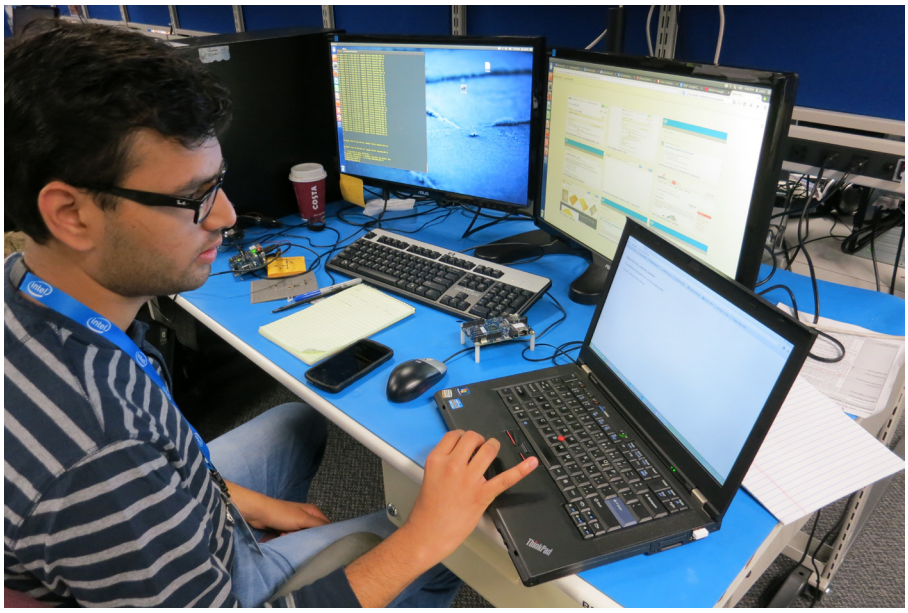
Pavlidis' decorated academic career is complemented by achievements in the field of microwave engineering. Pavlidis was involved in pioneering University Research Centers like the Space Terahertz Center and the High-Frequency Microelectronics Center and played a key role in establishing Nanofabrication facilities. Pavlidis is recognized for a dedication to advancing global microwave engineering efforts. He was appointed to be the Chair of the High Frequency Electronic Department at the Technical University of Darmstadt (TUD) and Director of International Relations at the Institute of Electronics, Microelectronics and Nanotechnology (IEMN). In this capacity, Pavlidis created an entirely new facility for high frequency micro-/nano-electronics at TUD that served for education and research. He introduced double-degree teaching programs between the universities that have been supported by the US Department of Education/EU Directorate General for Education and Culture (ATLANTIS Program) and Partner University Fund (PUF Program). He initiated major programs for graduate education through transatlantic mobility of students and obtaining of double degrees from US and European institutions. He played a key role in promoting microwave to terahertz engineering, chaired and assisted in the organization of numerous international and IEEE meetings and was the general TPC Chair of the 2010 European Microwave Conference.

His contributions to education continue as the program director of the National Science Foundation's Program on Electronic, Photonic and Magnetic Devices, Coordinator of future emerging technologies such as the Beyond Graphene (2DARE) program, and ECCS Coordinator of the Materials Genome (DMREF) program and various ERC Centers. In his present capacity, he is focused on boosting innovative potential by integrating the education of future scientists, engineers, and educators into a broad portfolio.

By Gabriella McNevin

Prof. Pavlidis (left) receives the Distinguished Educator Award from MMT-S Society President Tim Lee

SPOTLIGHT STUDENTS



CE MEng student Anish Shah working at an Intel lab. Photo courtesy of Intel.

STUDENT CREATES WHEELCHAIR TECHNOLOGY FOR INTEL

ANISH SHAH, a Boston University electrical and computer engineering graduate student, partnered with a team of Intel interns to develop a practical gateway device for improving the wheelchair experience and benefitting health care monitoring.

The team linked the wheelchair to the "Internet of Things" by developing technology that attaches to the chair and to the user to collect and send information. The technology monitors fluctuating data and transmits it to a second party by route of an Internet application, which will help caretakers respond in emergency situations.

Shah and his team discovered a huge variation in the needs of wheelchair users due to varying mobility and health restraints of each individual. To answer the range in needs, the team created technology that measured and sent information to Internet applications designed for different health and wellbeing needs.

The technology integrated a bio-harness able to track bio data of the wheelchair user – body measurements like heart rate, skin temperature, and the orientation of whoever sits in the wheelchair. The technology then connects to Internet applications specifically designed to allow health care providers to respond to emergency situations, as well as applications designed to improve how long-term internal vitals were monitored.

Another feature of the gateway device was mechanical data monitoring. Here, the orientation of the chair rather than that of the user was observed. This capability can be applied to identify mechanical usage patterns and anomalies.

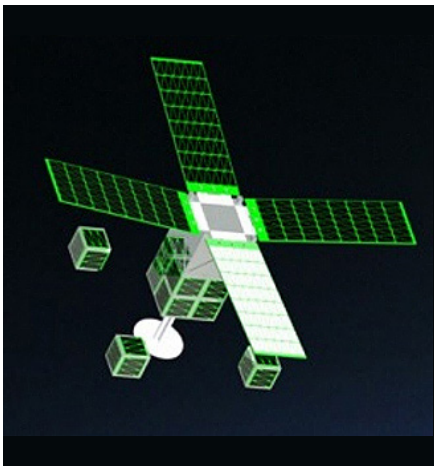
The wheelchair's battery was also connected to the internet-of-things to answer questions like, "Will the chair battery die tomorrow?" and "is the chair consuming an irregular amount of energy?"

Lastly, a geo-location monitor was enabled to benefit user navigation of urban areas. Wheelchair users could find wheelchair accessible venues and thus improve their future transportation preparations.

Stephen Hawking, world-renowned theoretical physicist and wheelchair user, publicly lauded the technological advancement in a video response for it's potential to change lives. "Medicine can't cure me, so I rely on technology," noted Hawking. "It lets me interface with the world. It propels me. It is how I'm speaking to you now. It is necessary for me to live."

Shah started the Intel internship one year into the Master of Engineering program at Boston University. He arrived at the Department of Electrical and Computer Engineering with an interest in embedded systems in 2013, and successfully applied the knowledge to create a device that received press coverage around the world. Now, he is working under Professor Thomas Little in Boston University's NSF Smart Lighting Engineering Research Center.

By Gabriella McNevin



A computer generated image of the satellite.

ANDESITE team presenting their satellite to a team of judges at the Air Force Final Competition Review (FCR) in Albuquerque, NM, February 2015. BU was one of 6 schools out of 16 selected to move on.

BU TO LAUNCH A SATELLITE IN THE FINAL ROUND OF A US AIR FORCE SPACE CHALLENGE

ONE OF SIX TEAMS SELECTED

ANDESITE, a task force within Boston University's Small Satellite Program, qualified to launch a self-designed satellite into orbit. The team is one of six that qualified for the final round of the US Air Force University Nanosat Program competition.

The ANDESITE satellite is on the forefront of an international movement to advance our understanding of "space weather" and its effects on society. Space weather arises from interactions between the Earth's plasma environment and the impinging solar wind. These interactions can damage satellites, harm astronauts in space, render GPS information erratic and unreliable, disrupt ground-space communications and even cause electricity blackouts on Earth. In 2013, the White House raised inadequate space weather forecasting to the global agenda, citing the significant "threat to modern systems posed by space weather events" and "the potential for "significant societal, economic, national security and health impacts."

The ANDESITE satellite has been designed to deploy a network of magnetic sensors from a central mother ship. The ejected sensors will operate collectively as a space-based wireless mesh network with the aim of studying fine-scale variations in Earth's geomagnetic environment caused by space weather events. The ANDESITE satellite's scientific and technological innovations place it at the cutting edge of the burgeoning cubesat movement.

ANDESITE is a unique interdisciplinary university-wide collaboration. The team of 16 students is comprised of Astronomy, Electrical, Computer and Mechanical Engineering scholars. The group is under the guidance of two faculty advisors Joshua Semeter (ECE/Photonics) and Ray Nagem (ME). Research Engineer Aleks Zosuls also provides support and acts as a liaison with the Engineering Product Innovation Center (EPIC).

The qualifying competition took place in the Kirtland Air Force Base in Albuquerque, New Mexico in February 2015. Now, the qualifiers must shift their focus from satellite fabrication to implementation. The University Nanosat Program will provide Air Force technical guidance and $110,000 to support each of the remaining six competitors.

By Gabriella McNevin

REAL-WORLD ENGINEERING

To graduate with an ECE degree, each senior must complete a team-driven capstone project in which each team designs and prototypes a product, electronic device or software system. Teams work with real-world customers—industry figures, small businesses, government, non-profits, schools, artists, faculty and staff. Below are six award winners, recognized for developing market-ready prototypes.

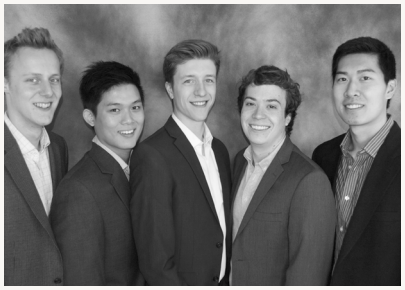
BEST ECE SENIOR DESIGN AWARD

GROWBOX

Students developed a low-cost, fully-automated, mobile app-controlled, hydroponic plant-growing box.

Team Members: Jesse Fordyce, Patrick Crawford, Alexandru Rosca, Ahmed Alfuwaires, Mark Barrasso
Customer: *Professor David Freedman, Boston University*

ECE DESIGN EXCELLENCE AWARD



INTERFACE DEVICE FOR LOCALLY CONFIGURING A FIELD CONTROLLER

The team worked with Schneider Electric to create an interface device for locally configuring a field controller. The product is a digital interface that mounts on a wall and tracks critical facility systems. It aims to improve the access building engineers have to the hardware configurations, which buildings operate on.

Team Members: *Oliver Baverstam, Clement Su, Anthony Domenick, John Moore, Sean Liu*
Customer: *Todd Snide, Schneider Electric*

ECE DESIGN EXCELLENCE AWARD

TOMOGRAPHY OF THE EYE

Students created a prototype called Tomography of the Eye to be an imaging system capable of obtaining accurate tomographic images of the anterior segment of the eye. To do so, the engineers developed functional software and an application source code.

Team Members: *Conner Richmond, Boshan Mo, Mounika Vutukuru, Gaukhar Yestemirova and James Bezuk*
Customer: *Matt Carnevale*

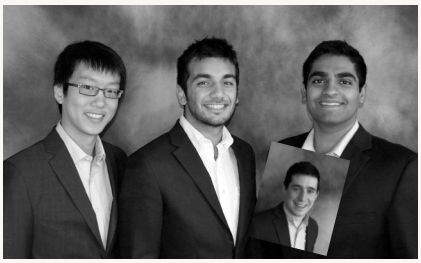
ECE DESIGN EXCELLENCE AWARD

SMART GRID TEST FACILITY

The team engineered a much-needed educational tool for electric energy courses. The final product supports active learning by students by offering a method for visual demonstration and a tool for hands-on experiments.

Team Members: *Jeremy Kramer, Edward Leung, Marissa Petersile, Christopher Powers, Suleyman Kahyaoglu*
Customer: *Prof. Horenstein, Boston University*

ECE ENTREPRENEURIAL AWARD



LYFECYCLE

The LyfeCycle team created a product to lessen the street biking dangers that are related to route planning and visibility. LyfeCycle is an iOS mobile map application that enables the user to be alert to high-accident locations. Additionally, it provides a light source that makes people uniquely aware of the biker.

Team Members: *Alexander Wong, Deven Dayal, Kanav Dhir, Kevin Mannix*
Customer: *Professor Osama AlShaykh, Boston University*

ENG SOCIETAL IMPACT AWARD

CARTER SCHOOL ANNOUNCEMENT SYSTEM

The team created an automated device that delivers a personalized greeting to Carter School students. The team won the ENG Societal Impact Award because the technology helps students with serious mental and physical disabilities make associations between cause and effect. The device develops cognitive skills, while complementing the Carter School learning environment.

Team Members: *Yicheng Pan, Sihang Zhou, Alexis Weaver, Sinan Eren, Jose Bautista*
Customer: *Principal Marianne Kopaczynski, Carter School*

MICHAEL F. RUANE AWARD FOR EXCELLENCE

JOHN MOOORE

This award is presented to the individual recognized by faculty and by his or her peers to embody the principles of engineering teamwork and design. This individual has demonstrated significant leadership by contributing to team cohesion and success, has maintained exceptional engineering record keeping and has adhered to best practices of the engineering design cycle.

INTEL-CORNELL CUP WINNER

GrowBox, an ECE senior design team made up of Ahmed Alfuwaires, Mark Barrasso, Patrick Crawford, Sasha Rosca and Jesse Fordyce, was named First Place winner at the fourth annual Intel-Cornell Cup, an undergraduate competition focused on innovative applications of embedded technology. The team developed a low-cost, fully-automated, mobile-app controlled, hydroponic plant growing box. GrowBox uses an iOS app that controls everything a plant needs to grow successfully.

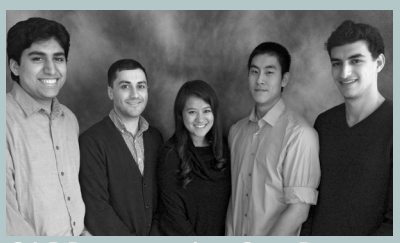
Stackable and suitable for small spaces, each unit senses key aspects of a solution of water and nutrients, modifies the solution as needed, adjusts water and lighting and uses image processing to track stages of plant growth so care can be optimized.

Vying with 21 other finalists from across the country, Team GrowBox emerged not only with one of seven $2,500 First Place awards but also the competition's People's Choice Award of $1,000.

"The key innovative aspect of the project is the clever use of image processing technology as well as the modular design of the GrowBox," said Associate Professor Alan Pisano, the lead faculty member for the ECE Senior Project Design course. Going forward, the team hopes to turn this research into a successful business, using the award money to jumpstart the project.

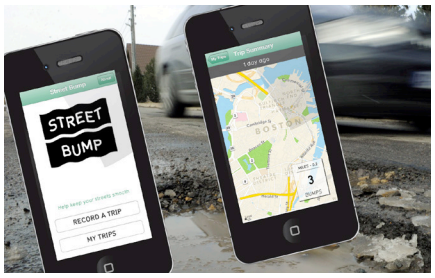
Team C.A.R.R. (Cyclist Alert Real-time Response), which notifies drivers of potential collisions with approaching cyclists, received one of seven Second Place awards at the annual Intel-Cornell Cup

By Mark Dwortzan



C.A.R.R. team members Omar Rana, Luke Poitras, Caroline Wu, Jason Tow, Jeremy Bensabat

ENABLING BOSTON TO BECOME A SMARTER CITY



PROJECT NETS 2ND PLACE IN IBM/IEEE SMARTER PLANET COMPETITION

As part of a multifaceted collaboration to create technology to solve urban problems, the City of Boston and a Boston University-led research team developed an iPhone app, Street Bump, to upgrade management of local road repairs. Now IBM and IEEE have recognized Street Bump as a significant contribution to Boston, awarding its developers the second place prize in the "IBM Students for a Smarter Planet/IEEE Smarter Planet Challenge: Student Projects Changing the World" competition.

The team's project, "Street Bumps and Big Data Analytics: Crowdsourcing Our Way to Better Roads," was honored for demonstrating engineering expertise and a commitment to improving the world. Advised by Professor CHRISTOS CASSANDRAS (ECE, SE) and Professor YANNIS PASCHALIDIS (ECE, SE, BME), the team included graduate students THEODORA BRISIMI (ECE), Yue Zhang (SE), WUYANG DAI (ECE), Setareh Ariafar (SE) and Nicholas Baladis (MIT). All BU researchers are affiliated with the Center for Information and Systems Engineering (CISE).

Used by city employees and citizens, Street Bump was designed to facilitate crowdsourcing as a means of collecting relevant road condition data. The app leverages the iPhone's accelerometer to detect road bumps sensed during a trip, transmitting the data to the City of Boston, where it is used to alert repair crews of road damage. The algorithms analyze the data received by the City and classify the detected bumps as "actionable" or "non-actionable." Severe bumps like potholes are actionable and can be prioritized in scheduling repairs. The team collaborated with The City of Boston's Office of New Urban Mechanics, which provided actual data from the City's servers.

Another BU-based app guided by Cassandras, Smart Parking, won second place in the same competition in 2011.

By Gabriella McNevin

DISSERTATIONS

Student	Advisor	Dissertation Title
Tenzile Cilingiroglu Berkin	Selim Unlu	A Sparsity-Based Framework for Resolution Enhancement in Optical Fault Analysis of Integrated Circuits
Delaram Motamed-vaziri	Venkatesh Saligrama	High Dimensional Inference and Non-Linear Measure-ment Channels
Haiding Sun	Theodore Moustakas	Development of Aluminum Gallium Nitride-Based Emitters Operating in the UV and the Visible Spec-tral Ranges
Wuyang Dai	Yannis Paschilids	Detection and Prediction Problems with Applications in Personalized Health Care
Joseph Wang	Venkatesh Salingrama	Local Learning by Partitioning
Hang Chen	Anna Swan	Carbon Nanotubes and Nanohoops: Probing the Vibrational Properties and Electron-phonon Coupling using Raman Spectroscopy
Andrew Fraine	Alexander Sergienko	Engineering Photonic Entanglement
Hassanali Akbari	Joshua Semeter	Micro-Scale Plasma Processes in the Auroral Plasma
Mahmoud Zangeneh	Ajay Joshi	Designing Energy-efficient Sub-threshold Logic Circuits Using Equalization and Non-volatile Memory Circuits Using Memristors
Chhavi Goenka	Joshua Semeter	Liquid Crystal Hyperspectral Imager
Pankil Butala	Thomas Little	Optical MIMO Communication Systems Under Il-lumination Constraints
Xirui Zhang (BME)	Selim Unlu	Dual-Spectral Interferometric Sensor for Quantitative Study of Protein-DNA Interactions
Abdulkadir Yurt (MSE)	Selim Unlu	Subsurface Optical Microscopy of SemiConductor Integrated Circuits
Xuchao Lin (SE)	Christos Cassandras	Optimal Control Approaches for Persistent Monitoring Problem
Mohammad Moghadasi (SE)	Yannis Paschalidis	Optimization Methods for Side-Chain Positioning and Macromolecular Docking
Jing Qian (SE)	Venkatesh Saligrama	Unsupervised Learning in High-Dimensional Space
Jing Wang (SE)	Yannis Paschalidis	Anomaly Detection and Dynamic Decision Making for Stochastic Systems

RECOGNITION

GRADUATE TEACHING FELLOW OF THE YEAR

MICHAEL HIRSCH is a Ph.D. candidate in electrical engineering jointly with ECE and the Center for Space Physics. His primary research is in high speed geospace remote sensing via advanced optical and machine vision applications.

BEST DISSERTATION AWARD

MAHMOUD ZANGENEH won the award for a dissertation titled "Designing Energy-efficient Sub-threshold Logic Circuits Using Equalization and Non-volatile Memory Circuits Using Memristors."Professor JOSHI advised Zangeneh.

IEEE PES SCHOLARSHIP

MARISSA PETERSILE (EE'15) won an IEEE Power & Energy Society (PES) Scholarship. PES is the world's largest forum for technological developments in the electric power industry. The $2,000, up-to-three-year scholarship program recognizes outstanding undergraduate electrical engineering students.

PUBLISHED

ANNIE LANE (CE'16) published an article on data center power and cost management in Circuit Cellular in November. Lane, who received a Clare Boothe Luce Scholar Award earlier in 2014, studies data center power and cost optimization strategies at the Performance and Energy-Aware Computing Lab.

DOWNTYME WINS BOSTON BUSINESS COMPETITION

STARTUP FOUNDED BY JUNIORS WOWS INNOVATION DISTRICT AUDIENCE

A team of BU students won the MIT Enterprise Forum's second annual Beantown Throwdown entrepreneurial business pitch competition this past year. Their entry – Downtyme, an app that enables users to meet up with others who are available and nearby – started out of their final project for an introduction to software engineering course. Co-founded by BARRON ROTH and LUKE SORENSON (both CE '16), the start-up's cross-functional team included JOHN MOORE (CE '15), Nick Sorensen (SMG '14), DARRYL JOHNSON (CE '17) and Ben Pusey (CAS '16). With an award of over $20,000 in in-kind legal and marketing services, mentoring and office space, the team was able to release the app's full version in January.

By Mark Dwortzan

SPOTLIGHT ALUMNI

A START-UP THAT CONNECTS SOLAR PANELS TO THE CLOUD

Michael Sun, ECE alumni, has found a new way to pass "green energy" to consumers. Sun, along with partners Cory Absi, an undergraduate at Boston University, and Xiaohang Li, formed a startup called CloudSolar.

The start-up operates by selling and installing solar panels for customers in centralized solar farms. CloudSolar sells the green energy generated from these panels to utility companies, benefitting the environment. Customers, in turn, receive a check from CloudSolar every three months for twenty five years.

Although this is an unconventional way to distribute solar energy, it will likely mitigate the drawbacks of buying solar panels, which include the high cost, unattractiveness of the panels and impracticality in places that do not receive much sunlight.

The startup began taking orders on the Indiegogo crowdfunding site at a goal of $300,000. As of March 2015, one-third of that goal was already reached. The company handles all paperwork, installation and maintenance of solar panels—which range from quarter to full—and provides owners with a mobile app, which shows their panels' energy output. Absi measures customers to get a full return on their purchase in ten to twelve years, realizing profits after that.

Owning a solar panel in a remote location is one of several new ways for consumers to join the solar movement and be environmentally conscious without sacrificing their home's aesthetic in the process. Sun and his partners are confident that CloudSolar is a smart way to invest in solar energy.

By Rebecca Jahnke (COM '17)

ALUM NAMED IN FORBES' 30 UNDER 30 LIST

Atlas cofounders Michael Kasparian (ECE '12, MS'13) and Peter Li, who created a wearable fitness tracker with 3D body tracking and advanced data analytics, were listed in Forbes' 2015 "30 Under 30: Consumer Tech."

INEXPENSIVE HANDHELD DEVICE THAT SCANS ONE'S EYE

Around 30 percent of people in the United States are nearsighted, and for most of them, the solution is simple: go to the eye doctor and get corrective lenses.

For most of the world, however, it's not so easy. About 90 percent of the world's visually impaired people live in low-income settings, according to the World Health Organization (WHO). Often, there are no eye doctors available to them. Without access to an eye exam or corrective lenses, simple nearsightedness becomes debilitating.

Two ECE graduates, YAOPENG ZHOU and MARC ALBANESE, are trying to change those statistics. They have invented a handheld device called Smart Vision One (SVOne) that scans one's eyes, instantly determines whether he or she needs glasses and decides the prescription. Bolstered by a $1 million 2013 Powerful Answers award from Verizon, their company, Smart Vision Labs, is poised to start manufacturing and delivering SVOne devices in early 2015.

"This could be big," said Thomas Bifano, director of BU's Photonics Center, who advised both Zhou and Albanese on their theses at BU and now serves on their board of directors. "If this caught on, it could be so cheap that everyone has one...It has the potential to be hugely disruptive."

The device is a small block of plastic, a little larger than a deck of playing cards, which slips over an iPhone. To perform an exam, one would hold the device (technically known as a "wavefront aberrometer") up to a patient's eye. Light shines into the eye so that curves and imperfections will cause beams of light to bend. A sensor collects this information, the computer in the iPhone interprets it and the result is a prescription specific to that eye.

Traditionally, optometrists have determined eyeglass prescriptions by asking patients to look through a phoropter, a bulky device on a swivel arm containing multiple lenses. "It's a big, clunky, subjective measure," said Albanese. "What we have is a small, portable device that offers you an objective number. It just gives you the answer! All you have to do is look straight."

The genesis for the device came over a decade ago, when both Zhou and Albanese were working on their graduate degrees in electrical engineering at BU's College of Engineering. Professor Bifano was invited to join a team from Schepens Eye Research Institute that was working with a grant from the National Institutes of Health (NIH) to use adaptive optics for taking better resolution photos of the mouse retina.

In the summer of 2002, Bifano chose Zhou and Albanese to join the team at Schepens to help develop the technology in mice. "The eye is a window into all these health issues," said Albanese. "Our goal was to see the blood flow in the retina, but it's not a clear optical path."

Eventually Zhou and Albanese wrapped up their work on the project and went their separate ways. In 2012, while both Zhou and Albanese were in New York, Zhou started thinking again of his work at Schepens. He and his old friend Marc Albanese met up, and they discussed the worldwide problem of the lack of access to eye care physicians, bringing about the idea of SVOne.

In the following years, technology had changed to their advantage. The two decided to work on the project together and formed a company. While they worked on optical problems, they also started raising money. In 2013, they won $75,000 in the NYU business plan competition that was followed by a $100,000 grant from Founders.org. Then, in January 2014, they received a $1 million award from Verizon.

They now have 11 working devices—all handmade—and will soon start production in Boston for 100 more. They are now accepting preorders for the SVOne and expect the first orders to ship out in early 2015. The device costs $3,950 with an iPhone, compared to other similar devices on the market, which cost between $15,000 and $40,000.

By Barbara Moran, *BU Research*

David Freedman's winning pitch on the startup stage at Consumer Electronic Show®, presented by Up Global.

TECHNOLOGY TO IMPROVE HEALTH CARE

NexGen Arrays develops light-based virus detection tests that could improve the health care industry. Alumnus David Freedman (ECE '09, @DScottFreedman) is the company Co-Founder.

NexGen Arrays' developments include both tests to rapidly identify viruses that cause hemorrhagic fevers like Ebola, Lassa and Marburg and additional tests in partnership with clinical collaborators in oncology and diabetes.

NexGen Arrays' tests are used at the patient's health care site, resulting in actionable clinical information. This deviates from standard sensitive diagnostic tests that require a full lab at a separate location, making them less timely. The new technology grew from biomedical optics research in Professor M. Selim Unlu's (@MSelimUnlu) laboratory.

NexGen Arrays collaborates with Becton Dickerson (BD), John Connor from the BU School of Medicine and the BU Photonics Center. The mission has received funding from the National Science Foundation (NSF) Smart Lighting Engineering Research Center, the National Institute of Health (NIH) and industrial partners.

The future of NexGen Array looks bright to Freedman. "I'm excited for 2015. We're growing rapidly and are positioning ourselves for great commercial success."

By Gabriella McNevin

Standing before hundreds of associates, suppliers and nonprofit organizations at Walmart's 2014 Global Sustainability Milestone Meeting in October, Walmart Foundation President and Walmart Senior Vice President (Sustainability) Kathleen McLaughlin (ECE'87) announced the company's commitment to create a more sustainable food system. "We want to benefit the customer. We want to benefit society. And we want to do it in a way that is good for business as well," said McLaughlin. Photo courtesy of Walmart.

SOCIETAL ENGINEERING AT WALMART

The world will need to find a way to boost food supplies by 70 percent by 2050, when the global population is expected to reach 9.5 billion. Achieving that goal requires better distribution systems and farmers who can increase yields considerably while reducing water consumption and greenhouse gas (GHG) emissions.

Enter Walmart, the world's biggest food retailer, serving 27 countries in 11,000 stores around the world. Working with its global network of suppliers and applying funding through the Walmart Foundation, the company is taking a leading role in providing safe, affordable, accessible, healthy food for hundreds of millions of people. Walmart's efforts include applying a "sustainability index" to suppliers to measure their progress in boosting yields and helping to train one million farmers. Through such initiatives, the company aims to increase practice in sustainable agriculture, thereby reducing the real cost of food—not only to the planet but also to the farmers and customers upon which its business depends.

Leading the team behind this ambitious program is KATHLEEN MCLAUGHLIN (ECE'87), who serves as president of the Walmart Foundation and senior vice president of Walmart in charge of social and environmental initiatives, including energy efficiency, hunger relief and healthy eating and women's economic empowerment.

"We're taking a holistic approach in which we look at the problem as a system and partner with others to address it," she said. "The problem-solving training I got in engineering, in systems thinking and feedback loops, is highly relevant in our efforts to rewire how the food system works."

On any given day, McLaughlin applies that training to several Walmart programs designed to simultaneously serve the needs of the business and the communities it serves—what she calls the double bottom line.

McLaughlin routinely applies the double bottom line to sustainable agriculture, recycling and other social and environmental commitments by Walmart and the Walmart Foundation that range from achieving zero waste to landfills in its operations by 2025 to sourcing an incremental $20 billion from women-owned businesses for its US business through 2016.

As she pursues these commitments, she repeatedly asks herself, "How can we continue to improve what we're doing so it's sustainable for the business and its suppliers, employees and customers, and strengthens the communities in which we operate?"

MAKING A DIFFERENCE

Concerned with global environmental issues and social justice from a young age, McLaughlin has devoted her career to making a difference.

Taking after her father, an electrical engineer, she developed an affinity for math and science and felt naturally drawn to undergraduate programs in engineering. She also maintained several other interests, from vocal music to international affairs, which she found ample opportunity to explore by pursuing her engineering studies at Boston University, where she was a Trustee Scholar. It was a University Professors Program course in the multinational politics of business—on how collaborations among businesses, governments and nonprofit organizations could thrive in an emerging era of globalization—which opened McLaughlin's eyes as to how she might combine her passions for engineering and societal impact.

"The course made me realize I had this passion for technology, but I wanted to pursue it in development, and I needed to learn more about economics and politics," she recalled.

When then-College of Engineering Dean Louis Padulo suggested that she might spend two years pursuing that knowledge at Oxford University as a Rhodes Scholar, she applied and was accepted. Upon graduating from BU summa cum laude, she earned a BA/MA degree in politics, philosophy and economics and a diploma in theology at Oxford. She spent the next two decades engaged in global commerce and development issues as a consultant for McKinsey and Company, a global management consulting firm, where she became a senior partner based in Toronto.

IMPACTING THE GLOBE

At McKinsey, McLaughlin worked with multinational companies that were expanding their operations into the Americas, Europe and Asia. She spent one-third of her time as director of the firm's Social Innovation Practice, partnering with corporate, philanthropic and nongovernmental agencies on programs to improve global health, nutrition and agricultural practices in developing countries.

She led efforts to spur more efficient government responses to HIV/AIDS in Africa and helped government and nongovernmental organizations (NGOs) in Namibia strategize on how to reduce maternal mortality.

In 2013, when Walmart offered her the chance to apply her development expertise on a much broader scale, she seized the opportunity.

"The private sector has resources that are critical to addressing important global challenges," said McLaughlin, now one year at her post at Walmart. "I believe we have limited time on the environmental and social inequality fronts, and companies can collaborate with governments and NGOs to shift the system more rapidly."

Charged to effect social and environmental change on a global scale, McLaughlin works with a team of Walmart associates to design and execute an ambitious portfolio of Walmart and Walmart Foundation initiatives. In addition, she oversees multiple Walmart teams working on energy efficiency, hunger and other domains, as well as improving sustainability of selected consumer product categories such as electronics and apparel.

To tackle such complex challenges at Walmart and McKinsey, McLaughlin has turned, time and time again, to her grounding in engineering, which she calls "the perfect underpinning" for everything she's done since graduating from BU. "It has served me very well in structuring ambiguous problems, taking them apart, dissecting them and solving them," she says. "It's such a fantastic foundation for pretty much anything you want to do in life."

By Mark Dwortzan

McLaughlin at a volunteer event in December at the Northwest Arkansas Food Bank, which serves more than 700,000 people annually. The NWA Food Bank is affiliated with Feeding America, the nation's largest hunger relief organization and beneficiary of the company's fall hunger campaign, in which Walmart teamed up with six of the nation's largest food companies to distribute $3.7 million, the monetary equivalent of more than 37 million meals, to Feeding America's food banks and local agencies throughout the US. Photo courtesy of Walmart.

UPDATE DEPARTMENT

PROFESSOR EMERITUS KINCAID PASSES AWAY

Professor Emeritus THOMAS G. KINCAID, a longtime faculty member and former chair of the ECE Department, died on January 18 at the age of 77. He joined Boston University faculty in 1983, served as ECE chair from 1983 to 1994 and retired in 2006.

Kincaid's research focused on signal and image processing, photonics, dynamic neural networks and nondestructive testing. He taught courses in engineering and in logic design, signals and systems, and advised graduate students pursuing degrees in electrical engineering. Previously, he worked as a researcher for General Electric. A member of the IEEE, he received his PhD from MIT in 1965.

As ECE chair, Kincaid increased the size of the department by more than fifty percent, hiring faculty who included three future ECE chairs—ECE Professors Bahaa Saleh (Emeritus), David Castanon (SE) and W. Clem Karl (BME, SE). He also increased the size of the graduate program and focused it on doctoral education.

By Mark Dwortzan

NEW HIRES

LECTURER
Osama Al Shakh

PROFESSOR OF THE PRACTICE
Orran Krieger

ASSISTANT PROFESSOR
Manuel Egele

ASSISTANT PROFESSOR
Sahar Sharifzedeh

LECTURER
Tali Moreshet

PROMOTIONS

ASSOCIATE PROFESSOR TO PROFESSOR

Martin Herbordt

Roberto Paiella

ASSISTANT PROFESSOR TO ASSOCIATE PROFESSOR

Ayse Coskun

Douglas Densmore

Vivek Goyal

ECE FACULTY

Clem Karl
Professor & Chair

Mark Horenstein
Professor & Senior Associate Chair of Undergraduate Studies

Hamid Nawab
Professor & Senior Associate Chair of Graduate Studies

Enrico Bellotti
Professor

Swapnil Bhatia
Research Assistant Professor

Irving Bigio
Professor

David Bishop
Professor

Richard Brower
Professor

Robert Brown
Professor and President

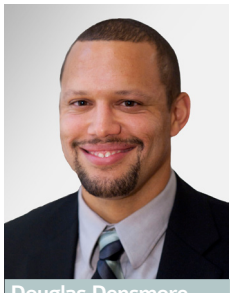
Jeffrey Carruthers
Associate Professor

Christos Cassandras
Professor

David Castañón
Professor

Ayse Coskun
Associate Professor

Luca Dal Negro
Associate Professor



Douglas Densmore
Associate Professor

Roscoe Giles
Professor

Robert Gray
Research Professor

Vivek Goyal
Associate Professor

Martin Herbordt
Professor

Allyn Hubbard
Professor

Prakash Ishwar
Associate Professor

Ajay Joshi
Assistant Professor

Mark Karpovsky
Professor

Gerd Keiser
Reseacrh Professor

Ronald Knepper
Professor

Janusz Konrad
Professor

Robert Kotiuga
Associate Professor

Min-Chang Lee
Professor

Lev Levitin
Distinguished Professor

Thomas Little
Professor

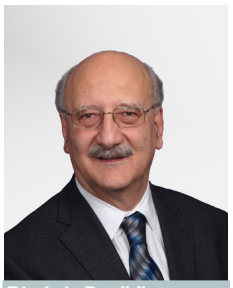
Malay Mazumder
Research Professor

Theodore Moustakas
Professor

Bobak Nazer
Assistant Professor

Roberto Paiella
Professor

Ioannis Paschalidis
Professor



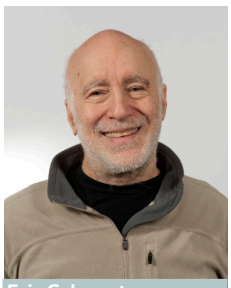
Dimitris Pavlidis
Research Professor

Alan Pisano
Associate Professor of the Practice

Siddharth Ramachandran
Professor

Venkatesh Salingrama
Professor

Michelle Sander
Assistant Professor



Eric Schwartz
Professor

Joshua Semeter
Professor

Alexander Sergienko
Professor

David Starobinski
Professor

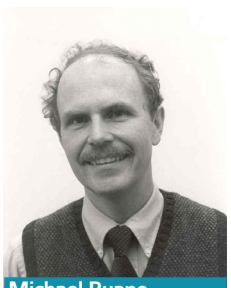
Anna Swan
Associate Professor

Ari Trachtenberg
Professor

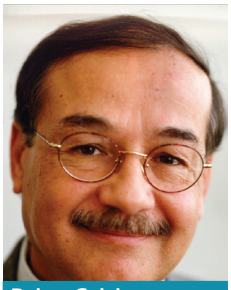
Selim Ünlü
Professor

Theodore Morse
Professor Emeritus

David Perreault
Professor Emeritus



Michael Ruane
Professor Emeritus



Bahaa Saleh
Professor Emeritus

Malvin Teich
Professor Emeritus

Richard Vidale
Professor Emeritus

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Calin Belta
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Department of Mechanical Engineering

Solomon Eisenberg
Professor & Chairman
Department of Biomedical Engineering

Farouk El-Baz
Research Professor
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