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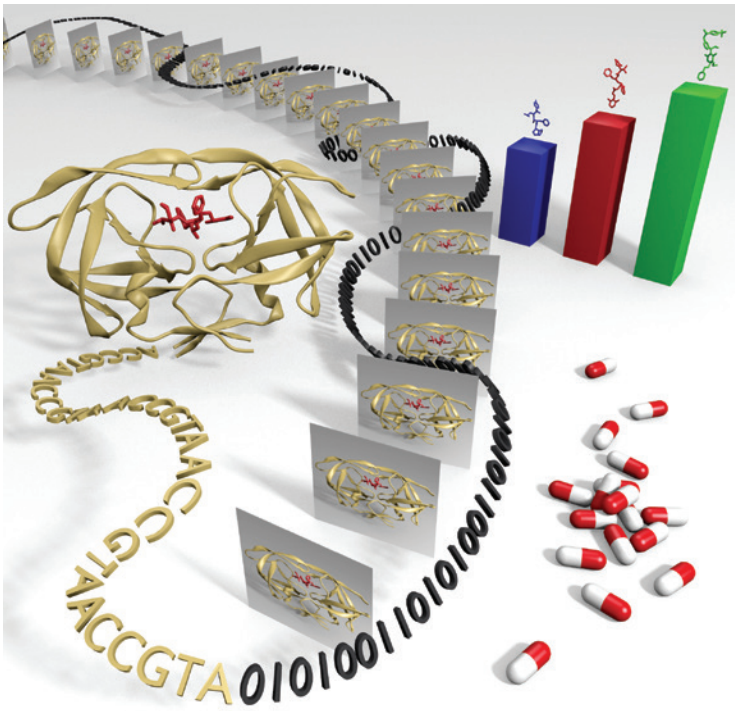
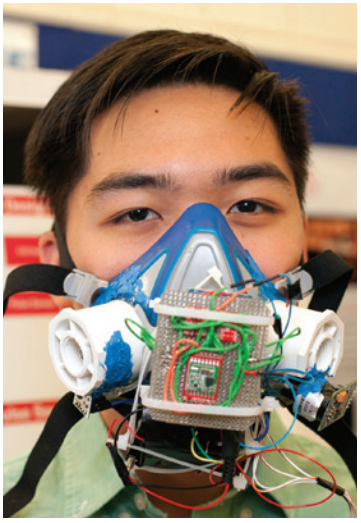
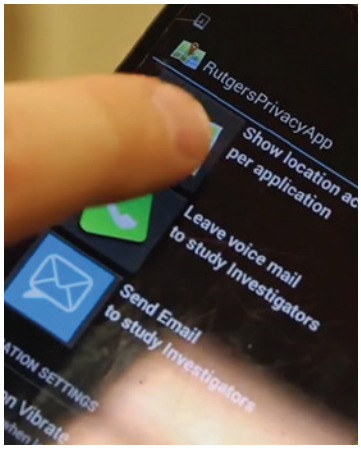
Rutgers University School of Engineering | Department of Electrical and Computer Engineering | 2013-2014







contents

ECE News is an annual publication of Rutgers ECE.

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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**

message from the Chair

Athina Petropulu

These are very exciting times for Rutgers University in general and the ECE Department in particular.

With its new medical school, Rutgers is now positioned as one of the most comprehensive public research universities in the country. Indeed, in 2014, Rutgers University leaped to 33rd place among the world's top 1,000 universities according to the Center for World University Rankings. Rutgers also joined the Committee on Institutional Cooperation (CIC), an academic consortium that includes all members of the Big Ten Conference and the University of Chicago. There is much excitement on campus with our Scarlet Knights football team competing in the Big Ten Conference this year.

Equally exciting is our departmental news. Our faculty has grown by adding outstanding people covering important emerging areas, such as security, privacy, and bioelectrical engineering. Last year we welcomed two new Assistant Professors, Janne Lindqvist and Anand Sarwate, and this Fall we welcomed two more Assistant Professors, Mehdi Javanmard and Saman Zonouz (meet them on page 12).

During the past year, our faculty were recognized with several prestigious honors. In particular, W. Trappe was elevated to IEEE Fellow for his contributions to information and communication security, D. Raychaudhuri and N. Mandayam received the 2014 IEEE Donald G. Fink Award for their IEEE Proceedings publication, and D. Raychaudhuri also received the 2014 ECEDHA Innovative Program Award as a representative of WINLAB, a center affiliated with ECE and major player in the wireless arena. Further, W. Bajwa received the ARO Young Investigator Award and K. Dana was part of a team that was recognized with the 2014 Charles Pankow Award for Innovation. The work of our faculty attracted substantial media attention; S. Jha's work has been discussed in an NSF publication as one of 9 ways computing has made an impact on HIV research, while J. Lindqvist's work on privacy has been featured repeatedly in MIT Technology Review, Scientific American, IEEE Spectrum, and at the NSF website, among many other venues. The year was marked by a large number of external research grants, including 18 new NSF grants, 2 NIH grants and several DARPA and corporate grants totaling ~$11 M.

Our enrollment keeps climbing, with ECE becoming the top choice among new undergraduate engineering students. Last year, our graduate program grew by 40% as compared to the year before. Our new international program with a top tier university in China brought us 23 high caliber students last year and 20 this year (read about this program on page 11).

Our connection with industry grew stronger, with several companies providing student internships such as AT&T Labs, Bell Labs Alcatel-Lucent, Bloomberg, Credit Suisse, Ericsson, Fujitsu Network Communications, Futurwei Technologies, General Motors Research, Google, IBM T.J. Watson, Intel, JP Morgan Chase, Lockheed Martin, Mass Electric Construction Co., NASA, National Instruments, Northrop Grumman, PSE&G, Qualcomm, Raytheon, Sandia National Laboratories, Siemens, Teledyne LeCroy, Verizon Wireless.

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.

I am very proud of the accomplishments highlighted in the following pages. Based on the trajectory I see our department is on a path for even greater achievements in the coming years.

I would like to thank everybody who supported us this past year.

Please contact me at athinap@rutgers.edu should you have any comments or suggestions.

Sincerely,

Athina Petropulu
Professor and Chair

Visit us at www.ece.rutgers.edu

ecefaculty

Waheed U. Bajwa
Assistant Professor
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
Associate Professor
NSF Career Award
Research Interests: Computer vision, pattern recognition, machine learning, convex optimization, novel cameras, camera networks, computer graphics, robotics

David Daut
Professor
Research Interests: Communications and information processing area. Special interests include stochastic processes in communication, detection and estimation theory, information theory and coding, multidimensional digital signal processing, optical communications systems

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

Marco Gruteser
Associate Professor
NSF Career Award
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

Wei Jiang
Associate Professor
DARPA Young Faculty Award
Research Interests: Silicon nanophotonics: modulators, switches, light emission Photonic crystals: devices & physics (e.g. slow light, superprism) silicon photonic microsystems: optical phased arrays, spatial light modulators, on-chip optical interconnects, optical information processing microsystems. Nanoimprint and molding plasmonics and metamaterials; disordered and quasi-periodic media **Other interests:** polymer photonics; fiber optics; laser beam steering; gratings; liquid crystals; phased array antennas

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

Narayan Mandayam
Distinguished Professor
Associate Director of WINLAB
IEEE Fellow,
Distinguished Lecturer of IEEE,
NSF Career Award
Research Interests: Cognitive radio networks and spectrum policy radio resource management network coding for wireless networks

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

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

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

Athina Petropulu
Professor & Department Chair
IEEE Fellow,
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
Distinguished Professor
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
Research Interests: Future network architectures and protocols, wireless systems and technology, dynamic spectrum access and cognitive radio, experimental prototyping and network research testbeds

Christopher Rose
Professor
IEEE Fellow
Research Interests: Technical interests include applications of communication/ information theory, biology, (nano/micro/ macro) mechanical systems Past wireless interests have included novel mobile communications networks, applications of genetic algorithms to control problems in communications networks and interference avoidance methods using universal radios to foster peaceful coexistence in what will be the wireless ecology of the 5GHz U-NII bands

Peddapullaiah Sannuti
Professor and Undergraduate Director
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
Research Interests: Machine learning, distributed systems, and optimization, with a focus on privacy and statistical methods

Deborah Silver
Professor
Research Interests: Scientific visualization, computer graphics

Predrag Spasojevic
Associate Professor
Research Interests: Communication and information theory, coding and sequence theory, signal processing and representation, cellular and wireless lan systems, ad-hoc and sensor networks

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
Associate 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
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

Michael Caggiano
Professor Emeritus
Research Interests: Electrical Packaging and microwave packaging

Hana Godrich
Assistant Research Professor
Research Interests: Signal processing, radar systems, power systems

Nagi Naganathan
Part-time Lecturer
Expertise: Computer engineering, VLSI Design, embedded systems

Ben Firner
Instructor
Expertise: Wireless sensor networks, low power sensing, low power protocols for sensor networks, context aware computing, healthcare monitoring, ubiquitous computing

studentnews

ECE Students Pham, Brazza and Kania won third place at the Myron Zucker Undergraduate Student Design Contest

The SURPASS group at the 2014 ECE Capstone competition

The award includes a $400 team cash award, a $300 cash award for the students' academic department, complimentary registration for the students to attend the 2014 IEEE Industry Applications Society Annual Meeting (5-9 October in Vancouver, BC Canada), complimentary lodging for the students at the 2014 Annual Meeting, the opportunity to present the project at a special Student Session held during the 2014 Annual Meeting, and up to $2000 USD reimbursement (per team) for travel expenses associated with attending the 2014 Annual Meeting.

The winning paper was entitled "SURPASS (Supplemented Urgency Regulating Personal Alert Safety System)" and was based on a capstone project that received the first prize at the 2014 ECE Capstone competition (mentored by Prof. Pompili).

Stephen Newberry recipient of the IEEE PES Scholarship Plus Initiative

ECE undergraduate student **Stephen Newberry**, was selected as an IEEE PES Scholarship recipient.

The PES Scholarship Plus Initiative recognizes undergraduate students who have declared a major in electrical and computer engineering, are high achievers with strong GPAs with distinctive extracurricular commitments and are committed to exploring the power and energy field. Each scholarship recipient receives $2,000 USD.

Nazmul Islam received the Qualcomm CR&D Roberto Padovani Fellowship

CE graduate student **Nazmul Islam** was selected to receive the Qualcomm CR&D Roberto Padovani Fellowship. At the time, Nazmul was member of WINLAB, working towards a PhD under the supervision of Professor Narayan Mandayam. The note that Nazmul received stated: "The fellowship

is awarded to only 7 nominated CR&D interns and is in recognition of your technical excellence and contribution. The interns in CR&D during the summer of 2013 represented the top students from the top academic institutions. It is quite an achievement to be selected from such a competitive pool of candidates." The fellowship consisted of a $5000 scholarship per academic year towards the student's school expenses. In addition, a $12,000 return bonus was promised if Nazmul returned CR&D for another internship or full-time employment.

After comptering his PhD degree, Nazmul will join Qualcomm CR&D as full-time staff.

Dionysios Kalogerias receives National Science Foundation travel award to attend ICASSP Conference

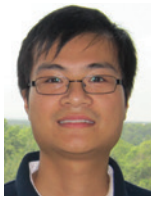
Dionysios S. Kalogerias received the National Science Foundation (NSF) travel award to attend the IEEE International Conference on Acoustics Speech and Signal Processing (ICASSP), held in Florence Italy, May 4-9, 2014. The award included a check of $1,100 for travel reimbursement, and the award selection was based on the paper reviews.

At ICASSP, Dionysios presented the paper "Mobi-cliques for improving ergodic secrecy in fading wiretap channels under power constraints," by D.S. Kalogerias and A. Petropulu.

Dionysios is an ECE Graduate student, member of the Communications and Signal Processing Laboratory, working towards a PhD under the supervision of Prof. Athina Petropulu.

Xianyi Gao received travel grant from ACM UbiComp Conference

Xianyi Gao won a $500 student travel grant to present his first paper, entitled "Elastic Pathing: Your Speed is Enough to Track You" at the UbiComp2014 Conference, a top-tier conference held in Seattle, Washington from September 13 through September 17.



Xianyi is an ECE student and a member of the ECE/WINLAB Human-Computer Interaction Group, working towards a PhD advised by Prof. Janne Lindqvist.

Gradeigh Clark received award to attend the Symposium on Usable Privacy & Security at Facebook Headquarters

Gradeigh Clark received full registration and scholarship award of $700.00 to attend the 2014 Symposium on Usable Privacy & Security (SOUPS), held at Facebook Headquarters in Menlo Park, California.

Gradeigh is an ECE PhD student, working under the supervision of Prof. Janne Lindqvist.

MobiHoc 2014 Best Poster Award for Feixiong Zhang

Feixiong Zhang, an ECE/WINLAB Ph.D. student working with Prof. Yanyong Zhang received the Best Poster Award at the 15th ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc 2014) conference for his presentation on content delivery in the MobilityFirst architecture.

The poster title was "Enabling Mobile Content-Oriented Networking in the MobilityFirst Future Internet Architecture".

ACM MobiHoc is the premier international symposium dedicated to addressing challenges emerging from wireless ad hoc networking and computing. The highly selective technical program has traditionally brought together a unique blend of researchers and practitioners thereby influencing the direction of a broad spectrum of wireless networking research.

The MobilityFirst project was started in 2010 with funding from the National Science Foundation's Future Internet Architecture (FIA) program.

The MobilityFirst project is founded on the premise that the Internet is approaching an historic inflection point, with mobile platforms and applications poised to replace the fixed-host/server model that has dominated the Internet since its inception. This predictable, yet fundamental, shift presents a unique opportunity to design a next generation Internet in which mobile devices, and applications, and the consequent changes in service, trustworthiness, and management are primary drivers of a new architecture.

ECE student Rajesh Kappera published article in Nature Materials

Rajesh (Raj) Kappera, is an ECE student, working towards his Ph.D. under the guidance of Prof. M. Chhowalla, Professor of Materials Science and Engineering, and ECE Graduate Faculty. Raj regularly visits Los Alamos National Laboratory in New Mexico where he is working as a visiting scientist in the Center for Integrated Nanotechnologies (CINT). His Ph.D. project is to study the properties of a relatively new material, Molybdenum disulfide (MoS2), which is an analogue to the 2D sensational material, Graphene.

Raj is the first author in an article that appeared in high impact journal Nature Materials, entitled **"High Performance Transistors from Ultra-Thin MoS2 by Phase Engineered Low Resistance Contacts".** This is joint work with researchers from Rutgers and Los Alamos National Laboratory, New Mexico, USA.

Parul Pandey awarded a GHC Scholarship Grant

ECE Graduate student **Parul Pandey** has been awarded a GHC Scholarship Grant to attend the 2014 Grace Hopper Celebration of Women in Computing, which is the world's largest gathering of women technologists. The event is produced by the Anita Borg Institute and presented in partnership with ACM. The GHC Scholarship Grant includes conference registration, a prepaid meal card, hotel accommodations and a travel grant of $550.

Parul is member of Cyber-Physical Systems Lab, pursuing her PhD in the area of mobile computing under the supervision of Prof. Dario Pompili. At the meeting she will be presenting her work on approximate computing in mobile computing grids.

ECE Travel Award Winners

The Department of Electrical and Computer Engineering congratulates the ECE Research Excellence Award Winners **Ashwin Ashok, Chenren Xu, Tong Jin, Bo Li, Li Liu, Li Zhu, Maja Skataric, Mehrnaz Tavan, Rajesh Kappera, Yi Huang, Wenjia Yuan** and **Parul Pandey.**

The ECE Research Excellence Award supports travel for the student author of a paper accepted for publication at a research conference. Each winner received $300 in the form of travel expenses reimbursement.

The Department of Electrical and Computer Engineering also congratulates the ECE Student Development Award Winners **Maria Peifer** and **Robert Gatdula.**

The ECE Student Development Award supports conference travel or access for PhD students initiating research. Each winner received $200 in the form of travel expenses reimbursement.

studentnews

The ECE Department Congratulates the Undergraduate Students Prize Winners

Kevin Wong won the **John B. Smith Memorial Prize.** This prize is awarded to the highest ranking graduating senior

K. Wong, N. Palumbo, S. Durant

Nicholas Palumbo won the **James L. Potter Award.** The prize is awarded to the student who, in the opinion of the department, has best exhibited the characteristics of original and independent investigation and creativity in his/her professional field and has obtained high academic standing.

Scott Durant won the **Georg Goubau Memorial Prize**. The prize is presented to a student who exhibited excellence in the study of Electromagnetic Phenomena.

The ECE Department Congratulates the Graduate Student Prize Winners

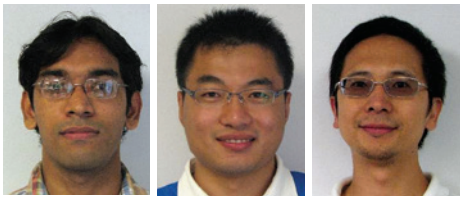
Gradeigh Clark won the **ECE Teaching Assistant Of The Year Award**

Ben Firner won the ECE Graduate Program Academic Accomplishments Award for **Academic Excellence in Wireless Communications**

G. Clark, B. Firner, H. Viswanathan

Hariharasudhan Viswanathan, won the ECE Graduate Program Academic Accomplishments Award for **Academic Excellence in Computer Engineering**

Akash Baid won the ECE Graduate Program Academic Accomplishments Award for **Academic Excellence in Communications**



A. Baid, G. Liu, L. Lin

Gang Liu won the ECE Graduate Program Academic Accomplishments Award for **Academic Excellence in Solid State Electronics**

Lei Lin, won the ECE Graduate Program Academic Accomplishments Award for **Academic Excellence in Solid State Electronics**

awarded PhDs

Jun Tan, *Novel Nanophotonic Structures and Devices for Communication and Lithography Applications,* Oct. 2013.
Advisor: **W. Jiang**
Currently at Intel Corp.

Lei Lin, *Design and Fabrication of 4H Silicon Carbide Gate Turn-off Thyristors,* Oct. 2013. Advisor: **J. Zhao**
Currently Senior Device Engineer at SandDisk, Milpitas, CA.

Tianming Li, *Cognitive Radio Networks: Resource Allocation and Effect of End-User Behavior*, Oct. 2013.
Advisor: **N. Mandayam**
Currently with Broadcom, NJ.

Narayanan Krishnan, *Coverage and Capacity of Next Generation Cellular Radio Systems: Bandwidth Sharing and Massive MIMO*, Oct. 2013. Advisors: **N. Mandayam** and **R. Yates.**
Currently with Qualcomm as Senior Engineer.

Rishabh Dudheria, *Resilient Regulation of Wireless Communication in Distributed Systems*, Oct. 2013. Advisor: **W. Trappe**

Saket Anand, *Robust Methods for Multiple Model Discovery in Structured and Unstructured Data*, Oct. 2013.
Advisor: **P. Meer**
Currently an Assistant Professor at Indraprastha Institute of Information Technology, I.I.I.T. Delhi, India

Bin Zan, *Vehicular Sensing Networks: Efficiency, Security & Privacy*, Oct. 2013.
Advisor: **M. Gruteser**.
Currently with Broadcom, CA.

Sedat Ozer, *Activity Detection in Scientific Visualization,* Oct. 2013.
Advisor: **D. Silver**

Bernhard Firner, *Transmit Only for Dense Wireless Networks*, Jan. 2014.
Advisor: **Y. Zhang**.
Currently Instructor at ECE Rutgers University

Gang Liu, *4H-Silicon Carbide MOSFET Interface Structure, Defect States and Inversion Layer Mobility*, Jan. 2014.
Advisor: **L. Feldman**.
Currently a Postodoctoral Fellow at Rutgers University

Gun-Hyung Park, *Modeling and Control of Proton Exchange Membrane and Solid Oxide Fuel Cells and Solar Cells*, Jan. 2014.
Advisor: **Z. Gajic**
Currently Senior Control Systems Engineer at Hyundai, Seoul, Korea

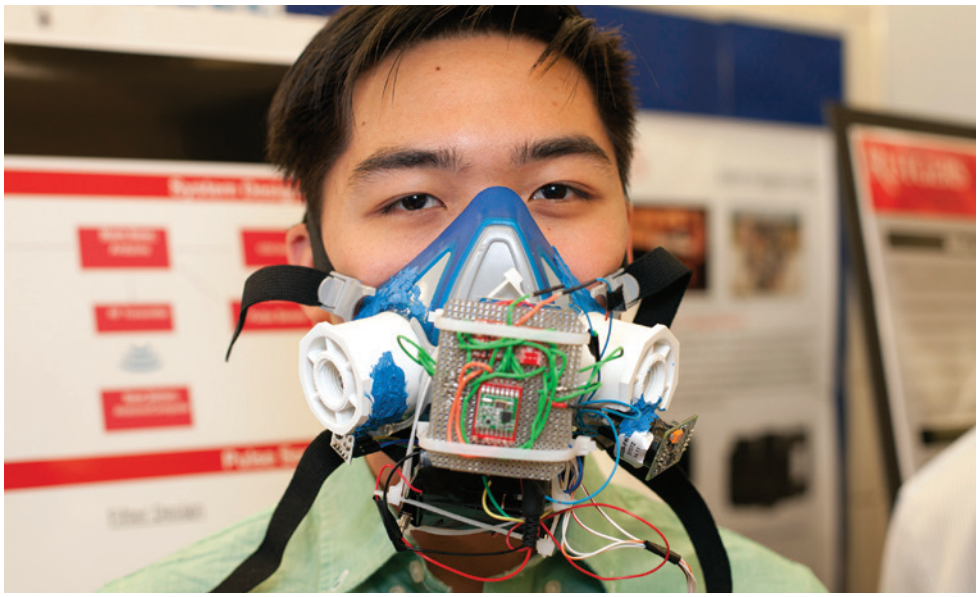
Hariharasudhan Viswanathan, *Uncertainty-Aware Autonomic Resource Management in Mobile Computing Grids,* May 2014.
Advisor: **D. Pompili**.
Currently at Zenefits, San Francisco, CA

Akash Baid, *Dynamic Spectrum Management Architecture and Algorithms for the Future Mobile Internet,* May 2014.
Advisor: **D. Raychaurdhuri**.
Currently at Verrano Wireless, CA

Tingting Sun, *Enhancing Network Functionalities for Emerging Mobile Networks Through Learning,* May 2014.
Advisors: **Y. Zhang and W. Trappe**.
Currently at Broadcom. Inc., NJ

Capstone 2014

by Dario Pompili, 2014 ECE Capstone Organizer



"Bio-metric mask" Capstone project

The ECE Capstone Design course requires students to apply the ECE skills they have acquired towards solving a real-world engineering problem and/or developing a viable product. With the mentoring of the capstone course faculty advisor, this course integrates all the ECE academic studies with an open-ended design project. In the Capstone experience, ECE students are guided towards the appropriate technology and tools to formulate and solve their problem, while being left enough room to explore alternative technologies when devising their project solutions.

Throughout the past 2013-2014 academic year, the Rutgers ECE program has successfully integrated the exposure of standardized engineering knowledge into the Capstone effort. Our ECE Capstone experience ensures that our students recognize that any engineering solution will face real-world design constraints (such as environmental, social, political, ethical, health and safety issues) as well as associated costs either in terms of parts/methods used or in environmental impact. As such, Capstone projects explore important constraints such as cost and sustainability to determine whether the technology solution meets them. To reinforce this practice and further enhance the experience, the ECE Department actively engages industry and alumni in the entire Capstone Design program. In particular, in 2014, industry directly sponsored several capstone design projects (e.g., PSE&G provided $5,000 to support equipment acquisition for energy-related projects aimed at reducing energy footprint and achieving sustainability via the use of renewable energy); also, the ECE Advisory Board members and industrial affiliates participated in the Capstone Design Presentation Day and interacted with students, providing valuable feedback on the student projects. Some also acted as judges of the ECE Capstone Design Competition. This year's judges included:

Nitesh Sateesh, Applications Engineer – Fuji Electric; **Spc. Agt. Michael Doyle**, Federal Bureau of Investigation; **Jim McDonald**, Director of Network & Operations – Verizon; **Lud Randazzo**, Sr. Major Acct Mgr. – Juniper; **Prateek Malhotra**, Proj. Mgr./Lead Web Apps. Dev. – Condor Capital; **Robert Andrews**, Director – Massachusetts Electric Construction/Kiewit; **Gil Figueroa**, AT&T; **Sherwin Shahraran**, AT&T; **Nagi Naganathan**, Principal Engineer - LSI Corporation; **David Katz**, Credit Suisse; **Doug Moseley**, L'Oreal

These judges provided feedback to the Department on the projects in the form of scoring sheets used to determine the "Top Ten" Capstone Design Winners (http://www.ece.rutgers.edu/Capstone_2014_Awards), the first three of which were awarded a monetary prizes by the ECE Department

Often students after graduation continue to work on their projects towards a marketable product or to start a small company; as an example, it is with great pride that we report that ECE alumnus Todd Katz' start-up company, ThermoVolt, was one of seven start-up companies from around the country selected this year in renewable energy to compete for the MIT Clean Energy Prize. ThermoVolt is a direct result of Todd's Capstone project at ECE Rutgers in 2013, when the team's capstone project had won first prize at the 2013 ECE Capstone competition.

Last, but not least, on behalf of the ECE faculty, I would like to congratulate ECE students **Minh Pham, Paul Kania** and **Matthew Brazza** for winning third place at the IEEE IAS Myron Zucker Undergraduate Student Design Contest with their paper "SURPASS, Supplemented Urgency Regulating Personal Alert Safety System". This prestigious nation-wide IEEE award for UG students, which also includes complimentary registration, complimentary lodging, and travel reimbursement to attend the IEEE IAS Annual Meeting in Vancouver, BC Canada, was based on the capstone project that received the first prize at the 2014 ECE Capstone competition.

Congratulations to all our 2014 Capstone Design students for their hard work and excellent projects, which are all listed (including their exciting videos) at http://www.ece.rutgers.edu/Capstone2014, and best of luck on their future academic and professional career!

Profs. A. Petropulu and D. Pompili with Industrial Affiliates who served as judges of the 2014 Capstone Competition

FIRST PRIZE ($400)
SURPASS: Supplemented Urgency Regulating Personal Alert Safety System
Group Members: **Minh Pham, Paul Kania** and **Matthew Brazza**
Faculty Advisor: **Prof. Pompili**

SECOND PRIZE ($300)
ZnO Thin Film Resonator – Based Heart Monitor
Group Members: **XinCheng Jin, Roy Jung** and **SangChul Shin.**
Faculty Advisors: **Prof. Lu** and **Dr. Pavel Reyes**

THIRD PRIZE ($200)
Award provided by IEEE
Bio-Metric Mask
Group Members: **Christopher Redziniak, Arthur Tapper** and **Wesley Guu.**
Faculty Advisor: **Prof. Lu**

4th
High Altitude Glider
Group members: **Nicholas Palumbo** and **David Becker.**
Faculty Advisor: **Prof. Pompili**

5th
PHEV/EV Li-Ion Battery Second-Use
Group Members: **Mohammad Aneeq Khan, Ammar Saleem, Jared Roszko,** and **Nabil Ali.**
Faculty Advisor: **Prof. Godrich**

6th
Vision-Based Mobile Free-Space Optical Communications
Group Members: **Jonathan Giordano, Kyle Cavorley, Taichi Hithiro** and **Wayne Chang.**
Faculty Advisor: **Prof. Daut**

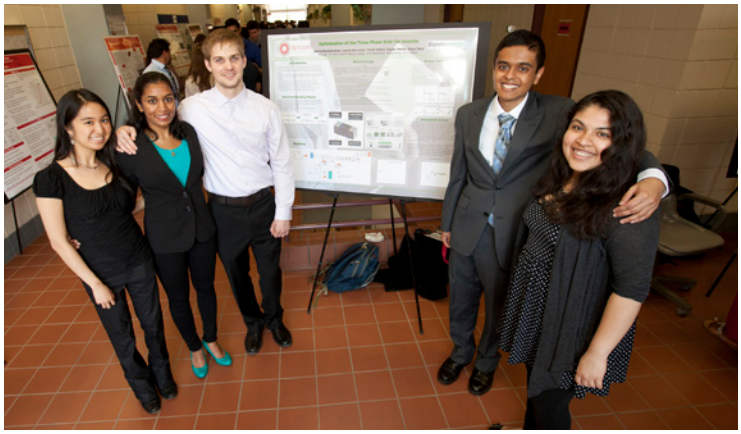
7th
Energy-Conscious Home Automation
Group Members: **Damon Chow, Sam Pinsky, Dominic Serenelli, Vishal Shah** and **Benjamin Skolozdra.** Faculty Advisor: **Prof. Pompili**

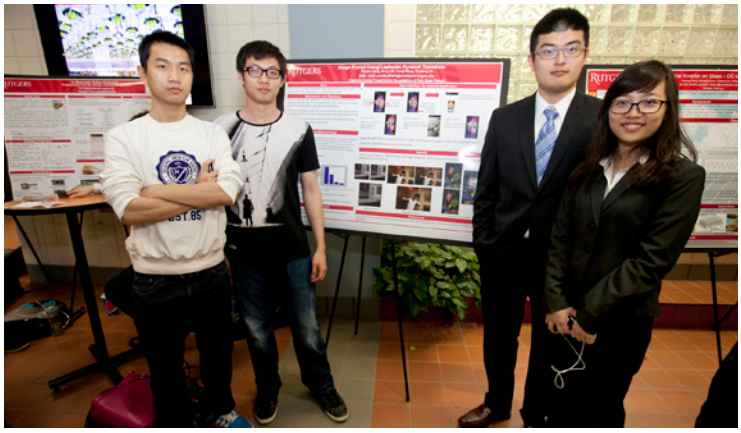
8th
Wearable Pulse Oximeter
Group Members: **Fanpeng Kong, Yubo Qin, Zhengyu Yang** and **Zhongtian Lin.** Faculty Advisor: **Prof. Najafizadeh**

9th
Rutgers Course Recommender
Group Members: **Simon Gao** and **Joshua Devasagayaraj.**
Faculty Advisor: **Prof. Parashar**

10th
Green Off Grid Paradise
Group Members: **Rolihlahla Ferdinand, Justin DeOliveira** and **John Pacheco.** Faculty Advisor: **Prof. Godrich**

links to videos and the winning posters can be found at **http://www.ece.rutgers.edu/Capstone_2014_Awards**





Our 3+2 Program with UESTC China has been growing

In Fall 2013 ECE welcomed 23 students from UESTC Chengdu, China to our 3+2 program. These students have completed their third year at UESTC. In two years they will graduate with a BS from UESTC and a Masters from Rutgers. In fall 2014 20 more students from UESTC joined our 3+2 program.

电子科技大学
University of Electronic Science and Technology of China

PSE&G Funds Capstone Projects

Through a $5,000 grant PSE&G supported 2014 capstone projects in the area of Smart Grid. Such projects focus on energy-smart technologies for future homes which reduce the home's energy footprint and achieve sustainability via the use of renewable energy.

In the United States, the residential sector consumes about seven percent of total energy use, thus, home energy efficiency is a key element in securing a more sustainable energy use. In these capstone projects, students designed and built an automation system that monitors and controls the electricity consumption of a house. The energy consumption was reduced by both minimizing the operation of typical household loads (i.e. lights, outlets, and heating and cooling systems) and by rescheduling consumption from peak demand to off-peak hours. In addition, control of local solar energy sources (photovoltaic) and energy storage were used to address peak hour supply, and reduce load on the electric grid.

Announcing the Rutgers ECE - Siemens Fellowships

The ECE Department is pleased to announce two new Fellowships that support graduate studies through a combination of an ECE stipend with guaranteed income from a summer internship with Siemens at Princeton NJ.

Siemens Corporation is a U.S. subsidiary of Siemens AG, a global powerhouse in electronics and electrical engineering, operating in the industry, energy, healthcare, and infrastructure & cities sectors.

This opportunity is open to incoming PhD level ECE students with interest in line with Siemens businesses.

Interested students should contact John McCarthy (john.mccarthy @ rutgers.edu).

Announcing the Rutgers ECE - Northrop Grumman Fellowships

The ECE Department is pleased to announce Fellowships that support graduate studies through a combination of an ECE Fellowship with guaranteed income from a summer internship with Northrop Grumman at Linthicum (Baltimore), Maryland.

Northrop Grumman is a leading global security company providing innovative systems, products and solutions in aerospace, electronics, information systems, and technical services to government and commercial customers worldwide.

This opportunity is open to new master or PhD level ECE students with interest in computer engineering with FPGA expertise, and/or electrical engineering with digital design expertise. US Citizenship is required.

Interested students should contact John McCarthy (john.mccarthy @ rutgers.edu).


J. Lindqvist


A. Sarwate


M. Javanmard


S. Zonouz

ECE Welcomed Assistant Professor Janne Lindqvist in Fall 2013

Dr. Janne Lindqvist received his M.Sc. degree in 2005, and D.Sc. degree in 2009, both in Computer Science and Engineering from Helsinki University of Technology, Finland.

Between 2009 and 2011 he was a post-doc with the Human-Computer Interaction Institute at Carnegie Mellon University's School of Computer Science. He joined Rutgers in 2011 as Research Assistant professor of Electrical and Computer Engineering and member of WINLAB. In 2013 he joined ECE as an Assistant Professor. Dr. Lindqvist works at the intersection of human-computer interaction, mobile computing and security engineering.

ECE Welcomed Assistant Professor Anand Sarwate in Spring 2014

Dr. Sarwate received B.S. degrees in Electrical Engineering and Mathematics from MIT in 2002 and his Ph.D. in Electrical Engineering from UC Berkeley in 2008. Before joining Rutgers he was Research Assistant Professor at the Toyota Technological Institute at Chicago.

From 2008-2011 he was a postdoctoral researcher at the Information Theory and Applications Center (ITA) at UC San Diego.

Dr. Sarwate's research is currently focused on the intersection of machine learning, distributed systems, and optimization, with a focus on privacy and statistical methods. He blogs semi-regularly on technical and non-technical matters at ergodicity.net. His hobbies include singing, theater, puzzles, and cooking.

ECE Welcomed Assistant Professor Mehdi Javanmard in Fall 2014

Dr. Mehdi Javanmard received a B.S. degree in Electrical Engineering Georgia Institute of Technology in 2002, and his M.S. and Ph.D. in Electrical Engineering from Stanford University in 2004 and 2008, respectively. Before joining Rutgers he was Postdoctoral Researcher at the Stanford Genome Technology Center of Stanford University.

Dr. Javanmard's research exploits emerging micro- and nanotechnologies, electronic, photonic, and microelectromechanical to develop biomarker based diagnostic platforms. In particular his aim is to develop sensing platforms which will decrease cost, increase assay speed, and improve limit of detection, thus enabling point-of-care disease diagnosis.

ECE Welcomed Assistant Professor Saman Zonouz in Fall 2014

Dr. Saman Zonouz received a B.S. degree in Computer Engineering, Sharif University of Technology in 2006, and his Ph.D. in Computer Science from the University of Illinois at Urbana-Champaign in 2011. Before joining Rutgers he was Assistant Professor at the Electrical and Computer Engineering Department of the University of Miami.

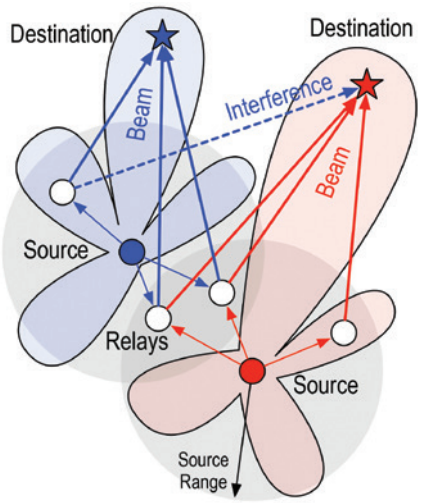
Dr. Zonouz's research interests include security and privacy, cyber-physical systems, intrusion detection and response, embedded and operating systems security, reverse engineering and malware analysis, trustworthy power-grid critical infrastructures.

Exploiting Cooperation and Mobility in Wireless Communications

Professor **Athina Petropulu**, in collaboration with Professor Michael M. Zavlanos of Mechanical Engineering of Duke University are conducting research on controlling teams of autonomous mobile robots in order to achieve reliable communications in challenging environments.

Network nodes that wish to communicate but do not have enough power to do so, and/or are subject to interference, enlist the help of mobile nodes, which act as a distributed antenna. The cooperating nodes can be controlled into an optimal configuration, which ensures high communication performance and optimal use of the network power. The proposed approach can achieve network connectivity and longevity in challenging environments, arising during high rate applications, such as transmission of video or images. It also enables significant performance gains as compared to static cooperating systems that do not exploit mobility.

This project is funded by the National Science Foundation.



Security and Memorability of Free-form Gestures as Passwords

Prof. J. Lindqvist and his research group

As more people use smart phones or tablets to pay bills, make purchases, store personal information and even control access to their houses, the need for robust password security has become more critical than ever. Dr. **Janne Lindqvist**'s research suggests that free-form gestures – sweeping fingers in shapes across the screen of a smartphone or tablet – can be used to unlock phones and grant access to apps. These gestures are less likely than traditional typed passwords or newer "connect-the-dots" grid exercises to be observed and reproduced by "shoulder surfers" who spy on users to gain unauthorized access.

"All it takes to steal a password is a quick eye," said Dr. Lindqvist. "With all the personal and transactional information we have on our phones today, improved mobile security is becoming increasingly critical."

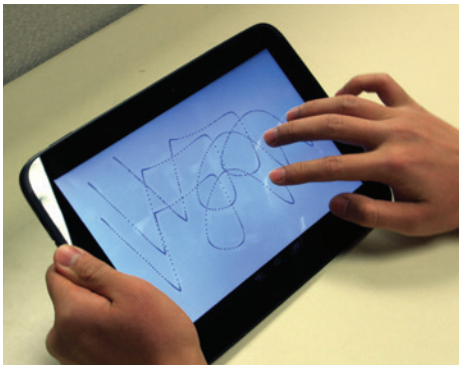
Dr. Lindqvist's work is probably the first study to explore free-form gestures as passwords. The finding of this work appeared in the proceedings of MobiSys '14, a premier international conference in mobile computing.

In developing a secure solution to this problem, Dr. Lindqvist's group, including his students **Michael Sherman** (former ECE undergraduate student, and currently WINLAB staff), **Gradeigh Clark** (ECE PhD student), **Yulong Yang** (ECE PhD student) and **Shridatt Sugrim** (ECE MS and WINLAB staff), and also collaborators from Max-Planck Institute for Informatics, including **Antti Oulasvirta**, and University of Helsinki studied the practicality of using free-form gestures for access authentication. With the ability to create any shape in any size and location on the screen, the gestures had an inherent appeal as passwords. Since users create them without following a template, the researchers predicted these gestures would allow for greater complexity than grid-based gestures offer.

"You can create any shape, using any number of fingers, and in any size or location on the screen," Dr. Lindqvist said. "We saw that this security protection option was clearly missing in the scientific literature and also in practice, so we decided to test its potential."

To do so, the researchers applied a generate-test-retest paradigm where 63 participants were asked to create a gesture, recall it, and recall it again 10 days later. The gestures were captured on a recognizer system designed by the team. Using this data, the authors tested the memorability of free-form gestures and invented a novel method to measure the complexity and accuracy of each gesture using information theory. Their analysis demonstrated results favorable to user-generated, free-form gestures as passwords.

To put their analysis to practice, the researchers then had seven computer science and engineering students, each with considerable experience with touchscreens, attempt to steal a free-form gesture password by shoulder surfing. None of the participants were able to replicate the gestures with enough accuracy, so while testing is in its preliminary stages, the gestures appear extremely powerful against attacks. This work was featured in International Business Times (reaches 5 million people in the UK and 50 million around the world), Phys.org, Science Daily, Daily Mail (2nd largest newspaper in the UK), London Times print edition, NDTV (Canadian TV), Yahoo News!, front page of Scientific Computing, Red Orbit, and Scientific American and Fortune. The work also appeared in around hundred sites around the world. Prof. Lindqvist was also interviewed by CBS Radio News and NSF Science 360 made a video cast of the work and featured it on NSF Science Now front page.



Networking Our Cars

Future cars can be expected to not only become smarter and more autonomous through increasingly sophisticated sensors and information processing but also through integrated wireless networks. Wireless networks can allow cars on our highways to talk to each other and exchange information about their past driving experience as well as their current and future actions. This will provide cars with great foresight – it enables them to know which route is least congested, where to find parking spots, and when to soften the suspension for an upcoming pothole. Moreover, wireless networking will allow cars to share their current position with nearby cars, which essentially enables them to "see through" trucks and buildings and avoid other cars that are on collision course. Realizing this vision will require software architectures for sharing information across vehicles and for assessing the confidence of such information. It will also require low-latency wireless network technologies that can reliable exchange information - even on congested highways where transmissions from hundreds or thousands of other vehicles create interference. **Prof. Gruteser's** group is working on projects to address these challenges.

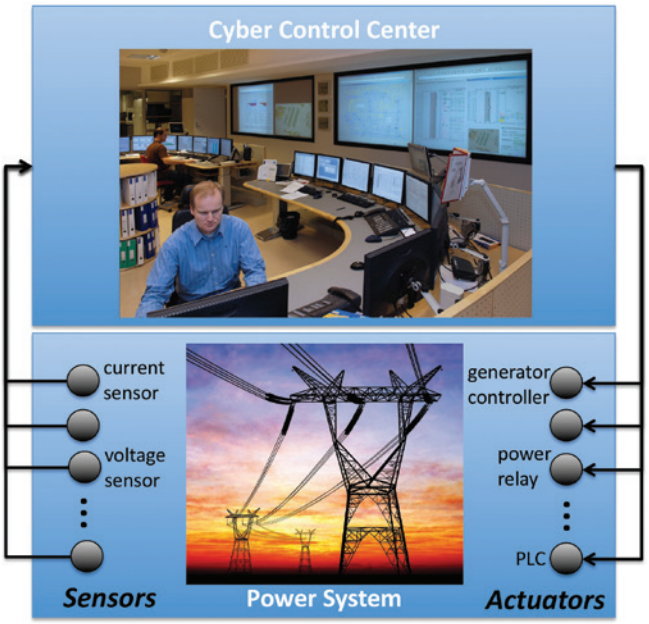
First, Dr. Grutester's group has been awarded a 4-year National Science Foundation grant to develop software abstractions for connected vehicles together with researchers at the University of Southern California and at General Motors. Until now, the "cyber" component of automobiles has consisted of control algorithms and associated software for vehicular subsystems designed to achieve one or more performance, efficiency, reliability, comfort, or safety goals, primarily based on short-term intrinsic vehicle sensor data. However, there exist many extrinsic factors that can affect the degree to which these goals can be achieved. These factors can be determined from: longer-term traces of in-built sensor data that can be abstracted as triplines, socialized versions of these that are shared amongst vehicle users, and online databases. Allowing vehicles and apps to share vehicle data with others and to use extrinsic information results in novel information processing, assurance, and privacy challenges. The project develops methods, algorithms and models to address these challenges.

Second, his group has been awarded a contract to develop a Dedicated Short Range Communications (DSRC) Vehicle-to-Vehicle (V2V) Scalability Simulator for the Crash Avoidance Metrics Partnership Vehicle Safety Communications 3 consortium, which is comprised of many of the world's major car makers, under USDOT's connected vehicle technology research program. The project will use field test data from hundreds of DSRC equipped vehicles to develop and calibrate simulation models so that the simulator can attempt to accurately predict V2V communication performance in very dense, interference-limited scenarios.

Ultimately, such networking technology is expected to lead to the next generation of car safety and efficiency technologies.

Trustworthy Critical Infrastructures: Threats, Challenges, and Countermeasures

Cyber-physical critical infrastructures, such as the power grid, transportation systems, and healthcare infrastructures, integrate networks of computational and physical processes to provide the society with essential services. Distributed and embedded computers monitor the physical processes and, at the same time, control them, usually with feedback loops in which physical processes affect computations and vice versa. The power grid, in particular, is a vast and interconnected cyber-physical network for delivering electricity from generation plants to end-point consumers. Protecting power grid critical infrastructures is a vital necessity because the failure of these systems would have a debilitating impact on economic security and public health and safety. However, several recent large-scale outages and an increase of 28 times in the number of major attacks from 2009 to last year, confirm the insufficiency of the current protection solutions.



To guarantee the trustworthy operation of next-generation complex power grid critical infrastructures is a challenging endeavor. Professor **Saman Zonouz** tackles this challenge through the following categories of solutions. First, via intrusion prevention techniques, Dr. Zonouz's group investigates built-in secure software/hardware architectures to minimize the power grid's attack surface and the possibility of potential attacks. Second, the group's projects on intrusion detection through monitoring of security events within computer operating systems and power system components aim at identifying malicious misbehaviors in case of attack occurrences. Finally, despite prevention and detection solution deployments, some attacks succeed and need to be responded to immediately before they cause catastrophic power grid failures. The group works on control-theoretic intrusion tolerance algorithms to adaptively decide upon optimal countermeasures in cyber or physical assets and recover the infrastructure's safe operations. The exciting and challenging open research question is how to design theoretical usable prevention, detection and tolerance solutions that take into account the complex interdependencies among computational components and physical processes in an integrated, automated and real-time manner.

Camera-Display Messaging (Visual MIMO)

This is an interdisciplinary project, cutting across wireless communications (led by Profs. **Marco Gruteser, Narayan Mandayam**) and computer vision (led by ECE Professor **Kristin Dana**). The goal of the work is to enable cameras and electronic displays (or any lights) to communicate. Since these methods employ optical encoding followed by computational decoding, the entire system may be considered a computational camera.

Our modern society has pervasive electronic displays such as billboards, computers, tablets, signage, kiosks and even vehicle lights. The prevalence of these displays provides opportunities to develop computational photographic methods where intentional messages are encoded in the display images that are undetectable to the eye and must be recovered by a camera. While watermarking methods can be used to hide information in images, the photometry of light emitted by a display and observed by the camera is modeled in our work to build messaging and decoding methods that work in real world scenarios. The idea is similar to a QR-code but different in very important and useful ways: 1) the message is dynamic, it can change from moment-to-moment and 2) the message is hidden (so the display or billboard) can be used for its original purpose.

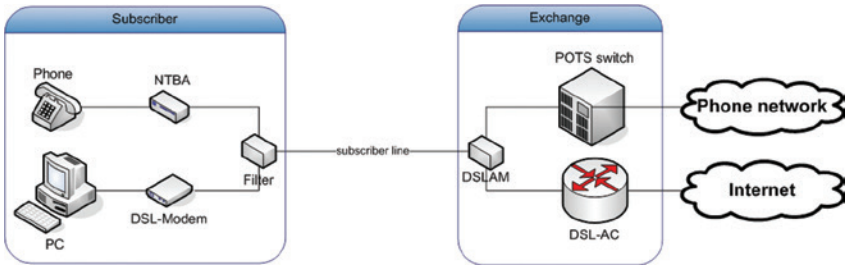
Applications of this technology include: billboard ads that send consumer information such as a purchase website, robot-to-robot communications that require line-of-sight to send secure messages, vehicle-to-vehicle communication through head or tail lights and cameras, and spatial maps to a specific room downloaded using a smartphone at a lobby kiosk.

Exploiting Sparsity for Interference Management in Broadband Communications

Prof. **Waheed Bajwa** collaborates with researchers from Qatar University and UT-Dallas on a project that exploits sparsity for interference management in broadband communications. The main objectives of the project are to: i) develop a new unified signal processing framework for interference mitigation in broadband communication systems based on identifying and exploiting sparsity ii) extend the theoretical guarantees in the field of compressive sensing (CS) to encompass the mathematical structure arising in the proposed framework and develop auto-tunable sparse recovery algorithms based on a frame-theoretic understanding of CS theory, and iii) demonstrate on experimental testbeds the value of the proposed framework in enhancing the performance and reducing the complexity of broadband transceivers.

The proposed proposed approach enjoys many advantages including: i) Computational efficiency due to its focus on low-complexity solutions of the interference mitigation problem; ii) no a priori assumptions are made on the interference probability density function, second-order statistics, frequency support, or power level. Instead, we make only a mild, but highly realistic, assumption on sparsity of the interference signals; and iii) The proposed sparsity-aware approach is applicable to a wide range of interference sources (e.g. radio frequency interference, impulse noise, intersymbol interference, crosstalk, etc..) and a number of applications including digital subscriber lines, wireless local area networks, power line communications, and millimeter-wave beamforming.

This work is funded by the Qatar National research Foundation.



Stepwise Functionalization and Surface Studies for ZnO Nanostructure-based Biosensors.

Professor **Yicheng Lu** and Chemistry Professor E. Galoppini are collaborating on an NSF funded grant on understanding and control of the interfacial chemistry between ZnO and biomolecules, which are the foundation and prerequisite for development of advanced sensors and other applications, are becoming the challenge for both science and technology. The overall goal of this project is to achieve the in-depth scientific understanding of surface and interface chemistry of nanostructured ZnO and MgZnO in order to design and develop innovative surface fuctionalization technology for a new generation of biosensors with ultra-high sensitivity and selectivity.

The scope and approach of the proposed research is illustrated in the Figure below.

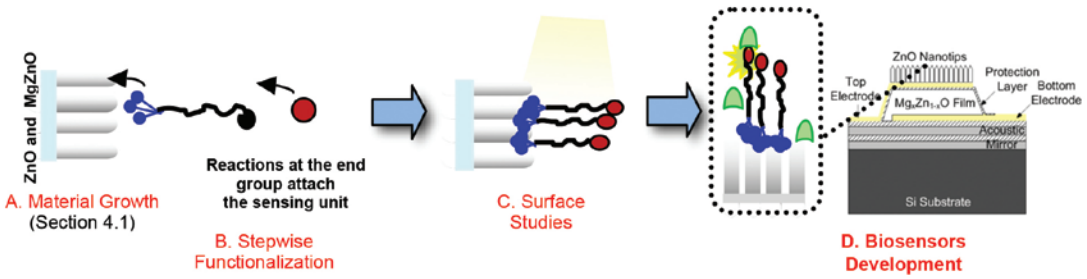


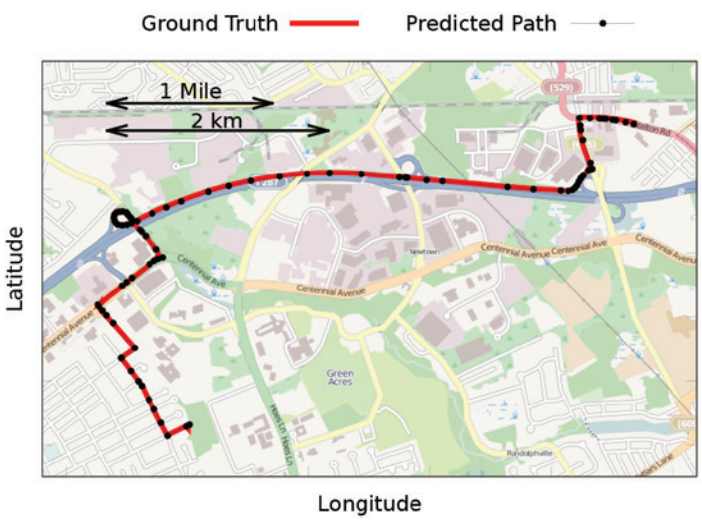
Figure: Overview of the proposed research

Elastic Pathing - Your Speed is Enough to Track You

Prof. **Janne Lindqvist** led a team to show how just your driving speed can be used to track where you drive. This work, "Elastic Pathing: Your Speed is Enough to Track You" is part of a NSF-funded project. Prof. Janne Lindqvist's team includes ECE PhD students **Xianyi Gao, Yulong Yang, Berhard Firner**, and recently graduated Master's student **Shridatt Sugrim**.

The motivation for the project was that today people increasingly have the opportunity to opt-in to "usage-based" automotive insurance programs for reducing insurance premiums. In these programs, participants install devices in their vehicles that monitor their driving behavior, which raises some privacy concerns. Some devices collect fine-grained speed data to monitor driving habits. Companies that use these devices claim that their approach is privacy-preserving because speedometer measurements do not have physical locations. However, in their work the team showed that with knowledge of the user's home location, as the insurance companies have, speed data is sufficient to discover driving routes and destinations when trip data is collected over a period of weeks. To demonstrate the real-world applicability of their approach the team applied their algorithm, elastic pathing, to data collected over hundreds of driving trips occurring over several months. With this data and their approach, they were able to predict trip destinations to within 250 meters of ground truth in 14% of the traces and within 500 meters in 24% of the traces. This result, combined with the amount of speed data that is being collected by insurance companies, constitutes a substantial breach of privacy because a person's regular driving pattern can be deduced with repeated examples of the same paths with just a few weeks of monitoring.

A preliminary version of this work was first featured in MIT Technology Review, Scientific American and ACM Technews. The final conference version has appeared in IEEE Spectrum, Communications of the ACM, Der Spiegel (a weekly circulation of over one million), several NSF web sites, Inside Science (a publication of the American Institute of Physics), Phys.org, Science Daily, Citylab, R&D Magazine, and around hundred sites in Asia, Europe, Middle East and the US. NSF also featured the work on its front page.



A Field Study of Run-Time Location Access Disclosures on Android Smartphones

Prof. **Janne Lindqvist** led a team to build an app to give Android smartphone users prominent warnings when apps are tracking their location. The work is part of the paper "A Field Study of Run-Time Location Access Disclosures on Android Smartphones," by **Huiqing Fu, Yulong Yang, Nileema Shingte, Prof. Janne Lindqvist** and **Prof. Marco Gruteser**. The paper was published in the proceedings of USEC'14 in February 2014.

The motivation for the study was that smartphone users are increasingly using apps that can access their location. Often these accesses can be without users' knowledge and consent. For example, recent research has shown that installation-time capability disclosures are ineffective in informing people about their app's location access.

The group's results confirm that the Android platform's location access disclosure method does not inform participants effectively. Almost all participants pointed out that their location was accessed by several apps they would have not expected to access their location. Further, several apps accessed their location more frequently than they expected.

This work appeared in MIT Technology Review, and subsequently in big sites such as Yahoo! Tech on their front page, Slashdot, IT World, PC World, Computer World, CSO (Chief Security Officer), The Register, IEEE Spectrum, totaling at least over 200 articles around the world. Local coverage included Star Ledger and New Brunswick Today. Rutgers Today also interviewed Prof. Lindqvist and the interview is available on Youtube. Prof. Lindqvist was also interviewed by WHYY Radio, and the work was featured in the newscast of Dutch TV broadcaster NOS.

DARPA Spectrum Challenge Hosted by WINLAB's ORBIT

On March 19-20, 2014, 15 teams from around the country demonstrated new ways to make radio communications more reliable and robust by participating in the final event of the DARPA Spectrum Challenge—a national competition to develop advanced radio techniques capable of communicating in congested and contested electromagnetic environments without direct coordination or spectrum preplanning.

Eighteen teams had previously participated in the Spectrum Challenge preliminary event in September 2013. Three teams that participated in the preliminaries were unable to complete their ambitious designs in time for the final event. The competitors at the final event represented the top 15 teams out of the 90 teams that initially registered. Academic institutions from around the country comprised 12 of the 15 teams, while the remaining three teams were individual radio hobbyists and practitioners working on their own time.

Both the preliminary and final events included two separate tournaments, each with its own goals:

Cooperative tournament: In each match, three teams attempted to effectively share the spectrum while transmitting random data files from their source radio to their destination radio over the same 5 MHz UHF band. Teams could not coordinate in advance on how to share the spectrum; instead, they had to develop and implement algorithms to enable their assigned software-defined radios to dynamically communicate at a high rate while leaving spectrum available for the other two teams to do the same.

Competitive tournament: In each match, two teams sought to dominate the spectrum, with the winner being the first to transmit all its files of random data (or to successfully transmit the most packets in three minutes) from a source radio to a destination radio.

Teams had to develop and implement algorithms to enable their assigned software-defined radio to dynamically communicate at a high rate in the presence of competitors' signals within the same 5 MHz UHF band. DARPA provided all teams with the same radio hardware to ensure that each team would win or lose based on its software algorithms alone. All the matches again occurred on the ORBIT Testbed at Rutgers University's WINLAB, which streamed the proceedings live to big screens in DARPA's conference center. Prof. **Wade Trappe** and **Ivan Seskar** led the effort to successfully run the DARPA Spectrum Challenge at WINLAB's ORBIT Testbed.

Above: WINLAB's ORBIT testbed

Left: At the DARPA Spectrum Challenge final event. The video can be found at http://www.youtube.com/embed/LZ9Q0df1fkw

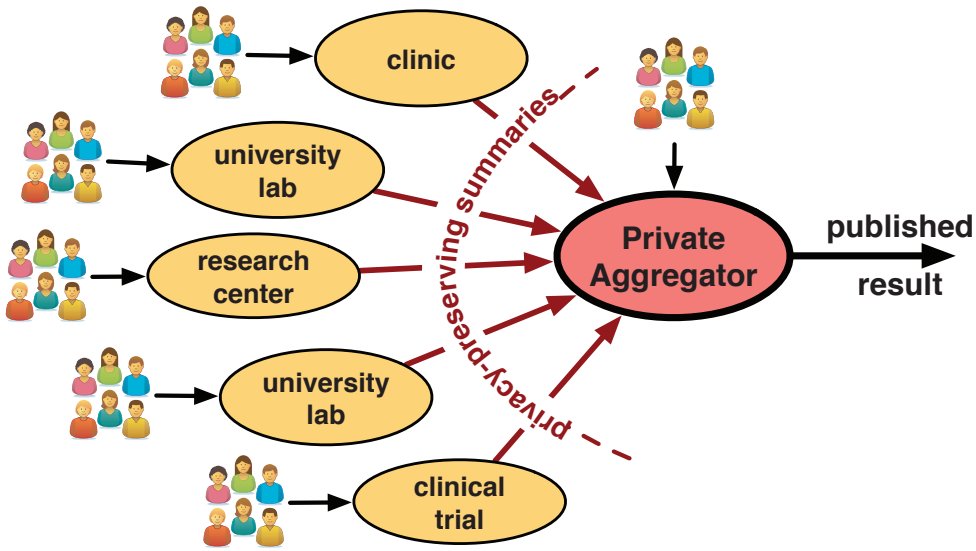
Enabling Research Collaborations on Private Data with Distributed Algorithms

by Anand D. Sarwate, Assistant Professor

The sinking cost of medical technologies such as imaging and genome sequencing is revolutionizing our understanding complex diseases, especially for mental health conditions such as Alzheimer's, schizophrenia, and addiction. Researchers studying these conditions can re-use the data gathered from patients and trial subjects by joining with other research groups in a research consortium. However, this raises important privacy concerns – for ethical and legal reasons, patient confidentiality needs to be protected. If directly sharing the data with other researchers is not allowed, how can we re-engineer our statistical analyses to harness the potential of this data?

My research seeks to tackle this challenge by designing algorithms that perform statistical inference on data held at different sites while guaranteeing a quantifiable level of privacy. As an example, many research studies on schizophrenia have tens of patients (including controls); the small sample size limits the strength of their findings. By performing an analysis across multiple sites, we can perform studies across hundreds of patients, dramatically increasing the statistical power. Such studies can impact clinical practice via early diagnoses and interventions; this will save costs and improve outcomes for patients.

The model of privacy that I use in my research is differential privacy, which measures privacy by re-identification risk: can someone figure out if you are in the data set? Privacy is a property of a computation performed on the data ("you can't guess my name from the output"), rather than the data itself ("my name is omitted, so I am private"). This is important, since the data about you is enough to uniquely identify you, even without your name and address – just think of your genome. Since being proposed in 2006, there has been a lot of research on how to make computations differentially private, and the time is ripe to try some of these ideas out in practice.



Aggregating information from different sites via privacy-preserving summaries can let researchers leverage data from a much larger population to augment their own data.

Think of a research consortium as being a collection of different research sites (labs, clinics, or research centers), each of which has its own set of individual patients enrolled in a study. The data stays at each site: the computation "moves to the data" and computes a privacy-preserving summary of the information at each site; the summaries are sent to a private aggregator that performs the final analysis. Differentially private algorithms guarantee privacy by deliberately introducing some noise into the computation – the uncertainty from the noise masks individual data points. This leads to a tradeoff between privacy and accuracy, which is where the design challenge lies.

My collaborators at the Mind Research Network and I recently demonstrated a test to distinguish patients from schizophrenia patients from healthy controls using magnetic resonance imaging (MRI) data. Each site on its own could only make a 20% accurate diagnosis, but through private summarization and aggregation we brought the error rate down to 5%. While encouraging, this is just a preliminary proof-of-concept. The hard work in the next few years will be to develop computational tools for other statistical analyses that have provable privacy guarantees. My hope is that this will serve as a blueprint for research consortia studying other diseases.

Demand-aware Dynamic Virtual Base Station Provisioning and Allocation in Cloud Radio Access Networks

The proliferation of personal mobile computing devices along with a plethora of data-intensive mobile applications has resulted in a tremendous increase in demand for ubiquitous and high-data-rate wireless communications over the last few years. Additional deployment of a large number of stand-alone cellular Base Stations (BSs) to meet the growing capacity demand are highly inefficient due to excessive capital and operating expenditures. Presently, multiple Radio Access Networks (RANs), each composed of geographically proximal BSs, are statically configured and deployed; such an approach, however, does not allow for any margin to handling the fluctuations in capacity demands due to the ever transforming mobile applications landscape and unexpected events such as emergencies. Cloud-RAN (C-RAN), composed of Remote Radio Units (RRUs) distributed over a wide geographic region controlled by remote Virtual Base Stations (VBSs) housed in centralized BS pools, is a new paradigm for broadband wireless access to address the fluctuation in capacity demand efficiently.

This project, led by **Prof. Dario Pompili** and sponsored by an NSF research grant, focuses on designing a dynamic reconfigurable cellular communication system that relies on elastic VBSs, which can be dynamically resized to meet the fluctuations in per-user capacity demands. This elasticity enables improvements in user Quality of Service (QoS) and efficiency in energy and computing resource utilization in C-RANs. However, Virtual Machine (VM) provisioning, i.e., determining the "size" of VMs that hold VBSs, as well as optimal allocation of VMs to physical servers are non-trivial challenges. The tasks of this project consist in the design and development of (i) a demand-aware dynamic VM provisioning algorithm that relies on an offline profiling of the computational complexity and memory footprint of the communication functionalities implemented in software; (ii) a QoS-aware VM allocation algorithm that exploits VBS co-location models; (iii) a C-RAN testbed on virtualized enterprise-class servers for validation of the profiling and allocation solutions through emulation campaigns.

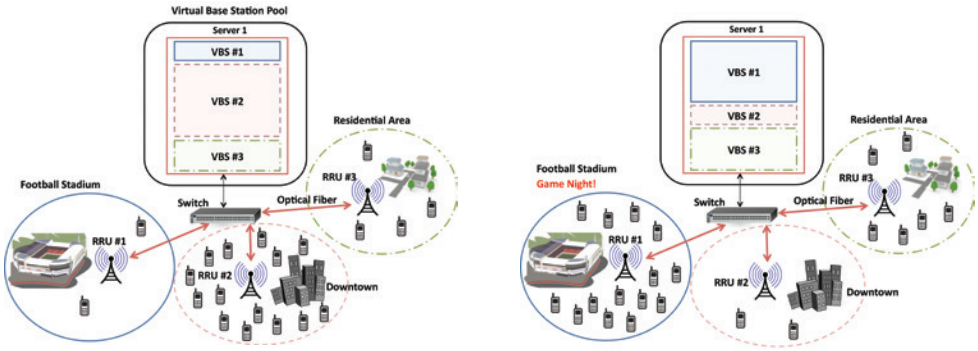


Figure 1: Daily movement of mobile network load from the downtown office area (left) to the residential and recreational areas (right); "virtualization" allows for the re-provisioning of spectral and computing resources to Virtual Base Stations (VBSs) (e.g., different VBS sizes) based on the demand fluctuation.

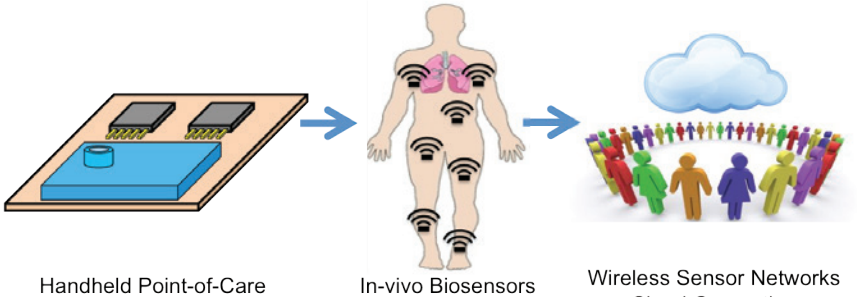
Personalized Medicine Using Supercomputers

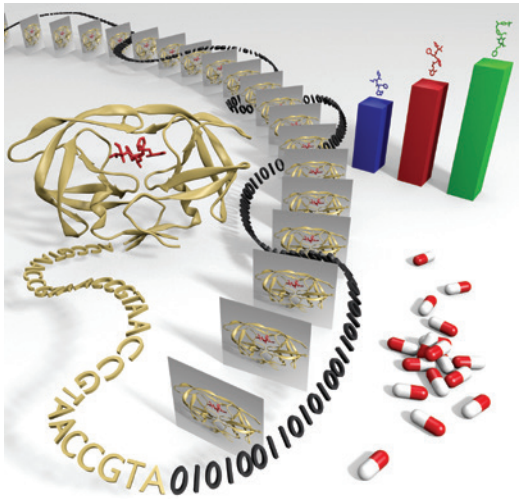
Prof. **Shantenu Jha** and Peter Coveney from University College London use supercomputers to simulate the shape of a key protein involved in HIV infection in an individual patient and then ranked the drug molecules most likely to block the activity. Researchers now recognize that pharmaceutical products do not have the same effects in all people. Subtle genetic differences between individuals will lead to a range of outcomes. In the future, it is expected that patient-specific drug selection will become routine.

Professors Coveney and Jha have demonstrated how you might tackle this problem using the latest genetic sequencing techniques and big computation. They took as their target the HIV protease molecule, which is critical in helping to build the viral particle, or virion, in a cell that will eventually break out to infect the next cell. The protease has a slightly different shape in each individual, in particular in the protein's active zone where it slices the components that will form the next virion. This is a consequence of the very specific genetic sequence of the virus in that person, but unless that shape is known, there is uncertainty as to which particular drug will bind to the protease and stop it in its tracks. The team showed how one could take the specific viral sequence, infer the shape and then work out the most appropriate drug. There are currently nine US Federal Drug Administration-approved HIV-protease inhibitors on the market. The UCL-Rutgers project ranked seven of them in its proof of principle experiment. Although the idea sounds simple, working out how each drug molecule would fit into the patient's shape-specific protease protein required enormous computing capability.

Bioelectronic Solutions for Enabling Personalized Medicine
by Assistant Professor Mehdi Javanmard

Healthcare in the US is better than ever. However, costs are rising faster than is sustainable. In order to maintain and even improve the quality of healthcare, while lowering the cost, we must develop disruptive low cost technologies. This requires bringing together creative solutions from engineering, biology, and chemistry. I want to exploit ultrasensitive micro- and nanotechnologies to improve disease diagnosis in the US and the developing world. One of the most promising approaches to enabling non-invasive early disease diagnosis is through biomarker-based screening. A biomarker is any type of molecular indicator that signals the presence and state of a disease. Biomarker based screening not only allows for early disease diagnosis, it also enables personalized medicine. That is, once given a comprehensive molecular understanding of the patient's condition, this allows for prescribing a course of treatment that has a much higher probability of being successful compared to giving a prescription based on the patient's outwardly symptoms.
As an Electrical Engineer my background is in solid-state devices and microsystems. My vision is within five years to develop a disposable biochip that costs less than one dollar that plugs into a handheld electronic platform, capable of diagnosing up to 100 diseases in less than an hour, and then wirelessly transmitting that data making it available for both the patient and the medical professional. In order to make this vision a reality, we need to overcome several key bottlenecks. My focus up till now has been to overcome several of the primary bottlenecks associated with making this type of vision a reality, namely the ability to detect low abundance proteins, the ability to perform high throughput multiplexing, and also the ability to perform low cost point-of-care genetic testing. As an example, for protein sensitivity, together with my colleagues, I developed an electronic platform for detecting proteins with a sensitivity of several orders of magnitude better (Javanmard et al. PNAS 2014) than the gold standard fluorescent techniques. My mid-term goal is to transform this knowledge to enabling in-vitro personalized health monitoring devices. My long term goal over the next 10-15 years is to develop edible nano-sensors which can perform health monitoring in real time, while wirelessly transmitting the data to a cell phone. The ultimate challenge and future of this research will be to solve and exploit both the challenges and opportunities associated with handling the billions of data points generated from millions of individuals using these ubiquitous sensors. Not only will this enable researchers to better tools for biomarker discovery, but will also enable patients to higher quality healthcare at a fraction of the costs.





Development of a Polymer-Probe-Based S Scanning Probe Microscope for Non-Invasive, High-Speed, and Broadband Investigation of Live Mammalian Cell

Prof. **Jaesok Jeon** collaborates with Mechanical and Aerospace Engineering Professor Qingze Zou on a project which aims at substantially improving the function and performance of scanning probe microscope (SPM) for interrogating cellular and subcellular evolutions of mammalian cells. This will be achieved via the development and integration of polymer-based cantilever probes with a new imaging protocol of minimal-deformation and a new control-based nanomechanical measurement protocol for in-liquid SPM operation on live cells.

facultynews

Professor Wade Trappe elevated to IEEE Fellow

In its November 2013 meeting, the Board of Directors of IEEE has conferred the grade of IEEE Fellow upon Professor **Wade Trappe** for "contributions to information and communication security".

According to IEEE, "the grade of IEEE Fellow recognizes unusual distinction in the profession, and shall be conferred only by invitation of the Board of Directors upon a person of outstanding and extraordinary qualifications and experience in IEEE-designated fields, and who has made important individual contributions to one or more of these fields." The number of new Fellows in any one year cannot exceed one-tenth percent of the total voting IEEE membership.

Professor Trappe joins several members of the ECE faculty who are IEEE Fellows, i.e., Professors M. Bushnell, N. Mandayam, P. Meer, M. Parashar, A. Petropulu, L. Rabiner, R. Raychaudhuri, C. Rose, P. Sannuti, R. Yates, J. Zhao.

D. Raychaudhuri and N. Mandayam recipients of the 2014 IEEE Donald G. Fink Award

Upon the recommendation of the IEEE Board of Directors, Professors **Dipankar Raychaudhuri** and **Narayan Mandayam** received the 2014 IEEE Donald Fink Award for their paper entitled "Frontiers of Wireless and Mobile Communications," Proceedings of the IEEE, Vol. 100, Issue 10, April 2012, pp. 824-840.

The paper was one of the top 100 most downloaded IEEE papers of 2012 and reviews new strategic research and applications in wireless communications, such as cognitive radio, vehicular networks, peer-to-peer networks, and location-aware pervasive computing networks.

Waheed Bajwa received ARO Young Investigator Award

Assistant Professor **Waheed Bajwa** was selected to participate in the Army Research Office (ARO) Young Investigator Program (YIP). The objectives of YIP are to attract outstanding young university faculty members to Army research, and to support and encourage their teaching and research careers.

The YIP award will support Dr. Bajwa's research on Information Processing and Fusion, entitled "A Novel, Data-Adaptive Union-of-Subspaces Approach to Processing of Imaging Data."

"The goal is to advance the state-of-the-art in automated processing of surveillance and reconnaissance data collected by the Army," said Dr. Bajwa of his research. Dr. Bajwa's research aims to achieve this goal through advances in mathematical data models, robust statistical methods, and collaborative computational algorithms.

D. Raychaudhuri receives 2014 ECEDHA Innovative Program Award

Prof. **Dipankar Raychaudhuri**, Distinguished ECE Professor and Director of WINLAB received the 2014 Innovative Program Award by the ECE Department Heads Association (ECEDHA). The awards ceremony took place at the ECEDHA Annual Conference and ECExpo, in Napa, CA, on March 24.

Prof. Raychaudhuri accepting the ECEDHA Innovative Program Award from Dr. Stephen Goochick, ECEDHA Awards Committee Chair

The Innovative Program Award is given to individual(s) or department(s) that has (have) created, implemented, and sustained the implementation of a successful innovative program and possibly assisted in the implementation of that program at other institutions. A successful program is one that has stood the test of time (i.e., formal integration into a program of study) and has produced measurable improvements in the quality of the electrical and computer education received by a significant number of students at one or more institutions.

About WINLAB

WINLAB (the Wireless Information Network LaWINLAB (the Wireless Information Network Laboratory) at Rutgers University is a collaborative industry-university research center with focus on wireless communications and networking.
The center operates as a part of the Rutgers School of Engineering (SOE) and is formally affiliated with the Dept. of Electrical and Computer Engineering (ECE). The center's research mission is to make fundamental contributions to both the theory and practice of emerging wireless technologies and

systems, working in close collaboration with industry and government. WINLAB's educational mission is to train the next generation of wireless technologists via graduate MS and PhD programs which expose students to a specialized wireless communications curriculum integrated with advanced research projects.

WINLAB was founded at Rutgers University in 1989 as the first of its kind wireless research center in academia. Over the years, WINLAB has been the pole of attraction of brilliant faculty, researchers, students, and visitors who come from all over the world to be immersed in WINLAB's unique research environment. The innovative work of WINLAB/ECE faculty is highly cited in scientific journals and conferences. With its excellent reputation, WINLAB has enabled ECE to recruit outstanding faculty and students, has revolutionized our curriculum and has strengthened our ties with industry. One of the signature features of the center's program is the involvement of industry via a sponsorship program that has attracted long-term support from 15-20 top-tier technology companies over the past 10 years. A second important aspect of the center's program is the emphasis on collaborative projects which involve multiple faculty members as well as external collaborators from universities and research labs. This collaborative work culture has made it possible for Rutgers ECE faculty to compete successfully for large NSF and DoD projects that are beyond the scope of most individual academic researchers. A third notable feature of WINLAB's program is the emphasis on building and operating state-of-the-art laboratory infrastructure that enables faculty and students to pursue ambitious experimental research goals that lead the field of wireless technology.

K. Dana's team recognized in the 2014 Charles Pankow Award for Innovation

Prof. **Kristin Dana**, was the computer vision task leader on the RABIT bridge deck assessment tool developed by CAIT (Rutgers Center for Advanced Infrastructure and Transportation) and the Federal Highway Administration. The project received the 2014 Charles Pankow Award for Innovation at the ASCE Opal Awards ceremony in Arlington, VA on March 20, 2014.

The computer vision group included ECE graduate students **Parneet Kaur** and **Prateek Prasanna**. The group developed novel algorithms for extracting knowledge from large-scale bridge data. These algorithms performed automatic crack detection and rebar corrosion detection using machine learning, signal processing and pattern recognition.

ASCE Opal Awards Ceremony in Arlington, VA. Rutgers University was awarded the 2014 Charles Pankow Award for Innovation for RABIT-Robotic Assesment Bridge Inspection Tool. A subset of the team is shown: (from left to right) Nenad Gucunski, Kristin Dana, Basily B. Basily, Hooman Parvardeh and Hung La.

The group designed and implemented the vision component of the robotics device including the incorporation of a panoramic 360 degree camera for contextual views, and dual high resolution cameras for surface coverage. A visual demonstration of the work was provided on-site to FHWA Administrator Victor Mendez. The project is led by Dr. Nenad Gucunski (CAIT/CEE) and Dr. Ali Maher (CAIT/CEE). Faculty Contributors and team members are: Dr. Basily B. Basily (ISE/CEE), Dr. Kristin Dana (ECE), Parneet Kaur (ECE/CAIT), Dr. Seong-Hoon Kee (CAIT/CEE), Dr. Hung La (CAIT), Ronny Lim (CAIT), Hooman Parvardeh (CAIT), Prateek Prassana (ECE/CAIT), Dr. Jingang Yi (MAE). Industry collaborators include: Dr. Mark Baker (Geomedia Research and Development), Giorgio Barsacchi, (Ingegneria Dei Sistemi). Core members from FHWA Turner-Fairbank Highway Research Center were:Dr. Hamid Ghasemi, Jorge E. Pagan-Ortiz, Dr. Firas I Sheikh-Ibrahim, Michael F. Trentacoste

ECE/WINLAB Team Received Best Paper Award at the 2013 ACM MobiArch Workshop

ECE/Winlab student **Francesco Bronzino**, Kiran Nagaraja, Ivan Seskar and Prof. **Dipankar Raychaudhuri** received best paper award at the 2013 ACM MobiArch workshop in Miami, FL.

The paper on the MobilityFirst service API is entitled, Network Service Abstractions for a Mobility-Centric Future Internet Architecture.

The paper's abstract is shown below. The increasing composition of mobile devices and mobile applications in the Internet requires us to revisit the traditional principles of fixed, host-centric communications, when designing a next-generation architecture. To support this major shift, we define in this paper a set of basic service abstractions that should be afforded by a future Internet that is centered upon the notion of self-certifying globally unique IDs (GUID) for all network principals - hosts, content, services, etc. alike. We follow up with a specific set of network service APIs that provide full access to the proposed abstractions, and implement these on Linux and Android hosts that connect to an instantiation of the future Internet architecture proposal - MobilityFirst. Using performance benchmarks and the implementation of representative use cases we show that the API is flexible and can enable efficient and robust versions of present and future applications.

ECE Team wins runner-up best student paper award at the 2014 IEEE ISCAS

Prof. **Laleh Najafizadeh**'s group won the runner-up best student paper award in competition with more than 600 papers, at the 2014 IEEE ISCAS (the flagship conference of the IEEE Circuits and Systems Society), which was held in Melbourne Australia in June 2014.

The first author in the paper is **Yi Huang**, an ECE student pursuing his Ph.D. at the Integrated Circuits and NeuroImaging Lab of ECE under the supervision of

Dr. Najafizadeh, while working concurrently at Intersil Corporation. Other authors on this paper are **Li Zhu** (ECE Ph.D. student), **Chun Cheung** (Intersil Corporation) and **Laleh Najafizadeh** (ECE).

The paper title was: "A Low Temperature Coefficient Voltage Reference Utilizing BiCMOS Compensation Technique."

Y. Huang receives the award at the conference.

The paper presents a novel low temperature coefficient BiCMOS reference circuit for applications requiring a high degree of precision. A BiCMOS compensation approach by combining the temperature properties of HBTs and CMOS transistors has been proposed to target the direct cancellation of the non-linear temperature term in the base-emitter expression. The Complementary to Absolute Temperature (CTAT) current is generated by a SiGe HBT, while the Proportional to Absolute Temperature (PTAT) current is generated by MOSFETs operating in the subthreshold region. In addition, by adding a nonlinear component, a higher level of temperature compensation is achieved. Designed in IBM's Silicon Germanium (SiGe) BiCMOS technology, simulation results show that with a power supply of 1.2 V, the circuit generates an output voltage of 0.981 V with a temperature coefficient of 0.6 ppm/°C over the temperature range of (-25:125) °C.

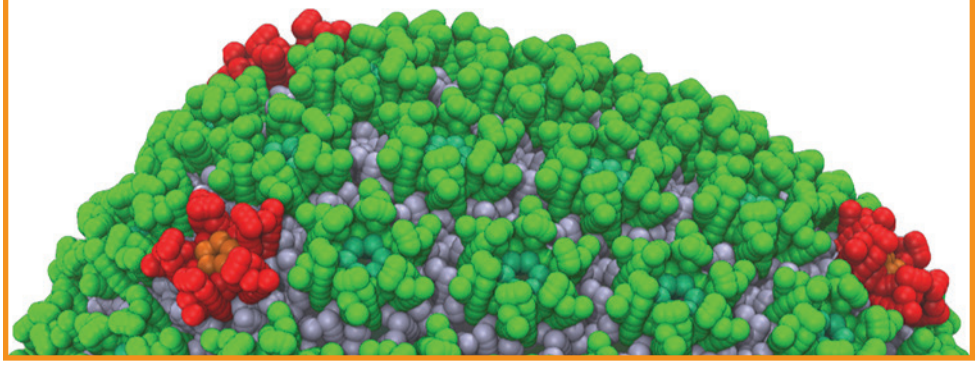
Prof. Jha's work one of 9 ways in which computing has made an impact on HIV research according to NSF

NSF has published an article where they talk about 9 ways in which computing has made an impact on HIV research. One of the 9 impactful ways is the work of ECE Professor **Shantenu Jha** with his collaborators: # 7 of, "Nine ways NSF-supported supercomputers help scientists understand and treat the disease"

http://www.nsf.gov/discoveries

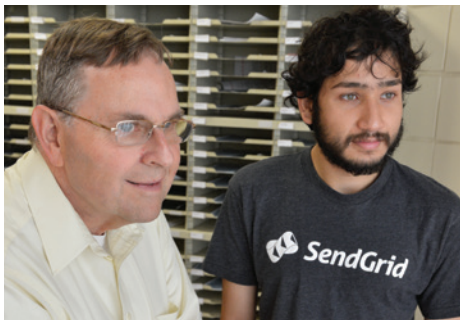
The project demonstrated how researchers might use genetic sequencing techniques and massive computations to design patient-specific treatment protocols in near-real-time. In the future, it is expected that this type of patient-specific drug selection will become routine.

See also article on page 26 on Prof. Jha.



Speech processing exercises uploaded on MATLAB Central

A team of speech processing specialists (Prof. **Lawrence Rabiner** from Rutgers ECE and Prof. Ronald Schafer from Stanford University), with the aid and assistance of **Kirty Vedula** (Rutgers ECE Graduate Student) and **Siva Yedithi** (ECE and CS undergraduate major at Rutgers) have created a set of about 58 Speech Processing MATLAB Exercises in support of classes and teaching in the area of digital speech processing. With financial and operational support from MathWorks (the parent company of MATLAB) all these speech processing exercises have been up-loaded to a special website called MATLAB Central and can be readily down-loaded by any instructor or student wishing to pursue research in speech processing.



L. Rabiner and S. Yedithi

S. Jha's work on Personalized Medicine using Supercomputers featured by BBC News

Professor **Shantenu Jha** is part of the UCL-Rutgers team that has recently published a paper titled, "Computing Clinically Relevant Binding Free Energies of HIV-1 Protease Inhibitors". Recognizing the impact and implications of this research, BBC News (Science & Environment) have published an article about the applications and consequences of this work.

A full link to BBC's article can be found at: **http://www.bbc.co.uk/news/science-environment-26213522**

and a link to the paper (Open Access) can be found at: **http://pubs.acs.org/doi/abs/10.1021/ct4007037**

NSF Science Now Story is live...

Prof. **Janne Lindqvist**'s work on gesture security is featured in the NSF Science Now video

Further, NSF has requested from Dr. Lindqvist "High Interest Information," a display with examples of his research and the opportunity to memorialize his work throughout the halls of the division or to use in NSF promotional materials.

Rutgers Partners with New Milford High School for a High-School STEM Symposium

Six Rutgers University faculty, led by Prof. **Waheed U. Bajwa** of the Department of Electrical and Computer Engineering, teamed up with the Principal, Eric Sheninger, and Guidance Counselor, Michelle Harle, of New Milford High School for a STEM Symposium for high-school students on January 10, 2014 at New Milford High School.

The symposium offered high-school students in Bergen county a unique opportunity to listen to some of the latest research being carried out in the labs of Rutgers University and to ask questions from the participating faculty regarding the students' future options and career choices. Four high schools from Bergen county participated in the event and benefited greatly from the talks given by Professors Pierce, Najafizadeh, Lindqvist, Spasojevic, and Bekris.

Distinguished Alumni Award for Wade Trappe

Prof. **Wade Trappe** has been awarded the 2014 ECE Distinguished Alumni Award from the University of Maryland. This prestigious award is presented annually to alumni who have provided leadership and meritorious contributions in the broad field of engineering.

Marco Gruteser received the 2014 Award for Outstanding Engineering Faculty

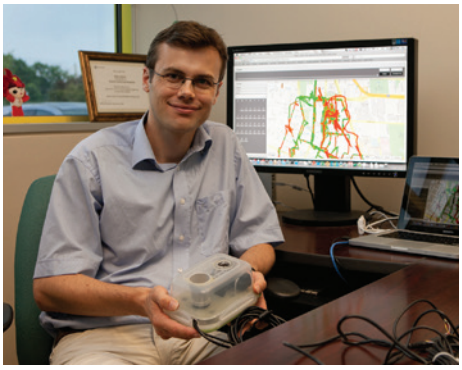
This award is an important opportunity for the Rutgers Engineering community to recognize the special achievements and contributions of its dedicated faculty members.

This is the second year in a row that an ECE Faculty received this award; Prof. **Wade Trappe** was recipient of the 2013 Outstanding EngineeringFaculty Award. Prof. **Marco Gruteser** is widely recognized for contributions to emerging Internet-connected cars, spanning topics from scalable car-to-car communication networks, over security and privacy in such systems, to apps that sense real-time traffic, parking information, or driver distraction.

In particular, he has developed pioneering techniques for enhancing the privacy of location data, and has demonstrated how they can be incorporated into real-time traffic or other vehicle telematics systems. This privacy work was cited in a letter from Senators Franken and Coons urging the car industry to reconsider their privacy practices. He further conceived and directed a project to conduct a security and privacy evaluation of wireless systems in cars, using the tire pressure monitoring system as a case study. This project was conducted collaboratively withProf. Wade Trappe (RU ECE) and Prof. Wenyuan Xu (Univ of South Carolina).

The identified security vulnerabilities generated significant press coverage and interest beyond the scientific computer security community, culminating in a national CNN TV segment with demonstrations and interviews. This study contributed to a heightened awareness for securing in-vehicle systems and has influenced decisions at major car makers and automotive standards groups.

Prof. Gruteser further invented an app with Prof. Rich Martin (RU CS) and Prof. Yingying Chen (Stevens) that allows a mobile phone to sense whether it is used by a driver and to adjust its behavior to reduce distractions (e.g., silence incoming text messages). This system relies on fine-grained localization of the phone inside the car to distinguish a driver's phone from a passenger's phone. This project received a best paper award from the ACM's most significant publication venue in mobile computing (ACM MobiCom), led to an Innovator's award from the NJ Inventors Hall of Fame, and gained considerable press coverage – even a joke in Jay Leno's tonight show.



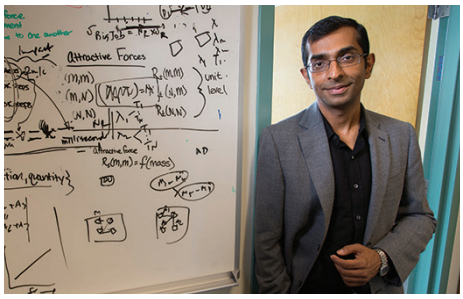
M. Gruteser

Beyond these highlights, testament to the impact and recognition of his overall body of work are a continuous stream of prize papers, keynotes, citations, press coverage, well-placed Ph.D. graduates, and research funding -- he has lead or contributed to projects totaling about $9.5 million for Rutgers University. He has published more than 100 articles and patents, including three significant prize papers. Two of them are consecutive best paper awards at the ACM SIGMOBILE flagship conference MobiCom. He has delivered four keynotes at IEEE conferences and various workshops and served as a panel moderator or panelist at numerous conferences.

Dr. Gruteser was the primary advisor for 8 graduated Ph.D. students, who have gone on to faculty or research positions at institutions such as the University of Colorado – Denver, AT&T Labs, Intel Labs, NEC Labs, and Nokia Research. He has further served as principal investigator on projects with over $3.5 million dollars support, including over $2 million from the National Science Foundation and $1.4 million from industry. He has also participated as co-principal investigator on projects totaling another $6 million for Rutgers University.

Shantenu Jha has been awarded a Board of Trustees Research Fellowship for Scholarly Excellence

Dr. Shantenu Jha has been awarded a Board of Trustees Research Fellowship for Scholarly Excellence as one of the university's most distinguished young faculty members. This award is bestowed in recognition of Dr. Jha's outstanding scholarly accomplishments in his years at Rutgers, as documented in the evaluation that has led to his recent promotion to Associate Professor.



S. Jha

Dr. Shantenu Jha joined the Department of Electrical and Computer Engineering in January 2011. Before that, he was Assistant Research Professor at the Dept. of Computer Science at Louisiana State University (LSU). Currently, he is an Associate Professor of ECE and Director of the RADICAL Laboratory (Research in Advanced Distributed Cyberinfrastructure and Applications).

Dr. Shantenu Jha is already an internationally recognized researcher in the broad area of parallel and distributed computing with a specific focus on the intersection of applied computing, cyberinfrastructure and computation and data-enabled science. While large-scale computation and data analytics are playing an increasingly critical role in all aspects of science and engineering, moving computational applications to current and emerging large-scale parallel and distributed platforms present significant computer engineering research challenges, primarily due to the complexities of system/application scale, heterogeneity and dynamics. Addressing these challenges requires a multidisciplinary research perspective and a unique blend of expertise, both of which Dr. Jha has clearly demonstrated.

In the short period of time since he joined Rutgers, Dr. Jha has established a vibrant and productive research group that is uniquely focused on solving real-world problems, combining conceptual models with implementations of systems in a cross-disciplinary manner, and building on theoretical foundations of parallel and distributed computing. He has made significant and quantifiable contributions in the development of algorithms and methods for high-performance and distributed computing infrastructures as well as their scalable implementations for solving important and challenging problems in science and engineering. For example, his research and research products (e.g., RADICAL-Cybertools (including SAGA)) are being used directly by dozens of scientific teams globally to study problems at unprecedented scales, to implement sustainable services and efficient tools on every major heterogeneous distributed cyberinfrastructure, as well as to support tens of millions of core-hours on production-grade resources.

He has received several recognitions, including the 2013 the prestigious NSF CAREER award for his research on abstractions and middleware for distributed dynamic data-intensive science, the IEEE/ACM Grid 2009 Best paper Award, International Supercomputing Conference (ISC'08) Best Paper Award, Life Sciences Award for Best Paper at the 2006 International Supercomputing Conference (ISC'06), and HPC Analytics Challenge Award, IEEE/ACM Supercomputing 2005. He was keynote speaker at the 10th International Conference on HealthGrid, held in Amsterdam in May 2012, and also at the 2010 IEEE/ACM Grid held in Brussels in October 2010.

Two aspects of Dr. Jha's research program are particularly impressive. First, his research is driven by real world problems and challenges and he works closely with scientists, engineers, and other practitioners, to understand these problems and challenges. Second, his research goes beyond conceptual models and theories and uses these concepts and theories to develop software systems, which he then not only disseminates to the community in general, but once again works with the end users to incorporate them into their applications, ensuring its impact.

Professor Jha has attracted an impressive amount of funding, with over $10M in research grants as PI or Co-PI from federal funding agencies. Since joining Rutgers he has received funding at ~$4.5M as PI and ~$500K ac Co-PI. Most of his grants are from very prestigious extremely competitive funding programs.

NSF Future Internet Architecture - Next Phase (FIA-NP) project awarded

A $5M NSF FIA-NP project, entitled "The Next-Phase MobilityFirst Project - From Architecture and Protocol Design to Advanced Services and Trial Deployments (MobilityFirst-NP)," has been awarded to Rutgers (lead) along with 6 other partner universities (UMass, Michigan, Duke, Wisconsin, MIT and U Nebraska).

The PIs are Profs. **D. Raychaudhuri, Rich Martin, Wade Trappe, Roy Yates** and **Yanyong Zhang,** with **Kiran Nagaraja** and **Ivan Seskar** as Senior Personnel and funding for the Rutgers portion is $2.269M over 2 years.

This grant is a follow on to WINLAB's earlier $8M MobilityFirst project funded under the NSF FIA program in 2010, and will focus on moving the proposed MobilityFirst future Internet architecture from design stage to multiple real-world technology trials.

Narayan Mandayam promoted to Distinguished Professor


N. Mandayam

The designation of Distinguished Professor is reserved for those selected faculty in the University who have achieved scholarly eminence in their discipline and fields of inquiry. Only those faculty who have demonstrated outstanding achievement in scholarship in their discipline and fields of inquiry by earning significant recognition inside and outside the University are eligible for promotion to Distinguished Professor. Typically, such recognition is reflected in clearly demonstrable national and international reputation in one's discipline. Professor **Narayan Mandayam** received the B.Tech (Hons.) degree in 1989 from the Indian Institute of Technology, Kharagpur, and the M.S. and Ph.D. degrees in 1991 and 1994 from Rice University, all in electrical engineering. He joined WINLAB as a Research Associate in 1994 and became an Assistant Professor in ECE in 1996. Dr. Mandayam's work has been recognized with several prestigious awards including the IEEE Donald G. Fink Award (2014), IEEE Fred W. Ellersick Prize (2009), Peter D. Cherasia Faculty Scholar Award from Rutgers University (2010), National Science Foundation CAREER Award (1998) and Institute Silver Medal from the Indian Institute of Technology (1989). He is a co-author of Principles of Cognitive Radio (Cambridge University Press, 2012), Wireless Networks: Multiuser Detection in Cross-Layer Design (Springer, 2004) and has served as an Editor for IEEE Communications Letters, IEEE Transactions on Wireless Communications, and IEEE JSAC. He is a Fellow of the IEEE and currently serves as its Distinguished Lecturer.

Collaborating primarily with his students, Dr. Mandayam pioneered the use of game theory as a tool for the design and analysis of radio resource allocation algorithms for wireless networks. He has also made fundamental contributions to various aspects of wireless data transmission with emphasis on techniques for cognitive radio networks and their implications for spectrum policy. His recent interests include modeling and analysis of trustworthy knowledge creation on the internet. He has been an active mentor to undergraduate and graduate students as the supervisor of 21 completed Ph.D. theses. Among these, three of his former PhD students (C. Comaniciu at Stevens, L. Sankar at Arizona State, and L. Xiao at Xiamen University) now hold tenured faculty positions.

Best Paper Award for W. Trappe at MACOM 2014

Prof. Trappe is co-recipient (with Andrey Garnaev of WINLAB) of the Best Paper Award from the 7th International Workshop on Multiple Access Communications (MACOM 2014) for their paper, "Secret Communication when the Eavesdropper Might be an Active Adversary".

Best Teacher Award for H. Godrich

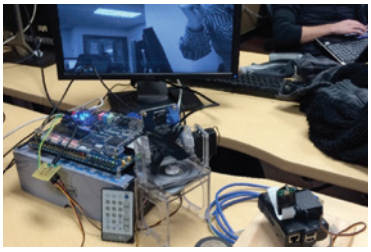

H. Godrich

Hana Godrich has been cited as the ECE' Department's Best Teacher as voted by the students during the Rutgers Engineering Governing Council's annual elections. Dr. Godrich had taught the sophomore course Principles of Electrical Engineering I during the Fall 2013 semester and has designed and taught new courses in power systems and sustainable system.

Introduction of a New Course and Laboratory on Hardware/Software Design of Embedded Systems

Embedded systems are utilized in a growing number of applications and systems, from everyday consumer electronics to aerospace. In collaboration with the Digital Technology group at Northrop Grumman Corporation (NGC), Prof. **Laleh Najafizadeh** designed a new course along with its laboratory on the topic of Hardware/Software Design of Embedded Systems. The course was introduced into our curriculum in Fall 2013 and was taught by Dr. **N. Naganathan**. The main objective of the course was to provide students with a practical view of building embedded systems with hands on exercises using Altera DE2-115 FPGA.

Laboratories were designed based on the VHDL hardware description language to equip students with skills necessary for modeling digital systems in software and for establishing the link between the software and the actual hardware implementation. Through several laboratory exercises students were guided to complete the design and implementation of a processing unit. They also formed groups and successfully delivered projects, some of which were defined by the NGC group, by the end of semester. Examples of the projects include Camera Tracking, RC Rover, Audio Synthesizer, and Sonar Processing system.



newgrants

Waheed Bajwa received a three-year $156,032 grant award for his project "Exploiting Sparsity for Interference Management in Broadband Communications: Theory, Applications, and Testbeds" from the Qatar National Research Fund.

Waheed Bajwa was also awarded a three-year grant of $150,000 from the Army Research Office, Computing Sciences Division (Young Investigator Program) for the project "A Novel, Data-Adaptive Union-of-Subspaces Approach to Processing of Imaging Data".

Waheed Bajwa, Anand Sarwate and **Athina Petropulu** received a one-year, $125,526 award from General Dynamics under an Army Research Lab Collaborative Technology Alliance (CTA) on Robotics. This basic research award is titled "Active Feature Learning and Classifier Training for Object Recognition".

Kristin Dana received two corporate contracts awards totaling $60,000 for her project "Skin Appearance and the Skin Microbiome" as one year projects.

Kristin Dana was awarded a 3 year NSF grant for the project "MatCam: A Camera that Sees Materials". Rutgers is the lead institution on this $500,000 collaborative grant with K. Dana as the Rutgers PI. Drexel University is the partner institution with PI Ko Nishino.

Marco Gruteser received a four-year $455,575 award from the NSF for the project "Harnessing the Automotive Infoverse". He also received a one-year $190,944 contract extension from the Crash Avoidance Metrics Partnership for the project "Development of the DSRC V2V Scalability Simulator", a one-year $14,877 Google Research Award for the project "One Ring to Rule Them All: A hardware token-based identification and authentication solution for Touchscreen-enabled devices with Capacitive Touch Communication", and $25,000 corporate funding for the project "Congestion Control Algorithms for Vehicular Networks".

Marco Gruteser also received a three-year NSF grant for the project "Guardian Angel: Enabling Mobile Safety Systems". This is a collaborative grant with Rich Martin (CS Rutgers), Yingying Chen (Stevens), Jie Yang (Florida State). The total funding is $700K, with the Rutgers part being $350,000.

Jeasok Jeon is part of a team that has been awarded an NSF grant of $636,557 for 3 years for the project "Development of a Polymer-Probe-Based Scanning Probe Microscope for Noninvasive, High-Speed, Broadband Investigation of Live Mammalian Cell." This is a collaborative project with Profs. Qingze Zou (PI) of Mechanical and Aerospace Engineering and Nan Gao of Biological Sciences.

Shantenu Jha received a three-year $617,005 grant from the NSF for the project " ExTASY Extensible Tools for Advanced Sampling and analysis". ExTASY is a $1.35M collaborative project between Rutgers, Rice, Duke and IBM. It has a sister project in the UK funded by the EPSRC -- UK's equivalent of NSF. The UK partners are Edinburgh, Nottingham and Imperial College.

Shantenu Jha also received a three-year $500,000 NSF grant for the project "SI2-SSE: RADICAL Cybertools: Scalable, Interoperable and Sustainable Tools for Science." He also received a $50,000 NSF award for the project "High-Performance & Distributed Computing for Polar Climate Sciences: Workshop on Applications, Cyberinfrastructure Requirements and Opportunities".

Yicheng Lu received a three-year $165,000 grant from NSF for the project "Stepwise Functionalization and Surface Modification for ZnO Nanostructure-based Biosensors".

Narayan Mandayam and **Ivan Seskar** won a $248,320 DURIP (Defense University Research Instrumentation Program) grant for "RF Equipment for Dynamic Spectrum Access and Sharing."

Ivan Marsic received a four-year $750,000 grant from the National Institute of Health (NIH) for the project "Automatic Workflow Capture & Analysis for Improving Trauma Resuscitation Outcomes" from the NIH. He also received a one-year $17,046 grant award for his project "A paper-Digital Interface for Time-Critical Information Management" from the NIH.

Laleh Najafizadeh is part of a team that was awarded a three-year NSF grant of $327,955 for the project "Microelectronically Stimulating and Actuating Nanofibers for Muscle Replacement and Regeneration. This is a collaborative project with J.W. Freeman (PI) of Biomedical Engineering.

Athina Petropulu received a three-year $300,000 grant award from NSF for the project "A Novel MIMO Radar Approach Based on Sparse Sensing and Matrix Completion".

Dario Pompili has received a three-year $400,000 grant from the NSF for the project "Demand-aware Dynamic Virtual Base Station Provisioning and Allocation in Cloud Radio Access Networks (C-RANs)".

Dipankar Raychaudhuri, Marco Gruteser, Richard Martin, Wade Trappe and **Roy Yates** received a two-year National Science Foundation (NSF) grant of $2,269,407 for the project "Next-Phase MobilityFirst Project - From Architecture and Protocol Design to Advanced Services and Trial Deployments".

Dipankar Raychaudhuri, Marco Gruteser, Richard Martin, Wade Trappe and **Roy Yates** received a one-year NSF grant of $545,000 for the project "MobilityFirst: A Robust and Trustworthy Mobility-Centric Architecture for the Future Internet".

Dipankar Raychaudhuri, Ivan Seskar and **Yangyong Zhang** received a three-year NSF grant of $300,000 for the project "Virtual Mobile Cloud Network for Realizing Scalable, Real-Time Cyber Physical Systems".

Dipankar Raychaudhuri received two corporate contract awards totaling $40,170 for the project "Open Virtualized WiMAX Base Station Node for GENI Wide-Area Wireless Deployments".

Anand Sarwate received a two year $175,762 grant award for his project "Inference by social sampling" from the NSF.

Wade Trappe received a one-year award of $123K from DARPA (via subcontract from Applied Communication Sciences) for the project "Management of RF Network and Tasking Infrastructure". He also received a one-year award of $70K award from DARPA (via subcontract from Lockheed Martin) for the project "Radar Communications Spectrum Sharing System (RCS3)," and a one year award of $128,125 also from DARPA (via subcontract from Lockheed Martin) for the project "Trust Enabled NetworkS with Policy".

Wade Trappe and **Ivan Seskar** received a one-year award of $631K from DARPA to design and administer the "DARPA Spectrum Challenge."

Wade Trappe and **Yanyong Zhang** received a 3-year award from the National Science Foundation for "A Multi-layer Approach Towards Reliable Cognitive Radio Networks" for a total of $285K.

Roy Yates received a three-year $476,000 grant award from NSF for the project "Status Updating Systems and Networks."

Yanyong Zhang and **Wade Trappe** received a one-year award of $128,893 from the Army Research Office for "Building the Computing Backend for In-Depth Analysis of Wireless and Network Data."

alumninews

ECE Alumnus Tom Kennedy appointed Chief Executive Officer of Raytheon

In January 2014, Raytheon's Board of Directors named Dr. **Tom Kennedy** CEO and appointed him as a fellow Board member. Dr. Kennedy became CEO in March 2014. Before serving as CEO, Dr. Kennedy was executive vice president and chief operating officer from April 2013 to March 2014.

T. Kennedy, A. Petropulu

In this role, he led the consolidation of Raytheon's six businesses to four to enhance productivity, agility and affordability of company operations. Dr. Kennedy also provided direct leadership to Raytheon business presidents and enterprise functional leaders including Engineering, Technology and Mission Assurance; Contracts and Supply Chain; Business Development; and Global Business Services. Previously, Dr. Kennedy served as a Raytheon Company vice president and president of the Integrated Defense Systems (IDS) business, overseeing a broad portfolio of weapons, sensors and integration systems spanning multiple mission areas and provided to a range of domestic and international customers.Before leading IDS, Dr. Kennedy served as vice president of Tactical Airborne Systems (TAS) for the Raytheon Space and Airborne Systems (SAS) business. At TAS, he was responsible for overall strategic direction and operation of the organization. He also served as Mission Systems Integration vice president with responsibility for the U.K. Ministry of Defence Airborne Stand-Off Radar program.

Dr. Kennedy holds a doctorate in engineering from the University of California, Los Angeles; bachelor and master's degrees in electrical engineering from Rutgers University and the Air Force Institute of Technology, respectively.

SOE Medal of Excellence Award for ECE Alumnus Lt. General USAF (Ret.) Charles E. Croom, ECE'73

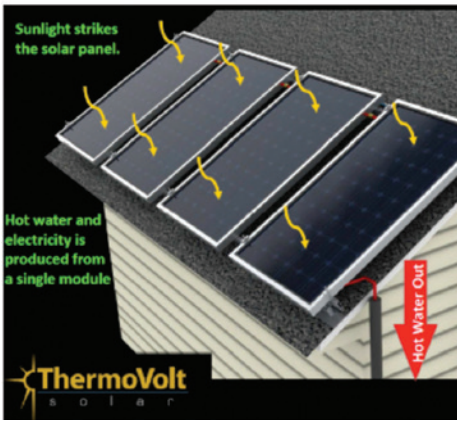
T. Kennedy, C.E. Croom and Dean T. Farris

Following a more than 30-year career of distinguished service and technology experience with the U.S. Air Force, **Charles "Charlie" Croom** is now responsible for shaping cyber security at Lockheed Martin Information Systems & Global Services. A graduate of Rutgers University's ROTC program, Croom entered the Air Force in 1973. His career spanned four commands that included: major command, numbered air force, Air Staff, defense agency, Joint Staff, Office of the Secretary of Defense, and unified command levels. Croom retired in 2008 as a U.S. Air Force lieutenant general, director of the Defense Information Systems Agency (DISA), and the commander of the Joint Task Force for Global Network Operations.

ThermoVolt semifinalist at the 2014 MIT Clean Energy Prize

ECE alumnus **Todd Katz**' startup company, ThermoVolt, was one of seven start-up companies from around the country this year selected in renewable energy to compete for the MIT Clean Energy Prize. ThermoVolt is a direct result of Todd's Capstone project at ECE Rutgers in 2013.

The team's capstone project had won first prize at the 2013 ECE Capstone competition.



Marconi Prize Paper Award for ECE Alumna Aylin Yener

ECE Alumna **Aylin Yener**, currently Professor at Penn State University, is the recipient of the 2014 IEEE Marconi Prize Paper Award in Wireless Communications for her paper "Optimum Transmission Policies for Battery Limited Energy Harvesting Nodes", IEEE Transactions on Wireless Communications, Vol. 11, No. 3, March 2012, pp. 1180-1189.

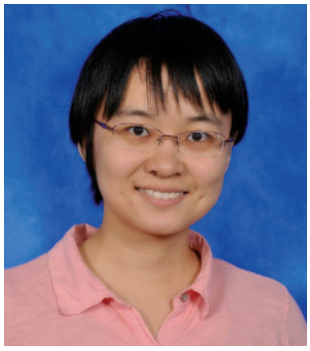
The award was presented at IEEE ICC 2014 in Sydney, Australia.

Dr. Yener's PhD thesis advisor was Prof. **Roy Yates**, who is co-recipient of the 2003 IEEE Marconi Prize Paper Award in Wireless Communications (along with Prof. **Chris Rose** and Prof. **Sennur Ulukus**; Dr. Ulukus is also an ECE Alumna and is currently Prof. at U Maryland). Aylin Yener received the B.Sc. degree in electrical and electronics engineering, and the B.Sc. degree in physics, from Bogazici University, Istanbul, Turkey; and the M.S. and Ph.D. degrees in electrical and computer engineering from Wireless Information Network Laboratory (WINLAB), Rutgers University, New Brunswick, NJ. Commencing fall 2000, for three semesters, she was a P.C. Rossin endowed assistant professor at the Electrical Engineering and Computer Science Department, Lehigh University, PA. In 2002, she joined the faculty of The Pennsylvania State University, University Park, PA, where she was an assistant Professor, then associate Professor, and is currently professor of Electrical Engineering since 2010.

During the academic year 2008-2009, she was a visiting associate professor with the Department of Electrical Engineering, Stanford University, CA. Her research interests are in wireless communications and networking, information theory, communication theory and network science, with recent emphasis on energy harvesting green communications and information security. She received the NSF CAREER award in 2003 and the Penn State Engineering Alumni Society Outstanding Research Award in 2010; and was a co-recipient of DARPA young investigator team award for the ITMANET program in 2006, and the best paper award in Communication Theory Symposium at the IEEE International Conference on Communications in 2010.

A. Yener

L. Sankar



L. Xiao

Dr. Yener has served as a technical program (co-)chair for various conferences including for the IEEE Communications Society (2008-2014). She was an associate editor for the IEEE Transactions on Communications (2009-2012), an associate editor and an editorial advisory board member for the IEEE Transactions on Wireless Communications (2001-2012). She served as the student committee chair for the IEEE Information Theory Society 2007-2011, and was the co-founder of the Annual School of Information Theory in North America in 2008. Dr. Yener is a member of the board of governors of the IEEE Information Theory Society and its treasurer since 2012.

ECE Alumna Lalitha Sankar, currently Assistant Prof. at ECEE Arizona State University, received NSF CAREER Award

Lalitha Sankar joined the Department of Electrical, Computer, and Energy Engineering at Arizona State University in Fall 2013. Prior to that she was a Research Scholar in the Department of Electrical Engineering at Princeton University working with Prof. H. Vincent Poor. She was also a Science and Technology Teaching and Research Fellow supported by the Council on Science and Technology at Princeton University. She graduated with a Ph.D from Rutgers University, where she worked with Prof. Narayan Mandayam while collaborating with Prof. Gerhard Kramer (then at Bell Labs). Prior to that, Dr. Sankar was a Senior Member of Technical Staff at AT&T Shannon Labs, Florham Park, NJ, where she worked on design, development, and prototyping of next-generation wired and wireless systems such as multi-band software radios and DSL modems. This was preceded by a year developing signal processing algorithms for the first digital camera prototype developed at Polaroid Corporation Engineering R&D in Cambridge, MA. Lalitha has a Masters from the Department of Electrical Engineering at the University of Maryland, Baltimore County and a bachelor's degree in Engineering Physics is from the Indian Institute of Technology, Bombay, India.

Lalitha Sankar received the best paper award from the IEEE Globecom 2011 for her paper on side-information privacy with R. Tandon and H. V. Poor. For her doctoral work, she received the 2007-2008 Electrical Engineering Academic Achievement Award from Rutgers University.

Liang Xiao promoted to Professor at Xiamen University

Liang Xiao received her Ph.D. degree from ECE Rutgers in 2009. Her PhD thesis advisor was Prof. Narayan Mandayam; she was also co-advised by Larry Greenstein and Wade Trappe of ECE/WINLAB. In 2009, she joined the Computer Engineering Department of Xiamen University in China as an Associate Professor, and was promoted to Professor in 2013. She has held visiting scholar positions at the ECE Dept. of the University of Maryland in 2011 and the EE Dept. at Princeton University in 2013.

Liang works at wireless security, smart grids, and wireless communications. She was awarded three Chinese NSF grants as PI or CoPI, and received New Century Excellent Talents award by Fujian province in 2011 and CCB Outstanding faculty award by Xiamen University in 2013.

advisoryboard

The Advisory Board provides input on academics, research, administration, outreach, advocacy and development. The Board reviews the graduate and undergraduate curriculum and degree programs, program educational objectives, and program outcomes, and offers suggestions to keep them current. The Board evaluates the quality and scope of our research, its relationship to our programs, its relevancy and helps guide future directions. The Board recommends ways to build new relationships with industry and to strengthen those we have.

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