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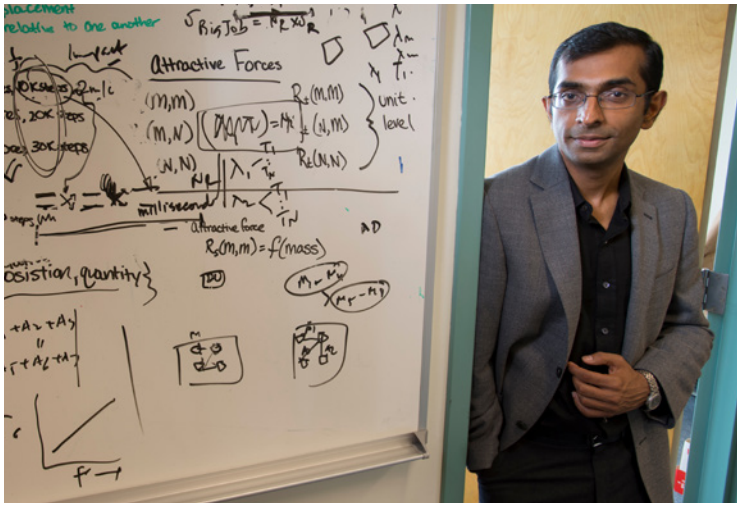

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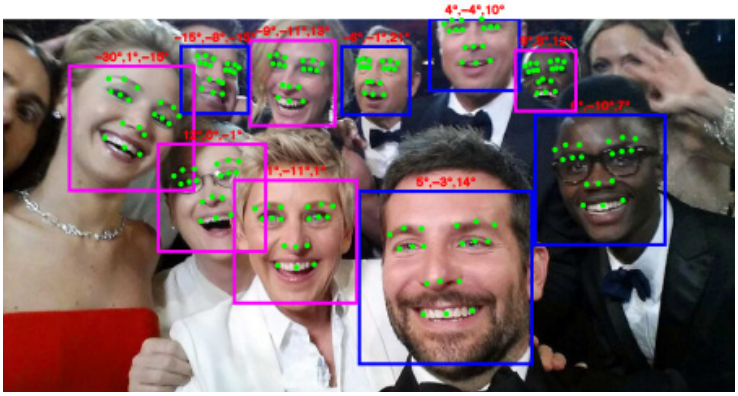

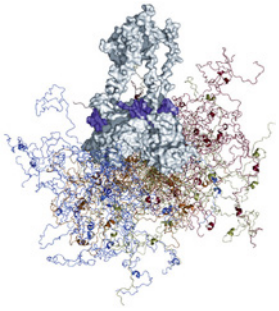

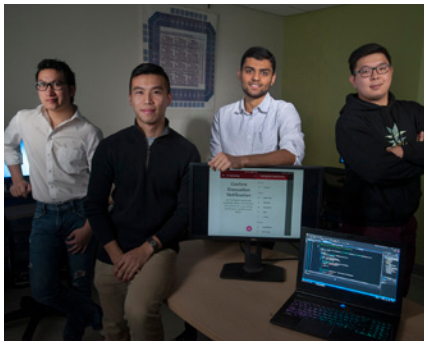

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ECE News is also available at **www.ece.rutgers.edu** or can be mailed by sending a request to **eceadmin@ece.rutgers.edu**

Visit us at **www.ece.rutgers.edu**

message from the Chair

N. Mandayam

ECE Numbers

37 Faculty

9 Part-Time Lecturers

757 Undergraduate Students

350 Graduate Students

Space: **51,115 sq. ft.**

Annual Research Expenditures: **$8,000,000**

New Research Grants: **$7,250,000**

It is my pleasure to share with you some exciting news about my department during this past academic year. Before I do that, I would like to offer my sincere thanks to Professor Athina Petropulu, for her tremendous leadership as Chair over the last 6 years and wish her well as she heads off to a well-earned sabbatical.

Our department continues to see an influx of highly talented faculty members contributing expertise in important emerging areas, such as signal and information processing, security, privacy, cyberphysical systems, bioelectrical engineering, big data and high performance computing. In addition to the 11 faculty members hired over the last 5 years, we welcomed this spring Professor Emina Soljanin. This Fall, we also welcomed teaching faculty members Assistant Professor John McGarvey and instructor Dr. Maria Striki.

Our faculty and students have made ECE at Rutgers into one the most vibrant departments, creating a community that fosters excellence in education and research. This excellence is reflected in the remarkable successes and outstanding achievements of both our students and faculty members alike. Highlights include an Office of Naval Research (ONR) Young Investigator Award for Assistant Professor Vishal Patel, who was also named the A. Walter Tyson Assistant Professor; an invitation to speak at the White House National Strategic Computing Initiative (NSCI) for Professor Shantenu Jha who also is playing a key role in the $20M Molecular Science Software Institute (MoISSI) funded by the National Science Foundation (NSF); and a best paper award for a WINLAB team led by Distinguished Professor Dipankar Raychaudhuri and Professor Wade Trappe at IEEE DySPAN, the premier conference on spectrum policy and technology. Also, Assistant Professor Janne Lindqvist's research on Bitcoin was featured multiple times in mainstream national and international media. Like the year before, this year too was marked with a large number of external grants, with research expenditures in the department pushing ~$8M.

ECE graduate students amassed a large number of awards and recognitions, including the Google Anita Borg Scholarship for graduate student Parneet Kaur; a best paper award at IEEE COMSNETS for graduate student Hajar Mahdavi-Doost; and a best student paper award at the IEEE IMVSP Workshop for graduate student Tong Wu. Graduate student Shubham Jain's work on pedestrian safety using smartphones was featured in the Wall Street journal. ECE undergraduate student teams won prizes for their research projects at several national competitions such as first place at the 7x24 Exchange Metro NYU Challenge, 2nd place at the HackHarvard Competition and were part of the Rutgers-University of Maryland team invited to the final stage of the SpaceX hosted Hyperloop Pod Competition. Further, our students received a large number of competitive travel grants to conferences from professional societies.

Consistent with this excellence, our student enrollment has grown dramatically with our incoming sophomore class size at over 250 students (a ~ 50% increase from the last year!) and the incoming graduate student class size at well over 100 students. Our international program with a top tier university in China continues to flourish and bring us excellent students. ECE also remains one of the most sought after majors for employers from a broad spectrum of industry, with the fundamentals that ECE students are exposed to here making them versatile and productive employees from day one.

This was a great year for our alumni, whose amazing success is a source of inspiration to our students and faculty. Our department has produced outstanding scholars, industry leaders, entrepreneurs. You can meet some of them on page 29-30.

In our pursuit of excellence the support of our alumni and friends is essential. I would like to thank everybody who supported us this past year. Through this support we were able to supplement startup packages of new faculty, provide student fellowships, support student travel to conferences and maintain state-of-art laboratories.

I am very proud of the accomplishments highlighted in this newsletter. Please visit us next time your travels bring you to our area, to experience up close the vibrancy of this department.

Sincerely,

Narayan Mandayam
Distinguished Professor and Chair

ecefaculty

Waheed U. Bajwa
Assistant Professor
NSF Career Award, ARO YIP Award
Research Interests: High-dimensional inference and inverse problems, compressed sensing, statistical signal processing, wireless communications, and applications in biological sciences, complex networked systems, and radar & image processing.

Grigore Burdea
Professor
NSF Initiation Award
Research Interests: Virtual rehabilitation, telerehabilitation, haptics virtual reality.

Kristin Dana
Professor
NSF Career Award,
ASCE Charles Pankow Award
Research Interests: Computer vision, pattern recognition, machine learning, convex optimization, novel cameras, camera networks, computer graphics, robotics.

Maryam Mehri Dehnavi
Assistant Professor
Research Interests: High-performance computing, machine learning, numerical analysis, compilers, and parallel systems.

Zoran Gajic
Professor and Graduate Director
Research Interests: Power control of wireless networks.

Hana Godrich
Undergraduate Director and
Assistant Teaching Professor
Research Interests: Distributed power systems, energy resources management and storage, energy efficiency, statistical and array signal processing, resource allocation optimization, distributed detection and estimation with application to smart grid, microgrids, and active sensor networks.

Marco Gruteser
Professor
NSF Career Award,
ACM Distinguished Scientist
Research Interests: Location-aware systems, pervasive computing systems, privacy and security, mobile networking, sensor networks and performance evaluation.

Mehdi Javanmard
Assistant Professor
Research Interests: Nanobiotechnology, bioMEMS, point of care diagnostics, biomarker detection, microfluidics, electrokinetics, applications of nanotechnology to medicine and biology.

Jaeseok Jeon
Assistant Professor
Research Interests: Nanoelectronic materials, devices and processing technologies, nano-electro-mechanical systems (NEMS).

Shantenu Jha
Associate Professor
NSF Career Award
Research Interests: High-performance and distributed computing, computational and data-intensive science and engineering, large-scale cyberinfrastructure for science & engineering.

Naghmeh Karimi
Assistant Teaching Professor
Research Interests: VLSI testing and design-for-testability, fault tolerance and design-for-reliability, hardware security and design-for-trust, microprocessor testing, computer architecture, computer aided design.

Janne Lindqvist
Assistant Professor
Research Interests: Systems security and privacy, mobile systems, social computing, context-aware communication, and human factors in computing systems.

Yicheng Lu
Distinguished Professor
IEEE Fellow
Research Interests: Microelectronics material and devices.

Richard Mammone
Professor
Fellow National Academy of Inventors
Research Interests: Computational pattern recognition, neural networks, signal processing, technology commercialization, processes involved with the innovation of new technology products, entrepreneurship.

Narayan Mandayam
Distinguished Professor
& Department Chair
Associate Director of Winlab
IEEE Fellow and Distinguished Lecturer,
IEEE Donald G. Fink Award,
NSF Career Award
Research Interests: Cognitive radio networks and spectrum policy radio, resource management for smart city, privacy in IoT.

Ivan Marsic
Professor
Research Interests: Mobile computing, software engineering, computer networks.

Sigrid McAfee
Associate Professor
Research Interests: Defects in semiconductors, nanotechnology, financial engineering.

John McGarvey
Assistant Teaching Professor
Research Interests: Design and simulation of power electronic systems, control system modeling via both the classic and modern state-space techniques, and the design and testing of motor control systems.

Peter Meer
Professor
IEEE Fellow
Research Interests: Statistical approaches to computer vision.

Laleh Najafizadeh
Assistant Professor
Research Interests: Functional brain imaging, brain connectivity, diffuse optical brain imaging, electroencephalography, cognitive rehabilitation, circuit design and microelectronics, ultra low-power circuits for biomedical applications, data converters, system on chip, wireless IC design.

Sophocles Orfanidis
Associate Professor
Research Interests: Statistical and adaptive signal processing, audio signal processing, electromagnetic waves and antennas.

Vishal M. Patel
Assistant Professor
ONR Young Investigator Award,
A. Walter Tyson Assistant Professor Award
Research Interests: Signal processing, computer vision, pattern recognition with applications in biometrics and imaging.

Athina Petropulu
Professor
IEEE Fellow and Distinguished Lecturer,
NSF Presidential Faculty Fellow
Research Interests: Statistical signal processing, blind source separation, cooperative protocols for wireless networks, physical layer security, MIMO radar, compressive sensing.

Dario Pompili
Associate Professor
NSF Career Award, ONR Young Investigator Award, DARPA Young Faculty Award
Research Interests: Wireless ad hoc and sensor networks, underwater acoustic communications, underwater vehicle coordination, team formation/steering, task allocation, thermal management of datacenters, green computing, cognitive radio networks, dynamic spectrum allocation, traffic engineering, network optimization and control.

Lawrence Rabiner
Professor Emeritus
IEEE Fellow, National Academy of Engineering, National Academy of Sciences, IEEE Kilby Medal, IEEE Piore Award, IEEE Millennium Medal
Research Interests: Digital signal processing, digital signal processing, speech recognition, speech analysis, speaker recognition, and multimedia.

Dipankar Raychaudhuri
Distinguished Professor
& Director of WINLAB
IEEE Fellow, IEEE Donald G. Fink Award
Research Interests: Future network architectures and protocols, wireless systems and technology, dynamic spectrum access and cognitive radio, experimental prototyping and network research testbeds.

Peddapullaiah Sannuti
Professor
IEEE Fellow
Research Interests: Simultaneous internal and external stabilization of linear time-invariant systems in the presence of constraints is pursued. Internal stabilization is in the sense of Lyapunov while external stabilization is in the sense of L_p l_p stability with different variations, e.g. with or without finite gain, with fixed or arbitrary initial conditions with or without bias.

Anand D. Sarwate
Assistant Professor
NSF Career Award
Research Interests: Machine learning, distributed systems, and optimization, with a focus on privacy and statistical methods.

Deborah Silver
Professor & Executive Director
PSM Program
Research Interests: Scientific visualization, computer graphics.

Emina Soljanin
Professor
IEEE Fellow and Distinguished Lecturer
Research Interests: Efficient, reliable, and secure storage and transmission networks, coding, informatin, and queueing theory.

Predrag Spasojevic
Associate Professor
Research Interests: Communication and information theory, coding and sequence theory, signal processing and representation, cellular and wireless LAN systems, adhoc and sensor networks.

Maria Striki
Teaching Professor
Research Interests: Analysis/design/optimization of data algorithms, statistical analysis, mathematical modeling, big data, data analytics, social networks, information systems, cybernetics, wireless-mobile-ad-hoc-cellular networks, (secure) routing, mobile computing, network-computer security.

Wade Trappe
Professor & Associate Director
of WINLAB
IEEE Fellow
Research Interests: Multimedia security, wireless security, wireless networking and cryptography.

Roy Yates
Distinguished Professor
& Associate Director of WINLAB
IEEE Fellow
Research Interests: Resource management in wireless systems, dynamic spectrum access and spectrum regulation, information theory for wireless networks and future internet architectures.

Yanyong Zhang
Professor
NSF Career Award
Research Interests: Computer architecture, operating systems, parallel computing cluster computer, performance evaluation and sensor networks.

Jian Zhao
Professor
IEEE Fellow, NSF Initiation Award
Research Interests: Silicon Carbide (SiC) semiconductor devices, SiC JFETs, BJTs, MOSFETS, GTOs, high efficiency smart power integrated circuits, SiC sensors, UV and EUV detectors, SiC inverters / converters.

Saman Zonouz
Assistant Professor
NSF Career Award
Research Interests: Networks security and privacy, trustworthy cyber-physical critical infrastructures, embedded systems, operating system security, intrusion detection and forensics analysis, and software reverse engineering.

Abraham Borno
Part-time Lecturer
AT&T Labs Research
Expertise: Optimal control, large-scale systems, Markov chains, parallel algorithms.

Michael Caggiano
Professor Emeritus
Expertise: Electrical Packaging, microwave packaging, analog circuit design, digital circuit and logic design.

Saad Khan
Part-time Lecturer
Managing Senior Research Scientist, Educational Testing Service, Princeton, NJ
Expertise: Computer Vision and Machine Learning

George V. Moustakides
Part-time Lecturer
Expertise: Statistics and statistical signal processing, adaptive signal processing algorithms, communications signal processing, and sequential detection.

Nagi Naganathan
Part-time Lecturer
Principal Engineer, Avago Technologies (LSI Logic)
Expertise: Computer engineering, digital design, FPGA design, VHDL/Verilog, VLSI Design, embedded systems.

Marta Rambaud
Part-time Lecturer
Expertise: Digital circuit design, FPGA design, high speed deep sub-micron custom digital and mixed-signal telecommunications design, wireless circuits, DSP design, Framer design, network processors, data interfaces and signal processing blocks.

Phil Southard
Part-time Lecturer
Principal, ProDigiSys
Expertise: Field programmable gate arrays (FPGA's), computer hardware, digital design, programmable logic, application specific integrated circuits.

Anwar Walid
Part-time Lecturer
Distinguished Member of Technical Staff, Bell Laboratories
Expertise: cloud computing, datacenter networking, multipath TCP, content acquisition and delivery, energy efficient networking, multi-media systems, distributed network cross-layer learning and optimization.

Shiyu Zhou
Part-time Lecturer
Expertise: design and analysis of data structures and algorithm, computational complexity, information theory.

studentnews

ECE student Parneet Kaur received a 2016 Google Anita Borg Scholarship

Parneet Kaur who is pursuing a PhD under the supervision of Prof. **Kristin Dana** is a recipient of the prestigious Google Anita Borg Scholarship. The Google Anita Borg Scholarship is awarded based on the strength of each candidate's academic background and demonstrated leadership. As a scholarship recipient, Parneet received a $10,000 award and attended a 3-day Google Scholars' Retreat in June 2016 at Google headquarters in Mountain View, California.


P. Kaur

Parneet's research focuses on developing computational skin texture models with applications in quantitative dermatology and telemedicine. The goal is to infer information about skin microbiome using computational photography. She is developing advanced methods of handling multiview high dimensional data by using computational appearance to supervise clustering of the bacteria genetic signature. In another project, she is using skin appearance modeling for classifying confocal microscopy skin images.

At Rutgers, she serves as vice-president of the Society of Women Engineers graduate chapter. She is also a co-founder and president of the Novice-to-Expert coding club. Parneet also received the MS.degree from Rutgers ECE where she was involved in the development of the Robotics Assisted Bridge Inspection Tool (RABIT) and analyzed ground penetrating radar scans to generate bridge deck deterioration maps. The American Society of Civil Engineers (ASCE) selected the RABIT project for the 2014 Charles Pankow National Award for Innovation. She is passionate about applications of computer vision and hopes to contribute to the advancements in this field.

ECE Student, Hajar Mahdavi-Doost wins Best Paper Award at COMSNETS 2016


H. Madavi-Doost

The paper entitled "Efficient Downlink Scheduling in LTE-Advanced Networks" by ECE student, **Hajar Mahdavi-Doost**, with Dr. Narayan Prasad (NEC Labs America, Princeton), and Dr. Sampath Rangarajan (NEC Labs America), received the best paper award at COMSNETS 2016, held January 5-9 in Bangalore, India.

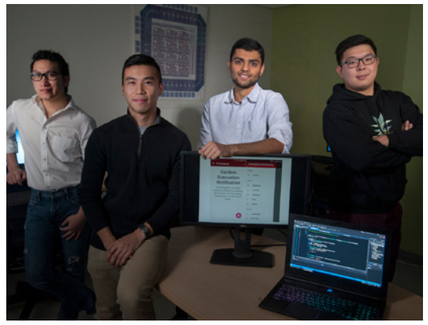
Hajar (pictured) was a PhD student, working under the supervision of Prof. **Roy Yates** on the design of efficient algorithms for energy harvesting and energy efficiency in communication systems. The award-winning paper was a result of Hajar's internship at NEC Labs America.

ECE Fall Capstone Project Wins 2nd Place at HackHarvard Competition

The ECE Fall Capstone Project "Firefighter Monitoring System" won 2nd Place at the HackHarvard Competition held recently at the Harvard Science Center.

Group members include **Kevin Leung, Jigar Bhalodia, Shivam Patel, Michael Zhou** and **Shawn Fong**. The group's advisor was **Dr. Wade Trappe**.

The participants, who were selected from a pool of more than 3,700 applicants, came from not only top universities across the United States (including nearby Massachusetts Institute of Technology and Yale), but seven countries as well.


Michael Zhou, Kevin Leung, Jigar Bhalodia, Shawn Fong

At the Nov. 13-15 competition, teams vied for prizes that totaled more than $12,500. Designated a Major League Hacking hackathon, HackHarvard sponsors included Microsoft, Facebook, Capital One, Twitter, and Google

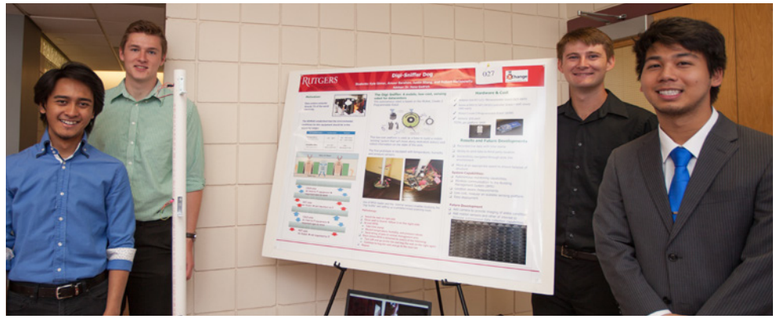
The HackHarvard results were posted in the *Microsoft Developer Blog* and the *Harvard Gazette.*

The group is planning to represent Rutgers at Microsoft's global competition, Imagine Cup, as well as Microsoft's Build 2016 conference at the Moscone Center in San Francisco.

As a result of HackHarvard, Kevin Leung has been offered a position with Microsoft as a Microsoft Student Partner on campus to help other capstone teams with any Microsoft products.

Capstone Team wins the 7x24 Exchange Metro New York University Challenge

An ECE Capstone team won $2K at the 7x24 Exchange Metro New York University Challenge for the second year in a row! The 2nd Annual 7X24 Exchange Metro New York University Challenge invited selected tri-state area universities to participate in a design challenge related to energy efficiency and data centers. Participating teams are awarded grants ranging from $1000 to $10,000 to further advance visbility of the data center industry to excellent students and expand senior year capstone projects and research on related topics. The 7X24 Exchange is a leading knowledge exchange organization in the mission critical facilities space for those who design, build, operate and own data centers.


Ameer Barahim, Kyle Ginter, Robert Stefanowitz, and Justin Silang

This year's event took place on Thursday April 28, 2016 in the Goldman Sachs Tower, Jersey City, New Jersey.

ECE Rutgers participated with the project "Digi-Sniffer Dog: A mobile platform for sensing and monitoring", by ECE students **Kyle Ginter, Ameer Barahim, Robert Stefanowitz,** and **Justin Silang.** The faculty advisor is **Dr. Hana Godrich.** This project was based on the group's 2016 Capstone Design project.

The students designed and built a mobile platform based on an iRobot integrated with sensory network. Projects were judged on innovation, applicability, energy and environmental benefits, financial feasibility and commercialization potential. Our students showcased strong capabilities in both their engineering knowledge and presentation skills. As a result of this event, Rutgers participants Aeon Brown (2015) was recruited to join ASCO Power and Robert Stefanowitz (2016) was recruited to join Highland Associates.

RUMD Loop Team advances to the Build round in the Hyperloop SpaceX Competition

On January 29-30, 2016 SpaceX hosted Hyperloop Pod Competition Design at Texas A&M University. Four Computer Engineering Department students took part in the competition as part of the combined Rutgers/Maryland (RUMD Loop Team). **Michael Feinstein** (Senior), **Shreyas Hirday** (Junior, team leader), **Cedric Blake** (Junior), **Dominic Ok** (Junior) helped design a robust, efficient design for a pod to be used in a Hyperloop tube, a low pressure tube that transports people at very high speeds, up to 215 mph.

HYPERLOOP POD COMPETITION

Specifically, they handled designing the computer systems and software for the pod. In November 2016 RUMD Loop Team was one of the 115 teams that has progressed from the preliminary design round into the final design round. We are pleased to say that RUMD Loop Team as one of 22 teams has now advanced to the Build round of the competition and is heading to California this summer to test their design prototype at the world's first Hyperloop Test Track.

In 2013, Elon Musk co-founder of SpaceX and Tesla Motors proposed the Hyperloop, a high-speed ground transport concept. Based on this concept student teams were asked to designs the Hyperloop system that meets and exceeds the requirements of SpaceX. The goal was to create a pod that efficiently and robustly can operate in the Hyperloop Tube. The system itself is a super speedy transport system that beats modern-ground based transport by long. All teams designed an optimal pod with a braking system, levitation system, propulsion system, communications system, and battery system to compete in this competition. Overall pod designs were judged based on innovation and uniqueness of design, full Hyperloop system applicability, level of design detail, strength of supporting analysis and tests, and feasibility for test track competition.

ECE Students Host a Scratch Programming Outreach Event

This past summer, the Novice-to-Expert (N2E) Coding Club organized an outreach event for elementary and middle school students (ages 6 to 11) on July 16, 2016. The aim of the 3 hours workshop was to familiarize the students with basic programming concepts in a fun and interactive way. The students used Scratch, a kid-friendly programming language created at MIT (http://scratch.mit.edu/). It simplifies the programming concepts by providing an interactive block interface to design games, animations and stories.

The workshop took place in ECE computer labs on July 16, 2016 and was led by the student volunteers **Parneet Kaur** (graduate student), **Sumathi Arumugam** (junior), **Dylan Patel** (senior) from ECE and **Grishma Shah** (sophomore) from Mechanical Engineering. In all, 25 young programming enthusiasts and their parents attended the event. After a brief introduction of programming in Scratch, students made a trivia game and a fun animation along with the instructors. The event was well received by the students and their parents. When asked what they liked about the workshop, an 11 year old student replied: "The event was well-presented and very informative for kids, very interesting things about coding". "Kids had fun and at the same time they learned new things." replied a parent. The volunteers enjoyed the workshop as much as the students. "Our goal was to get the students excited about programming so that they get involved with it in future. We hope to organize more such events." said Parneet Kaur, one of the volunteer instructors.

N2E Coding Club is a student run organization co-founded in March 2016 by ECE graduate students **Parneet Kaur** and **Anvita Patel** with Prof. **Kristin Dana** as their faculty advisor. The club's goal is to create a peer-to-peer learning environment through various activities. Earlier this year N2E volunteer instructors organized programming workshops to teach basic programming skills in Java, C++ and Python. They will be organizing more workshops in Fall 2016.

More details are available at:
www.facebook.com/groups/1169145529795573/

Shubham Jain's research on Pedestrian Safety featured in Wall Street Journal

Shubham Jain is a PhD student in Prof. **Marco Gruteser**'s group at WINLAB. Her work on 'Pedestrian safety using smartphones' was recently featured in the Wall Street Journal story titled "Texting While Walking Isn't Funny Anymore" (http://on.wsj.com/1Oil0pT) The article points out her smartphone application that determines when someone using a phone is walking into an intersection. When you do, it momentarily locks the phone screen—and flashes a warning to look up.

Technology distractions are having a negative impact on pedestrian safety in urban environments. Pedestrians engrossed in texting and playing games like Pokemon-Go become oblivious to oncoming traffic, thereby putting their own lives in danger. To this end, she has developed LookUp!, a solution that warns distracted pedestrians when they are potentially at risk. This technology uses shoe-based gradient profiling to learn the pedestrians' surroundings and consign appropriate warnings. Look Up! has previously received the Large Organization Recognition Award at the AT&T Connected Intersections challenge.

Shubham's research interests lie in the design and development of mobile systems for enhancing traffic safety. She is investigating other smartphone sensors that can be used for pedestrian safety, such as cameras. She is also working on integrating her system into a smart city infrastructure that facilitates vehicle-pedestrian communication.


S. Jain


T. Wu

Tong Wu Wins Best Student Paper Award

Tong Wu, is a fourth-year PhD student in the Department of ECE and is being supervised by Prof. **Waheed Bajwa**, has won the Best Student Paper Award at the 12th IEEE Image Video and Multidimensional Signal Processing (IVMSP) Workshop for his paper entitled "Clustering-aware structure-constrained low-rank representation model for learning human action attributes." This work, which is a collaboration between Rutgers and Drs. Raghuveer Rao and Prudhvi Gurram at the Army Research Lab in Adelphi, MD, is expected to help robots autonomously interact with humans in their surroundings.

Szu-Ying Wang wins Paul Panayotatos Endowed Scholarship

Szu-Ying Wang, an ECE PhD student working with Prof. **Yicheng Lu**, has been selected as the 2016 recipient of the Paul Panayotatos Endowed Scholarship.

Szu-Ying will receive $5,000 in support of her project entitled "Fully-Transparent MgZnO High Voltage Thin Film Transistors on Glass for Inverters in Building Integrated Photovoltaics". By using magnesium-doped zinc oxide (MZO) as the channel material of a thin-film transistor, the transistor can operate at high voltage. This MZO thin-film transistor can be used for the solar inverter for photovoltaic systems with increase efficiency and reliability.


S. Wang


V. Sadhu

Vidyasagar Sadhu working with Prof. Pompili wins a Center for Science of Information student research grant

ECE graduate student **Vidyasagar Sadhu** (working with Prof. **Dario Pompili**) and his multi-university team has won the Center for Science of Information (CsoI) student research project grant funded by the National Science Foundation (NSF). The year-long project, titled "Defending Large-Scale Distributed Machine Learning Against Adversarial Attacks", is supported with an amount of $6,000 towards meeting/travel expenses. This student-led project, which is in collaboration with three other PhD students – Lili Su (University of Illinois, Urbana-Champaign), Seyyed Fatemi (University of Hawaii, Manoa), and Rehana Mahfuz (Purdue University, West Lafayette), aims at developing novel algorithmic techniques that can contain/counter the effects of selfish agents/Byzantine attacks in a distributed machine-learning scenario.

Filmmaker Charlie Chalkin came to Rutgers in the fall to film two videos on the ECE Department and students. The videos can be viewed online at **http://goo.gl/a3Bz3r**

Meet an ECE Student


S. Shaikh

By Safa Shaikh

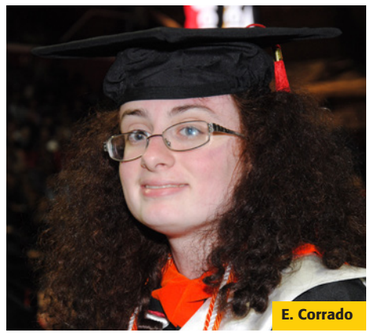
I am a sophomore majoring in Computer Engineering and minoring in Computer Science. During the spring semester of my freshman year I started working with Prof. **Laleh Najafizadeh** in the NeuroImaging and Integrated Circuits Laboratory. I started off researching Brain-Computer Interface (BCI) paradigms, which essentially provide a neural pathway for the human brain to interact with a computer program or robot in order to stimulate motor activity. This technology piqued my interest due to its potential to solve many of the motor impediments to paralyzed or immobile patients. This summer, I worked with Ph.D. student **Tianjiao Zeng** on an oral health study as well as Ph.D. student **Ali Haddad** on a multimodal (BCI) experiment. These were human subject studies, so I was quite active in the recruitment of subjects and the design and preparation of brain caps to be compatible with the Functional Near-Infrared Spectroscopy (fNIRS) machine and the electroencephalogram (EEG). I enjoyed this research experience, especially since it was so hands-on. NeuroImaging research captures the real-world connection between humans and technology, allowing us to learn more about the human brain and potentially be able to use technology to find solutions to several obstacles in modern medicine.

By Jaimie Swartz

I am a senior majoring in Electrical and Computer Engineering and I am highly interested in power systems and smart grid technologies. Since 2015, I have been working as researcher in the Laboratory for Energy Smart Systems (LESS) under **Dr. Jafari** (Industrial and Systems Engineering Department). Under advising of Dr. Jafari, I won 2nd place at the 2016 SWE Region E Conference Research Poster Competition. In addition, since 2015 I have been appointed as President of Society of Women Engineers - Rutgers Section and received Most Outstanding SWE Member and Governor's Choice Award for the 29th Annual SHE-SWE-MEET Career Fair which awarded by SWE Region Council. I was also selected for the Collegiate Leadership Institute, a special program within the 2015 SWE National Conference that offers professional development workshops for 60 student leaders from around the country. In 2016, I was also accepted into James J. Slade Scholars Program.


J. Swartz

Upon entering college, I knew my ultimate dream job was to design the powering of a major city with 100% renewables. My experiences at Rutgers has further motivated me towards this goal. My Byrne seminar, Energy and Sustainability on Campus, allowed me to tour the inner workings of the solar panel control center and co-generation plant. Several Rutgers Energy Institute events including the annual Renewable Energy Symposium, a Light-trapping in Solar Cells seminar, and Energy Café taught me major challenges with establishing renewable energy systems. Now, I am part of a team that is building precisely the renewable energy system that I dreamed to build several years go. I hope to continue to gain deeper understanding of smart grid systems in graduate study, through pursuing either a Masters or PHD degree in Electrical Engineering. Ultimately, I plan to contribute my technical knowledge and leadership skills to industry to help usher in a new era of clean, renewable energy systems. Symposium, a Light-trapping in Solar Cells seminar, and Energy Café taught me major challenges with establishing renewable energy systems. Now, I am part of a team that is building precisely the renewable energy system that I dreamed to build several years go. I hope to continue to gain deeper understanding of smart grid systems in graduate study, through pursuing either a Masters or PHD degree in Electrical Engineering. Ultimately, I plan to contribute my technical knowledge and leadership skills to industry to help usher in a new era of clean, renewable energy systems.


E. Corrado

By Erin Corrado

I graduated from Rutgers University Department of Electrical and Computer Engineering in May 2016. During my time at Rutgers, I worked at Winlab where I performed research involving human-computer interaction for small flying drones. I also worked with Profs. **Roy Yates** and **Waheed Bajwa,** where I helped to process and analyze large statistical data sets and images in order to optimize control planning and acquire insights into the data. In addition to my research involvements, I served as the Professional Development officer of the engineering honors society, Tau Beta Pi, where I helped organize events to help current Rutgers students develop professional skills and locate job positions.

I am currently working for LGS Innovations in the cyber security department, where my team and I develop products and perform security analysis and assessments for the government intelligence community. I enjoy cyber security since it requires me to understand complex technology systems and the human factors that can make a system insecure.

By Eric Wengrowski

I am a 25-year-old PhD student working on research problems in the areas of Computational Photography, Computer Vision, and Machine Learning. I am advised by world-class scientists Professor **Kristin Dana,** Prof. **Marco Gruteser,** and Prof. **Narayan Mandayam.** I have spent my entire academic career in the ECE department at Rutgers. I came here as a freshman in 2009 and graduated with a B.Sc. in Electrical and Computer Engineering in 2013 with a focus on robotics and computer vision. Before coming to Rutgers, I grew up in the coastal community of Toms River, New Jersey. Like many students, I initially found electrical and computer engineering to be extremely challenging. But scientific curiosity ultimately left me with a robust work ethic that has earned me success. The world-class research opportunities here at Rutgers ECE are truly inspiring. I am extremely grateful to have taken interesting courses with my three favorite undergraduate teachers who later became my PhD advisers.

As an undergrad, my ECE education awarded me with internships at AT&T Research Labs and the U.S. Army Corps of Engineers. As a PhD student, I have had phenomenal summer internships at Microsoft Research in Redmond, a tech startup in San Francisco, and the computer vision research company Kitware in New York. At Microsoft Research, I worked with many of the top scientists in the computer vision field to design algorithms for automated storytelling. At Kitware, I collaborated with top scientists at universities like UC Berkeley, Dartmouth, Columbia, and industry to work on design algorithms for image forensic. My work at Kitware recently resulted in the paper "Reflection Correspondence for Exposing Photograph Manipulation." My education from the ECE department imparted me with the skills to excel at these institutions.


E. Wengrowski

As a PhD student, my research has been focused on invisible light-based communication called "Photographic Steganography."

My collaborators and I have documented our scientific contributions with papers like "Radiometric Calibration for Camera-Display Messaging," "Photographic Steganography for Camera-Display Messaging," and "High-Rate Flicker-Free Screen-Camera Communication with Spatially Adaptive Embedding." I have presented my published work at top-tier IEEE academic conferences like Computer Vision and Pattern Recognition (CVPR), the International Conference on Computational Photography, the Winter Conference on Applications in Computer Vision (WACV), and the International Conference on Computer Communications (INFOCOM). I have also worked with fabulous undergraduate students Revan Sopher and Joseph Boyle to create a ground-breaking Android app showcasing our research on Photographic Steganography. My PhD is currently funded with a research grant by Lockheed Martin, where I am designing Deep Learning algorithms to classify objects based on their radar signatures.

By Gradeigh Clark

I am a PhD student advised by Prof. **Janne Lindqvist** and funded by the 3-year National Defense Science and Engineering Graduate (NDSEG) fellowship, supplied by the United States Department of Defense and sponsored by the Air Force Office of Scientific Research (AFOSR). My research interests cover intersecting areas of human-computer interaction and security. I have publications or ongoing research in the following subcategories of those two fields: authentication, cryptocurrencies, crowdsourcing, keyboard design, and usable security. My work on authentication and usable security focuses on trying to figure out how to innovate gesture passwords as a more usable, secure, and memorable unlocking method for mobile devices, with accomplishments being four publications in top venues (CHI, Mobisys) covering aspects from design of gesture recognizers to unique metrics for computing visual complexity of user-generated gesture passwords. I am interested in pushing the boundaries on innovating authentication methods made to fit the interaction environments of a 21st century society.

My accomplishments for cryptocurrencies is a first-look publication on how people use and perceive Bitcoin, which revealed various misconceptions among groups about how Bitcoin operates and what it can be used for. Ongoing work in this area is on trying to compromise authentication keys from a hardware wallet built for Bitcoin using side-channel attacks. For crowdsourcing, I am examining the design space of on-demand mobile workplaces -- how services are created, what features they offer, and how they differentiate among themselves. My work on keyboard design focuses on helping people learn research-optimized keyboards different from the standard QWERTY layout on mobile platforms.


G. Clark

I rely on the collaboration and cooperation of graduate and undergraduate students both at Rutgers and elsewhere to accomplish these multiple thrusts. I've applied for and received funding for undergraduates through NSF grant addendums, DIMACS, and Aresty. This summer I worked with five undergraduates on developing new projects from topics spanning keyboard optimization to gesture password policies. I am looking forward to continuing my work in the Fall while also teaching a course on Mobile Application Development.

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Capstone Projects 2016

Another exciting year in the ECE Capstone project design program has resulted in innovative ideas and inspiring concepts. Around 170 senior year students participated in this year's program. The resulting 47 projects showcase a wide spectrum of skills, knowledge and technology mastered by our students. Projects ranging from the Ey3, a wearable electronics product that enables the use of a computer on any surface, to a distributed machine learning test bed and the Herbivore, an autonomous robot that seeks to localize and exterminate weeds. IoT and autonomous vehicles inspired ideas addressed topics related to energy efficiency, smart homes and smart cities with projects like the Smart Helmet, Vision based autonomous vehicles, AVLS, wireless utility pole integrity sensor, and Digi-Sniffer Dog, to name a few. Digital Health was another field of interest with the Guardian project and WatchMe, Read Me Out and other health monitoring devices and services. Applications spanning information security, electrical power, communications, networking, imaging, big data, mobile platforms, information and signal processing, and control were all represented in this year's capstone.

The enthusiastic participation of our students with their creativity and the extensive support of a large number of faculty advisers produced a large number of working products that has the potential to be taken to market. This year, our department enjoyed increased support from the industry in both advising and funding. Capstone competitions, projects funding and awards have been supported by Dr. Dorin Comaniciu, Vice President of Medical Imaging Technologies at Siemens Healthcare and a member of the ECE department advisory board, Mr. William Marushak, Lutron Electronics and the 7x24 Exchange Metro New York Chapter. This funding enabled the department to offer additional 'seed' money to projects competing for these resources.

A dedicated team of ECE faculty advisers supported the successful execution of the capstone program and the completion of top-tier projects. Setting projects milestones and deadlines for the teams along with budget constraints and the required presentations sessions, reinforced working habits for students that will come useful in the workplace.

In addition to the ECE faculty advisers, we would like to recognize the following advisers for their support: Dr. Anthony Tobia, Dr. Rich Howard, Dr. Pavel Reyes, Dr. Saad Khan, Dr. Assimina A. Pelegri, Mr. Samuel Ramrajkar, Dr. A. Bhattacharjee, Mr. Michael Kornitas, and Mr. Donald Bachman. The partnership with Lutron resulted in two capstone projects on a smart classroom. Mr. Michael Kornitas, Director of Sustainability and Energy at Rutgers University supported these projects.

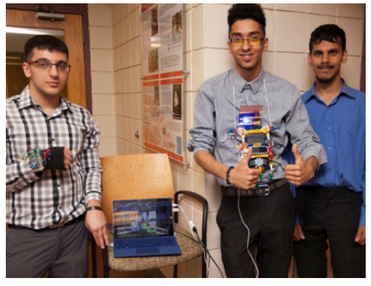
Collaboration with the 7x24 Exchange Metro New York Chapter produced a mobile, autonomous, monitoring platform for data centers. Donald Bachman, alumni of the Rutgers ECE Department, has been an active adviser on the project that resulted in another win at the yearly University Challenge competition.

The culmination and highlight of the capstone project was Poster Day that was held this year on Wednesday, April 27. This event celebrates our students -- their hard work, creativity, skills and knowledge. A large crowd filled the ECE department corridors on this day when fellow students, faculty, alumni, and industry members came fto witness a showcase of engineering capabilities. Every year a panel of judges in nominated to choose the top-ten capstone projects and this year was no exception. They faced the hard task of recognizing the best in class from a large number of exciting projects. We would like to acknowledge and thank the judges that participated this year: Barry Novick (BlackRock) Stephen Wilkus (Spectrum Financial Partners), Ren-Yi Lo (Siemens), Kumar Ramaswamy (Igolgi Inc.), Thomas Davidson (DLB Associates), Manny Rodriguez (Lutron Electronics), Ali Zaringhalam (Juniper), Anand Bhagwat (JP Morgan Chase), Donald Bachman (Emerson), Teddy Brown (Verizon Wireless), Michael Kornitas, (Rutgers University) and Nagi Naganathan (Avago Technologies).

THE TOP-TEN PROJECTS FOR 2016

First Place Innovation Award $600

(Sponsored by Siemens)
Project 023: **"EY3"**
Team members: **Ali Rahimi, Hammad Ajmal,** and **Rami Madbouly,** Advisor: **Dr. Naghmeh Karimi**



First Place Impact award $600

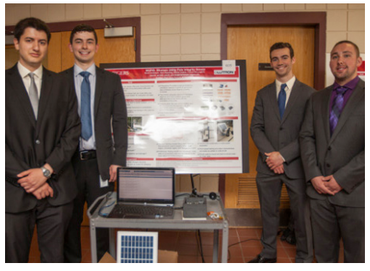
(Sponsored by 7x24 Echange, NYC Chapter)
Project 031: "Distributed Machine Learning Test Bench with Raspberry Pis"
Team members: **Nikhil Shenoy** and **Revan Sopher,** Advisor: **Dr. Anand Sarwate**

First Place Sustainability Award

(Sponsored by Lutron) - $600
Project 043: "The Herbivore"
Team members: **Samuel Stratter, Robert Marrs, Doreen Sparrow**, MAE: **Martin Liza, Adam Burrous, Jeremy Garrabrant, Robert Froster, Bhavya Patel,** and **Parth Patel**, Advisor: **Dr. Assimina A. Pelegri** (MAE) and **Dr. Hana Godrich**

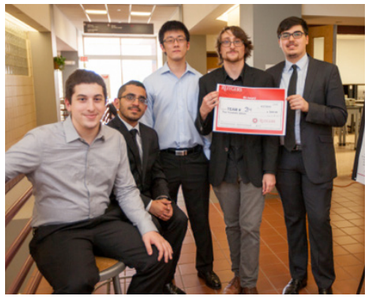
Second Place $400

Project 035: "WUPIS: Wireless Utility Pole Integrity Sensor"
Team members: **Patrick Coates, Patrick McLaughlin, Sam Baysting** and **David Arakelyan**, Advisor: **Dr. Dario Pompili**



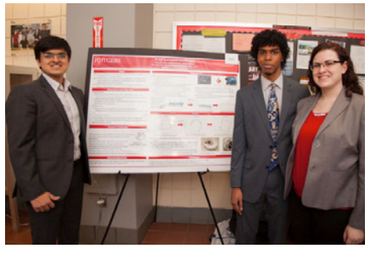
Third Place $300

Project 034: "Autonomous Vehicle Learning System (AVLS)"
Team members: **Rahul Tandon, Robert W. Schult, Frank Hoffman, Peter Cai** and **Luke Miller,** Advisor: **Dr. Kristin Dana**



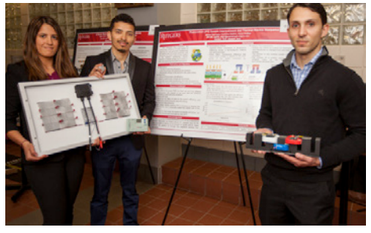
Fouth Place

Project 020: "SLAM Surveying on a Budget"
Team members: **Kshitij Minhas, Cesar Castillo** and **Ashley Weaver,** Advisor: **Dr. Rich Howard**



Fifth Place

Project 012: "Photovoltaic (PV) System Improvement and Thermal Electric Dissipation"
Team members: **Oscar Guillen, Christina Baalkini** and **James Henrique,** Advisor: **Dr. Jaeseok Jeon**



Sixth Place

Project 033: "Project Guardian"
Team members: **Jonathan Du, Paolo Umali** and **Peter Nguyen**, Advisor: **Dr. Mehdi Javanmard**

Seventh Place

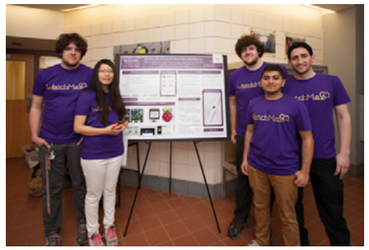
Project 027: "Digi-Sniffer Dog"
Team members: **Kyle Ginter, Robert Stefanowitz, Justin Silang,** and **Ameer Barahim,** Advisor: **Dr. Hana Godrich**

THE TOP-TEN PROJECTS FOR 2016

Eighth Place

Project 024: "WatchMe: Non-intrusive IoT Medical Wearable Apparatus"

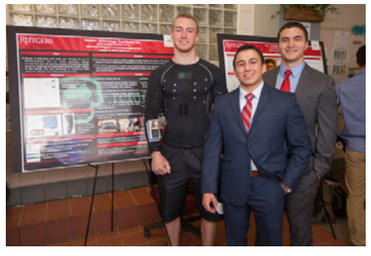
Team members: **Demetrios Lambropoulos, David Lambropoulos, Harsh Shah, Wanxia Long,** and **Yaniv Myszkin,** Advisors: **Dr. Janne Lindqvist** and **Dr. Rich Howard**



Ninth Place

Project 004: "Remeo: Technology That Reads You"

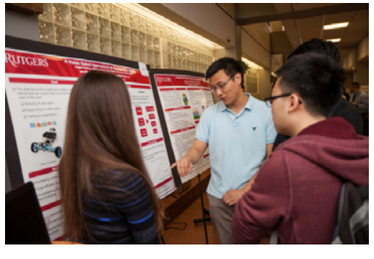
Team members: **Henry Torres** and **Adam Coulson**, Advisor: **Dr. Mehdi Javanmard**



Tenth Place

Project 013: "Transportation Analytics and Optimization with 802.11 Probe Tracking"

Team members: **Angela Ciummo, Andrea Penafiel, Cat Le, Michael Jang,** and **Harsh Khatri,** Advisor: **Dr. Kristin Dana**



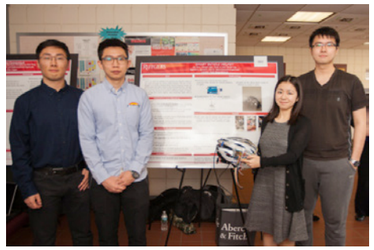
ADDITIONAL AWARDS

Students Favorite Award $200

Sponsored by 7X24 Exchange Metro New York Chapter

Project 001: "Smart Bicycle Helmet"

Team members: **Jianqin Gao, Shuyu Lyu, Ao Guo,** and **Xuan Li**, Advisor: **Dr. Hana Godrich**



Community Award $200

Sponsored by Siemens

Project 011: "Firefighting Unit Utilizing Autonomous Modular Target-Tracking Turret (AMT)"

Team members: **Neil Patel, Het Patel, Manassa Suresh,** and **Jonathan Ksiezopolski**, Advisor: **Dr. Michael Caggiano**

Community Award $200

Sponsored by Lutron

Project 025: "Collision Avoidance with Drone Technology"

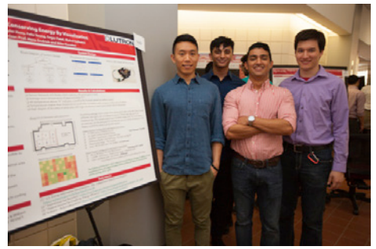
Team members: **Charu Jain, Bunty Patel, Akshay Sardana,** and **Maxine Deines**, Advisor: **Dr. Hana Godrich**

Lutron Appreciation Award $400

Sponsored by Lutron

Project 040: "Where RU? Conserving Energy by Visualization"

Team members: **Mehul Salhotra, Felix Yeung, Tyler Huey**, and **Sagar Patel**



Over the years, the ECE department advisory board support for the capstone program has been instrumental in enhancing our students' experience and drive for excellence. We would like to acknowledge and thank the board for their continuous support of the capstone program. They made themselves available for the program in ample of ways including participation in talks, judging panels, project ideas, and projects sponsorship, to name a few.

Congratulation to our students for their achievements! We wish them success in their professional careers and hope that the skills and knowledge they acquired over their years at Rutgers ECE department will serve them well in the future.

More details on the winners can be found at:
http://www.ece.rutgers.edu/Capstone2016

New Faculty

Emina Soljanin joined Rutgers ECE as a Full Professor last year. Before moving to Rutgers in January 2016, she was a (Distinguished) Member of Technical Staff for 21 years in the Mathematicas Sciences Research of Bell Labs. She works as an information, coding, and, more recently, queueing theorist. Her interests and expertise are wide. Over the past quarter of the century, she has participated in numerous research and business projects, as diverse as power system optimization, magnetic recording, color space quantization, hybrid ARQ, network coding, data and network security, and quantum information theory and networking. Dr. Soljanin served as the Associate Editor for Coding Techniques, for the IEEE Transactions on Information Theory, on the Information Theory Society Board of Governors, and in various roles on other journal editorial boards and conference program committees. She is a co-organizer of the DIMACS 2001-2005 Special Focus on Computational Information Theory and Coding and 2011-2015 Special Focus on Cybersecurity. She is an IEEE Fellow, member of AMS, AWM, and currently serves as a Distinguished Lecturer for the IEEE Information Theory Society.

Kristan Dana promoted to Professor

Kristin Dana, is a Full Professor in Electrical and Computer Engineering Department at Rutgers University. She is the director of the Rutgers ECE Vision lab conducting research in computer vision, computational photography, machine learning, illumination modeling, texture and reflectance, bioimaging, motion estimation, optical devices, optimization, and robotics. She has authored over sixty peer-reviewed publications in the area of computer vision. She has served as corporate relations chair for IEEE CVPR, publicity chair for ICCV and CVPR, and area chair for several conferences including CVPR, ICCV, ECCV, WACV and ICPR. She was elected to the Rutgers University Senate in 2016. She is also a member of the Rutgers Center for Cognitive Science and a member of Graduate Faculty of the Computer Science Department. Dr. Dana received the PhD from Columbia University (NY,NY) in 1999 and the MS degree from Massachusetts Institute of Technology in 1992, and a BS degree in 1990 from the Cooper Union and NYU (NY,NY). She held student research positions at NYU robotics lab, the machine perception research group of Bell Laboratories, and the auditory physiology group at MIT. From 1992-1995 she was on the research staff at Sarnoff Corporation developing real-time motion estimation algorithms. She is the recipient of the GE Faculty of the Future Award, Sarnoff Technical Achievement Award (1994), National Science Foundation Career Award (2001) for a program investigating surface science for vision and graphics and a team member recipient of the Charles Pankow Innovation Award in 2014 from the ASCE. Her outreach work includes K-12 activities such as MathCounts team coach and High Technology High School Advisory Board. Dr. Dana's lab has leveraged her seminal PhD work on surface appearance for research funded over 16 years by the NSF, FHWA, and numerous industry partners in diverse fields such as dermatology, automotive, visible light communications, microscopy and robotic inspection.

Hana Godrich Appointed ECE Undergraduate Director

Assistant Professor **Hana Godrich** has taken on the role of ECE Undergraduate Director. Since joining the department in 2013, Dr. Godrich has played an active role in the undergraduate program in terms of education and research. Since joining Rutgers Dr. Godrich has designed and taught new courses in power systems, smart grid and sustainable energy. In 2014 she was awarded the Best Teacher Award for Electrical and Computer Engineering Department by the Rutgers Engineering Governing Council. Dr. Godrich took on capstone course organization in Fall of 2014, focusing on enhancing students' hands-on experience and increasing industrial collaboration. The program has generated over 90 projects in the last two years with interdisciplinary collaboration and industry sponsorship of $37K. In addition, she has been involved with undergraduate research and students advising.

Before joining Rutgers Dr. Godrich was a postdoctoral associate at Princeton University and previously has had rich industrial experience performing research and development as well as project management and team leadership. She received her Ph.D. in Electrical and Computer Engineering from New Jersey Institute of Technology in 2010, her M.S. in Electrical Engineering from Ben-Gurion University in 1993 and her B.S. degree from Technion Institute of Technology in 1987.

Rutgers leads a DHS initiative on Privacy-Preserving Practical Smartphone Security

Smartphones are increasingly used in a variety of roles with wildly differing data-protection requirements ranging from the access of sensitive content to the production and sharing of personal content via online social networks. The increasing popularity of these devices has recently attracted adversarial parties. The number of complex and fast-spreading privacy and security attacks has grown significantly during the last few years. A team of researchers from Rutgers Electrical and Computer Engineering (ECE) Department were selected by United States Department of Homeland Security (DHS) to develop novel cybersecurity techniques and theoretical algorithms against adversarial misbehaviors. The team consists of Profs. **Saman Zonouz** and **Dario Pompili**, and Ph.D. students Vidyasagar Sadhu and Gabriel Salles-Loustau from Rutgers ECE. Following a successful demonstration of a solid working prototype of the solution (SWIRLS) and the corresponding research publications and presentations, the research team is currently working on technology transfer aspects of the project in parallel to the proposed the research tasks during the second year of the project.

Today, the only line of defense against accidental or malicious sensitive data leakage is through isolation of execution environments, e.g., virtualization-based techniques that provide separate virtual phones that run on the same hardware but are otherwise completely isolated. However, the development and maintenance of multiple such environments is burdensome for both content owners and users. Content owners are burdened by having to develop apps for the sole purpose of enforcing data protection when, otherwise, a third-party app, perhaps with better functionalities, might have sufficed. These apps often live in silo'ed containers and are unable to access services provided by the rest of the mobile platform for fear of information contamination. For users, these multiple environments present a fragmented and often inconsistent experience that increases cognitive effort.

Finally, in cases where system resources such as camera, microphones, or location are concerned, container-based approaches fail entirely. SWIRLS provides a first-class data-protection architecture for mobile operating systems that uses dynamic information flow tracking and cryptographic policy enforcement technologies to isolate data instead of execution environments. SWIRLS provides formal methods capabilities to simplify the guaranteed trustworthy usage of mobile phones without worrying about potential data leakage and unauthorized sensitive data access by third parties. Consequently, Government and enterprise personnel could use their devices for various purposes involving sensitive data with different security requirements while SWIRLS controls the data flow and access through the system in a very fine-grained manner and with negligible overhead. In addition to collaborative academic publications and presentations by the research team, as a part of this effort, Gabriel Salles-Loustau discovered a severe security vulnerability in Google Android operating systems that are used by millions of users in the world. Following the standard responsible disclosure procedures with Google, Gabriel was awarded $10K Reward by Google, and the Rutgers ECE Department is recognized on the Google Hall of Fame portal.

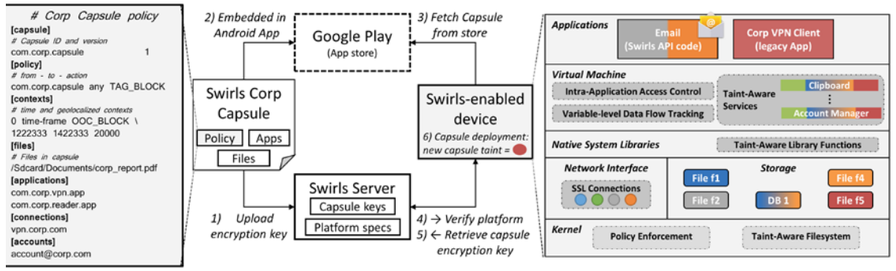
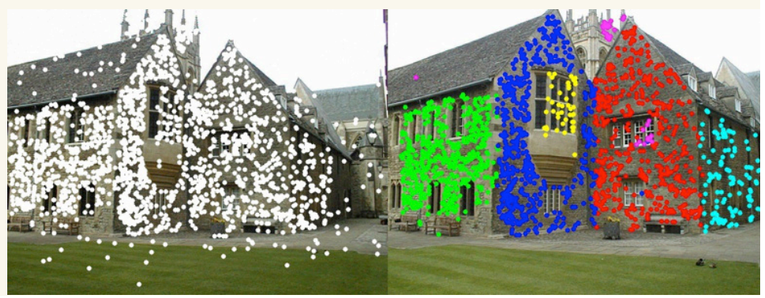


Figure 1: Smartphone clients usually use or are asked to use their devices for several purposes in various contexts with different security requirements on a daily basis. A context may represent a user role, a specific activity, time, location, or any combination thereof. SWIRLS enables secure realization of such scenarios through a formally verified architecture including dynamic information flow tracking as well as cryptographic system-wide and multi-layer policy enforcement.

Robust Estimation of Multiple Inlier Structures

Modern computer vision has moved from the labs and into real world applications. Future technologies that are being built with a computer vision foundation include automated driving, augmented reality and robot navigation. None of these future trends can come to fruition safely without solid robustness to handle the variations of real world illumination, motion and unexpected visual interruptions. The underlying algorithms must be developed with robustness to noise and outliers. The inlier points, which are close to the true model but corrupted by noise, have to be first separated from the outliers in the background. The scale of the structure, indicating the range of its inliers, is the critical parameter for the classification. For the past 35 years the robust recovery has been mostly done with RANdom SAmple Consensus (RANSAC), which returns the maximum number of inlier points within a user specified scale. The scale in RANSAC is a heuristic parameter and can lead to problems if not predicted accurately, or in the presence of multiple structures with different scales.

Prof. **Peter Meer**, a pioneer in computer vision and recipient of the 2010 IEEE Longuet-Higgins prize, and his PhD student **Xiang Yang** have developed a new algorithm for robust estimation that first adaptively computes the scale from the input data instead of an empirical user given priori, followed by the estimation of the current structure. It provides a fast implementation, stable performance and can segment multiple structures existing simultaneously inside the input data. A 2D homography estimation where planes in two images are correlated, is shown as an example. From all the points in the left image, five plane correspondences shown in 5 different colors are recovered.



ECE Faculty Host "Role of Engineering in 21st Century Healthcare"

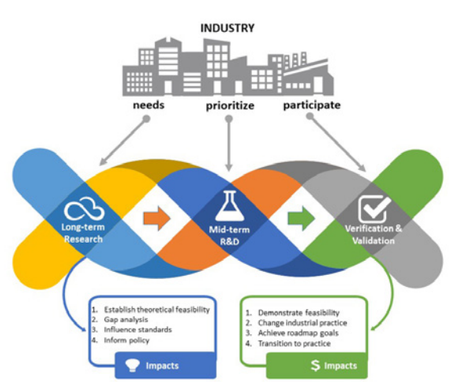
The Rutgers ECE Department, under the leadership of Prof. **Waheed U. Bajwa**, organized the Johns Hopkins Center for Talented Youth Program at Rutgers University on the "Role of engineering in 21st century healthcare" for students in grades 7–12 in April 2016. This event was attended by a total of 75 participants, who interacted with some of the leading researchers at the intersection of engineering and healthcare, and who also got an opportunity to understand the workings of some of the devices that play/will play a role in the delivery of 21st century healthcare. ECE faculty who were instrumental in making this event a success included Profs. **Dana, Najafizadeh,** and **Sarwate.**

Rutgers is playing a key role in designing critical controller device-level resilience solutions as a part of the DOE-initiated Cyber Resilient Energy Delivery Consortium (CREDC)

CREDC, a $28.1 million consortium supported by Department of Energy (DOE), is advancing security and resiliency in the cyber support infrastructure as a key enabler of Energy Delivery System (EDS) resiliency. The cyber security of energy delivery systems, such as power grids and oil and gas (O&G) refinery and pipeline operations, has been the subject of media attention and been addressed in legislation, standards, and executive actions. However, there is growing awareness that we must also explicitly ensure cyber resiliency in order for an EDS to maintain critical functions in the presence of disruptive events, in particular those arising from attacks on the cyber infrastructure.

CREDC consists of 11 universities and national laboratories from Argonne National Laboratory, Arizona State University, Dartmouth College, the Massachusetts Institute of Technology, Oregon State University, the Pacific Northwest National Laboratory, Rutgers University, Tennessee State University, the University of Houston, and Washington State University. The team is addressing project objectives through research and outreach activities at the partner institutions, working in close collaboration with industry (utilities, O&G asset owners, and equipment vendors). The CREDC model explicitly creates a pipeline that generates research results and takes them through to evaluation and deployment of prototypes in industrial settings, with a handoff to the sectors through licensing, startups, and open-source mechanisms. CREDC is impacting foundational science and engineering approaches to EDS cyber security and resiliency, will impact practice through provisioning of industry-vetted solutions to near-term and far-term problems, and will impact the practice of education and workforce training in EDS cyber security and resiliency.

The Rutgers team led by Assistant Prof. **Saman Zonouz** will concentrate on foundations of automated trustworthy intrusion tolerance, and adaptive response and recovery capabilities in cyber-physical safety-critical energy delivery platforms. The team will design adaptive cyber-physical intrusion tolerance architectures with minimum trusted-computing base (attack surface) considering both existing legacy systems and emerging state-of-the-art real-world capabilities. The team brings strong expertise in development of novel and practical real-time and distributed intrusion response and recovery algorithms leveraging theoretical foundations in hybrid cyber-physical systems with simultaneous continuous and discrete dynamics. As a part of this project, in addition to academic research publications and presentations, the Rutgers team has discovered a security weakness in Allen-Bradley (Rockwell) Programmable Logic Controllers (PLCs) that are widely used (ranked one nationwide) in safety-critical industrial control systems in U.S. and internationally. The team has followed the responsible disclosure procedures with Rockwell, and is now working in collaboration with Siemens Labs to realize the corresponding mitigation solutions against similar intrusions on critical embedded controllers.



Discovering the Dynamics of Human Brain Function


L. Najafizadeh

The human brain is a highly complex dynamic system, constituted by interdependent subsystems with elements that are subjected to various types of time-varying interactions. Achieving a complete understanding of how the anatomical structure of the brain supports a diverse range of functions such as action, perception, and cognition has been the ultimate goal in the field neuroscience, but it is still far from reach. At the NeuroImaging Laboratory in ECE, Prof. **Laleh Najafizadeh** and her collaborators are working to achieve this goal with support from NSF, NIH and the state of NJ.

A common experimental approach to understand the functionality of the human brain has been to stimulate it, record it's response by monitoring activities related to a particular physiological element in the brain, and find the functional relationship between the stimuli and the observed outcomes. This approach sets the basis for a wide range of functional neuroimaging studies that are designed to investigate the functional organization of the brain at different spatial (e.g. single neurons, cortical circuits) and temporal (e.g. millisecond neuronal responses, slow hemodynamic responses) scales. Outcomes of these studies has led to the knowledge that human cognition arises from patterns of neural activity forming functionally distinct networks across the brain, which are ultimately coordinated via the brain's anatomical structure, setting the motivation to investigate the functionality of the brain at the network level, within the context of functional connectivity.

Brain functional networks however, exhibit complex structures across time and spatial scales. For exmaple, neural functional connections are continuously changing at multiple time scales. These changes can occur at very short scales (e.g. due to learning a simple task), or at relatively longer scales (e.g. due learning complex concepts or brain-related diseases such as Alzheimer's). Given the limitations each neuroimaging technique in terms of spatial and temporal resolutions, to uncover such dynamic properties of brain functional networks, new computational and experimental techniques should be developed.

Professor Najafizadeh and her students are developing data driven techniques that can reliably characterize the temporal evolution of the dynamics of brain functional networks, at multiple scales, for different physiological elements. They experimentally examine the ability of theoretical frameworks in quantifying the dynamics of brain networks, via data that we collect through simultaneous monitoring of brain function at multiple physiological levels, and various controlled conditions. The outcome of this work can provide important insights into the neural mechanisms underlying learning, and brain related diseases.

Professor Najafizadeh in collaboration with Professor David Margolis at the Department of Cell Biology and Neuroscience is also conducting research on the quantitative characterization of the dynamics of neural functional connections. Currently, our understanding of how the neural functional interactions form and change with time has been very limited because of lack of 1) quantitative measures that can reliably characterize network changes at different time scales, and 2) the ability to continuously monitor and record brain activities at different time scales, from millisecond to days and weeks. By taking a combined theoretical-experimental approach, Professors Najafizadeh and Margolis aim to address these limitations by establishing a data-driven computational framework with new quantitative measures that can characterize the temporal evolution of dynamics of brain functional networks, across short-and long time scales. To further broaden the capabilities of the framework, they will take a step further and will computationally and experimentally investigate how brain networks reorganize and change with time in response to transient, localized manipulations of the network structure.

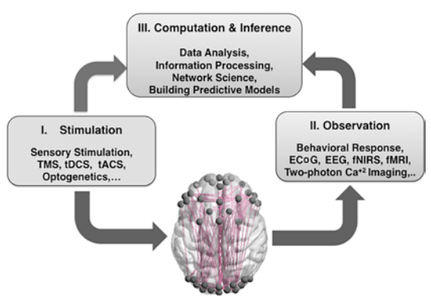


Figure 1: Learning the brain function.

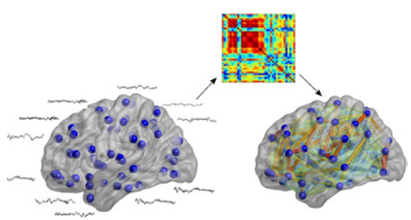


Figure 2: Construing functional brain networks.

ECE Offers First "Flipped Class" led by ECE Professor of the Year Dr. Waheed Bajwa


W. Bajwa

In Spring 2015, Rutgers ECE Department offered its first "flipped" class to 133 juniors taking the Electrical Engineering option. This effort was led by Prof. Waheed U. Bajwa, whose flipped offering of the junior-level, required Digital Signal Processing class received high praise from the students. Briefly, a flipped classroom "flips" the learning paradigm in traditional lecturing. The idea in flipped classrooms is that students watch short lecture videos created by the instructor outside the classroom, whereas the classroom time is devoted to the instructor actively interacting with the students through activities such as personalized problem solving, adaptive quizzes, and discussion of ideas that build on top of the watched videos. Instructors who have experimented with this new method of teaching have reported considerable success in the sense that weaker students tend to respond much better in flipped classrooms, when compared to their counterparts in traditional classrooms. While flipped classes are becoming more common in engineering schools, almost all of these efforts have been focused on small, elective classes. Prof. Bajwa's flipped offering of a required class to 133 juniors is one of the efforts in the US to extend the benefits of flipped classrooms to schools with large student populations. Notably, Prof. Bajwa received the Rutgers Engineering Governing Council ECE Professor of the Year Award. He was selected for this award by the entire student undergraduate student body of the ECE department through a voting process solely managed by the student-run Rutgers Engineering Governing Council.

LabTV profiles ECE students and faculty

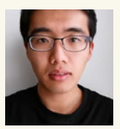
Professor **Anand Sarwate** is part of a grant-funded project spearheaded by the Mind Research Network in Albuquerque, NM. The goal is to build a decentralized, privacy-sensitive collaborative research system for neuroinformatics system. This new COINSTAC system would automate the process of setting up research collaborations and will allow researchers to conduct analyses across much larger groups of study subjects while protecting the privacy and confidentiality of subject data. This project is sponsored by the National Institutes of Health (NIH), who has partnered with a LabTV (http://www.labtv.com/), an organization founded by TEDMED curator Jay Walker and is partnered with Dr. Francis Collins, the Director of the NIH. They have a funding to create mini-videos with local filmmakers about NIH-funded research project around the country. Their mission is to "interest and engage a generation of students to consider a career in medical research."

Filmmaker Charlie Chalkin came to Rutgers in the fall to film Professor Sarwate and some of the students with whom he is working. The profiles can be viewed online:

Hafiz Imtiaz is a Ph.D. student advised by Professor Sarwate. He is working on machine learning and signal processing algorithms that are used in neuroimaging, and in particular on how to design those algorithms with provable privacy guarantees.
http://www.labtv.com/Home/Profile?researcherId=2077

Sijie Xiong is a Ph.D. student advised by Professors Sarwate and Mandayam. Her current research is on privacy and data gathering in networked systems such future smart buildings, cities, and the "internet of things."

Liyang Xie received his M.S. degree in 2015 with a thesis supervised by Professor Sarwate on methods for ensemble learning in distributed systems when local data processing is done in a privacy-sensitive way. He is currently a Ph.D. student in computer science at Michigan State University.
http://www.labtv.com/Home/Profile?researcherId=2112



Kevin Sun is an undergraduate at Rutgers majoring in Computer Science and Mathematics. He worked on research with Professor Sarwate through the Aresty program and is continuing this fall, looking at information flow and decision making in social networks.
http://www.labtv.com/Home/Profile?researcherId=2111

Anand D. Sarwate is an Assistant Professor in the ECE Department at Rutgers. His research interests are in information theory, machine learning, and signal processing, with applications to distributed systems, privacy and security, and biomedical research.
http://www.labtv.com/Home/Profile?researcherId=2110

Please see the back cover for a video profile of the Rutgers ECE Department

The WINLAB Summer Internship


I. Seskar

Summer internships provide students a chance to explore ideas and develop new skills outside of the classroom, as well as have fun. With this in mind, the WINLAB summer internship program designs a collection of projects that builds on those ideas, with an eye to the lab's areas of interest in wireless technologies.

This year, the program founded by **Ivan Seskar**, Associate Director of Information Technology at WINLAB, and which is in its 14th year of existence, hosted 49 students (14 high school, 19 undergraduate, and 16 graduate) who came together to tackle problems in areas such as Sensor Networks, Augmented Reality, and Software Defined Radios. All told, there were 18 project teams this year. Many teams found themselves working on projects that dovetailed with those of others, in keeping with the program's goal of providing students with real-world, team-based research experience.

Each week, the students gathered together to report on their progress, answer questions from fellow students and WINLAB faculty, and get advice on how to solve their most pressing problems. "Though we were each assigned a topic to work on, we always felt welcome to discuss, collaborate and involve ourselves in other projects," says Siddharth Rupavatharam, a graduate student at Rutgers, "It was the right mix of fun and work."

It seems as though they certainly did have fun. Between building robotic butlers, detecting the number of people in a room using a variety of sensors, recreating a popular video karting game in virtual reality (and relying on the simulation to drive a real-world kart), and more, this year's summer internship program was at its busiest ever, filling all available spots in the program.

The application process resulted in a collection of students from different backgrounds, and even different countries. "The exposure to such a wide range of interests was priceless," Rutgers undergraduate Michael Sanzari says, "I often learned more over lunch than I could in a semester's worth of classes."

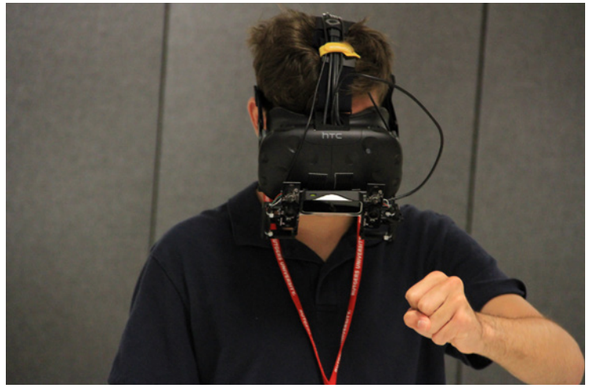
"There's a lot of accumulated wisdom in the lab, and it's always interesting to watch the interns encounter it. When students come ask for help, Ivan's particularly good at separating the interesting or educational problems from those that are either impossible, or boring and already solved," says Michael Sherman, a laboratory engineer at WINLAB, "For both cases, he points them to someone who's made a career out of the area. For example: every year a group tries to do RSSI based localization, and they get sent to Prof. Rich Howard (formerly of Bell Labs) to be told why it won't work, and things to try instead."

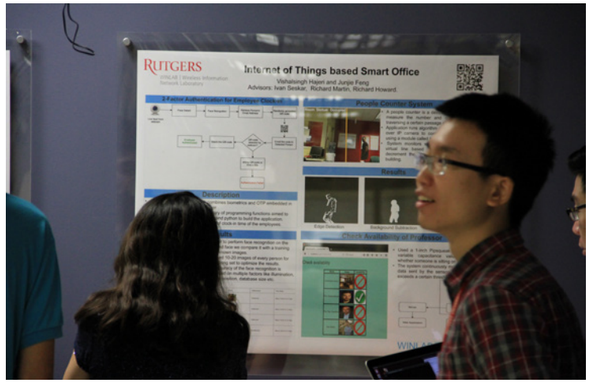
It's an observation echoed by students and peers as well. Kush Oza, another Rutgers undergraduate, had this to say after completing the program: "Students can pursue research topics pertaining to their interests as well as develop teamwork, leadership, and presentation skills under the guidance of great professors and mentors such as Ivan Seskar." Professor Roy Yates also confirms this, "While many of the projects are associated with ongoing faculty research, students know that Ivan will point them toward solutions to their problems."

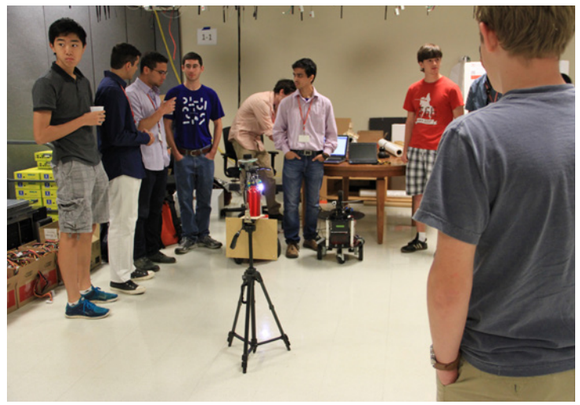
Discovering problems in the middle of research is arguably traditional, and in this setting instructive. Regardless, the students kept working through them, occasionally celebrating small victories over the course of the internship.

The program supported in part by NSF Research Experiences for Undergraduate (REU) funding, culminated on August 17 th with an Open House at the WINLAB Tech Centre with over 100 visitors. On this occasion, a presentation by Christopher Pflaum of the Rutgers New Ventures Office of Research Commercialization was followed by demos and posters presented by the Summer Research students.

When all's said and done, the success of the internship program depends on the students. In the words of Kush Oza: "I would definitely do research at Winlab again next summer given the opportunity."

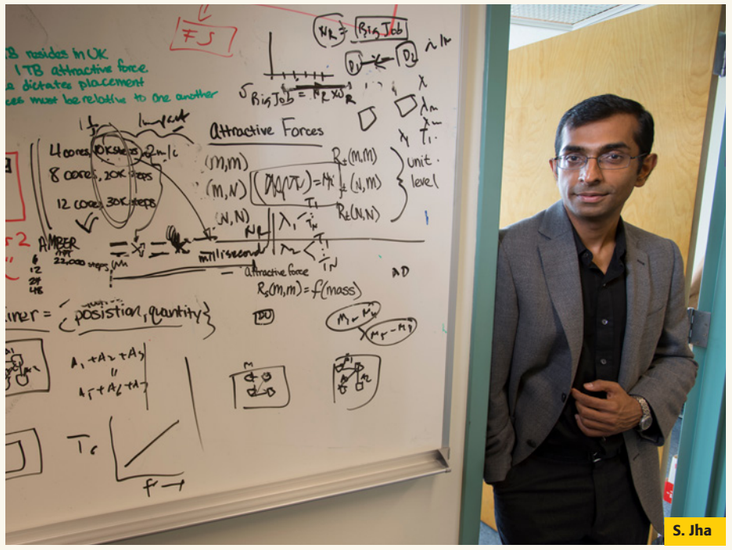






facultynews

Professor Shantenu Jha invited to White House Workshop on National Strategic Computing Initiative



S. Jha

Prof. **Shantenu Jha** was invited to The White House on July 29 to attend a workshop being held on the one year anniversary of the National Strategic Computing Initiative (NCSI). The National Strategic Computing Initiative (NSCI), an Executive Order of the President of the United States, is a whole-of-Nation effort to sustain and enhance U.S. leadership in high-performance computing (HPC). The NSCI seeks to accomplish five strategic objectivesin a government collaboration with industry and academia: (1) accelerate the successful deployment and application of capable exascale computing; (2) ensure that new technologies support coherence in data analytics as well assimulation and modeling; (3) explore and accelerate new paths for future computing architectures and technologies, including digital computing and alternative computing paradigms; (4) holistically expand capabilities and capacity of a robust and enduring HPC ecosystem; and (5) establish an enduring public-private collaboration to ensure shared benefit across government, academia, and industry.

At this event organized by the Office of Science and Technology Policy, Professor Jha and fellow invitees discussed high-performance computing and its role in advancing U.S. economic competitiveness, scientific discovery, and innovation. The White House heard individual views about the opportunities for discovery and innovation that NSCI will afford, as well as solutions to the challenges that the high-performance computing community faces in achieving the visionary goals of the initiative. This is a wonderful recognition of Professor Jha's expertise in high-performance computing and its application to computational science.

Professor Vishal Patel recognized with Office of Naval Research (ONR) Young Investigator Program (YIP)

The Department of Electrical and Computer Engineering congratulates **Vishal M. Patel** for being recognized with the prestigious Office of Naval Research (ONR) Young Investigator Program (YIP) Award in 2016.

As part of this award, Dr. Patel will study "Structured Sparse and Low-Rank Representations for Multimodal Recognition". The total award is $500,684 and its duration is three years.

The goal of Dr. Patel's project is to develop robust and efficient methods for learning structured representations of multimodal data. In particular, he will develop methods for multimodal metric learning and multimodal data fusion based on sparse and low-rank representations.

The Office of Naval Research awarded the ONR YIP to 47 scientists whose exceptionally creative research holds promise across a range of naval-relevant science and technology areas, from robotics to solar cells. Awardees represent 34 academic institutions across the country, in disciplines including optoelectronics, corrosion, biofilms, organic semiconductors, structural dynamics, combustion, ocean-atmospheric interaction, metamaterials, energetic materials, active flow control, efficient computing, foodborne diseases and warfighter training.


V. Patel

ECE Bitcoin Study Reveals False Beliefs on Ease of Use and Privacy

Prof. **Janne Lindqvist's** group published a study on Bitcoin that received attention world-wide. This first-of-its-kind peer-reviewed study "Of Two Minds, Multiple Addresses, and One Ledger: Characterizing Opinions, Knowledge, and Perceptions of Bitcoin Across Users and Non-Users" was formally published in May 2016 at the annual Association for Computing Machinery's Conference on Human Factors in Computing Systems (CHI 2016). CHI is the premier international conference on human-computer interaction, the most prestigious publication venue in the field. Prof. Lindqvist authored the study with two PhD candidates in his group, **Xianyi Gao** and **Gradeigh D. Clark.**

The major findings of the study included: " 1) although some non-users thought not knowing how Bitcoin works was what stopped them from using it, we found our users did not need this knowledge to make transactions; 2) most user participants thought Bitcoin had good security and privacy controls despite evidence to the contrary; 3) participants highly disapproved of government regulation but still wanted governments to insure deposits; 4) participants' opinions about attributes of an ideal payment system map directly to properties that Bitcoin has; and 5) Bitcoin has barriers to overcome that make it difficult to be used for mainstream adoption."

Over 100 websites featured the story, first published in Rutgers Today Top Stories. In addition to usual science websites, prominent finance and investment sites such as Yahoo! Finance, Morningstar and IBS Intelligence included coverage.

The preprint (published in the Social Science Research Network (SSRN) preprint service) version the Bitcoin study was featured in length in a European Parliament study "The Collaborative Economy - Impact and Potential of Collaborative Internet and Additive Manufacturing.", and was during 2015 among the top downloads in SSRN for categories such as "IRPN: Innovation & Finance (Topic)" and "LSN: Consumer Credit & Payment Issues (Topic)."

Professor Vishal Patel's Mobile Face Detection in the News

Prof. **Vishal M. Patel**'s recent work on mobile face detection and recognition is making the news! His research work was featured on ZDNet, the business technology news website owned by CBS Interactive.

Dr. Patel's group, working with researchers at University of Maryland and Google's Advanced Technology and Projects (ATAP), developed a method to use the cellphone's front camera to continuously authenticate users when they are logged into bank or email accounts.

Dr. Patel's group developed a part-based technique for real time detection of users' faces on mobile devices. The proposed method is specifically designed for detecting partially cropped and occluded faces captured using a smartphone's front-facing camera for continuous authentication. The key idea is to detect facial segments in the frame and cluster the results to obtain the region which is most likely to contain a face.

Dr. Patels' work in collaboration with University of Maryland researchers Dr. Rama Chellappa and Dr. Rajeev Ranjan has resulted in created an invention named "HyperFace", which won the 2015 Invention of the Year Award in the Information Sciences category at the University of Maryland. The Office of Technology Commercialization at the University of Maryland gave this award.

HyperFace is an algorithm that simultaneously detects faces, finds facial landmarks (including eye center, nose tip, etc.), estimates the head pose, and recognizes their gender from any real-world images and videos. Its applications include automatic face tagging, mobile active authentication, automatic monitoring through surveillance cameras, face identification, affective computing, and expression analysis for medical applications, such as automatic pain and fatigue detection, facial emotion analysis, and many more. The Office of the Director of National Intelligence (ODNI), Intelligence Advanced Research Projects Activity (IARPA) has provided funding and support for the project.

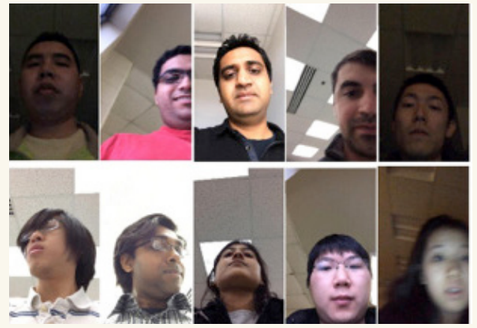


Figure 1: The face detection system was tested using face video from the front-facing camera of 50 iPhone users in different illumination conditions.

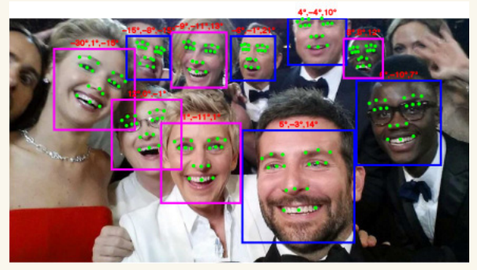


Figure 2: Sample results from HyperFace.

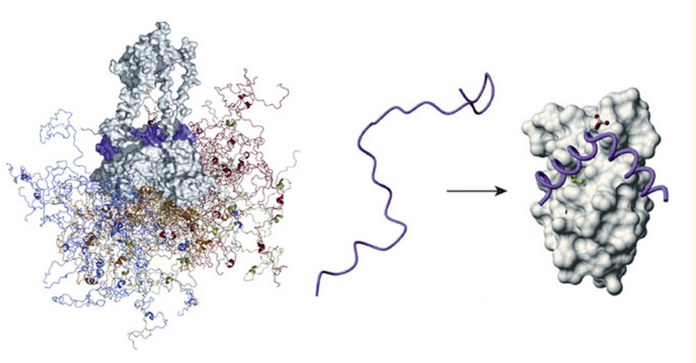
Rutgers is playing a key role in a new NSF scientific software initiative

Highlighting the importance and challenge of sustainable and scalable software in the scientific discovery process, the US National Science Foundation recently announced the establishment of a Scientific Software Innovation Institutes for Molecular Sciences. **Dr. Shantenu Jha**, Associate Professor in ECE is a co-PI and the lead Computing Faculty on this ambitious 5 year $20M Institute. The Institute called MolSSI – Molecular Science Software Institute, will enable computational scientists to tackle problems that are significantly larger and more complex than those currently within reach. MolSSI will impact domains that use molecular simulations – from proteins and drug designs to the next generation of materials.

There are many challenging problems that MolSSI will address which would not be possible otherwise. For example, the scientific efforts in the past 30 years have significantly advanced our collective understanding of the folding dynamics and conformational changes present in structured proteins. However, it has long been known that regions of intrinsic disorder are common in eukaryotic proteins. In fact intrinsically disordered proteins (IDPs) comprise nearly 25% of the human proteome. IDPs are directly associated with numerous human disease such as cancer, cardiovascular disease, amyloidoses, neurodegenerative diseases (e.g. alzheimers) and diabetes. Compared with structured proteins, simulations of IDPs present new computational challenges. More aggressive sampling methods and more accurate force field parameters are required in order to fully characterize the dynamics and functions of these proteins. Tools, techniques and software improvements enabled by Prof. Jha's team in collaboration with other MolSSI Investigators will help overcome the computational efficiency and resource limits of simulating and understanding IDPs.

MolSSI is one of only two Software Institutes funded by the NSF and represents some of the most innovative and daring investment in cyberinfrastructure in decades by the NSF. As part of this initiative, Prof. Jha will be responsible for the (i) software engineering process, (ii) middleware upon which MolSSI supported science and codes will depend, and (iii) deployment and integration with NSF production infrastructure.

Figure 1 (Left) Some parts of the p53 protein take on a definitie structure (gray model) while other regions remain disordered in the unbound state. (Right) Disordered protein region can become structured upon binding with another protein (images adapted from Tompa, P and Dyson, H. J et al).



Prof. Waheed U. Bajwa selected for National Academy of Engineering Frontiers Symposium

Prof. **Waheed U. Bajwa** was selected as a Member of the Class of 2015 National Academy of Engineering (NAE) Frontiers of Engineering Education Symposium. According to the NAE, the purpose of this symposium is to "bring together some of the nation's most engaged and innovative engineering educators in order to recognize, reward, and promote effective, substantive, and inspirational engineering education." Prof. Bajwa was selected among this prestigious group of academics in recognition of his efforts for enabling flipped classroom experiences in large-scale settings.

Shantenu Jha wins Chancellor's Award for Excellence in Research


S. Jha

Prof. **Shantenu Jha** has been named a recipient of the 2016 Rutgers Chancellor's Award for Excellence in Research. The award carries an honorarium in the amount of $1000 and will be presented to Dr. Jha Shantenu and fellow honorees at the awards reception in October. Dr. Jha leads the RADICAL – Research in Applied DIstributed Computing and Applications Laboratory – which is involved in research at the triple point of Cyberinfrastructure, Applied Computing and Computational Science. His team has collaborated with high-energy physicists, climate scientists, and bio-molecular scientists to develop and apply advanced computing techniques. His research is supported by DOE and NSF awards. He is an NSF CAREER Awardee.

ECE Professor Richard Frenkiel has been named Fellow of the National Academy of Inventors.

The National Academy of Inventors announced its 2015 fellows Dec. 15. They include 168 inventors who collectively hold more than 5,300 U.S. patents. This year's class brings to 583 the number of NAI fellows, including 310 members of the National Academies, 32 recipients of the U.S. National Medal of Technology and Innovation and 27 Nobel Laureates.


R. Frenkiel

Frenkiel, who is a cellular pioneer recognized for his contributions to establishing the world's first cell phone networks, earned a master's degree in engineering mechanics from Rutgers in 1965. He joined Bell Labs in 1963 and quickly became involved in the design of cellular systems, which he worked on for 16 years. He co-authored the technical report on cellular that AT&T submitted to the FCC in 1971, which became the basis for the first cellular systems. For his work in cellular and cordless, Frenkiel received the IEEE Alexander Graham Bell Medal in 1987, the Achievement Award of the Industrial Research Institute in 1992, the National Medal of Technology from the president of the United States in 1995 and the Draper Prize in 2013. He was named N.J. Inventor of the Year in 1995 and was elected to the National Academy of Engineering in 1997. He received the Rutgers University Alumni Association's Engineering Achievement in 2004. After the commercialization of AT&T's first cellular system in Chicago, Frenkiel moved into consumer electronics, becoming head of R&D for AT&T's cordless telephone business and leading the team that designed a series of cordless telephones that set a new standard of voice quality with improved battery life and security, moving cordless telephones from unreliable gadgets to useful telecommunications devices. Following 30 years at AT&T, Frenkiel joined WINLAB (the Wireless Information Networks Laboratory) at Rutgers in 1993, where he serves as senior adviser and also teaches an interdisciplinary course in wireless systems and strategic thinking. Frenkiel served two terms on the Township Committee of Manalapan Township in NJ and was mayor of Manalapan in 1999.

Professor Athina Petropulu has been named a Distinguished Lecturer of the IEEE

Prof. **Athina Petropulu** has been named a Distinguished Lecturer of the IEEE Signal Processing Society for the term January 1, 2017 to December 31, 2018. IEEE Distinguished Lecturers are engineering professionals who help lead their fields in new technical developments that shape the global community. These experts specialize in the field of interest of their society and travel to various technical and regional groups, such as society and technical council chapters to lecture at events.

In this role, Professor Petropulu will deliver lectures worldwide on the topics of sparse sensing based MIMO radars, coexistence of radar and communication systems, cooperative approaches for physical layer security, cooperative approaches for improving the performance of wireless network, mobile beamforming, and localization of brain activations based on EEG recordings and sparse signal recovery theory.


A. Petropulu

WINLAB Faculty Win Best Paper Award

Researchers from WINLAB have won best paper awards at multiple conferences in the past year. The paper entitled "Coordinated Dynamic Spectrum Management of LTE-U and WiFi Networks" by the WINLAB team led by Profs. **Dipankar Raychaudhuri** and **Wade Trappe** won the best paper award at IEEE DySpan2015 conference held in Stockholm. **Shweta Sagari** (ECE PhD student) was the first author, and the other authors are **Samuel Baysting, Dola Saha,** and **Ivan Seskar.** IEEE DySpan is the premier conference on spectrum policy and technology and is sponsored by NSF and several communications companies. The team od Andrey Garnaev (WINLAB Research Scientist), Shweta Suresh Sagari (ECE/WINLAB student) and Prof. Wade Trappe (ECE/WINLAB) also received the best paper award at the Multiple Access Communications (MACOM 2015) Workshop held in Helsinki for their paper "Fair Allocation of Throughput under Harsh Operational Conditions".

Vishal Patel selected for the A. Walter Tyson Assistant Professorship Award

Prof. **Vishal M. Patel** has been selected for the A. Walter Tyson Assistant Professorship Award. The Tyson fund, established by A. Walter Tyson, a 1952 alumnus of the School of Engineering, is used to recruit promising junior faculty. Funds made available through the generosity of the Tyson Family are used to offset the School's investments in talented young faculty. With this award, funds will be used toward the School commitments that were made toward Professor Patel's start-up package.

Professor Lawrence Rabiner Retires

Prof. **Lawrence (Larry) Rabiner** recently retired from his position as Distinguished Professor of Electrical and Computer Engineering at Rutgers University. He joined the ECE department at Rutgers in 2002 after an illustrious career at AT&T.

Professor Rabiner received a PhD from the Massachusetts Institute of Technology , and for almost 55 years, he has been a pioneer and a leading innovator in the field of digital signal processing, with applications to speech processing and telecommunications.

A key motivating factor for the research that Professor Rabiner carried out in his early years as a Research Member of the Technical Staff at Bell Labs was the inability to properly model a range of signal processing phenomena (spectral analysis, filtering, source creation, etc.) using existing analog signal processing methods. This led to Professor Rabiner working with many of the pioneers of digital signal processing with the goal of creating understanding and algorithms for virtually every aspect of digital signal processing, from fundamentals of z-transform analysis to filter design and ultimately to spectral analysis and synthesis tools. These building blocks rapidly became the basic toolkit of digital signal processing and were widely used.

The early years of Professor Rabiner's research career resulted in a range of fundamental speech processing systems, including one of the earliest speech synthesis systems that converted phonemic text to intelligible speech, the first practical method for tracking speech resonances (formants) from analysis of the speech waveform (using cepstral methods) resulting in a viable formant vocoder at very low bit rates, and a set of world class methods of tracking speech pitch (fundamental frequency) that were robust to distortion and noise. Professor Rabiner (along with his colleague Ron Schafer) also was one of the pioneers in creating the area of short-time speech processing, with applications to time-domain, frequency-domain, cepstral-domain and LPC-domain signal processing representations and algorithms, which today are the core methods used in virtually every viable speech processing application in the real world. The next phase of Dr. Rabiner's career was devoted to study and understanding of the communication and signal processing methods that were used for speech recognition technology. Here Professor Rabiner was again a leading contributor to the field, helping to define the signal processing methods that provided the framework for several generations of recognition systems, formulating and expanding the set of techniques, known collectively as dynamic programming methods, and creating world class technology for isolated and connected word speech recognition systems. Dr. Rabiner was a key proponent of the statistical method of speech recognition, known as the Hidden Markov Model, (HMM). He was the first researcher to clearly explain the basic statistical concepts of HMM technology and to publish his analysis results in a landmark IEEE Proceedings article that has been referenced widely since its publication in 1989. This paper is one of the most referenced papers in engineering and computer science, having been cited over 23,000 times as of August 2016 (per Google Scholar). By the end of the 1980s, Professor Rabiner recognized that speech recognition technology had matured enough to be considered for use within the AT&T network and he worked tirelessly with development colleagues to create the speech recognition system, widely known as Voice Recognition Call Processing (VRCP), which was capable of recognizing a set of 5 spoken commands and taking appropriate action. This system was introduced into the AT&T Network in 1992 and successfully handled more than 1 billion calls each year with error rates lower than 1%.

For his work, Dr. Rabiner has enjoyed a long list of honors

- Acoustical Society of America Fellow, 1970
- Paper Award of IEEE Group on Audio and Electroacoustics, 1971
- ASA Biennial Award, 1974
- IEEE Fellow, 1976
- IEEE ASSP Achievement Award, 1978
- IEEE Piore Award, 1980
- IEEE ASSP Society Award, 1980
- Election to National Academy of Engineering, 1983
- IEEE Centennial Award, 1984
- AT&T Bell Laboratories Fellow, 1989
- Election to National Academy of Sciences, 1990
- Speech Processing Magazine Award of the IEEE, 1994
- AT&T Patent Award, 1995
- AT&T Fellow Award, 1996
- IEEE Millennium Medal, 1999
- IEEE Kilby Medal, 1999

During his career at Rutgers, Professor Rabiner educated hundreds of students in advanced signal and speech processing methodology, and produced a landmark textbook (with his colleague Ron Schafer) that unified and set into print the fundamentals as well as the practical sides of speech processing systems. This new textbook has been well received in the technical and academic communities and is used as the basis of speech processing courses throughout the world.

From his AT&T years, Prof. Larry Rabiner (right), with J.L. Flanagan (center) and R. W. Schafer.

Prof. Janne Lindqvist Gesture Recognition Work in Extended Media Coverage

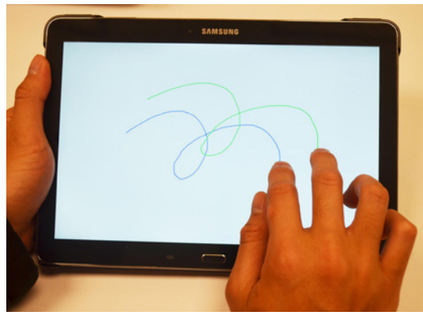
Prof. **Janne Lindqvist's** group has received sustained media coverage for the past two years their work on free-form user-generated gestures for authentication. Their first paper, published in the tier-1 conference MobiSys'14, received world-wide attention and was featured in media including Scientific American, Fortune, CBS Radio News and NPR and its syndicated radio network among hundreds of others.

In May 2016, the group (co-authors **Yulong Yang**, ECE / PhD October 2016, **Gradeigh D. Clark**, ECE / PhD candidate, **Antti Oulasvirta** (Aalto University) published a new paper "Free-Form Gesture Authentication in the Wild." This paper is part of the proceedings of CHI'16, which is /the/ premier annual ACM international conference on human-computer interaction.

For the first time, free-form gesture authentication passwords were used in the real world, in a 91-participant field study. Participants created and used eight different gesture passwords during the study. The study showed gesture passwords were faster to perform, faster to create new passwords and log in, and easy to remember. This is the first study to show the feasibility and usability of free-form gesture passwords in the people's everyday lives, making a big step towards the actual deployment of such novel authentication.

The results of this new field study indicate that free-form gestures are a serious alternative to existing technologies, such as text passwords, PIN numbers, grid-based method (Android) or biometrics such as fingerprinting. The existing methods mentioned on mobile devices suffer from various shortcomings: limited password space, susceptibility to shoulder surfing, easily crackable, slow entry and harmful for privacy (e.g. databases of fingerprints).

Importantly, the new field study indicates that free-form gesture authentication is particularly suited for mobile use. This was expected, however, Lindqvist group's previous study was done in a laboratory so there was yet no scientific evidence for this from field. For example, all the other alternatives rely on aimed movements, but



our approach relies on shapes, which makes a crucial difference. This better supports mobility.

The media coverage of this work has been extensive and includes over 400 broadcast media, print and news outlets including media outlets such as MIT Technology Review, ABC Radio News and its affiliates, Daily Mail, International Business Times , Security Brief Au, Wired (UK), Metro (UK), Yahoo!

Professor Puri In Memoriam

Prof. **Narendra Nath Puri**, who retired from Rutgers in 2008 passed away in December, 2015. Dr. Puri who received his Ph.D. from University of Pennsylvania joined Rutgers ECE as a full professor in 1968, was a researcher with broad interests and publications in mathematics, physics, and engineering. Outside of his primary research interests (automatic control systems), he published an award winning journal paper on antennas in IEEE Transactions on Antennas and Propagation in 1982, published papers on electrical and electronic circuits, power systems, image processing, financial engineering, biomedical engineering, and mathematics. It is little known that the famous Kleinman's algorithm developed in 1968 for solving the algebraic Riccati equation (the main equation of optimal control theory and Kalman filtering) was previously derived and presented at the Joint American Control Conference by a young scientist Narendra Nath Puri, at that time an Assistant Professor at Drexel University.

He was a person who spoke with great authority in the classroom and at faculty meetings with everybody listening carefully to this extraordinarily charismatic man. In private conversations, however, he was a soft spoken person, like an old friend and a father figure, giving cheerful advice to his students and young faculty members. Like his research, Dr. Puri had broad interests in all aspects of human life and society, was very knowledgeable about many world cultures, and loved the card game bridge. His many doctoral graduates have gone on to successful careers in academia, entrepreneurship and Wall Street.
Dr. Puri is survived by his wife Dr. Kamal Puri, daughter Dr. Monica Puri, son Dr. Lalit Puri and six grandchildren.

newgrants

Waheed Bajwa received a one year, $110K subaward from General Dynamics as part of the ARL Robotics CTA Program for the project: "Models and Algorithms for Human Activity Recognition."

Also, **Dr. Bajwa** and **Mark Pierce** (Biomedical Engineering) received DoD grant of $275,000 for the project "MANTIS: A Multimodal Imaging Suite to Enhance Army's ISTAR Capabilities and Improve Soldiers Health".

Mehdi Javanmard received a DARPA grant of $185,887.15 for 15 months. The title of the project is "The ProteOhmic Smart-Patch: Transcutaneous Monitoring of Molecular Levels in Blood Using Flexible and Natural Substrates".

Also, **Dr. Javanmard** received a $344,942 NSF grant for the project "The ThruProt Analyzer: Bringing Proteomics to the Field Using a Sample-to-Answer Electronic Multiplexed Platform". This is a 3-year collaborative grant with colleagues from the RU Ocean Sciences Department.

Janne Lindqvist received an NSF award for $300K from the NSF for project "Enhancing Access to the Radio Spectrum (EARS): Machine Learning and Social Protocols for Enhancing Spectrum Access for Wireless Communications". Richard Howard of WINLAB is senior personnel on the grant.

Narayan Mandayam and **Arnold Glass** (Psychology) received an NSF EAGER Award of $100K for "EAGER: Renewables: Collaborative Research: Foundations of Prosumer-Centric Grid Energy Management."

Laleh Najafizadeh received $250,000 from DARPA for the project titled "Leveraging Multi-Modal Multi-Layer Functional Networks for Next Generation BMIs".

Also, **Dr. Najafizadeh** and **David Margolis** (Department of Cell Biology and Neuroscience) received an NSF grant of $363,273 for the project titled "Probing Neural Connectivity at Multiple Temporal Scales".

Also, **Dr. Najafizadeh** and **David Margolis** were part of a team with **Janet Adler** (Neuroscience and Cell Biology) and received a grant of $540,000 from New Jersey Commission on Brain Injury Research for a project titled "Role of Cortical Network Plasticity in Recovery from Traumatic Brain Injury".

Vishal M. Patel received an NSF award of $249,152 for the project titled "Sparse and Low Rank Methods for Imbalanced and Heterogeneous Data." This is a two year collaborative effort between Dr. Patel and The Johns Hopkins University.

Also, **Dr. Patel** received a 3-year grant of $327,127 from ARO for the project "Adaptive Sparse and Low-Rank Models for Real-World Visual Recognition".

Dipankar Raychaudhuri, Roy D. Yates, Yanyong Zhang, Wade K. Trappe, Richard P. Martin received supplemental funding in the amount of $598,451 for FIA-NP: Collaborative Research: The Next-Phase MobilityFirst Project - From Architecture and Protocol Design to Advanced Services and Trial Deployments. The award, with this amendment, now totals $2,899,858.

Anand Sarwate received a 5-year grant of $1,013.723 from DARPA for projected entitled, "Jana: Ensuring Secure, Private and Flexible Data Access".

Also, **Dr. Sarwate** received an award of $125K from the Department of Homeland Security (DHS) for the project "Differentially Private Anomaly Detection".

Drs. **Sarwate** and **Mandayam** (co-PI) received NSF grant from the Secure and Trustworthy Cyberspace (SaTC) program. The title of the project is "PERMIT: Privacy-Enabled Resource Management for IoT Networks" and the award amount is $500,000 for 3 years.

Wade Trappe received 8-month contract with initial budget of $71,395 from The Space and Terrestrial Communications Directorate (S&TCD) of the U.S. Army. Team will support the Army's development of a next generation tactical waveform.

Also, **Dr. Trappe**, in collaboration with Mayflower Inc, received a Phase-1 STTR from the US Air Force for a project titled, "Collaborative Situation Aware PNT (CSAP) Solution". This is a 6-month contract with award of $45K.

Saman Zonouz received a grant of $500K from the Department of Energy for the project "Cyber Resilient Energy Delivery Consortium". This is a joint grant with MIT, OSU, UIUC, TSU, WSU, Dartmouth, ANL, PNNL, ASU. The total budget is $22M for 5 years.

Professor **Shantenu Jha** is the lead PI on a 3 year NSF award for $1.25M on a project titled "The Power of Many: Ensemble Toolkit for Earth Sciences." This is a three way collaborative project between Rutgers, Penn State University and Princeton. In this project, Dr. Jha will work with Michael Mann (https://en.wikipedia.org/wiki/Michael_E._Mann) a distinguished Climate Scientist at Penn State and Guido Cervone to advance high-performance computing based methods for the analysis of CMIP5 data. Dr. Jha will also work with Jeroen Tromp and others at Princeton to help advance computational modelling capabilities of Seismic Inverse Problems and thus seismic hazard assessment. This award is funded as part of the NSF EarthCube Program which is a joint solicitation between Advanced Cyberinfrastructure and Geosciences.

alumninews

Dr. Dorin Comaniciu wins the 2016 Rutgers SOE Distinguished Alumnus Research & Education Award


D. Comanicu

Dr. Dorin Comaniciu has been named the recipient of the 2016 Rutgers SOE "Distinguished Alumnus Research & Education Award." Dr. Comaniciu is currently Vice president, Medical Imaging Technologies, Siemens Healthcare. Before that, Dr. Comaniciu directed Siemens research and development in medical imaging and computer vision for 12 years, being responsible for more than $250M of R&D projects, and contributing to the company's success in the field of healthcare. At Siemens Healthcare, one of the largest global suppliers to the healthcare industry, Dr. Comaniciu and his team pioneered the first automated algorithms to guide minimally invasive, catheter-based heart valve implantations. The new technology called Marginal Space Learning reconstructs in seconds a 3D representation of the patient's aortic root, providing a model of the aortic valve and best projection angle for the valve implant. Thousands of patients have received new heart valves under the guidance of the Siemens clinical products Aortic ValveGuide and CT TAVI Planning resulted from Dr. Comaniciu's research. The new products are in use at multiple heart centers, including New York Presbyterian Hospital, Yale School of Medicine, Leipzig Heart Center, and Munich Heart Center. The recent release of the clinical product eSie Valves in 2014 improves the care of numerous patients, by addressing in real-time the para-valvular leakage after aortic valve implant and mitral valve repair. eSie Valves is the first clinical application that allows joint real-time 3D visualization of the heart valves anatomy and blood flow.

Furthermore, Dr. Comaniciu has established the theoretical basis for machine learning-based whole body image analysis and led the development of highly innovative automated imaging algorithms and subsequent diagnostic products. His work concentrated on volumetric measurements of internal organs and vessels, and characterization of tumors and lymph nodes, coronary plaque, and structural heart disease. The new products are used daily worldwide, making a difference for millions of patients, increasing the quality of healthcare while reducing its cost. For example, one year after its release, the CT Bone Reading has been installed in 147 hospitals in 63 countries and applied to more than 40,000 patients, being used daily to diagnose bone pathologies.

During his early career and building upon his graduate work at Rutgers under the supervision of Prof. **Peter Meer,** Dr. Comaniciu introduced a new family of robust methods for image analysis, based on the iterative procedure Mean shift. Mean shift analysis, Variable bandwidth mean shift, and Kernel-based Tracking are among the highest cited non-parametric methods in the imaging and computer vision literature, e.g., most cited IEEE Transactions on Pattern Analysis and Machine Intelligence paper published since 2002 and 7th most cited of all time, being often taught as part of graduate courses. Kernel-based Tracking introduced object tracking based on feature histogram representations with a metric derived from the Bhattacharyya coefficient as similarity measure. Due to its robustness and impact in computer vision, the work has been awarded the 2010 IEEE Longuet-Higgins Prize for 'Fundamental Contributions in Computer Vision." The mean shift algorithms have been deployed into multiple medical and industrial systems. Dr. Comaniciu is one of the highly cited authors in imaging and computer vision, his 300 publications generating more than 28,000 citations according to Google Scholar. He is also a prolific inventor, being granted 202 US and International patents. A graduate of the Advanced Management Program at the University of Pennsylvania's Wharton School (2011), Dr. Comaniciu received a doctorate in electrical and computer engineering from Rutgers University in 1999 and a doctorate in electronics and telecommunications from Polytechnic University of Bucharest in 1995. He is a Fellow of the IEEE, the Medical Image Computing and Computer Assisted Intervention Society, the American Institute for Medical and Biological Engineering, and a Top Innovator of Siemens.

Class of 2016 Yulong Yang joins Uber

Yulong Yang joined ECE of Rutgers in 2011. His research area mainly focuses on security, but overlaps with mobile computing and human computer interaction. Yulong received his Ph.D. in 2016. His thesis is titled "Usable Security: Human Factors in Mobile Authentication", advised by Prof. **Janne Lindqvist.** His research was funded by the National Science Foundation. Yulong has publications in premier peer-reviewed ACM conferences, including CHI, MobiSys and UbiComp. During his research, he was also a member of WINLAB at Rutgers. He interned at Amazon in the fall of 2015, and Uber in the winter of 2015. Yulong Yang is currently a software engineer with Uber Technologies, Inc. in San Francisco.


Y. Yang

My experience at Rutgers ECE

By **Revan Sopher,** Class of 2016 and a Software Engineer at Google

Choosing Rutgers was probably the best decision I made senior year of high school. The peculiar thing about the tech industry is that employers care about what a candidate knows, not which school they attended – certainly more so than in business or law, but also more than in more "traditional" engineering fields. I was confident that I could achieve my goals no matter which university I chose, so I couldn't justify paying the high prices of the "elite" schools. As an in-state student, Rutgers was a fantastic value – the scholarships only made the choice easier.

At the time, I was unsure whether I wanted to follow an academic or industry career path: the former would involve undergraduate research and careful GPA preening to prepare for graduate studies, while the latter would entail internships and the self-driven study of practical skills. Fortunately, Rutgers afforded me the luxury to straddle the divide, pursuing both directions through senior year as I continued my soul-searching.


R. Sopher

During semesters, I had the opportunity to contribute to a biomedical research project on stroke rehabilitation using smartphones, and to a computer vision research project on transmitting hidden messages using light (funded by NASA's NJ Space Grant Consortium). During summers, I interned at a nutrition app startup in New York, and at an online university course startup in Silicon Valley.

My advice to current students, then, is to muster up the drive to take advantage of the opportunities available at Rutgers. There's an excellent Computer Science undergrad community which regularly holds workshops, events, and "hackathon" competitions to help beginners pick up essential skills and prepare for technical interviews. And as a large research university, there's an abundance of projects which would appreciate the contributions of a programmer, if you only reach out to the professor. My advice to prospective students, hesitating between Rutgers and pricier private options, is to believe in your ability to develop yourself and shape your career. With motivation, you can achieve as much at Rutgers as at any Ivy.

Sennur Ulukus Elevated to IEEE Fellow

Sennur Ulukus, a 1998 Ph.D. graduate of WINLAB, Department of Electrical and Computer Engineering, Rutgers University, has been elevated to Fellow of the Institute of Electrical and Electronics Engineers (IEEE) "for contributions to characterizing performance limits of wireless networks," effective Jan. 1, 2016.

Ulukus is a Professor of Electrical and Computer Engineering at the University of Maryland at College Park, where she also holds a joint appointment with the Institute for Systems Research (ISR). Prior to joining UMD, she was a Senior Technical Staff Member at AT&T Labs-Research. She received her B.S. and M.S. degrees in Electrical and Electronics Engineering from Bilkent University. Her research interests are in wireless communications, information theory, signal processing, networking, information theoretic physical layer security, and energy harvesting communications.


S. Ulukus

Dr. Ulukus, who was advised by Prof. **Roy Yates** at Rutgers, was named a Distinguished Scholar-Teacher of the University of Maryland in 2016. She received the 2003 IEEE Marconi Prize Paper Award in Wireless Communications, the 2005 NSF CAREER Award, the 2010-2011 ISR Outstanding Systems Engineering Faculty Award, and the 2012 ECE George Corcoran Education Award. Dr. Ulukus is on the Editorial Board of the IEEE Transactions on Green Communications and Networking (2016-) and IEEE Journal on Selected Areas in Communications – Series on Green Communications and Networking (2015-2016). She was an Associate Editor for the IEEE Transactions on Information Theory (2007-2010) and IEEE Transactions on Communications (2003-2007). She was a Guest Editor for the IEEE Journal on Selected Areas in Communications (2015 and 2008), Journal of Communications and Networks (2012), and IEEE Transactions on Information Theory (2011). She is a general TPC co-chair of 2017 IEEE ISIT, 2016 IEEE Globecom, 2014 IEEE PIMRC, and 2011 IEEE CTW.

advisoryboard

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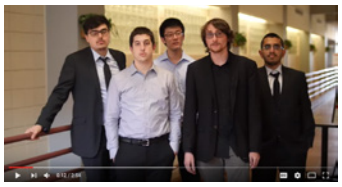

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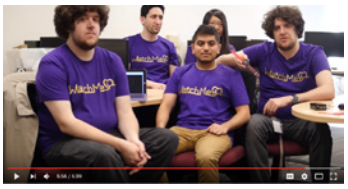

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