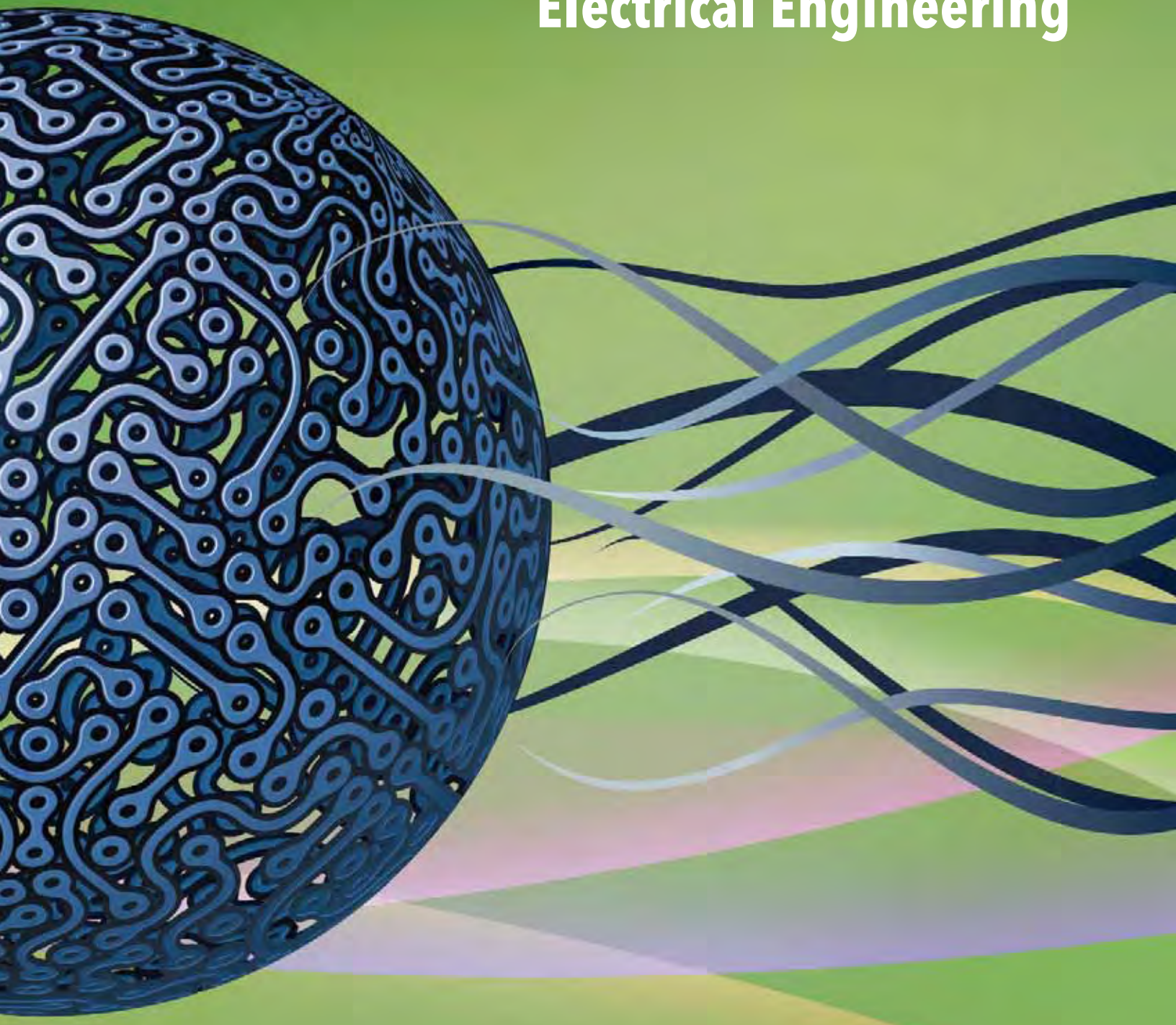
UCLA

Henry Samueli School of Engineering and Applied Science

Electrical Engineering



Annual Report

2012-2013

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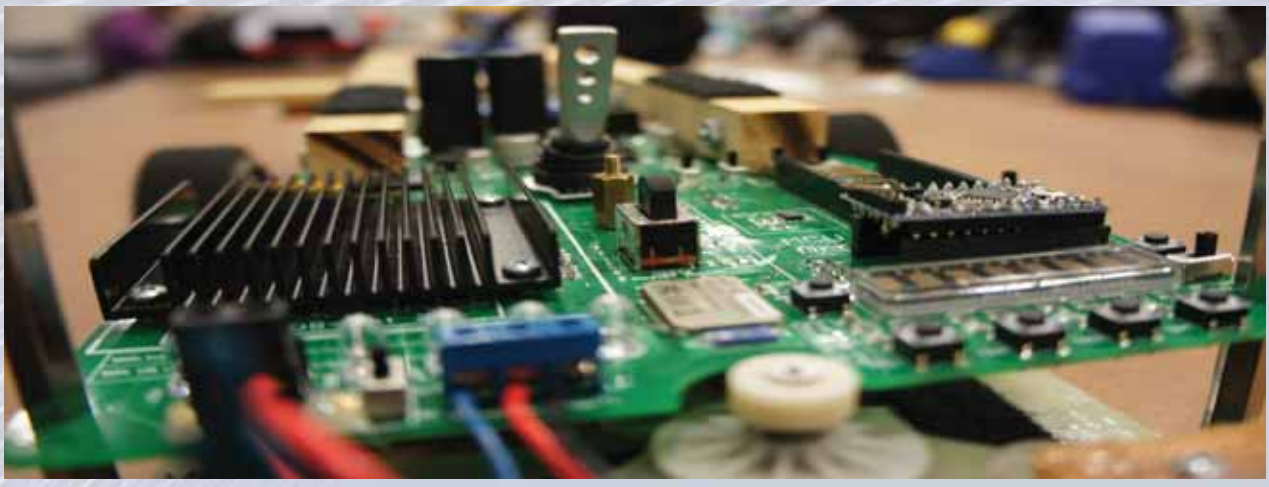


Message from the Chair

Professor M. -C. Frank Chang

Welcome to the 2012-2013 Annual Report, highlighting UCLA Electrical Engineering's achievements and activities over the past year!

Our faculty and students have been conducting cutting-edge research over the past year, sharing their results in 400 journal and conference papers. A collaborative effort by graduate students Philip Hon, Amir Tavallaee, Qi-Sheng Chen, Professor Ben Williams and Professor Tatsuo Itoh on "Radiation Model for Terahertz Transmission-Line Metamaterial Quantum Cascade Lasers" was awarded the 2013 IEEE Transactions on THz Science and Technology Best Paper Award by IEEE MTT-S. Grad students Chih-Kai Chen and Ralph Hudson with Professor Kung Yao were honored with the IEEE CORAL Best Student Paper Award for their work on "Modeling and Theoretical Performance Analysis for Dynamic Spatially Distributed Energy-based Spectrum Sensing in Cognitive Radios". Recent Ph.D. graduates David Murphy and Amr Hafez, who received the 2012 ISSCC Distinguished Technical Paper with Professor Asad Abidi, Professor Frank Chang, and Broadcom colleagues, were awarded the Jack Kilby Award for Outstanding Student Paper at 2013 ISSCC.

Garnering great distinction, our faculty have also been recognized with technical, society, and teaching awards. Professor Aydogan Ozcan was awarded the Biophotonics Technology Innovator Award from SPIE, recognizing his seminal contributions to computational imaging, sensing and bio-photonics technologies impacting telemedicine and global health challenges. For his fundamental contributions to adaptive and statistical signal processing, Professor Ali Sayed was awarded the IEEE Signal Processing Society's Technical Achievement Award. Society awards were presented to:

- Professor Alan Willson (Vitold Belevitch Award)
- Professor Asad Madni (IEEE Aerospace and Electronic Systems Society's Pioneer Award)
- Professor Bahram Jalali (IEEE Photonics Society Aron Kressel Award; The Engineers' Council Distinguished Engineering Achievement Award)
- Professor Jason Speyer (AIAAA Guidance, Navigation, and Control Award)
- Professor King-Ning Tu (EMPMD John Bardeen Award)
- Professor Kuo-Nan Liou (Quadrennial Gold Medal Award)
- Professor Yahya Rahmat-Samii (NASA Group Achieve Award)
- Professor Robert Candler (Northrop Grumman Excellence in Teaching Award)

Following suit, our students also were honored for their significant research developments. Distinguished Ph.D. Dissertation Awards were granted to:

- Chengcheng Wang for research on Building Efficient, Reconfigurable Hardware Using Hierarchical Interconnects
- Amir Ali Tavallaee for research on Terahertz Quantum-Cascade Transmission-Line Metamaterial
- Yu Zhang for research on System and Incentive Design in Socio-Technical Networks

Continuing in our mission of placing graduates in academia, five recent graduates have accepted faculty positions at institutions worldwide from UC Berkeley (Thomas Courtade), Pennsylvania State University (Ahmad Mirzae) and State University of New York in Buffalo (Wenyao Xu) to Cairo University (Mohamed Aboudina) and Ain Shams University (Sameh Ibrahim), both in Egypt.

We also welcome two new Associate Professors to our distinguished faculty: Dr. Christina Fragouli (UCLA Ph.D. 2000) whose research focuses on network coding and algorithms and Dr. Mona Jarrahi (Stanford Ph.D. 2007) whose research focuses on terahertz electronics.

Lastly, I am delighted to announce that the UCLA Electrical Engineering undergraduate program has received Accreditation Board for Engineering and Technology (ABET) accreditation through September 2019. The six-year review cycle, culminating with a self-study and site visit by ABET program evaluators, assesses how well we prepare our graduates for successful careers and lifelong learning.

We thank all of our friends, alumni, collaborators and customers in industry, government and academia for their continuous support, and look forward to future interactions with all of you.

Network Coding, Wireless Networks and Network Security

Associate Professor Christina Fragouli

The focus of Professor Fragouli's research is on how to make communication networks more efficient, reliable and secure. We increasingly rely on communication networks for services that are considered fundamental, such as education, news coverage, health and entertainment. Yet as the demand for network services increases, so do our requirements and expectations: we require and expect availability, performance, security, and cost-efficiency. At UCLA, Professor Fragouli leads ARNI, the Algorithimic Research in Network Information Flow Laboratory, that works on addressing such challenges. ARNI develops information transfer schemes that enable new capabilities for networks, such as being able to better identify network defects, achieve unconditional security at low complexity, and significantly increase the bandwidth efficiency of wireless networks. The work in ARNI spans from deriving theoretical performance bounds and combinatorial algorithms to designing and deploying practical protocols on testbeds. We next briefly describe three main research directions.

Network coding

Over the last decade, Professor Fragouli has helped develop the theory and practice of network coding. Network coding is a new area, that breaks away from the traditional point-to-point information transfer model, and tailors instead the information flow to the network structure through the use of coding techniques. For instance, with her student Javad Ebrahimi, she developed novel algebraic code designs, that enable lowering the complexity of network coding operations; with her student Mahdi Jafari and collaborators, she studied subspace properties of network coding and their application to network tomography; and with her student Lorenzo Keller and collaborators she designed and deployed the first implemented network coding protocols for sensor networks. Professor Fragouli is among the pioneers in the area of network coding, with two monographs and more than 80 journal and conference publications in this area.

Wireless networks

Professor Fragouli works on developing new physical layer and packet layer cooperation schemes, that extract a near optimal throughput and reliability performance from wireless networks. As an example, she introduced with her collaborator Ayfer Ozgur the theory of wireless network simplification, that examines how much we can simplify a wireless network by shutting down relays, while still maintaining a target fraction of the network capacity. As another example, she was awarded the 2013 Mobihoc best paper award (with Melissa Duarte, Ayan Sengupta, Sid Brahma and Suhas Diggavi), for designing and deploying physical layer cooperation schemes that can double the throughput over the traditional point to point schemes. In 2012, she co-founded the startup ShoelaceWireless, to commercialize technologies that increase the speed and reliability of video delivery over wireless.

Network security

Professor Fragouli's research aims to promote our fundamental understanding of secrecy over arbitrary networks, as well as design protocols that enable offering unconditional security at low complexity. Her student Laszlo Czap and collaborators Vinod Prabhakaran and Suhas Diggavi and she developed secrecy capacity characterizations for interactive network secrecy. With her collaborator Katerina Argyraki and students Iris Safaka and Panagiotis Kostopoulos and other collaborators, she designed and deployed secrecy protocols on testbeds of software radios and smartphones. This work was the first to experimentally demonstrate the feasibility of creating tenths of Kbits per seconds of secret bits among groups of wireless nodes, without using cryptographic methods.

Addressing Performance Limitations of Existing Terahertz Systems

Associate Professor Mona Jarrahi

Associate Professor Mona Jarrahi is joining the Electrical Engineering Department in academic year 2013-2014. Her research is focused on ultrafast electronic and optoelectronic devices and integrated systems for terahertz/millimeter-wave sensing, imaging, computing, and communication systems.

Although unique potentials of terahertz waves for chemical identification, material characterization, biological sensing, and medical imaging have been recognized for quite a while, the relatively poor performance, higher costs, and bulky nature of current terahertz systems continue to impede their deployment in field settings. Professor Jarrahi's research group is currently investigating the use of novel materials, nanostructures, quantum well structures, as well as innovative nano-plasmonic and optical concepts to address the performance limitations of existing terahertz systems. In this regard, they have already made significant contributions, advancing the state-of-the-art terahertz/millimeter-wave devices and systems.

Professor Jarrahi is an early advocate of the use of plasmonic nano-structures inside photoconductive terahertz devices and led the first research effort that seminally demonstrated more than two-orders of magnitude enhancement in the output power and efficiency of photoconductive terahertz sources and more than one-order of magnitude enhancement in the responsivity and detection sensitivity of photoconductive terahertz detectors that incorporate plasmonic nano-structures. Through use of this innovative device architecture, Professor Jarrahi's research team has demonstrated record-high-power terahertz sources with output powers exceeding 2 mW.

Professor Jarrahi has also made a number of contributions to development of passive terahertz devices including integrated intensity modulators, phase modulators, tunable filters, and polarizers. She has led a research team responsible for developing a novel MEMS-reconfigurable terahertz filter technology with unprecedented frequency tunability, which was utilized by her group to demonstrate terahertz intensity modulation with the highest reported modulation depth and modulation bandwidth at terahertz frequencies through a fully integrated system platform.

Professor Jarrahi is also the inventor of a very powerful technique for direct monitoring of ultrafast carrier dynamics in semiconductor nanostructures, which allows direct monitoring of ballistic and quasi-ballistic carrier transport dynamics in nanoscale with relation to the applied electric field, while accounting for the quantum phenomena and interface effects, for the first time. This unique capability has become possible by a new class of multi-spectral plasmonic nanostructures integrated with semiconductors, which enable efficient interaction of optical and terahertz beams with semiconductors at nanoscale in a time-resolved optical-pump terahertz-probe measurement system.

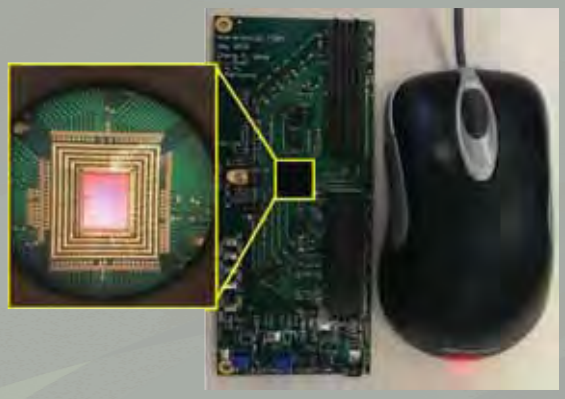
Professor Jarrahi has also made numerous contributions to monolithic integration of quantum well based optoelectronic devices for high-speed integrated systems beyond the frequencies offered by existing transistor technologies. As an example, she has demonstrated a fully-integrated optical switch with record-high-speed switching times on the order of a few tens of picoseconds by using a novel interferometric system integrated with GaAs/AlGaAs multiple quantum well structures. In another related work, she has demonstrated a world-record high-speed analog-to-digital convertor with 100 GS/s sampling speed by introducing a totally new analog-to-digital conversion scheme based on an interferometric spatial quantizer and digital encoder integrated with GaAs/AlGaAs multiple quantum well structures.

Building Efficient, Reconfigurable Hardware using Hierarchical Interconnects

Chengcheng Wang

In the semiconductor industry today, most chips are built for a specific purpose, as application-specific integrated circuits (ASICs). ASICs offer by far the most performance with the lowest energy and chip area. Altogether, ASICs are able to offer 10x-1000x higher energy and area efficiencies than non-dedicated chips, such as programmable DSP processors, field-programmable gate arrays (FPGAs), and microprocessors. Modern VLSI designs place utmost importance on efficiency, for it directly translates to battery life, thermal limit, chip cost, and yield. Not surprisingly, most system-on-a-chip (SoC) today has become an integration of many ASIC blocks, each performing a few dedicated tasks, and centrally controlled by a microprocessor.

The growing size of modern SoC chips, accelerated by the increasing consumer demands for more integrated functionalities, has exposed the major drawback of ASIC: design cost. These large SoCs are re-designed a few times a year to rectify hardware-bugs and to support new features. Because ASICs are not reconfigurable, even the smallest hardware change would require a re-design. Additionally, design cost is rising exponentially with every technology generation. Today, only the largest SoC companies can afford the latest technology generations, while most VLSI designs are bottlenecked to 65-nm and older technologies.



Compact ASIC saves space and battery life.

The rising design cost of ASICs has exposed a huge need today: efficiency and flexibility must co-exist. But among flexible hardware candidates, microprocessors and programmable DSP processors are far too slow to meet the throughput requirements of ASICs. FPGAs do come close in terms of performance (2.5-6.7x slower than ASICs, but massively parallel), but are extremely inefficient due to its high energy (5.7–62x) and large area (17–54x) compared to ASICs. While the inherent flexibility of FPGAs allow for effortless hardware changes, we must bridge the huge gap in efficiency for FPGA to become a viable contender to ASICs. This work bridges the gap.

The primary culprit for FPGA inefficiency is interconnect, which accounts for over 75% of area and delay. For over 20 years, 2D-mesh network has been the back-bone of FPGA interconnects, but full connectivity in a 2D-mesh require $O(N^2)$ switches, requiring interconnects to grow much faster than Moore's Law. As a result, various heuristics are used to simplify switch-box arrays at the cost of resource utilization, but interconnect area of modern FPGA is still around 80%. This work builds FPGA using hierarchical interconnects based on Beneš networks, requiring $O(N \cdot \log \cdot N)$ switches. Although Beneš is commonly used in telecommunication, this work is its first silicon realization of a FPGA. To realize a highly efficient interconnect architecture, significant pruning of the network is required. Novel techniques such as fast-path U-turns and unbalanced branching are also implemented. A custom place-and-route software is developed to map benchmark designs on a variety of interconnect candidates. From mapping results, the architecture is updated based on network utilization until an optimized design is converged.

The large area of FPGA chip requires aggressive power gating (PG), but interconnect signals often lack spatial locality, making block-level PG difficult. A fine-grained PG is required, but that makes traditional PG techniques very inefficient. A novel PG circuit technique is developed to power-gate individual interconnect switches with very small overhead in area and performance. Such technique requires fundamental circuit changes, even modifying the CMOS inverter.

With innovations in chip architecture, circuit design, and extensive software development, Wang's work has demonstrated 5 FPGAs of different scale (from 1K-16K LUTs) all with only around 50% interconnect area: a 3–4x reduction from commercial FPGAs while preserving connectivity. An energy efficiency of 1.1 GOPS/mW is the highest among reported FPGAs, and is 22x more efficient than the most efficient commercial FPGA today, significantly bridging the gap to ASICs.

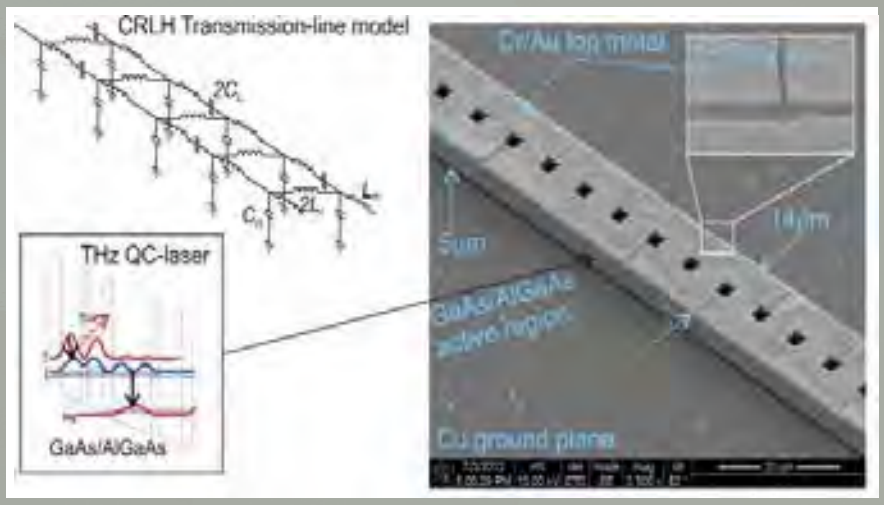
Terahertz Metamaterial Laser Antennas

Amir Ali Tavallaee

The terahertz quantum-cascade (QC) laser is an emerging technology for continuous-wave (cw) generation of far-infrared radiation with milliwatt-level power or greater which has been demonstrated at a range of frequencies from 1.2 – 5 THz (λ = 60 – 250 micrometer). One of the last unconquered regions of the electromagnetic spectrum, the terahertz regime has long resisted technological development due to the lack of compact and efficient sources of coherent radiation. Availability of such sources promises to enable applications in THz sensing, imaging, and spectroscopy in particular for security screening, radio astronomy, drug and explosive detection, and non-destructive industrial evaluation.

In an effort to address practical challenges associated with the efficiency, pattern, and direction of the emitted beam from a THz QC laser, our group in collaboration with the Microwave Electronics research laboratory at UCLA, leveraged microwaves transmission-line metamaterial concepts to demonstrate a one-dimensional waveguide for terahertz quantum-cascade lasers that tailors laser radiation to a directional "steerable" fan beam.

The proximity of the THz range to both the microwave and infrared/optical ranges has allowed the use of many hybrid device concepts that borrow liberally from the adjacent spectral ranges. For example, in our work the QC laser material (i.e. quantum wells composed of the compound semiconductors GaAs and AlGaAs) is incorporated into a so called "composite right/left handed" (CRLH) metamaterial waveguide. This concept for metamaterials was first developed in the microwave by the Professor Itoh group, but has now been demonstrated as part of a laser for the first time. By monolithically incorporating gap capacitors (~250 nm) in the top metallization of a THz QC laser waveguide operating in its higher order lateral mode, it is possible to engineer the frequency and phase response to achieve many novel properties for guided-wave and antenna devices. We have used this to demonstrate an active CRLH "leaky-wave" antenna, where the beam emission angle can be scanned from front to back by changing the frequency of the laser.



The terahertz quantum-cascade (QC) laser can be used to demonstrate an active CRLH "leaky-wave" antenna.

This is the first experimental demonstration of THz laser beam steering from forward to broadside to backwards direction, unique to the CRLH leaky-wave approach. A THz laser source with a steerable beam would be useful for THz imaging applications, where an electronically scanned beam could replace mechanically moving mirrors for faster image acquisition including spectroscopy and multi-spectral imaging of materials such as explosives and drugs, non-destructive evaluation imaging of films and coatings, for industrial process control or corrosion detection. These results are a proof-of-concept demonstration for a new class of laser devices which can exhibit dynamic beam steering and laser wavelength tuning.

Building the Framework of Social Networks

Yu Zhang

As the web evolves, it has become increasingly social. People turn to the web to exchange services, data, and resources, as evidenced by the popularity of peer production sites like Wikipedia, peer-to-peer systems like BitTorrent, and online labor markets like Amazon Mechanical Turk. Systems like these, which we refer to as socio-technical networks, have been attracting unprecedented amounts of attention. While these systems differ in many ways, they share a common vulnerability to selfish behavior and free-riding. A worker on Amazon Mechanical Turk may attempt to complete jobs with as little effort as possible while still being paid. Similarly, a user in a peer-to-peer system may wish to download files from others without using its bandwidth to upload files to others. It is of critical importance to properly motivate participants to contribute their resource, knowledge or services in order for these systems to thrive.

Achieving resource sharing efficiency in socio-technical networks is a challenging problem, because the information available about the various resources is decentralized and it is changing dynamically; the agents may be heterogeneous and have different learning abilities; and the agents may be self-interested, maximizing individual utilities rather than the collective social welfare. The goal is to develop a rigorous and unified paradigm for the joint design of efficient incentive mechanisms and resource management schemes in socio-technical networks, using novel techniques from several fields including network economics, game theory, network science, stream mining, signal processing, and artificial intelligence.

The first part of this research focuses on the efficient resource sharing in socio-technical networks. Existing distributed network optimization techniques that enable efficient resource allocation when agents are obedient or cooperative are no longer suitable in socio-technical networks which are formed by self-interested agents. The strategic interactions of such self-interested agents lead in numerous socio-technical networks to (Nash) equilibria that are highly inefficient from a social perspective. A general methodology for the design and analysis of rating protocols and associated multi-agent learning algorithms is needed to sustain cooperation in socio-technical networks. Under a rating protocol, an agent is rated based on its behavior. This affects the agent's rewards received in the network, which are typically determined according to a differential resource management scheme: compliant agents receive higher ratings and are rewarded by gaining more access to resources compared to non-compliant agents.

The second part of the research augments the proposed rating protocols by considering the strategic resource production and link formation of agents: a novel game-theoretic framework to model and analyze the trade-offs between the costs and benefits of producing resources and forming links to collect and disseminate resources. The analysis has implications for the topology that emerges endogenously. For large populations, the implication is that the topology is necessarily of a core-periphery type. Meanwhile as the population grows, the agents' degree distribution converges to a "power-law" distribution and the network becomes "scale-free". The conclusion had been conjectured by numerous empirical studies on distributed networking and social computing systems but had not been previously derived in any formal framework.

In summary, the results from Zhang's dissertation research form a unified framework for the analysis and design of socio-technical networks. This framework provides two main contributions. First, it delivers essential insights for modeling and characterizing the agents' strategic behavior, the equilibrium network topologies and the resulting efficiency loss. Second, it proposes various important design principles that serve as a guideline for platform designers when comparing and selecting incentive mechanisms and resource management rules for socio-technical networks, and has the potential to influence a wide variety of related domains such as cloud computing, Internet domain security, social computing, user interface design, and human-computer interaction.

Spectrum Sensing in Cognitive Radio in Public Safety Networks

Chih-Kai Chen

The massive use of real-time multimedia services in various wireless 4G cellular / public safety (PS) network systems requires extensive bandwidth in these systems. The scarcity and therefore the efficient utilization of the spectrum pose great technical challenges. Cognitive radio network provides a solution to this problem. As a secondary overlay network, cognitive radio network has to guarantee not to cause harmful interference to the licensed primary users. Spectrum sensing is one of key components in cognitive radio network to monitor the licensed primary users' activities. When the primary users are not using their licensed frequency bands, cognitive radio network is allowed to temporarily exploit these frequency bands. Hence, cognitive radio network methodology can opportunistically allocate transmission data dynamically in other licensed spectrum to supply broadband service demands.

Due to the fading and shadowing phenomena of the wireless channels, cognitive radio network has to explore the spatial diversity through the cooperation among cognitive radios to overcome the hidden primary user issue. The wireless terminal often resides in the composite random shadowed fading environment. This was particularly frustrating for researchers for decades due to the analytical intractability. Chih-Kai first analyzed closed-form complete solution for cognitive radio network system performance in the composite shadowed fading environment. This general complete solution can be degenerated to the well-studied special cases, shadowing wireless channel environment and fading wireless channel environment respectively. This important breakthrough establishes the theoretical foundation to evaluate the system performance in the time-varying composite shadowed fading wireless environment for cognitive radio network practical implementation.

In addition, cognitive radio network is not a static but a dynamic network. This further poses great challenges in analyzing the system performance and designing a real-time system adapting to the dynamic networks and the surrounding wireless environment. Hence, Chih-Kai further studies the dynamic cognitive radio network by using hyper-semi-Markov random process with 2-state Hidden Markov Model and cell dwell time distributions from the practical wireless communication system field measurements. The analytical complete expression for the dynamic probability mass function is obtained. Based on the dynamic probability mass function and the wireless channel models, the dynamic probability of detection and probability of false alarm are obtained in closed-forms. Hence, the canonical receiver operating characteristic curves and complementary receiver operating characteristic curves can be obtained for efficient system performance evaluation and adaptation.

In summary, Chih-Kai's work provides the theoretical fundamental framework for real-world cognitive radio networks system implementation. The resulting Best Student Award-winning paper, "Modeling and Theoretical Performance Analysis for Dynamic Spatially Distributed Energy-based Spectrum Sensing in Cognitive Radios over Shadowed Fading Channels in Public Safety Networks," co-authored with Ralph Hudson and Kung Yao, was presented at the 2012 IEEE CORAL (Cognitive Radio Applications and aLgorithms). His advisor at UCLA was Professor Kung Yao.

Professor Ali H. Sayed Receives Multiple Awards Including the Technical Achievement Award

Professor Ali H. Sayed, who directs the UCLA Adaptive Systems Laboratory *(www.ee.ucla.edu/asl)*, is an accomplished researcher and a prolific author with 430+ scholarly publications and five books. He is recognized internationally for his leadership in the broad area of statistical signal processing. His research involves several areas of inquiry including adaptation and learning, network science, information processing theories, and biologically-inspired designs. His work deals with the analysis and design of systems with self-learning abilities. These systems continually learn and adjust their structure in response to streaming information and to drifts in the environment, in order to deliver consistent performance. Such adaptive structures are widely used across many fields including communication systems, guidance and control, biomedical devices, and electronic circuitry. Professor Sayed's ingenious contributions to the field have taken adaptation to a new level. He has published two authoritative textbooks on the subject, which are now used as references at many institutions worldwide: *Fundamentals of Adaptive Filtering* (2003) and *Adaptive Filters* (2008). The first textbook was recognized for its quality and awarded the 2005 Terman Award by the American Society of Engineering Education.

Professor Sayed's recent efforts deal with the design of complex networks of adaptive agents that coordinate their operation in intelligent ways to solve challenging inference and optimization tasks. His research group pioneered the concept of diffusion adaptation for distributed learning over networks, and was the first to show how to perform adaptation in real-time over networks. His work established important analogies with the cognitive abilities of biological networks including fish schooling, bird formations, and bee swarming. Several of his articles in this area are well cited and have motivated a flurry of investigations by other researchers worldwide. In November 2009, he organized in Los Angeles an NSF Workshop on the topic of *Distributed Processing over Cognitive Networks* to help highlight the research challenges and opportunities in this field of research. He delivered recently keynote lectures at the two major international conferences in the signal processing field. His May 2013 plenary lecture at ICASSP (in Vancouver, Canada) was entitled "The Splendor of Nature: Lessons in Adaptation and Learning over Networks," while his September 2013 plenary lecture at EUSIPCO (in Marrakesh, Morocco) was entitled "Online Learning and Adaptation over Networks." ICASSP is the flagship international conference with over 2400 attendees and EUSIPCO is the main annual European conference in the field.

Professor Sayed's work has been recognized with several recent awards including the 2013-2015 Leverhulme Visiting Professorship Award (United Kingdom) and the 2012 Technical Achievement Award from the IEEE Signal Processing Society for his *"fundamental contributions to adaptive and statistical signal processing."* The Technical Achievement Award honors a person who, over a period of years, has made outstanding and impactful technical contributions to theory and/or practice of signal processing. He has also been awarded several Best Paper Awards from IEEE (1996, 2002, 2005, 2012) and served as a 2005 Distinguished Lecturer for the IEEE Signal Processing Society. In 2003 he received the prestigious Kuwait Prize in Basic Sciences from the Government of Kuwait. He is a Fellow of IEEE and was elevated in 2012 to Fellow of the American Association for the Advancement of Science (AAAS), publisher of the journal *Science*. Fellows are chosen for their distinguished efforts to advance science or its applications.

Despite his extensive research efforts, Professor Sayed is able to find quality time to serve his community, department, and university. Among other activities, he served as Editor-in-Chief of the IEEE Transactions on Signal Processing (2003-2005), which is the leading journal in the field, as General Chairman of IEEE ICASSP (Las Vegas, 2008), and as Vice-President of Publications of the IEEE Signal Processing Society (2009-2011). He also served as member of the Board of Governors (2007-2011), Awards Board (2005), Publications Board (2003-2005, 2009-2011), Conference Board (2007-2011), and Technical Directions Board (2008-2009) of the same Society.

Professor Sayed served as Chairman of Electrical Engineering at UCLA (2005-2010). He is the inventor and lead architect of the EEweb interface for online and integrated assessment of curricular activities, which has been adopted by all engineering departments at UCLA since 2003.

Professor Aydogan Ozcan Receives the SPIE Biophotonics Technology Innovator Award

Aydogan Ozcan, Professor of Electrical Engineering, University of California Los Angeles (UCLA), has been awarded the Biophotonics Technology Innovator Award by SPIE, the international society for optics and photonics. The award recognizes his seminal contributions to computational imaging, sensing and bio-photonics technologies impacting telemedicine and global health challenges.

"Dr. Ozcan is clearly one of the most innovative biophotonics researchers of his generation and he stands out as truly exceptional with regards to clear-sightedness in research, ingenuity of approach, effectiveness in completion of the research projects and publication record," said Bahram Jalali, Northrop Grumman Endowed Chair and Professor, UCLA. His work has already been published in the most prestigious academic journals, and has resulted in more than 20 licensed patents as well as several major international awards; and therefore the impact of his work is evident.

An SPIE Fellow, Ozcan has authored numerous papers for SPIE symposia. He has served as a program committee member for SPIE Photonics West since 2009. He was also honored with the SPIE Early Career Achievement Award in 2011.

The Biophotonics Technology Innovator Award is presented annually for extraordinary achievements in biophotonics technology development that show strong promise or potential impact in biology, medicine, and biomedical optics. The award targets achievements that span disciplines and may include elements of basic research, technology development, and clinical translation Dr. Ozcan is the first recipient of the award, established in 2012.

Ozcan's inovative research on-chip imaging and telemedicine.

Ozcan also received several other major awards including the 2011 Presidential Early Career Award for Scientists and Engineers (PECASE), which is the highest honor bestowed by the United States government on science and engineering professionals in the early stages of their independent research careers. Dr. Ozcan also received the 2011 Army Research Office (ARO) Young Investigator Award, the 2010 NSF CAREER Award, the 2009 NIH Director's New Innovator Award, the 2009 Office of Naval Research (ONR) Young Investigator Award, the 2009 IEEE Photonics Society Young Investigator Award, the MIT's Technology Review TR35 Award, the 2013 Microscopy Today Innovation Award, 2012 Popular Science Brilliant 10 Award, 2012 National Academy of Engineering (NAE) The Grainger Foundation Frontiers of Engineering Award, 2011 Innovators Challenge Award presented by the Rockefeller Foundation and mHealth Alliance, the 2010 National Geographic Emerging Explorer Award, the 2010 Bill & Melinda Gates Foundation Grand Challenges Award and the 2010 Popular Mechanics Breakthrough Award for his seminal contributions to near-field and on-chip imaging, and telemedicine-based diagnostics.

Terahertz Quantum-Cascade Laser Research Wins Best Paper 2012

Benjamin Williams and Tatsuo Itoh

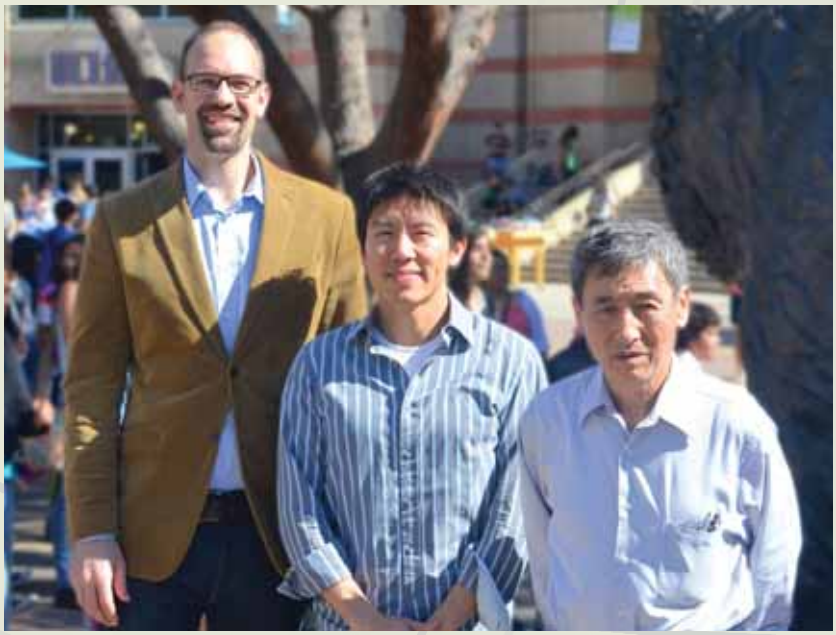
The IEEE Microwave Theory and Techniques Society (MTT) presented the 2012 Best Paper Award for Transactions on Terahertz Science and Technology to Benjamin Williams and Tatuo Itoh's research groups during the International Microwave Symposium (IMS) in Seattle in June of 2013. The IEEE IMS is the premier annual international meeting for technologists involved in all aspects of microwave theory and practice. It consists of a full week of events, including technical paper presentations, workshops, and tutorials.

Recently, the groups of Benjamin Williams and Tatsuo Itoh at UCLA have been collaborating with Northrop Grumman Aerospace Systems in the development of new laser sources of radiation for the underdeveloped terahertz frequency range (frequencies of approximately 10^{12} Hz). The availability of compact, efficient laser sources in the THz range promises to enable applications in fields as diverse as chemical and biological sensing, security screening, explosive and drug detection, astrophysics and space science, medical imaging, nondestructive evaluation of materials, and short-range high-bandwidth communications.

The paper entitled *"Radiation model for terahertz transmission-line metamaterial quantum-cascade lasers"* and authored by Philip Hon, Amir A. Tavallaee, Qi-Sheng Chen, Benjamin Williams, and Tatsuo Itoh was selected to receive the Best Paper Award for 2012.

The paper addresses the challenge of predicting and engineering the radiation emitted from terahertz quantum cascade (QC) laser waveguides, including a newly developed type of metamaterial waveguide. A terahertz quantum-cascade laser generates radiation via quantum-mechanical transitions — a widely used technique in the visible and infrared spectral ranges. However, the wavelength of terahertz radiation is approximately 100 microns — approximately 100x larger than for visible lasers. For this reason, the waveguide used for a terahertz QC-laser is more like a microstrip transmission line of the type widely used for microwave circuits and antennas. Therefore, the typical techniques used to calculate the emitted beam pattern from a semiconductor laser are not effective.

The paper demonstrated that a technique known as the cavity antenna model that is often used to calculate the beam patterns from microstrip patch antennas could be applied to THz QC-lasers. Unlike previous models, this new method can be used to calculate not only the beam pattern, but the amount of radiated THz power, the polarization of the beam, and the sensitivity to the details of the propagating waveguide mode — all critical considerations when designing a laser. The new model can also be used to calculate the radiation properties of a new type of metamaterial waveguide antenna, which has the capability to steer a beam from forward to broadside to backward directions. This new type of metamaterial antenna is described in more detail on page 5 in the description of the Ph.D. work of Amir Ali Tavallaee — for which he won the departmental Ph.D. thesis award. Our work in this paper lays the foundation for a new class of THz laser sources which can be engineered to have exquisite control of the laser radiation (i.e. the beam shape, phase front, polarization, beam direction, etc.) — a degree of control not currently achievable in the terahertz frequency range.



Bahram Jalali Receives Aaron Kressel Award, and Distinguished Engineering Achievement Award

In recognition of his contributions to the science of silicon photonics, Professor Bahram Jalali was awarded the Aaron Kressel Award of IEEE Photonic Society.

Professor Jalali is one of the founders of the field of silicon photonics, and his landmark results including the first demonstration of silicon laser in 2004 literally helped kick-start the field. Current and future progress in computing systems is increasingly driven by interconnects between processor cores, memory and graphics and I/O devices. Dr. Jalali has been instrumental in firmly establishing silicon photonics as the platform of choice for low cost and high volume data communication, and an important material in the world of photonics.

Professor Jalali was the first to show optical amplification and lasing in silicon which overcame the textbook notion that silicon is unable to amplify light and hence unable to lase. In recognition of this achievement, he was awarded the R.W. Wood Prize by the Optical Society of America. The accomplishment was elected by *MIT Technology Review* magazine as one of the Top 10 technology trends of the year, and appeared as a featured article in the *Scientific American* magazine. His group was responsible for the first ever demonstration of most nonlinear optical effects in silicon, one example of which is the two-photon photovoltaic phenomenon, and further demonstration that this important effect can be used to harvest and recycle the energy that is inevitably lost when light travels in silicon. Jalali's work has seeded two successful companies in this field.

Professor Alan Willson Receives the 2013 Vitold Belevitch Award

The Vitold Belevitch Award is a biennial award, given since 2003 by the IEEE Circuits and Systems Society. The award is presented at the (biennial) European Conference on Circuit Theory & Design (ECCTD). The 2013 ECCTD, where Dr. Willson received the award in September, was held in Dresden, Germany. His award plaque reads: "For fundamental research contributions to theory and design of electrical circuits and systems, and for contributions to engineering education and for the impact of these contributions to the electronics industry." For the last half of the 20th century Vitold Belevitch was the most eminent circuit theorist in Europe. One of his most important contributions was the development of a coherent theory of passive multiports. He was head of the Philips Research Laboratories in Belgium for 21 years while simultaneously holding a teaching position at the Catholic University of Leuven. Belevich also made very significant contributions to filter theory, modulator theory and nonlinear circuits.

Professor Willson has a record of seminal contributions to the theory of nonlinear circuits and to filter theory and modulator theory in the context of digital filters and digital modulators. Willson has also made numerous significant contributions to the theory and design of gyrators, direct digital synthesizers and a variety of other topics in circuit theory and mathematics. His publications on these topics began while he was a member of the technical staff at Bell Telephone Laboratories from the late 1960s to the early 1970s and have continued throughout his more than 40-year career at UCLA.

Professor Yahya Rahmat-Samii Was Elected Fellow by the ACES Society

Distinguished Professor Yahya Rahmat-Samii was elected an ACES Fellow by the Applied Computational Electromagnetics Society, the world's largest society in the area of computational electromagnetics. ACES is the premier international computational society which serves scientists and engineers in industry, academia, and government working in a wide variety of fields related but not limited to EM scattering by complex objects, advanced numerical techniques and modern antenna designs. ACES Fellows are chosen for their distinguished efforts to advance computational techniques in electromagnetics and antennas.

Professor Rahmat-Samii was honored for his pioneering contributions in the areas of spectral theory of diffraction, natured inspired evolutionary optimization techniques in electromagnetics, FDTD modeling of handset antennas including human interactions, and reflector antenna synthesis and analysis. The author of more than 900 scholarly publications and four books, he has given numerous courses on these topics including developing two IEEE e-courses. Professor Rahmat-Samii was among three who received the fellow recognition at the ACES conference awards banquet in Monterey, California, March 24-28, 2013.

Professor Jason L. Speyer Receives AIAA Guidance,Na vigation, and Control Award

UCLA MAE Professor Jason L. Speyer, the Ronald and Valerie Sugar Distinguished Professor in Engineering, has received the American Institute of Aeronautics and Astronautics Aerospace Guidance, Navigation, and Control Award for 2012. The award is "for significant contributions to deterministic and stochastic optimal control theory and their application to important aerospace engineering problems."

Professor Speyer received the award at the Awards Luncheon in 2012, held in conjunction with the 2012 AIAA Guidance Navigation and Control Conference at the Minneapolis Hyatt Regency, in Minneapolis, MN.

This award was approved by the Board of Directors in 1998 and was established to recognize individuals who have made important and sustained contributions in the field of Guidance, Navigation and Control. The award is given every two years.

Professor King-Ning Tu Wins John Bardeen Award

The Minerals, Metals, and Materials Society has selected Professor King-Ning Tu for the 2013 EMPMD John Bardeen Award, presented to an individual who has made outstanding contributions and is a leader in the field of electronic materials. The Award honors Prof. K. N. Tu's contribution to the study of formation and properties of silicide contacts to silicon and the study of reliability science of failure in interconnect technology induced by irreversible processes.

Dr. King-Ning Tu is a distinguished professor in both Departments of Materials Science & Engineering and Electrical Engineering. Aside from his fellowships at various societies, he has been decorated with a Distinguished Scientist Award from the Electronic, Magnetic, and Photonic Materials Division of TMS in 2006; elected member of Academia Sinica, Republic of China in 2002; and received the Humboldt Award for US Senior Scientists in 1996.

Distinguished Adjunct Professor Asad M. Madni Is the Recipient of Four Major Awards

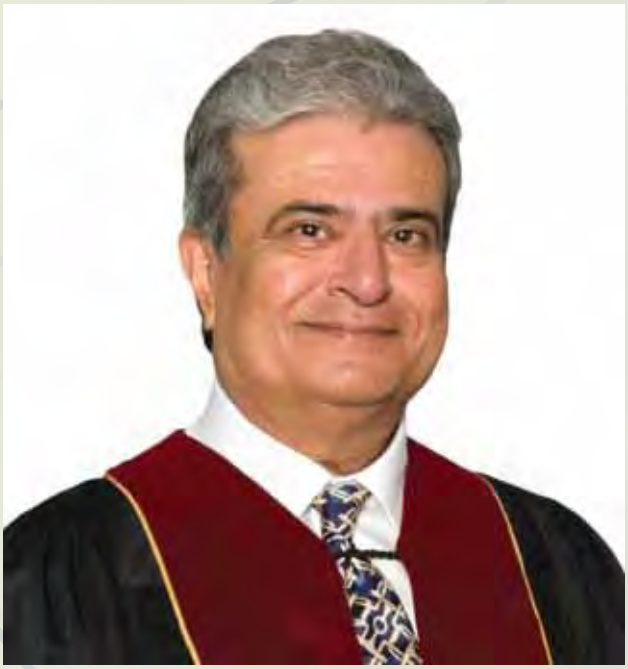
Professor Asad M. Madni was the recipient of the 2012 prestigious IEEE Aerospace and Electronic Systems Society's Pioneer Award for his pioneering contributions and accomplishments that have stood the test of time. His award citation reads "for seminal and pioneering contributions to the development and commercialization of aerospace and electronic systems." The Pioneer Award has been given annually since 1949 to an individual or team for "contributions significant to bringing into being systems that are still in existence today." These systems fall within the specific areas of interest to the society, that is, electronic or aerospace systems. The contributions for which the award is bestowed are to have been made at least twenty years prior to the year of the award, to ensure proper historical perspective.

Professor Madni was elected a Fellow of the American Institute of Aeronautics and Astronautics "for seminal contributions and distinguished leadership in the development and commercialization of sensors and systems for aerospace, transportation and commercial aviation." AIAA is the world's largest technical society dedicated to the global aerospace profession. AIAA Fellows are persons of distinction who have made notable and valuable contributions to the arts, sciences, or technology of aeronautics or astronautics.

Professor Madni was also awarded the Doctor of Science (Sc.D.) degree, honoris causa, jointly by The Board of Trustees of the California State University and California State University Northridge "in recognition of his pioneering research work and achievements in science, engineering and technology, particularly in the aerospace, military, automotive, commercial, and industrial fields, and his distinguished record of leadership and service at the university and in the community." He also received a Doctor of Engineering (D.Eng.) degree, honoris causa, from the Technical University of Crete, Chania, Greece.

During his career, Professor Madni led the development and commercialization of numerous intelligent sensors, systems and instrumentation including:

- the Extremely Slow Motion Servo Control System for Hubble Space Telescope's Star Selector System which provided it with unprecedented accuracy and stability, resulting in truly remarkable images that have enhanced our understanding of the universe
- the revolutionary Quartz MEMS GyroChip technology which is used worldwide for Electronic Stability Control and Rollover Protection in passenger vehicles and for inertial navigation in major aerospace and commercial aviation platforms
- an intelligent actuation system for Huygens Probe, an atmospheric entry probe carried to Saturn's moon Titan as part of the Cassini-Huygens mission. The system was instrumental in the precise landing of the probe on Titan's Xanadu region after it separated from the Cassini orbiter
- the first broadband, miniaturized, solid-state, Microwave Noise & Deception Jamming System used for ECM in unmanned aerial targets, manned aircrafts, and ECM pods. The system is used by all 3 US services and a number of allies to provide a realistic ECM threat environment, and has significantly enhanced US EW capability
- Transmission Line/Antenna System Analyzer (AN/PSM-40) which replaced an entire rack of equipment and was the first system capable of detecting the locations and magnitude of multiple faults in coaxial and waveguide transmission lines/antenna systems within minutes and with unprecedented accuracy. This breakthrough established the basis for future communication systems & network analysis and significantly enhanced the combat readiness of the United States Navy.



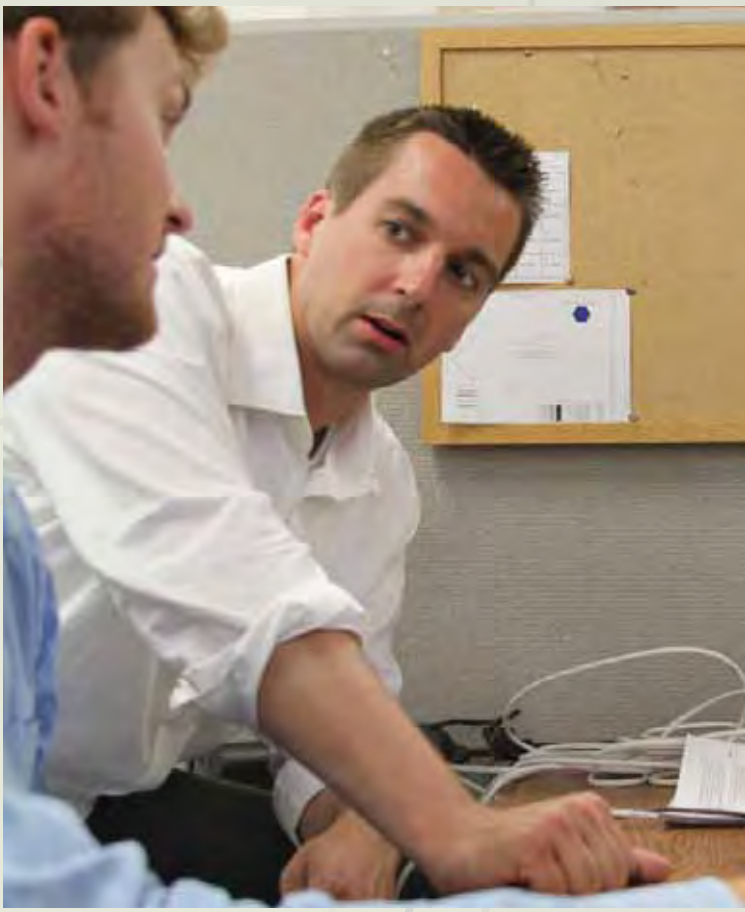
Distinguished Professor Kuo-Nan Liou Wins Revelle Medal from American GeophysicalU nion

Distinguished Professor Kuo-Nan Liou has been named the recipient of the prestigious 2013 American Geophysical Union Roger Revelle Medal, an award that recognizes scientists for "their outstanding contributions in atmospheric sciences, atmosphere-ocean coupling, atmosphere-land coupling, biogeochemical cycles, climate, or related aspects of the Earth system." The Medal was established in 1991 in honor of Roger Revelle, an internationally known oceanographer who made substantial contributions to awareness of global change.

Dr. Liou, a Distinguished Professor in the Department of Atmospheric and Oceanic Sciences since 1997, holds an appointment as a professor in the Department of Electrical Engineering since 2010, and directs UCLA's Joint Institute for Regional Earth System Science and Engineering (JIFRESSE), in collaboration with earth scientists at JPL/Caltech and other National Labs to study and develop projects on global climate change and its impact on regional climate and environment.

Among his numerous achievements, Professor Liou discovered the backscattering depolarization principle to differentiate nonspherical ice crystals from spherical water droplets and, along with his graduate students, developed a unified theory for light scattering by ice crystals and aerosols for application to remote sensing and climate research. His recent work focuses on radiative transfer and satellite remote sensing in mountain/snow regions and development of a regional computer model which incorporates the deposition of black carbon and dust over these areas in association with surface temperature and snowmelt amplification and feedback.

A Fellow of the American Association of the Advancement of Science, Optical Society of America, American Geophysical Union, and American Meteorological Society, Professor Liou was elected to the National Academy of Engineering in 1999 and the Academia Sinica in 2004. He was awarded the 2012 Quadrennial Gold Medal given by the International Radiation Commission (IRC) for "contributions of lasting significance to the field of radiation research," received the 2010 Biennial COSPAR (Committee on Space Research) William Nordberg Medal for "outstanding contribution to the application of space science," and shared the 2007 Nobel Peace Prize bestowed on the Intergovernmental Panel on Climate Change (IPCC) for "substantial contributions to its work."



Professor Candler Receives Teaching Award

Professor Rob Candler, Assistant Professor in Electrical Engineering and the California NanoSystems Institute, received the 2013 Northrop Grumman Excellence in Teaching Award. The award honors the junior faculty member in HSSEAS who demonstrates high quality teaching. Professor Candler's teaching career started between his undergraduate and graduate degrees, when he taught high school math for three months as a replacement instructor. He continued his teaching career after graduate school as a consulting assistant professor at Stanford University while he was simultaneously a senior engineer at the Robert Bosch Research and Technology Center in Palo Alto, California.

NORTHROP GRUMMAN

Since arriving at UCLA, he has taught courses ranging from sophomore level physics to advanced graduate courses in nanofabrication. He focuses on creating an interactive classroom environment, engaging students with active learning techniques. In addition to classroom teaching, Professor Candler mentors research students in his laboratory ranging from high school students to postdoctoral scholars.

Alumni Board

The mission of the Alumni Advisory Board is to provide critical and supportive advice to the UCLA Electrical Engineering Department in enhancing its leadership role in education and research.

Sharon Black
Special Projects Program Director
Raytheon

Bill Goodin
Associate Director of Alumni Relations,
UCLA HSSEAS

Leonard Bonilla
Retired Program Manager
Raytheon

Bob Green
Attorney
Christie, Parker, and Hale, LLP

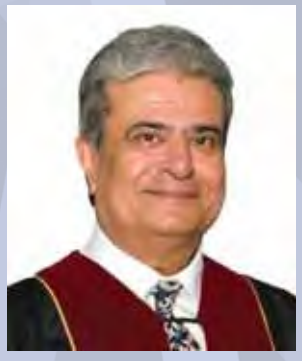
David Doami
Director, Program Manager
Northrop Grumman

Sharon V. Hong
Systems Integration Specialist Motorola

Vicky Gih
Design Engineer & Product Lead
Northrop Grumman

Gigi Lau
Senior Multi-Disciplined Engineer
Raytheon

Dan Goebel
Senior Research Scientist
Jet Propulsion Laboratory



Asad Madni
EE AAB Chair
President, COO and CTO (Retired)
BEI Technologies, Inc,

Members of National Academies






In 2007, Professor **Asad A. Abidi** was inducted into the **National Academy of Engineering** for his contributions to the development of MOS integrated circuits for RF Communications. Prior to joining UCLA in 1985, Professor Abidi worked at Bell Laboratories, as a member of the technical staff in the Advanced LSI Development Laboratory. He received a number of awards and honors throughout his career, including the 1988 TRW Award for Innovative Teaching, the 1997 IEEE Donald G. Fink Award, presented for the most outstanding survey, review, or tutorial paper published by the IEEE, and the 2008 IEEE Donald O. Pederson Award in solid state circuits.

Professor **Mau-Chung Frank Chang** was elected to the **National Academy of Engineering** in 2008 for his contributions in development and commercialization of III-V-based heterojunction bipolar transistors (HBTs) and field-effective transistors (FETs) for RF wireless communications. Prior to joining UCLA, Professor Chang was the Assistant Director at Rockwell Science Center where he successfully developed and transferred AlGaAs/GaAs Heterojunction Bipolar Transistor (HBT) and BiFET (Planar HBT/MESFET) integrated circuits technologies from the research laboratory to the production line. His research focuses on the development of high-speed semiconductor devices, integrated circuits for RF and mixed-signal communication, and interconnect system applications. Professor Chang received the IEEE David Sarnoff Award (IEEE-wide Technical Field Award) in 2006 and the Pan Wen-Yuan Foundation Award in 2008.

Professor **Deborah Estrin** holds the Jonathan B. Postel Chair in Computer Networking. Elected to the **National Academy of Engineering** in 2009, Professor Estrin led the development and deployment of wireless sensing systems that provide real-time, multifaceted information about natural and urban environments. She created the Center for Embedded Networked Sensing, a NSF research center. Professor Estrin was selected as the first Athena Lecturer of the Association for Computing Machinery's (ACM) Committee on Women in Computing and was honored with the Women of Vision Award for Innovation from the Anita Borg Institute for Women and Technology. She is a fellow of the American Academy of Arts and Sciences, the American Association for the Advancement of Science, the ACM and the IEEE.

Professor **Tatsuo Itoh** pioneered the interdisciplinary electromagnetics research beyond traditional electromagnetic engineering. He was elected to the **National Academy of Engineering** in 2003, "for seminal contributions in advancing electromagnetic engineering for microwave and wireless components, circuits, and systems". He developed several numerical methods to understand microwave problems, and developed the first CAD program for designing E-plane filters for millimeter wave systems. His research focuses in combining solid state devices and electromagnetic circuits for cost-effectiveness and system performance, developing the first global simulator for the RF front end. He also created the Active Integrated Antenna, which is not only a radiating element, but also a circuit element for the RF front end.

Professor **Kuo-Nan Liou** is director of the Joint Institute for Regional Earth System Science and Engineering. Professor Liou pioneered the use of combinations of remote sensors to obtain important cloud ice and aerosol parameters and climate radiative forcing. He derived the analytic four-stream solution for radiative transfer and discovered the depolarization principle to differentiate ice crystals and water droplets. Professor Liou was elected a Member of the **National Academy of Engineering** in 1999 and was the Chair of Special Fields and Interdisciplinary Engineering Section. Elected a Member of the Academia Sinica in 2004, Professor Liou is also a Fellow of the American Association of the Advancement of Science, AGU, AMS and OSA. He shared the Nobel Peace Prize bestowed on the Intergovernmental Panel on Climate Change in 2007.

Professor **Asad M. Madni** was elected to the **National Academy of Engineering** in 2011 "for contributions to development and commercialization of sensors and systems for aerospace and automotive safety." Prior to joining UCLA, he was President, COO and CTO of BEI Technologies Inc., where he led the development and commercialization of intelligent micro-sensors and systems for aerospace, defense, industrial and transportation industries, including the Quartz MEMS GyroChip technology. Prior to joining BEI he was Chairman, President & CEO of Systron Donner Corp. where he developed RF & Microwave Systems & Instrumentation which enhanced Combat Readiness and provided the ability to simulate threat representative ECM environments for warfare training. His honors include the IEEE Millenium Medal, IET Achievement Medal, TCI Marconi Medal and UCLA Professional Achievement Medal. In 2004, he received the UCLA Engineering Alumnus of the Year Award and in 2010 was awarded the UCLA Engineering Lifetime Contribution Award. He is a Fellow of the IEEE, IEE, IET, AAAS, NYAS, SAE, IAE and AIAA.







Professor **Stanley Osher** was elected to the **National Academy of Sciences** for "major contributions to algorithm development and applications in level set methods, high-resolution shock capturing methods, and PDE-based methods in imaging science." He has been at UCLA since 1976 and is Director of Special Projects at the Institute for Pure and Applied Mathematics. Dr. Osher was a Fulbright and Alfred P. Sloan Fellow, and received the NASA Public Service Group Achievement Award, the Japan Society of Mechanical Engineers Computational Mechanics Award, the SIAM Pioneer Prize, and the SIAM Kleinman Prize.

Professor **C. Kumar Patel, National Academy of Sciences,** made numerous seminal contributions in gas lasers, nonlinear optics, molecular spectroscopy, pollution detection and laser surgery. He received numerous honors, including the National Medal of Science for his invention of the carbon dioxide laser. He also received the Lomb Medal of the Optical Society of America, the Franklin Institute's Ballantine Medal, the Pake Prize of the American Physical Society, and the Coblentz Society's Coblentz Prize.

Distinguished Professor **Yahya Rahmat-Samii** was elected to the **National Academy of Engineering** in 2008 for his pioneering contributions to the design and measurement of reflector and hand-held device antennas. Many of his design concepts are currently used in cell phones, aerospace, earth-observation satellites, and satellite dishes. Prior to joining UCLA, he was a Senior Research Scientist at Jet Propulsion Laboratory. His honors include the 2007 Chen-To Tai Distinguished Educator Award from the IEEE Antennas and Propagation Society; the 2005 International Union of Radio Science's Booker Gold Medal; the 2000 Antenna Measurement Techniques Association's Distinguished Achievement Award; the IEEE's Third Millennium Medal; and a Distinguished Alumni Award from the University of Illinois, Urbana-Champaign. He holds the Northrop Grumman Chair in Electromagnetics.

Dr. **Henry Samueli** was elected to the **National Academy of Engineering** in recognition of his "pioneering contributions to academic research and technology entrepreneurship in the broadband communications system-on-a-chip industry." Dr. Samueli has over 25 years of experience in the fields of digital signal processing and communications systems engineering and is widely recognized as one of the world's leading experts in the field. He received his B.S., M.S. and Ph.D. degrees in electrical engineering from UCLA. Since 1985, Dr. Samueli is a professor in the Electrical Engineering Department. He is also well known as the co-founder of Broadcom Corporation. In 2010, Professor Samueli received the UCLA Medal.

Professor **Jason Speyer** was elected to the **National Academy of Engineering** for "the development and application of advanced techniques for optimal navigation and control of a wide range of aerospace vehicles." He pioneered new deterministic and stochastic control, team and differential game strategies, estimation, and model-based fault detection, identification, and reconstruction theories and algorithms, as well as matrix calculus of variations for the Apollo autonomous navigation system. He pioneered the development and mechanization of periodic optimal control for aircraft fuel-optimal cruise and endurance, as well as differential carrier phase GPS blended with an inertial navigation system. He is a fellow of AIAA and IEEE (Life Fellow) and received the IEEE Third Millennium Medal as well as several AIAA Awards.

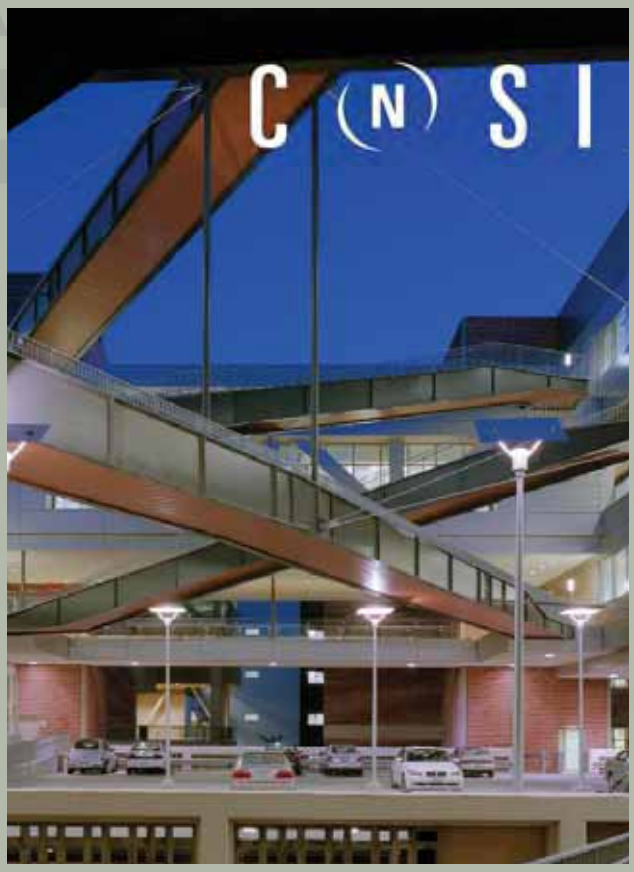
Professor **Dwight Streit** became a member of the **National Academy of Engineering** in 2001 for contributions to the development and production of heterojunction transistors and circuits. He received his Master's degree and Ph.D. in Electrical Engineering from UCLA. He joined the faculty of UCLA's Materials Science and Engineering and Electrical Engineering departments in 2010. Prior to joining UCLA, he was vice president, director, technical fellow and contributing engineer for advanced technologies at Northrop Grumman and TRW Space & Electronics. He is also a Fellow of the Institute of Electrical and Electronic Engineers and the American Association for the Advancement of Science, and a member of the NASA Space Foundation Technology Hall of Fame.

Professor **Eli Yablonovitch, National Academy of Engineering, National Academy of Sciences,** is a Fellow of the Institute of Electrical and Electronic Engineers, the Optical Society of America, and the American Physical Society. He has been awarded the Adolf Lomb Medal, the W. Streifer Scientific Achievement Award, the R.W. Wood Prize, and the Julius Springer Prize. He is The Northrop Grumman Opto-Electronics Chair, Professor of Electrical Engineering at UCLA, and also a Professor of Electrical and Computer Engineering at UC Berkeley.

California Nano Systems Institute(CNSI)

One of four Governor Gray Davis Institutes for Science & Innovation, the California NanoSystems Institute is an integrated research facility located at UCLA and UC Santa Barbara. Its mission is to foster interdisciplinary collaborations in all fields, with a focus on nanoscience and nanotechnology; to train a new generation of scientists, educators, and technology leaders to create new innovations and to deliver those innovations to the public; to generate partnerships with industry; and to contribute to the economic development and the social well-being of California, the United States, and the world. CNSI was established in 2000 with $100 million from the state of California. More than $900 million of support has come from federal research grants, private donors, foundations, and industry. CNSI members are drawn from multiple disciplines, including the physical and life sciences, engineering, medicine, neuroscience, the arts, and public health. This dynamic research setting enables the institute to overcome complex problems that impact our health, energy resources, the environment, and the creation of new devices .

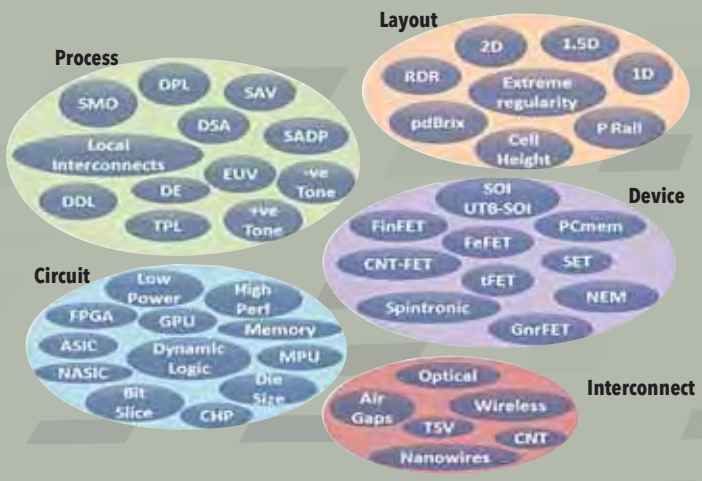
http://www.cnsi.ucla.edu



Impact +

IMPACT+ Center is a cross-university research center center with 10 faculty researchers from UCLA, Berkeley and UCSD. It is supported by 14 semiconductor companies and Professor Puneet Gupta serves as its director. The IMPACT+ research team — with its strengths spanning patterning, devices, algorithms, modeling and design automation — plans to address future semiconductor technology challenges via two intertwined themes of process and devices & design interface.

http://impact.ee.ucla.edu



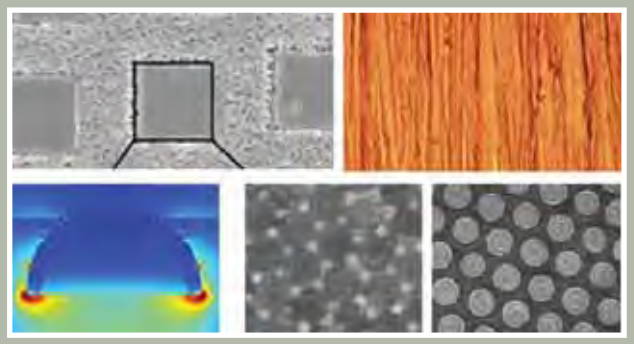
Expedition into Hardware-Variability-Aware Software

The National Science Foundation awarded $10 million to the research initiative "Hardware-Variability-Aware Software for Efficient Computing with Nanoscale Devices." The grant is part of the funding agency's Expeditions in Computing program, which rewards far-reaching agendas that "promise significant advances in the computing frontier and great benefit to society." Variability-aware computing systems would benefit the entire spectrum of embedded, mobile, desktop and server-class applications by dramatically reducing hardware design and test costs for computing systems while enhancing their performance and energy efficiency. The expedition's deputy director, Mani Srivastava, joins Lara Dolecek and Puneet Gupta from UCLA in a team of eleven researchers from various universities.

http://www.variability.org/

World Institute of Nanoelectronics(WIN)

Through the multidisciplinary research efforts of the UCLA WIN Center, NIST awarded UCLA $6M to build the WIN-GEM building as part of the Engineering Building 1 replacement, which broke ground in 2013. The WIN-GEM building will give home to cutting edge research for nanoscale, low dissipation devices, circuits and systems. In particular, WIN focuses on studies of interactive, correlated nanosystems for applications and neutrally inspired neuromorphic electronics, leading to self-learning intelligent systems. The interactive nanosystems include electronic, magnetic and photonic interactive dynamics elements.



Center for Excellence in Green Nanotechnology

King Abdul Aziz City for Science & Technology (KACST) in Saudi Arabia and the Henry Samueli School of Engineering and Applied Science are working together under an established Center of Excellence in Green Nanotechnology to promote educational technology transfer and research exchanges, as well as an agreement with UCLA for research in nanoelectronics and clean energy for the next 10 years. On the UCLA side, the center is directed by Professor Kang L. Wang. KACST is both Saudi Arabia's national science agency and the nations's premier national laboratory. The Center is continuing an additional $11M over the course of the next 6 years, in addition to the $3.7M in Phase I at UCLA. In Phase II, the center will also investigate low dissipation electronics devices and systems, which will not consume energy in standby.

STARnet Center on FunctionalA ccelerated nanoMaterial Engineering (FAME)

FAME

STARnet

The FAME Center aims to incorporate nonconventional materials and nanostructures with their quantum properties for enabling analog, logic and memory devices for beyond Boolean computation. The Center's main focus is nonconventional material solutions ranging from semiconductors, dielectrics and metallic materials as well as their correlated quantum properties. The mission of FAME is to create and investigate new nonconventional atomic-scale engineered materials and structures of multi-function oxides, metals and semiconductors to accelerate innovations in analog, logic and memory devices for revolutionary impact on the semiconductor and defense industries. FAME is one of six university-based research centers established by the SRC through its Semiconductor Technology Advanced Research network (STARnet). Funded by DARPA and U.S. semiconductor and supplier industries as a public-private partnership, STARnet projects help maintain U.S. leadership in semiconductor technology vital to U.S. prosperity, security and intelligence. The FAME Center is expected to receive a total of $35M through 2018.

Center for Translational Applications of Nanoscale Multiferroic Systems

TANMS

The Center for Translational Applications of Nanoscale Multiferroic Systems (TANMS) is one of the 16 Engineering Research Centers (ERC) nationwide established by the National Science Foundation (NSF). It is focusing on research, technology translation, and education associated with magnetism on the small scale. TANMS' vision is to develop a fundamentally new approach coupling electricity to magnetism using engineered nanoscale multiferroic elements to enable increased energy efficiency, reduced physical size, and increased power output in consumer electronics. This new nanoscale multiferroic approach overcomes the scaling limitations present in the century-old mechanism to control magnetism that was originally discovered by Oersted in 1820. TANMS' goals are to translate its research discoveries on nanoscale multiferroics to industry while seamlessly integrating a cradle-to-career education philosophy involving all of its students and future engineers in unique research and entrepreneurial experiences. The TANMS Center was established in 2012 and it is expected to receive a total of $35M from NSF through 2022.

The Electrical Engineering Department Overview

Faculty and Staff

Ladder Faculty	45 FTEs
Courtesy Appointments	13
Emeriti Faculty	13
Adjunct	7
Lecturers	19
Staff	44

Recognitions

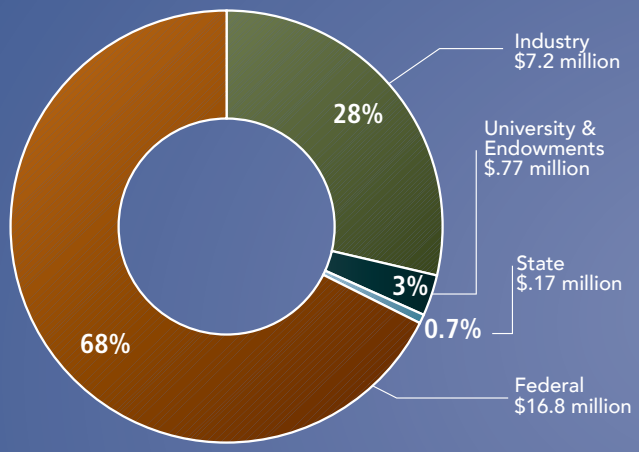
Society Fellows	40
NAE Members	12
NAS Members	3
National Medal of Science	1
Inventors Hall of Fame	1
Marconi Prize	1

Research Facilities

Laboratories and Research Groups: 40
Space: 100,772 square feet

Research Funding for 2012-2013

$ 24.9M



Research Centers

The Electrical Engineering Department contributes to the following Research Centers:

California NanoSystems Institute (CNSI)
Center for Engineering Economics, Learning & Networks
Center for Excellence in Green Nanotechnology
Center for High Frequency Electronics (CHFE)
Center for Systems, Dynamics and Controls (SyDyC)
Center for Translational Applications of Nanoscale Multiferroic Systems (TANMS)
Expedition into Hardware Variability-Aware Software
Functional Engineered Nano Architectonics Focus Center (FENA)
Impact +
Institute for Cell Mimetic Space Exploration (CMISE)
Institute for Digital Research and Education (IDRE)
Institute for Pure and Applied Mathematics (IPAM)
Institute for Technology Advancement (ITA)
Nanoelectronics Research Center (NRC)
Public Safety Network System (PSNS)
Water Technology Research Center (WaTer)
World Institute of Nanotechnology (WIN)
Wireless Health Institute

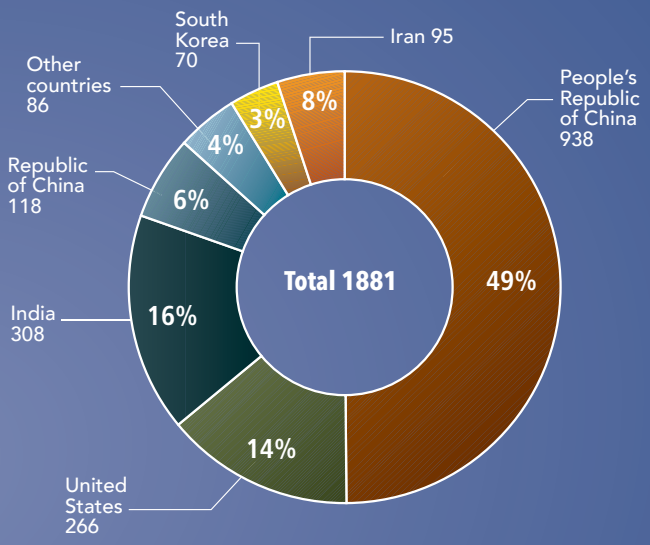
Graduate Students

Students Enrolled	510
Applicants	1881
Admitted	365
New Students Enrolled	176
Median Incoming GPA	3.71

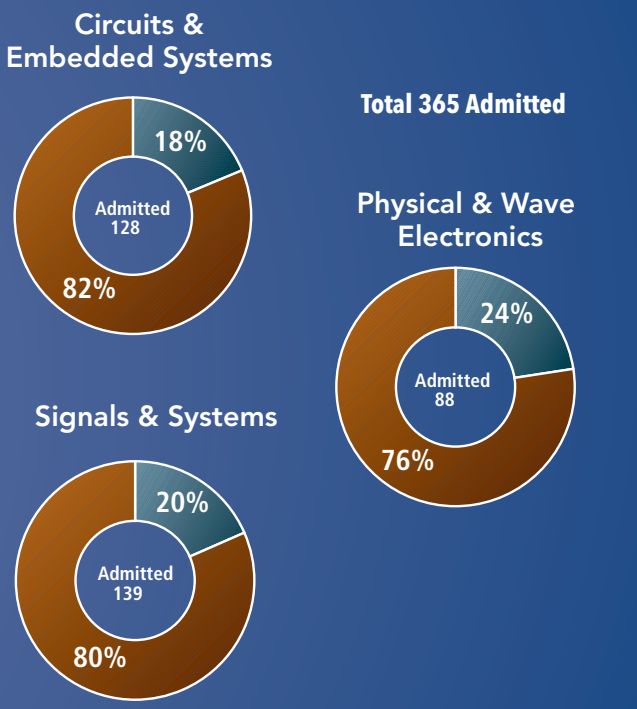
Undergraduate Students

Students Enrolled	724
Applicants	1160
Admitted	388
New Students Enrolled	130
Averge Incoming GPA	4.321(weighted) 3.924 (unweighted)

Graduate Applicants for Fall 2012



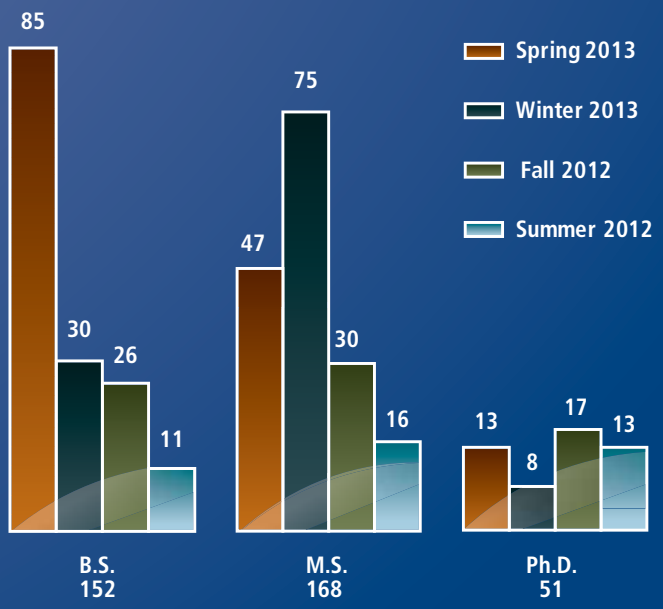
Graduate Students Admitted



Graduate Student Fellowships

Department Fellowships	$859,111
Non-Resident Tuition Support for Teaching Assistants	$246,444
Dean's GSR Support & NRT Matching Funds	$111,697
Dissertation Year Fellowships	$104,427
Henry Samueli Partial Fellowships	$84,821
Eugene Cota Robles Fellowship	$50,911
Ph.D. Preliminary Exam Top Score Fellowships	$50,610
Graduate Opportunity Fellowship	$32,809
Dean's Fellowship & Camp Funds	$29,000
Dr. Ursula Mandel Fellowship	$15,000
Will Rogers Memorial	$10,000
Guru Krupa Foundation Fellowship	$9,970
Living Spring Fellowship	$9,970
Conference Travel Funds	$6,800
Graduate Dean's Scholar Award	$5,000
Philip and Aida Siff Fellowship	$5,000
Total	$1,631,570

Degrees Conferred in 2012-2013



Circuits and Embedded Systems

Asad A. Abidi

Distinguished Chancellor's Professor
Ph.D., University of California, Berkeley, 1981

CMOS RF design, high speed analog integrated circuit design, data conversion, and other techniques of analog signal processing.

- National Academy of Engineering, 2007
- IEEE Donald Pederson Award, 2007
- Fellow, IEEE, 1996

Danijela Cabric

Assistant Professor
Ph.D., University of California, Berkeley, 2007

Wireless communications system design; cognitive radio networks; VLSI architectures of signal processing and digital communication algorithms; performance analysis and experiments on embedded system platforms.

- NSF CAREER Award, 2012
- Okawa Foundation Award, 2009
- Samueli Fellow, 2008

M. -C. Frank Chang

Distinguished Professor and Chairman
Wintek Professor of Electrical Engineering
Ph.D., National Chiao-Tung University, Taiwan, R.O.C., 1979
** Also in Physical and Wave Electronics*

High speed electronics including ultra high speed/ frequency devices and integrated circuits for radio, radar and imaging system applications.

- Academia Sinica, 2012
- National Academy of Engineering, 2008
- IEEE David Sarnoff Award, 2006

Jingsheng Jason Cong

Chancellor's Professor
Ph.D., University of Illinois at Urbana-Champaign, 1990

Synthesis of VLSI circuits and systems, programmable systems, novel computer architectures, nano-systems, and highly scalable algorithms.

- ACM/IEEE A. Richard Newton Technical Impact Award in Electric Design Automation, 2011
- ACM Fellow, 2008
- Fellow, IEEE, 2000

Babak Daneshrad

Professor
Ph.D., University of California, Los Angeles, 1993

Wireless communication systems, High performance VLSI architectures and testbeds for wireless systems.

Deborah L. Estrin

Distinguished Professor
Jonathan B. Postel Professor of Networking
Ph.D., Massachusetts Institute of Technology, 1985

Participatory sensing, mobile health, environmental monitoring, open systems, privacy.

- National Academy of Engineering, 2009
- Anita Borg Institute's Women of Vision Award for Innovation in 2007
- Fellow, AAAS, 2001

William J. Kaiser

Professor
Ph.D., Wayne State University, 1984

Development of networked embedded computing for linking the Internet to the physical world. Distributed and wearable systems for advancing the quality and international accessibility of healthcare through Wireless Health.

- UCLA Gold Shield Faculty Prize, 2009
- Brian P. Copenhaver Award, 2005
- Allied Signal Faculty Research Award, 1995

Puneet Gupta

Associate Professor
Ph.D., University of California, San Diego, 2007

CAD techniques to enable design aware manufacturing. VLSI physical design for manufacturability, robustness and low-power. Software methods to mitigate hardware variability and reliability.

- IBM Faculty Award, 2012
- ACM/SIGDA Outstanding New Faculty Award, 2010
- NSF CAREER Award, 2009

Dejan Markovic

Associate Professor
Ph.D., University of California, Berkeley, 2006

Power/area-efficient digital integrated circuits for communication and healthcare applications, design with post-CMOS devices, design optimization methods and supporting CAD flows.

- NSF CAREER Award, 2009
- David J. Sakrison Memorial Prize, UC Berkeley, 2007

Lei He

Professor
Ph.D., University of California, Los Angeles, 1999

Modeling and simulation, programmable logic and reconfigurable computing, and embedded and cyber-physical systems for applications such as health care, electric vehicle and smart grid.

- Northrop Grumman Excellence in Teaching Award, 2005
- IBM Faculty Award, 2003
- NSF CAREER Award, 2000

SudhakarP amarti

Associate Professor
Ph.D., University of California, San Diego, 2003

Mixed-signal IC design: wireless/wireline communication applications, digitally-assisted analog/RF circuit design, delta-sigma modulation, quantization noise theory.

- NSF CAREER Award, 2010

Behzad Razavi

Professor
Ph.D., Stanford University, 1992

Analog, RF, and mixed-signal integrated circuit design, dual-standard RF transceivers, phase-locked systems and frequency synthesizers, A/D and D/A converters, high-speed data communication circuits.

- IEEE VLSI Circuits Symp. Best Student Paper Award, 2012
- IEEE CICC Best Invited Paper Award, 2012
- IEEE Pederson Award in Solid-State Circuits, 2012

Mani B. Srivastava

Professor and Area Director
Ph.D., University of California, Berkeley, 1992

Embedded and cyber-physical systems; distributed and participatory sensing; mobile, wearable, and pervasive computing; wireless networks; power & energy-aware systems; energy harvesting technologies; applications in mHealth, green buildings, and smart grids.

- Fellow, IEEE, 2008
- Okawa Foundation Grant Award, 1998.
- NSF CAREER Award, 1997

Henry Samueli

Professor
Ph.D., University of California, Los Angeles, 1980

Digital signal processing, communications systems engineering, and CMOS integrated circuit design for applications in high-speed data transmission systems.

- Marconi Society Prize and Fellowship, 2012
- American Academy of Arts and Sciences, 2004
- National Academy of Engineering, 2003

C.-K. Ken Yang

Professor
Ph.D., Stanford University, 1998

High-speed data and clock recovery circuits for large digital systems, low-power, high-performance functional blocks and clock distribution for high-speed digital processing, and low-power high-precision capacitive sensing interface for MEMS.

- Fellow, IEEE, 2011
- IBM Faculty Development Fellowship, 2003-2005
- Northrup-Grumman Outstanding Teaching Award, 2003

Majid Sarrafzadeh

Professor
Ph.D., University of Illinois at Urbana-Champaign, 1987

Embedded and reconfigurable computing; VLSI CAD; design and analysis of algorithms.

- Co-Director, UCLA Wireless Health Institute, since 2008
- Co-Founder, four Startups, since 2000
- Fellow, IEEE, 1996

Physical and Wave Electronics

Katsushi Arisaka

Distinguished Professor
Ph.D., University of Tokyo, Japan, 1985

High energy and astro-particle experiments, Kaon rare decays and CP violation, ultra high energy Cosmic ray, Hadron Colliderex periment.

- UCLA Distinguished Teaching Award, 2010

Robert N. Candler

Assistant Professor
Ph.D., Stanford University, 2006

MEMS and NEMS devices, micro/nanoscale technology development, and the interface of physical microsystems with biology.

- Northrop Grumman Excellence in Teaching Award, 2013
- ARO YIP Award, 2012

Chi On Chui

Associate Professor
Ph.D., Stanford University, 2004

Bioelectronics, biosensing, device-circuit interaction, heterogeneous integration technology, and nanoelectronics.

- von Liebig Entrepreneurism Center Regional Healthcaree Innovation Challenge Award, 2011
- HSSEAS Northrop Grumman Excellence in Teaching Award, 2011
- IEEE Electron Devices Society Early Career Award, 2009

Warren Grundfest

Professor
M.D., Columbia University, 1980

Lasers for minimally invasive surgery, magnetic resonance-guided interventional procedures, laser lithotripsy, micro-endoscopy, spectroscopy, photodynamic therapy, optical technology, biologic feedback control mechanisms.

- Fellow, SPIE, 1996
- Fellow, American Institute of Medical & Biologic Engineers, 1996

Diana L. Huffaker

Professor
Ph.D., University of Texas at Austin, 1994

Directed and self-assembled nanostructure solid-state epitaxy, optoelectronic devices including solar cells and III-V/Si photonics.

- IEEE Fellow, 2008
- DoD NSSEFF Fellow, 2008
- Humboldt Research Award, 2004

Tatsuo Itoh

Distinguished Professor
Northrop Grumman Professor in Microwave Electronics
Ph.D., University of Illinois at Urbana-Champaign, 1969

Microwave and millimeter wave electronics, guided wave structures, low power wireless electronics, integrated passive components and antennas.

- National Academy of Engineering, 2003
- Fellow, IEEE, 1982

Bahram Jalali

Professor and Area Director
Northrop Grumman Endowed Opto-Electronic Chair in Electrical Engineering
Ph.D., Columbia University, 1989

Silicon photonics, biophotonics, real-time instruments for biomedical and communication applications.

- R.W. Wood Prize, Optical Society of America, 2008
- Fellow, Optical Society of America, 2004
- Fellow, IEEE, 2003

Mona Jarrahi

Associate Professor
Ph.D., Stanford University, 2007

Terahertz/millimeter-wave electronics, optoelectronics, and novel materials; Microwave photonics and ultrafast electro-optics; Terahertz/infrared imaging and spectroscopy

- National Academy of Engineering, Grainger Foundation Frontiers of Engineering Award, 2013
- Office of Naval Research Young Investigator Award, 2012
- National Science Foundation Early CAREER Award, 2011

Chandrashekar J. Joshi

Distinguished Professor
Ph.D., Hull University, England, 1979

Laser fusion, laser acceleration of particles, nonlinear optics, high-power lasers, plasma physics.

- Fellow, Institute of Physics (U.K.), 1998
- Fellow, IEEE, 1993
- Fellow, American Physical Society, 1990

Kuo-Nan Liou

Distinguished Professor
Ph.D. New York University, 1970

Electromagnetic scattering by ice crystals and aerosols, satellite remote sensing, radiative transfer, and climate modeling.

- Roger Revelle Medal, American Geophysical Union, 2013
- Quadrennial Gold Medal, International Radiation Commission, 2012
- National Academy of Engineering, 1999

Jia-Ming Liu

Professor
Ph.D., Harvard University, 1982

Nonlinear optics, ultrafast optics, semiconductor lasers, photonic devices, optical wave propagation, nonlinear laser dynamics, chaotic communications, chaotic radar, nanophotonic imaging, and biophotonics.

- Fellow, IEEE, 2008
- Guggenheim Fellow, 2006
- Fellow, American Physical Society, 2003

Warren Mori

Professor
Ph.D., University of California, Los Angeles, 1987

Advanced accelerator concepts, advanced light sources, inertial confinement fusion, nonlinear optics of plasmas, plasma physics, and massively parallel computing.

- Fellow, IEEE, 2007
- Fellow, American Physical Society, 1995

Aydogan Ozcan

Chancellor's Professor
Ph.D., Stanford University, 2005

Photonics and its applications to nano and biotechnology.

- PECASE Award, 2012
- NSF CAREER Award, 2010
- NIH Director's New Innovator Award, 2009

C. Kumar N. Patel

Distinguished Professor
Ph.D., Stanford University, 1961

Condensed matter physics, especially the structure and dynamics of "interesting systems," broadly defined; spectroscopic techniques and detection methods; development of high power laser systems including quantum cascade lasers.

- National Inventors Hall of Fame, 2012
- National Medal of Science, 1996
- National Academy of Engineering, 1978

Yahya Rahmat-Samii

Distinguished Professor
Northrop Grumman Professor of Electrical Engineering/Electromagnetics
Ph.D., Univ. of Illinois at Urbana-Champaign, 1975

Personal communications, medical, miniaturized, fractal, reflectors, remote sensing, satellite and radio astronomy antennas; electromagnetic band gap, meta-materials, reflectarrays and frequency selective structures, computational and optimization techniques, modern antenna measurements and diagnostics.

- UCLA Distinguished Teaching Award 2011
- IEEE Electromagnetics Award, 2011
- National Academy of Engineering, 2008

Oscar M. Stafsudd

Professor and Vice Chair
Ph.D., University of California, Los Angeles, 1967

Mid-infrared lasers for applications in materials processing, dentistry, and surgery; ceramic laser media for high power laser systems; Raman imaging and time dependent fluorescent imaging for medical applications (cancer/ wounds); infrared detectors.

- Lockheed Martin Excellence in Teaching Award, 2011
- Fulbright Fellowship, 1986

Dwight C. Streit

Distinguished Professor
Ph.D., University of California, Los Angeles, 1986

Solid-state electronics, millimeter-wave devices and circuits, electronic materials, heterogeneous integration.

- National Research Council Lifetime Associate, 2008
- Northrop Grumman Distinguished Innovator, 2008
- National Academy of Engineering, 2001

King-Ning Tu

Distinguished Professor
Ph. D., Harvard 1968

VLSI processing and reliability, and 3D IC packaging technology.

- TMS John Bardeen Award, 2013
- Fellow: APS, 1981, TMS, 1988, MRS, 2010
- Humboldt Award,1996

Kang L. Wang

Distinguished Professor
Raytheon Company Professor of Electrical Engineering
Ph.D., Massachusetts Institute of Technology, 1970

Nanoelectronics, spintronics and nanomagnetics; interacting complex nanoscale systems; nanoscale science, devices and quantum systems; nonvolatile electronics and low dissipation devices; MBE; optoelectronics and solar cells.

- Semiconductor Industry Association Award, 2009
- Semiconductor Research Corporation Technical Excellence Award, 1995
- Fellow, IEEE, 1992

Yuanxun Ethan Wang

Associate Professor
Ph.D., University of Texas at Austin, 1999

High performance antenna array and microwave amplifier systems for wireless communication and radar; numerical modeling techniques; fusion of signal processing and circuit techniques in microwave system design.

Benjamin S. Williams

Associate Professor
Ph.D., Massachusetts Institute of Technology, 2003

Terahertz and mid-infrared lasers and devices; low-dimensional semiconductor nanostructures for opto-electronics; sub-wavelength photonics, plasmonics, and meta-materials.

- NSF CAREER Award, 2012
- DARPA Young Faculty Award, 2008

Jason C. S. Woo

Professor and Vice Chair
Ph.D., Stanford University, 1987

Solid state technology, CMOS and bipolar device/circuit optimization, novel device design, modeling of integrated circuits, VLSI fabrication.

- Fellow, IEEE, 2005

Signals and Systems

Abeer A. H. Alwan

Professor

Ph.D., Massachusetts Institute of Technology, 1992

Speech processing, acoustic properties of speech sounds with applications to speech synthesis, recognition by machine and coding, hearing aid design, digital signal processing.

- Distinguished Lecturer, ISCA, 2010-2011
- Fellow, IEEE, 2008
- Fellow, Acoustical Society of America, 2003

Panagiotis Christofides

Professor

Ph.D., University of Minnesota, 1996

Control theory for nonlinear, hybrid and distributed parameter systems, networked control, model predictive control, fault detection and fault-tolerant control, process control applications

- IFAC Fellow, 2011
- IEEE Fellow, 2009
- Donald P. Eckman Award, 2004

Suhas Diggavi

Professor

Ph.D., Stanford University, 1998

Information theory with applications to wireless and sensor networks, network data compression and storage, network secrecy, machine learning and large scale data analysis algorithms.

- Fellow, IEEE, 2013
- IEEE Information Theory Society & Communications Society Joint Paper Award, 2013
- IEEE Donald G. Fink Prize Paper Award, 2006

Lara Dolecek

Assistant Professor

Ph.D., University of California, Berkeley, 2007

Information and probability theory, graphical models, combinatorics, statistical algorithms and computational methods with applications to high-performance complex systems for data processing, communication, and storage.

- Intel Early Career Award, 2013
- NSF CAREER Award, 2012
- David J. Sakrison Memorial Prize, UC Berkeley, 2007

Florian Dörfler

Assistant Professor

Ph.D., University of California, Santa Barbara, 2013

Analysis, control design, and security in cyber-physical systems and smart power grids; Synchronization and dynamic phenomena in complex networks; Cooperative control and coordination in autonomous multi-agent systems

- O. Hugo Schuck Best Paper Award
- UC Regent's Special International Fellowship

Christina Fragouli

Associate Professor

Ph.D., University of California, Los Angeles, 2000

Network coding, wireless networks, security.

- Distinguished Lecturer, IEEE Information Theory Society, 2011-2013
- Young Investigator ERC award, 2009
- Zonta Award, 2008

Alan J. Laub
Distinguished Professor
Ph.D., University of Minnesota, 1974

Numerical linear algebra, numerical analysis, high-end scientific computation, and computer-aided control system design, especially algorithms for control and filtering.
- Fellow, IEEE, 1986

Stanley J. Osher
Professor
Ph.D., Courant Institute, New York University, 1966

Innovative numerical methods for applications ranging from image science to control to electromagnetics to computational physics and beyond.
- American Academy of Arts and Sciences, 2010
- National Academy of Sciences, 2005

Gregory J. Pottie
Professor and Area Director
Ph.D., McMaster University, Canada, 1988

Wireless communications, modeling and reliable inference in sensor networks with application to wireless health.
- Fulbright Senior Scholar, 2009
- Fellow, IEEE, 2005
- Allied Signal Award for Outstanding Faculty Researcher in HSSEAS, 1998

Vwani P. Roychowdhury
Professor
Ph.D., Stanford University, 1989

Models of computation: parallel systems, quantum information processing, nanoscale and molecular electronics, statistical algorithms for large-scale information processing, combinatorics and complexity and information theory, bioinformatics,cr yptography.

Izhak Rubin
Distinguished Professor
Ph.D., Princeton University, 1970

Telecommunications and computer communications systems and networks; public safety networks; mobile cellular and ad hoc wireless networks; vehicular networks; heterogeneous networks; optical nets; satellite networks; queueing systems; C4ISR systems and networks; network simulations, analysis and design; traffic modeling/engineering.
- Life Fellow, IEEE, 1987

Ali H. Sayed
Professor
Ph.D., Stanford University, 1992

Adaptation and learning, network science, information-processing theories, distributed processing, biologically-inspired designs.
- Technical Achievement Award, IEEE Signal Processing Society, 2012
- Frederick E. Terman Award, 2005
- Fellow, IEEE, 2001

Stefano Soatto
Professor
Ph.D., California Institute of Technology, 1996

Estimation theory, control theory, video, image and signal processing, computer vision, robotics.
- IEEE Fellow, 2013
- Okawa Foundation, 2001
- David Marr Prize, 1999

Jason L. Speyer
Distinguished Professor
Ph.D., Harvard University, 1968

Stochastic and deterministic optimal control and estimation with application to aerospace systems; guidance, flight control, and flight mechanics.
- National Academy of Engineering, 2005
- Life Fellow, IEEE, 2005
- Fellow, AIAA, 1985

Paulo Tabuada

Professor and Vice Chair
Ph.D., Technical University of Lisbon, Portugal, 2002

Modeling, analysis, and control of cyber-physical systems. Control and systems theory.

- Donald P. Eckman Award, 2009
- NSF Career Award, 2005
- George S. Axelby Award, 2011

Mihaela van der Schaar

Chancellor's Professor
Ph.D., University of Technology, Eindhoven, The Netherlands, 2001

Information processing, network economics and game theory, multi-user communications and networking, multimedia communications, networking and processing, multimedia systems, distributed and large-scale stream mining systems

- Fellow, IEEE, 2010
- Editor in Chief, IEEE Trans. on Multimedia, 2011-2013
- NSF CAREER Award 2004

Lieven Vandenberghe

Professor
Ph.D., Katholieke Universiteit Leuven, Belgium, 1992

Optimization in engineering, applications in systems and control, circuit design, and signal processing.

- HSSEAS TRW Excellence in Teaching Award, 2002
- NSF CAREER Award, 1998
- Robert Stock Award, K.U. Leuven, 1993

John D. Villasenor

Professor
Ph.D., Stanford University, 1989

Cybersecurity, wireless mobile devices and systems, cloud computing, digital currencies and emerging payment methods, supply chain and infrastructure security, digital privacy, medical imaging, intellectual property.

Richard D. Wesel

Professor and Associate Dean
Ph.D., Stanford University, 1996

Communication theory, channel coding including low-density parity-check codes and turbo codes, information theory, network optimization

- TRW Excellence in Teaching Award, 2000
- Okawa Foundation Award, 1999
- NSF CAREER Award, 1998

Kung Yao

Distinguished Professor
Ph.D., Princeton University, 1965

Communication theory, signal, acoustic, and array processing, wireless communication systems, sensor networks, chaos system theory, and VLSI and systolic algorithms and architectures.

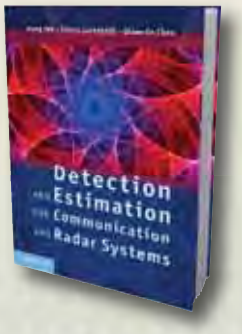
- Best Paper Award, Journal of Communications and Networks, 2011
- IEEE Joint Information Theory/Communication Theory Societies Best Paper Award, 2008
- Life Fellow, IEEE, 1994

Books by Faculty

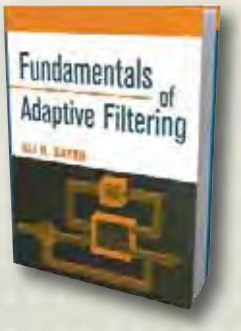
Numerous textbooks on graduate and undergraduate instruction are authored by our electrical engineering faculty. These are samples of the publications.

B. Razavi

K. Yao



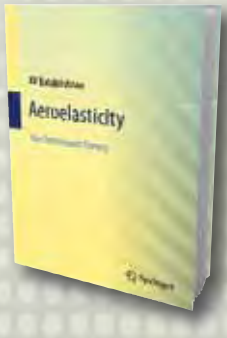
A. Sayed



P. Gupta

M. Sarrafzadeh

A. V. Balakrishnan



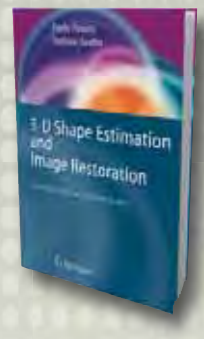
J. Cong

K. N. Liou

D. Markovic

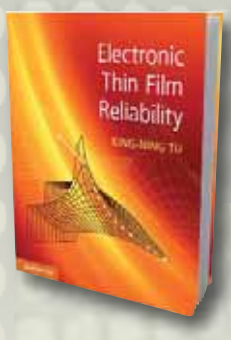
J. Speyer

S. Soatto



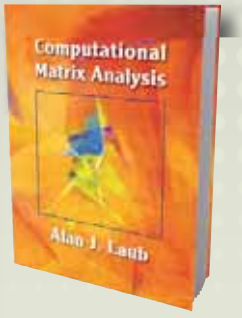
A. Ozcan

K. N. Tu

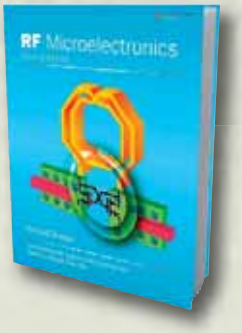


S. Osher

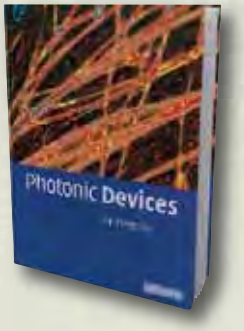
A. Laub



B. Razavi



J. M. Liu



Post-Graduation Academic Placement

Mohamed Aboudina

Assistant Professor, Cairo University, Egypt
Advisor: Behzad Razavi

Dr. Aboudina received the B.Sc. and M.Sc. degrees in Electrical Engineering from Cairo University, Egypt in 2000 (valedictorian) and 2002 respectively and the Ph.D. degree in Electrical Engineering at University of California, Los Angeles (UCLA) in 2009. He is currently an Assistant Professor in Electronics and Electrical Communications Engineering Department, Cairo University, Egypt. His research interest include high-speed and high-performance data converters, power management and Integrated bio-medical circuits.

Thomas Courtade

Assistant Professor, UC Berkeley
Advisor: Richard Wesel

Thomas Courtade received the Distinguished Ph.D. Dissertation Award from the UCLA Department of Electrical Engineering and the Excellence in Teaching Award in 2010-2011. His research focuses on multi-terminal source coding. His work in this area was recognized with the best student paper award at the 2012 IEEE International Symposium on Information Theory. He was named the inaugural postdoctoral fellow at the NSF Center for Science of Information. His appointment at Berkeley begins in 2014.

Sameh Ibrahim

Assistant Professor / Unit Head of the Communications Engineering Program, Ain Shams University, Egypt
Advisor: Behzad Razavi

Dr. Ibrahim received the B.Sc. and M.Sc. degrees in electrical engineering from Ain Shams University, Cairo, Egypt, in 2001 and 2005, respectively. He received the Ph.D. degree in Electrical Engineering from the University of California, Los Angeles, in 2009. In May 2011, he became an Assistant Professor of electrical engineering at Ain Shams University, Cairo, Egypt where he also serves as the unit head of the Communication Systems Engineering program.

Ahmad Mirzaei

Associate Professor, Pennsylvania State University
Advisor: Asad Abidi

Dr. Ahmad Mirzaei received a B.S. and M.S. from Sharif University of Technology, Iran, and a Ph.D. degree from UCLA in 2006. He served as a senior principal scientist at the advanced RF research and development department at Broadcom Corporation. He has authored numerous research publications and patent applications in the field of RF-CMOS. He is a senior member of IEEE. His research interests include analog/RF integrated circuits and systems for wireless applications.

Wenyao Xu

Assistant Professor, State University of New York at Buffalo
Advisors: Majid Sarrafzadeh & Lei He

Wenyao Xu received his Ph.D. in July 2013 from UCLA and joined SUNY Buffalo in the Computer Science and Engineering Department as an Assistant Professor in August 2013. His research interests are in the area of embedded systems, computational modeling and algorithm design. During his Ph.D. study, he focused on new sensing and computing technologies for healthcare applications. He holds five U.S. patents, which are licensed to nationally renowned bio-medical device companies.

2013 Student Awards

Frederick Sala, Distinguished MS Research in Signals & Systems Award recipient with his advisor Professor Lara Dolecek (left) and Chairman Frank Chang (right)

Justin Wong, Outstanding Bachelor of Science Award and the Christina Huang Memorial Prize

Shihan Qin, Distinguished MS Research in Physical & Wave Electronics Award recipient with his advisor Professor Ethan Wang (left) and Chairman Frank Chang (right)

Chengcheng Wang, Distinguished Ph.D. Dissertation Award in Circuits & Embedded Systems with his advisor Professor Dejan Markovic (left) and Chairman Frank Chang

Yu Zhang, Distinguished PhD Dissertation Award in Signals & Systems and Chairman Frank Chang (right)
Advisor: Professor Mihaela van der Schaar

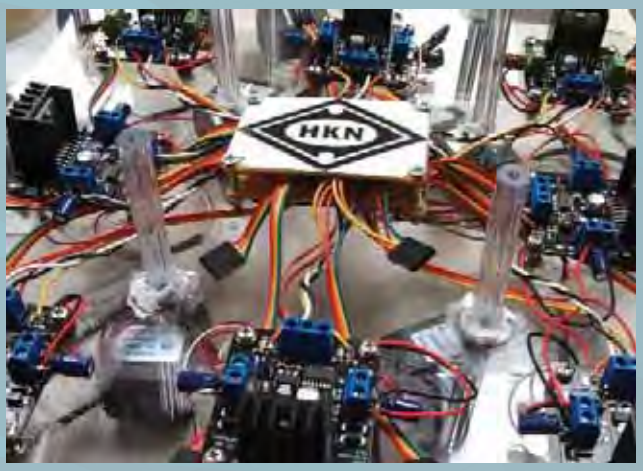
Amir Tavallaee, Distinguished PhD Dissertation Award in Physical & Wave Electronics
Advisor: Professor Benjamin Williams

The 2012-2013 Henry Samueli Excellence in Teaching Awards recipients from left to right: **Hari Chandrakumar** (Graduate course), **Alexander Tai** (Lecture course), and **Arthur Densmore** (Lab course) with Chairman Frank Chang

2013 Top Preliminary Exam Scores went to: **Adam Williamson**, **Can Karakus**, & **Frederick Sala** (Signals & Systems); **Sameed Hameed** (Circuits & Embedded Systems); **Luyao Xu** (Physical & Wave Electronics)

Eta Kappa Nu Reaches out to Students and Faculty to Create Better Engineers

Eta Kappa Nu (HKN) is a unique organization dedicated to encouraging and recognizing excellence in the electrical and computer engineering fields. Through a variety of service programs and leadership training, student members develop lifelong skills that earmark them for prominent positions in industry and academia. In order to be eligible for membership, students must be either in the top fourth of their junior standing class or top third of their senior standing class. For the 2012-2013 academic year, Eta Kappa Nu at UCLA (Iota Gamma chapter) set out to grow in three areas: establish a larger member body, initiate new chapter projects, and improve freshman outreach to make sure students know and want to join HKN well before their junior standing year. Under the leadership of former President Erica Skoglund, the chapter achieved impressive improvements in all three areas.



The World of Colors Project tapped into student creativity (above) and a group outing.

HKN broke a chapter record in Fall 2012 with its largest induction class to date, totaling 41 new members of HKN, bringing the current membership to 192. Also, in Spring 2013, HKN was honored to have Professor M.-C. Frank Chang join HKN as a faculty member, bringing the HKN faculty member total at UCLA to 18.

The projects division grew tremendously over the past school year. With funding assistance from the Electrical Engineering department, HKN completed a new functional interactive water and light display. The "World of Colors" project challenged our members to create an aesthetically pleasing and physically engaging display using Microsoft's Kinect, LED modules, and water pumps, and to further interface these components with Labview and a microcontroller. The project, once only an idea in 2011, is now a showpiece and thing of beauty for the chapter. HKN is planning to start two new projects this year and will be applying for its own lab space.

Finally, HKN grew its outreach and feedback efforts to freshman EE and CS&E students while maintaining the quality of the services already provided to the student body. HKN put together its first student magazine, *Project Accessibility*, to help students learn about all the different projects at UCLA as well as how to kick-start their own. The magazine was given to dozens of first year students at Engineering Welcome Day. Also, through the mentorship program, HKN held events to educate first year students about all the options available within their major and to provide general information about the benefits of graduate school. Finally, HKN's tutoring program serviced a multitude of students and received extraordinary testimonials — one student even attributed her score of 20% above the average to the tutoring!

For the next year, HKN plans to expand its tutoring services to include MATLAB instruction and will provide a textbook reserve in the undergraduate lounge so students can reference multiple sources when studying without the need to leave the lounge and go to the library. HKN is also planning its first emerging companies fair in winter that will cater to start-up, VC firms, and growing technology companies looking to recruit Bruin talent. This year, the chapter celebrates its 30th year at UCLA. We look forward to continued support from the department and enthusiastic participation from a new group of young engineers.

UCLA Institute of Electrical and Electronics Engineers (IEEE) Club

UCLA IEEE (Institute of Electrical and Electronics Engineers) is one of the largest engineering clubs on the UCLA campus. In addition to our corporate info-sessions, workshops, and events, the group is known for the challenging but fun projects that teach students hands-on electrical engineering skills they don't necessarily learn in the classroom. The program OPS is catered to first and second-year students, while the C3 projects are geared towards computer science nerds, and Micromouse and Natcar to those who want a more challenging robotics experience. The IEEE club also sponsor independent projects and have a project match-making service to match people who have a project idea and want to help to people who don't have an idea but want to do something interesting.

The UCLA IEEE club is based on the second floor of Boelter Hall with its own lab. The club has a 3D printer and PCB mill that students can use for a small fee. Students don't need to be members of the Electrical Engineering or Computer Science programs, nor have experience to join a project. The club welcomes anyone who is interested.

http://www.ieee.ucla.edu or *general@ieee.ucla.edu*

2012-2013 honors awarded to UCLA IEEE

- *Region 6 Exemplary Student Branch Award*
- *IEEE Region 6 Outstanding Large Student Branch*
- *UCLA Engineering Student Group of the Year*
- *All America Micromouse Competition (held at UCLA), First Place*
- *UCLA Natcar Competition (held at UCLA), First Place*
- *UCLA Natcar Competition (held at UCLA), Second Place*
- *Davis Cup Competition (held at UC Davis), Third Place*
- *California MicroMouse (held at UCSD), First Place*
- *ViaCar Competition (held at UCSD), First Place*
- *ViaCar Competition (held at UCSD), Second Place*
- *IEEE Region 6 Ethics Contest (held at UCLA), First Place*
- *IEEE Student Professional Awareness Venture (S-PAVe) (held at UCLA)*

UCLA IEEE club programs OPS and Micromouse allow students to get hands-on experience (left).

Natcar program goal is to build a robot that will follow a line (below).

Industrial Affiliates Program

The Electrical Engineering Department is dedicated to initiating and forging partnerships with industry, in which both the school and the companies involved benefit from the exchange of technology innovations and talent. The Industrial Affiliates Program (IAP), initiated in 1981, provides a variety of services that include:

- Nurturing the talent pipeline between UCLA and IAP members
- Providing access to UCLA intellectual capital
- Exploring collaborative research opportunities
- Providing access to state-of-the-art research facilities
- Enhancing industry visibility on campus

The department also serves as an invaluable consulting resource to our affiliate members. In turn, a company's participation in IAP provides essential program enhancement and aid to students with a portion of the membership fees being applied towards laboratory, instructional and other equipment needs. More details are available at the IAP website:

http://www.ee.ucla.edu/people/industry

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