[2018-2019]

ELECTRICAL AND COMPUTER ENGINEERING

UC San Diego

JACOBS SCHOOL OF ENGINEERING

Electrical and Computer Engineering

LETTER FROM THE CHAIRS

Welcome to the Electrical and Computer Engineering Department (ECE) in the UC San Diego Jacobs School of Engineering. ECE has long been a powerhouse at UC San Diego with its innovative and impactful research, led by top-notch faculty and outstanding graduate and undergraduate students. When our Chancellor challenged us to "break from the ordinary" to make the world a better place, ECE accepted it with a conviction that the work we do can change our future.

Our faculty conduct extraordinary research that pushes the boundaries of electrical and computer engineering to new limits. We added six new faculty members in the last two years to our growing department of 58 active faculty, 16 adjunct faculty, and 12 affiliated faculty. We are proud to have had two of our faculty elected to the National Academy of Engineering (NAE) over the past two years, bringing the total number of NAE members to 10. Our faculty continue to earn awards for their research and have been honored by their peers as fellows in the major organizations in their fields.

This year, ECE admitted a record number of MS students and launched two new graduate programs to expand research areas within the department—Applied Electromagnetics and Machine Learning & Data Science. Research initiatives on Machine Learning & Data Science support seven faculty teams on fundamental development and exciting application domains. In the coming year, we will focus on developing a graduate program in Medical Imaging in collaboration with the departments of Radiology and Bioengineering.

We continue to expand research opportunities for our students. The second year of our Summer Research Internship Program (SRIP) provided 62 projects with 36 faculty to 107 BS and MS students. In collaboration with the Department of Psychiatry, we were able to further expand internship opportunities with the Engineering Psychiatry Research Program (EPRP). We had 23 students participate in 14 projects under the guidance of nine faculty. We are exploring opportunities to collaborate with other departments and centers in the School of Medicine to develop additional internship programs.

Our new hands-on and systems-level courses have helped recruit a record number of new undergraduate students. These courses inspire students and help them connect the dots between theory and application. Additionally, we were honored to organize and host eight universities at the Electrical and Computer Engineering Department Heads Association (ECEDHA) Hands-on Workshop this summer, where we shared course development tips and materials for hands-on courses.

Outreach is at the forefront of our minds, and our efforts have grown due to the strength and coordination of our student organizations: IEEE, Eta Kappa Nu (HKN), and Project in a Box (PiB). Our alumni were invited to join us for Alumni-Family workshops, where families worked together to build a robot using one of our PiB projects. The workshops were a huge success and touched not only our alumni, but hopefully future students who will join the ranks of ECE alumni. To support our student organizations' outreach efforts, Professor Emeritus Charles W. Tu initiated the Charles W. Tu Collaborative OutReach and Education (CORE) ECE Endowment. As this endowment grows, so too will our outreach to middle school and high school students who usually have little exposure to STEM fields like electrical engineering.

We encourage you to read more about what we have done this year. Come visit us and see what it is about the UC San Diego ECE Department that permits us to be leaders in the industry and keeps us among the best!

Truong Nguyen, PhD
Chair

Bill Lin, PhD
Vice Chair

Truong Nguyen, PhD
Chair

Bill Lin, PhD
Vice Chair

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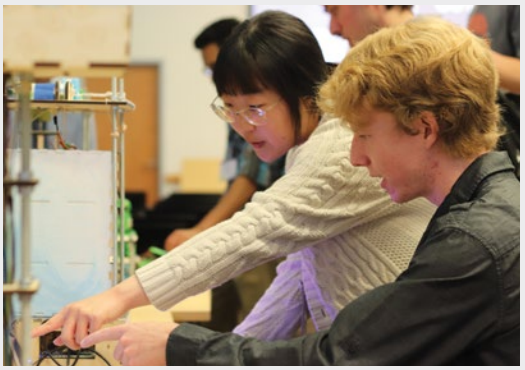
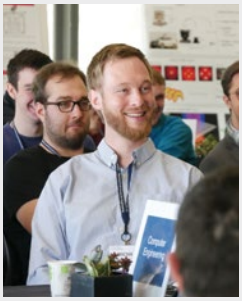




ECE BY THE NUMBERS

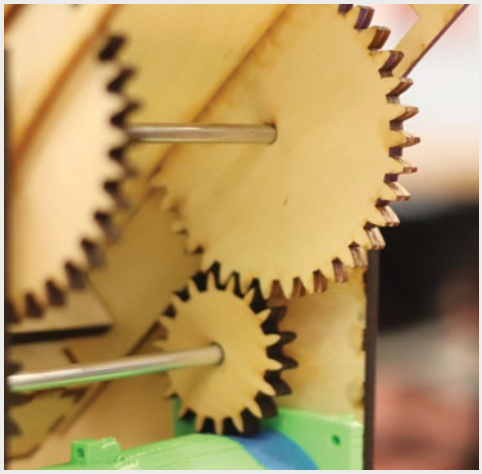
2018–2019

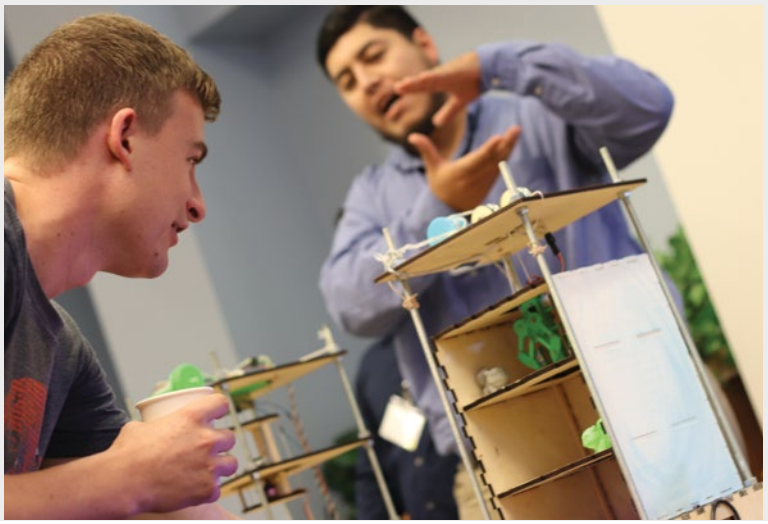
RESEARCH EXPENDITURES **$31M**

58 FACULTY

16,000+ ALUMNI

UNDERGRADUATE STUDENTS	1300
GRADUATE STUDENTS	970
MS STUDENTS	650
PHD STUDENTS	320
INCOMING MS STUDENTS	400
INCOMING PHD STUDENTS	60





NEW FACULTY

TZU-CHIEN HSUEH [ASSISTANT PROFESSOR]

Tzu-Chien Hsueh received his Ph.D. in Electrical and Computer Engineering from the University of California Los Angeles.

Hsueh's research focuses on analog and mixed-signal integrated circuits and systems in the applications of high-performance communications, data centers, Ethernet, and cloud computing networks. The major sub-topics under his development include high-speed and low-power wireline electrical/optical transceivers, channel equalizations, clock-and-data recovery, silicon photonics, switch-capacitor filters, data-conversion circuits, on-chip performance analyzers, audio-band transceivers, and digital/mixed signal processing techniques.

Hsueh is continuously exploring circuit techniques for the realizations of various communication theories and signal modulation schemes. He welcomes motivated, honest, and responsible graduate students to join his newly started research group.

JOHN R. SANFORD [PROFESSOR OF PRACTICE]

John R. Sanford received his Ph.D. from École polytechnique fédérale de Lausanne. He was the CTO of Ubiquiti Networks where he worked on the development of next generation wireless communications systems that employ advanced MIMO techniques. Before a long career in industry, he was an Associate Professor at Chalmers University of Technology where he taught courses and conducted research related to Electromagnetics, Antennas, and Array Signal Processing (MIMO).

Sanford uses advanced artificial intelligence methods to develop products with performance that would be impossible to realize using conventional techniques. These products include wind turbines, microwave antennas, transceivers and related products including, filters, amplifiers, self-organizing networks (SON), and MIMO signal processing algorithms. His most recent focus is on self-organizing networks for large scale Wi-Fi and wireless backhaul.

FACULTY HONORS

This past academic year has been a tremendous success for many of our faculty. Here are some of the awards and accolades our outstanding faculty have earned.

ERIC FULLERTON [PROFESSOR]

Eric Fullerton was elected to the **National Academy of Engineering** "for invention and development of multilayer, high-density magnetic recording media." After years of working in industry, Fullerton joined our faculty and serves as the Director of the Center for Memory and Recording Research (CMRR), one of the world's leading institutions for research on storage and memory technologies including magnetic recording. Fullerton's research impacts are broad and include efforts to develop cutting-edge nanotechnologies to build hard disk drives and non-volatile memories that can store data at unprecedented levels.

NAMBI SESHADRI [PROFESSOR OF PRACTICE]

Nambi Seshadri, professor of practice and Quantenna's chief technologist, received the **2018 IEEE Alexander Graham Bell Medal Award** for exceptional contributions to wireless, networking and engineering. In addition to this highest honor, Seshadri's prize consisted of a gold medal, a bronze replica, a certificate, and an honorarium.

"The innovations by Nambi form the basis for some of today's Wi-Fi and other wireless networking standards and systems now in use by billions of Wi-Fi users," said Sam Heidari, Chairman and Chief Executive Officer at Quantenna.

FACULTY HONORS

BEHROUZ TOURI [ASSISTANT PROFESSOR]

The American Automatic Control Council selected Behrouz Touri for the **2018 Donald P. Eckman Award.** He was recognized "for outstanding contributions to stochastic methods applied to distributed and networked control systems." The award is given annually to an outstanding engineer under the age of 35 in the field of automatic control.

Touri's research aims to provide a fundamental understanding of behaviors in interconnected random network systems. Applications of his work include studying opinion dynamics over random networks; studying team formation in a network of swarm robots; analyzing network influence in social networks with random connectivities; and designing mechanisms for efficient power grids.

DINESH BHARADIA [ASSISTANT PROFESSOR]

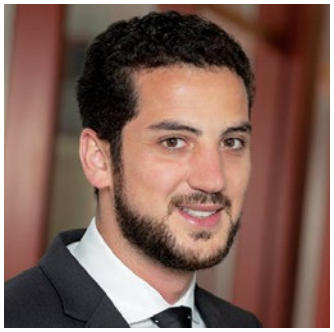
Dinesh Bharadia was honored as one of ***Forbes* 30 under 30.** It was a long-standing assumption that it was impossible for a radio to transmit and receive at the same time at the same frequency. Bharadia proved that assumption wrong by building a radio that did just that. His research was commercialized by Kumu Networks and Deutsche Telekom and has led successful field tests of the technology.

ALEX VARDY [PROFESSOR]

Since 2013, **Alex Vardy has held the Jack Keil Wolf Endowed Chair in Electrical Engineering** here at the Jacobs School of Engineering.

Vardy is a leading expert in coding theory, information theory, and communications. Over a span of three decades, Vardy has contributed consistently and profoundly to the theory and practice of error-correcting codes and to their study in complexity theory. With the recent adoption of polar codes in the 5G wireless standard, his work has also had a tremendous impact in practice.

SHADI DAYEH [ASSOCIATE PROFESSOR]



Shadi Dayeh received the **2018 International Symposium on Compound Semiconductors (ISCS) Young Scientist Award** for "contributions to overcoming the critical thickness limitation in heteroepitaxy." Established in 1986, the ISCS Young Scientist Award acknowledges technical achievements in the field of compound semiconductors by a scientist younger than 40.

Dayeh has advanced heteroepitaxy at two fronts. At Los Alamos National Lab, he established the growth of axial and radial Germanium/Silicon heterostructures and carried out the first experimental measure of an increased critical thickness in core/shell nanowires. At UC San Diego, his lab expanded the growth of Gallium Nitride on Si from ~4.5μm to over 20μm, exceeding the limitations of the thermal mismatches based on the principle of diverting the stresses to planar surfaces that are parallel to crack planes.

MASSIMO FRANCESCHETTI [PROFESSOR]

Massimo Franceschetti was named **2018 IEEE Fellow,** a distinction reserved for select IEEE members who have extraordinary accomplishments in any of the IEEE fields of interest.

His recent research explores key mechanisms underlying how large-scale distributed systems, including wireless networks, handle, process, and communicate information. Such pervasive networking is expected to lead to massive changes in the way we interact with the world, and Franceschetti's papers in this area span a continuum from algorithms, models of wave propagation, network analysis and design, information theoretic limits, and control technologies.

IAN GALTON [PROFESSOR]

Ian Galton was named **Skyworks Professor in High Performance Communications Devices and Circuits.** He specializes in the invention, analysis, and integrated circuit implementation of critical communication system blocks. He and his research group have developed many enabling techniques that enhance the performance of mixed-signal and radio frequency integrated circuits for communications systems.

FACULTY HONORS

DUYGU KUZUM [ASSISTANT PROFESSOR]

Duygu Kuzum received a **National Science Foundation (NSF) Career Award** for her project "Bio-artificial Neuromorphic System Based on Synaptic Devices." Her goal is to develop a neuromorphic interface made of synthetic synaptic devices to form a stable, long-term input/output interface to the brain. Such a technology can help development of targeted and selective neuromodulation therapies for various neurological disorders affecting one billion people worldwide.

NIKOLAY ATANASOV [ASSISTANT PROFESSOR]

Nikolay Atanasov received the **Best Conference Paper Award** at the 2017 IEEE International Conference on Robotics and Automation. Traditional approaches for simultaneous localization and mapping (SLAM) in robotics rely on geometric features such as points, lines, and planes to infer the environment structure. They make hard decisions about the (data) association between observed features and mapped landmarks to update the environment model. This paper makes two contributions to the state of the art in SLAM. First, it generalizes the purely geometric models by introducing semantically meaningful object landmarks, represented as structured models of mid-level part features. Second, instead of making hard, potentially wrong associations between semantic features and objects, it shows that SLAM inference can be performed efficiently with probabilistic data association. The approach not only allows building meaningful maps (containing doors, chairs, cars, etc.), but also offers significant advantages in ambiguous environments.

ANDREW KAHNG [PROFESSOR]

Andrew Kahng and his students received the **Best Paper Award at the 2018 International Symposium on Physical Design** for "Prim-Dijkstra Revisited: Achieving Superior Timing-Driven Routing Trees," a collaboration between UC San Diego and Cadence Design Systems, Inc.

BOUBACAR KANTÉ [ASSOCIATE PROFESSOR]

Creating the first "topological laser" was recognized as one of the top **10 breakthroughs of 2017 by *Physics World*.** The device, created by Boubacar Kanté and colleagues, involves light snaking around a cavity of any shape without scattering—much like the motion of electrons on the surface of a topological insulator. The laser works at telecom wavelengths and could lead to better photonic circuits or even protect quantum information from scattering.

The work was also featured in *Science* 2017. "Laser Cavities Take on New Shapes and Functionalities" demonstrated the first laser cavity that can confine and propagate light in any shape imaginable, even pathways with sharp bends and angles. Kanté's goal is to overcome the fundamental limitations of optical devices and uncover new physical principles that can enable what was previously thought impossible.

Kanté and Babak Bahari, a fourth year graduate student, won **the grand prize at the 2017 Triton Innovation Challenge for their Solid State LIDAR Startup.** The team, BIC LIDAR, focused on their system's possible applications in wildfire detection in forestry.

FARINAZ KOUSHANFAR [PROFESSOR]

Farinaz Koushanfar was awarded the **2018 ICCAD Ten Year Retrospective Most Influential Paper Award** for her 2008 paper titled, "Lightweight Secure PUF." The paper explores a new methodology for PUF design that significantly lowers predictability and higher resilience against circuit faults, reverse engineering, and other security attacks.

Koushanfar's research goal is to build more intelligent embedded computer systems that can ensure low-overhead security and trust, reduce energy usage, and improve performance within the physical resource constraints. Her work has applications in Internet of Things (IoT), antipiracy systems, medical devices, automotive systems, deep learning networks, and secure bioinformatics.

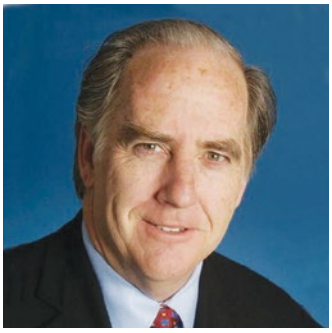
Mohammad Ghasemzadeh, Mohammad Samragh and Koushanfar earned Field-Programmable Custom Computing Machines (FCCM) **Best Paper 2018** at the 26th Annual IEEE International for "ReBNet: Residual Binarized Neural Network."

Azalia Mirhoseini, Bita Rouhani, Ebrahim Songhori and Koushanfar earned **Best Paper Award** at the 6th International Workshop on Parallel and Distributed Computing for Large Scale Machine Learning and Big Data Analytics for "ExtDict: Extensible Dictionaries for Data- and Platform-Aware Large-Scale Learning."

SUJIT DEY [PROFESSOR]

Sujit Dey was awarded the **Jacobs Family Chair in Engineering Management Leadership** for his leadership at the UC San Diego Institute for the Global Entrepreneur, which is the centerpiece of the collaboration between the Jacobs School of Engineering and the Rady School of Management. The endowment is reserved for faculty with joint appointments between the Jacobs School of Engineering and the Rady School of Management to further build innovative programs in education and in technology commercialization.

DAVID WHELAN [PROFESSOR OF PRACTICE]



David Whelan was selected as an **2018 IEEE Fellow.** Whelan's expertise is in electromagnetic systems engineering for sensing, imaging and communications, as well as in the management of Science, Technology and Innovation. He designs and engineers aircraft, RADAR and LIDAR systems, space-based communications and navigation systems, and diagnostic sensors for high energy density physics experiments. His work has been used in space mission systems, airborne navigation and surveillance systems.

PATRICK MERCIER [ASSOCIATE PROFESSOR]

Patrick Mercier received the **2017 Biocom Life Sciences Catalyst Award.** The award celebrates up-and-coming entrepreneurs, academics, investors, corporate leaders and business advisers who are making a lasting and positive mark on Southern California's life science industry prior to reaching their 40th birthday. Mercier also received the **CAREER award from the NSF.** His research goal is to dramatically reduce the power needed to communicate information around the body in order to enable the next generation of wearable medical and wellness devices.

TSE NGA "TINA" NG [ASSOCIATE PROFESSOR]

Tse Nga "Tina" Ng won a **2017 Hartwell Individual Biomedical Research Award** which provides support for three years at $100,000 direct cost per year. She was recognized for her point-of-care biomechanical device for quantitative assessment of spasticity through-the-skin with wearable, thin, flexible devices.

Ng and Jason Azoulay, with the University of Southern Mississippi, won **second place at the illustrious Bell Labs Prize** competition for their invention of new photosensitive polymer materials that can be used for health and medical monitoring

Ng and her group (with postdoc Zhenghui Wu and graduate student Weichuan Yao) won the **Chemical Science Award from the 9th Asian Conference on Organic Electronics** for their work in elucidating the detectivity limits in shortwave infrared organic photodiodes.

Quyen Hoang and Carl Demolder won the **ZPower Battery Bowl Design Challenge,** an undergraduate engineering competition with a cash prize of $25,000. Mentored by Amit Moran, Ph.D. , and professors Tina Ng and Hari Garudadri, Hoang and Demolder used ZPower silver-zinc rechargeable batteries to power an innovative and much-needed medical device called Handske. Handske is a spasticity evaluation tool designed to assist doctors and therapists in the monitoring and treatment of patient spasticity over time, as well as gauge the efficacy of drug and physical therapies.

CURT SCHURGERS [ASSOCIATE TEACHING PROFESSOR]

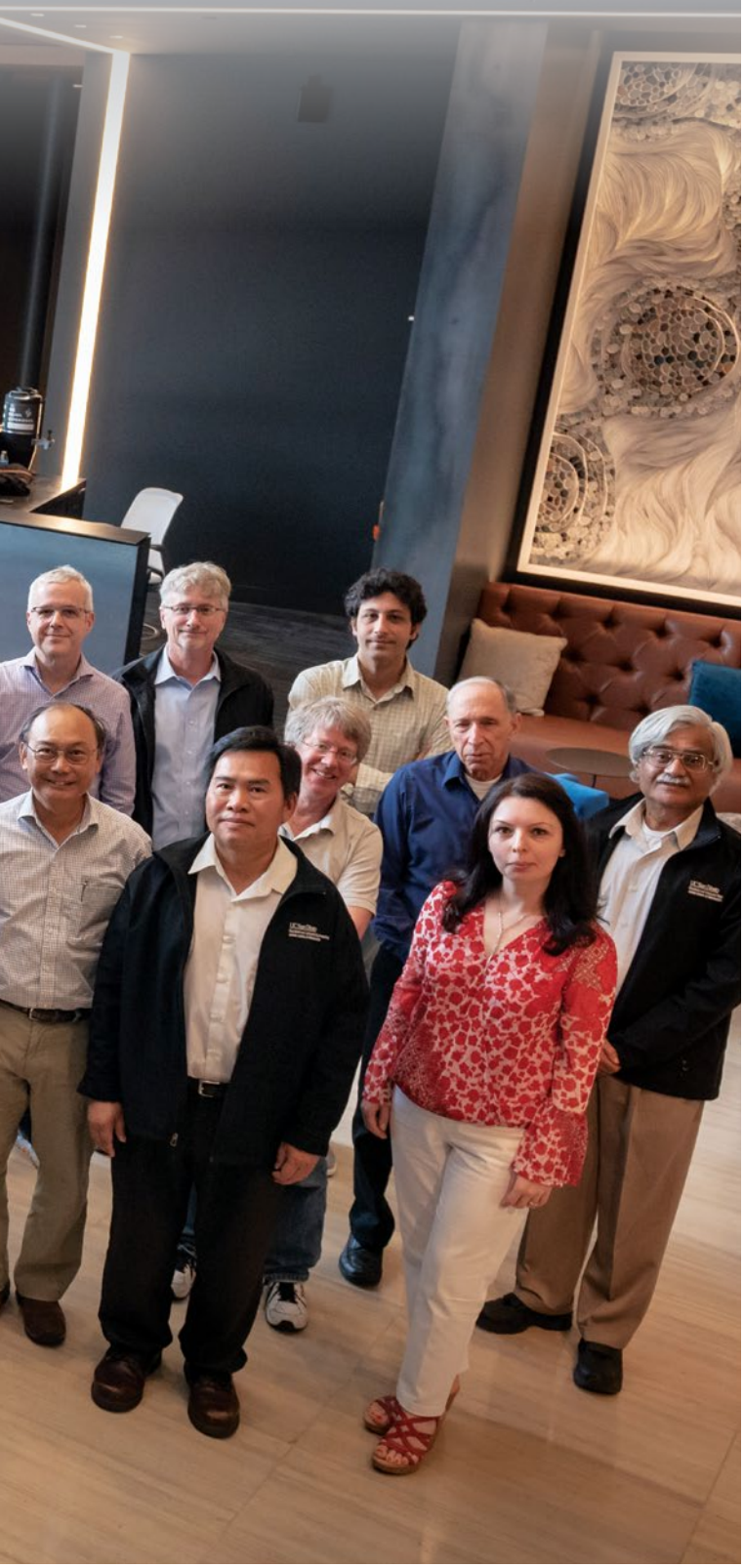
Curt Schurgers received a **Fulbright U.S. Scholar award** to teach project-based computer science classes at International Ataturk Alatoo University in Bishkek, Kyrgyzstan. He brought his signature brand of hands-on learning to a country with a marked need for instruction in engineering and computer science.

His courses incorporate Arduino and Raspberry Pi microcontrollers to help small groups of students come up with a common goal and give them the tools—whether programming instruction or soldering irons—to make their visions real.

[2018-2019]

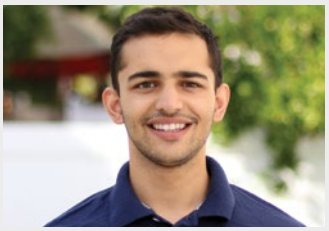
ELECTRICAL AND COMPUTER ENGINEERING

FACULTY



STUDENT AWARDS

MIHIR SATHE

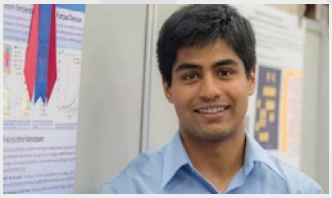


This year's **ECE Undergraduate Student Award** went to Mihir Sathe for his numerous contributions to the department. He served as HKN social chair and volunteered at several events including, HARD Hack and ECE Day. Sathe has been a tutor at the ECE Tutoring Center since Spring 2017.

SAMUEL SUNARJO

The **2018 ECE Department Award for Excellence** went to Samuel Sunario. This award is given to one graduating student per engineering department that exhibits excellence in academic, leadership, potential as alumni leader, and overall contribution to student life. Sunarjo was a pillar of the ECE community during his undergraduate career—from serving as president of HKN, to being a tutor at the ECE Tutoring Center for two years, and a member of Students for the Exploration and Development of Space. He is continuing his studies to earn his master's degree and is taking his leadership in these organizations to the next level. Sunarjo will be the lead tutor at the ECE Tutoring Center—spearheading the effort to expand the program—and will serve as a graduate advisor for HKN.

SURUJ SAMBHAV DEKA



At Research Expo 2018 more than 200 graduate students from six engineering departments presented their research. Out of 41 ECE submissions, Suruj Sambhav Deka won **Best ECE Poster** for his work on Metal-Clad Semiconductor Nanolasers for Dense On-Chip Integration. Under the guidance of Y. Shaya Fainman, Deka's work explores the viability of dense chip-scale integration of nanolasers, along with ongoing efforts to attain room-temperature, electrically pumped devices that can be modulated and/or tuned at high speeds.

HAMNA KHAN

The Gordon Engineering Leadership Center selects a handful of Gordon Scholars each year who exemplify leadership, engineering ability, communication skills, and teamwork ability. The Gordon Scholars program offers a clearly defined pathway for students to develop into engineering leaders. Hamna Khan was **selected for her numerous contributions to the department and the engineering community** including directing HackXX and being Vice Chair of IEEE, among her research and numerous internship positions.

AWARDS

The 2018 Annual ECE Awards Ceremony honored numerous students, instructors, and alumni for their contributions to department academics, research, and service. The following individuals were recognized for their efforts.

Best Teaching Award
Paul Siegel (Undergraduate)
Nikolay Atanasov (Graduate)
Piya Pal (Graduate)

Best Ph.D. Thesis
Joseph Connelly
Peter Orlando Weigel

Undergraduate Research Award
Alexander Bergman

Best TAs
Christian Koguchi (FA17)
Karcher Morris (FA17)
Sonika Obheroi (SP17)
Bentao Zhang (WI18)

Best Tutor
Andrew Saad

Best Lecturer Award
Rick Gessner
Ramsin Khoshabeh

Student Service Awards
Hamna Khan (Undergraduate)
Cooper Levy (Graduate)
Michael Ostertag (Graduate)
Mihir Sathe (Undergraduate)

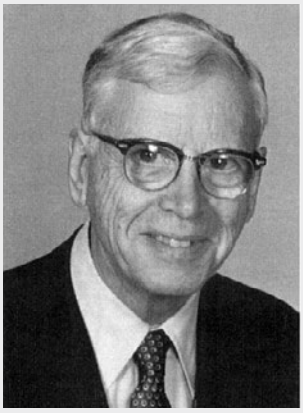
Exceptional Contributions to ECE (Alumni Service Awards)
Curtis Williams, '96
Robert Wolff, '15

[2017–2018]

HENRY G. BOOKER MEMORIAL HONORS AWARD HONOREES

The following students received the **Henry G. Booker Award** in 2017-2018. In the spirit of Dr. Booker's educational philosophy, the department recognizes students for their hard work, dedication, and commitment to their studies. They achieved this honor by obtaining a GPA of 3.7 or above in all of their ECE courses.

Alexander Bergman
Nathaniel Danandeh
Jay Gandhi
Chenghao Gong
Christian Jack Gunther
Brian Manuel Henriquez
Shiyuan Huang
Ali Jafrani
Joseph Kadifa
Jason Kelley
Thy Le
Junshan Leng
Wei Nan Liang
Jianling Liu
John Messerly
Jared Pham
Haotian Sheng
Samuel Sunarjo
RunXuan Tay
Gustaaf Vogel
Johnny Wang
Tianyi Wang
Rong Xi
Alan Yessenbayev
Christopher Yin
Matthew Yu



HENRY BOOKER

FRONT:
Jack Messerly
Jared Pham
Samuel Sunarjo
Brian Henriquez
Alan Yessenbayev
Christopher Yin
Matthew Yu

MIDDLE ROW:
Jianling Liu
Runxuan Tay
Thy Le
Jason Kelley

BACK ROW:
Nathaniel Danandeh
Alexander Bergman
Chenghao Gong
Alex Gunther
Ali Jafrani
Junshan Leng
Haotian Sheng

NOT PICTURED:
Jay Gandhi
Shiyuan Huang
Joseph Kadifa
Wei Nan Liang
Gustaaf Vogel
Johnny Wang
Tianyi Wang
Rong Xi

CENTER FOR WIRELESS COMMUNICATIONS

5G AND BEYOND: HEALTH CARE AND SMART TRANSPORTATION

The 2018 5G Forum hosted by the Center for Wireless Communications (CWC) focused on the new applications this enhanced communication network will enable, since its technical components are now well defined. 5G connectivity, which is expected to become a reality in 2019 with limited local deployments as early as 2020, will enable latency of less than one millisecond, speeds upwards of 10 gigabits per second, and extremely high reliability, while supporting 10 to 100 times more devices on the network than currently possible.

Two applications in particular are expected to dramatically evolve thanks to 5G—health care and autonomous vehicles.

CONNECTED HEALTH

Digital health and the promises of 5G can make future goals a reality. From video visits to remote patient monitoring, home health visits and precision medicine, these initiatives can better serve patients while cutting down on the costs of healthcare.

The CWC is also spearheading a virtual physical therapist program that allows the physical therapist to get sensor-based feedback on the motions and amount of pressure the patient is using in their at-home prescribed stretches or strength activities.

The technology will also allow for monitoring patients remotely, beginning with those with chronic conditions, such as diabetes and hypertension. 5G will then be able to continuously monitor a patient's glucose level or blood pressure, and immediately alert their physician and health team when they hit dangerous levels.

"Our researchers are also working with partners to see if we can get to a day where data collection is continuous, automatic and streaming—no manual intervention," said Sujit Dey, CWC Director.

UC San Diego's own healthcare system is already taking advantage of this data to increase positive patient outcomes. Clinicians are starting to leverage the discreet data in an electronic medical record when they encounter a situation with no clear best practice, through what UC San Diego Health is calling a Clinical Informatics Console Service.

SMART TRANSPORTATION

Another application in need of 5G is smart transportation—connected and autonomous cars, and smart city streets. CWC researchers are working to enable more collaboration between vehicles, infrastructure and even pedestrians, so that it's possible to not only have extremely high fidelity maps of the present, but create predictive maps as well.

"Instead of one vehicle being intelligent, can we have multiple vehicles talking to each other and creating collaborative awareness?" Dey asked. This collaborative awareness, in addition to 5G allowing cars to share their intent with each other, will enable safer and more efficient streets.

Researchers like Xinyu Zhang are exploring the use of the millimeter wave spectrum (30 gigahertz to 300 GHz) to ensure 5G can provide the low latency, high reliability and fast speeds needed for such platforms.

Health care and smart transportation are two of many applications that 5G connectivity is expected to have a significant impact on in the coming years. The forum discussed how decreased latency and increased reliability will allow for more industrial uses of internet-enabled devices to reshape the industrial sector with sensors in settings like oil refineries and rigs, container ports and mines. The forum also explored how 5G will make virtual, augmented and mixed reality platforms more tenable in a variety of settings.

GRADUATE STUDENTS

[RESEARCH + EXPERIMENTATION]

SHAHAB SARMASHGHI

Computational Methods for Identifying Biological Samples

Imagine having to complete a jigsaw puzzle with only a few pieces. At Professor Siavash Mirarab's lab (ECE) and Professor Vineet Bafna's lab (Computer Science and Engineering), Ph.D. student Shahab Sarmashghi is currently focused on developing methods to tackle a similar problem where the complete picture is the "genome" that contains all genetic information, and millions of short DNA sequences are the puzzle pieces. The goal is to utilize this information using fast and accurate computational methods for the purpose of identifying biological samples with a whole host of applications.

Sarmashghi developed a method called Skmer, which accurately estimates the hamming distances between complex genomes by only looking at low-coverage (sparse) and erroneous sets of short reads. High accuracy and low data requirements of Skmer pave the way for a variety of applications that can benefit from low-cost, fast, and informative whole genome sequencing (WGS) analysis. It could therefore equip airports with sequencing machines to trace the source of animal parts and detect illegally poached wildlife or find applications in food provenance and contamination tests.

WEICHUAN YAO

Using Novel Organic Semiconductors in SWIR Photodetectors

There is a great wealth of chemical and structural information in the infrared spectral region, and infrared light detection is the basis for numerous applications in biomedical fields, communications, environmental monitoring, etc. Shortwave infrared (SWIR, wavelength from 1–3 micron) detectors, however, are expensive because of their complex manufacturing processes and constraints associated with conventional epitaxial semiconductors. Ph.D. student Weichuan Yao started his research in SWIR photodetectors using novel organic semiconductors to overcome the material limitations in existing SWIR imaging technologies after joining Professor Tina Tse Nga Ng's flexible electronics lab.

Yao's research focuses on understanding the recombination mechanisms, enhancing the device efficiency and suppressing the dark noise in organic devices. Organic semiconductors offer the potential to lower manufacturing costs and realize economical SWIR imagers. With Yao's efforts, the current SWIR devices developed in the lab exhibit detectivities as high as silicon in the visible and are comparable with germanium photo detectors in the SWIR region.

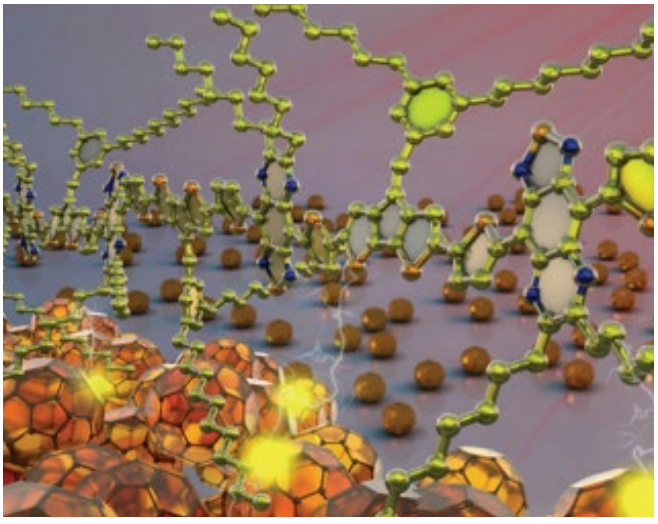


Figure: Molecular structures of the organic materials used for shortwave infrared detection.

DIA'AALDIN BISHARAT

Guiding Electromagnetic Energy into a Confined Line

The ability to focus electromagnetic energy, such as light, is key to modern communications, sensing, and quantum processing technologies. Extensive research has been done on localization and transmission of waves over material interfaces, as well as flat surfaces, without the aid of enclosing structures. Dia'aaldin Bisharat's work in Professor Dan Sievenpiper's lab takes this further by confining the energy to a simple line between two thin sheets, thus creating a "Line Wave", the smallest waveguide possible. By engineering the adjacent sheets to exhibit complementary properties, they provide an equal but opposite effect on the electric and magnetic components of the wave.

By squeezing waves into a guiding channel of virtually zero width, electromagnetic fields have a singularity at the line interface, meaning their intensity approaches infinity in the mathematical limit. This field concentration may be useful for exploring nonlinear effects, for ultra-sensitive bio-molecular sensing, as well as variety of enhanced light-matter interactions, such as chiral quantum processes. It also gives rise to orthogonal polarizations which travel only in predefined directions opposite to each other. This is promising for building efficient and robust photonic-integrated circuitry, a goal that has been the driving force behind photonic topological insulators, yet without their restrictive performance requirements or design complexity.

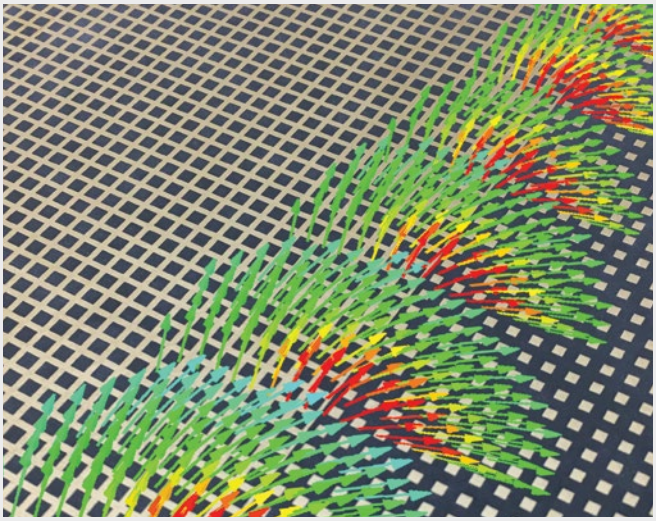
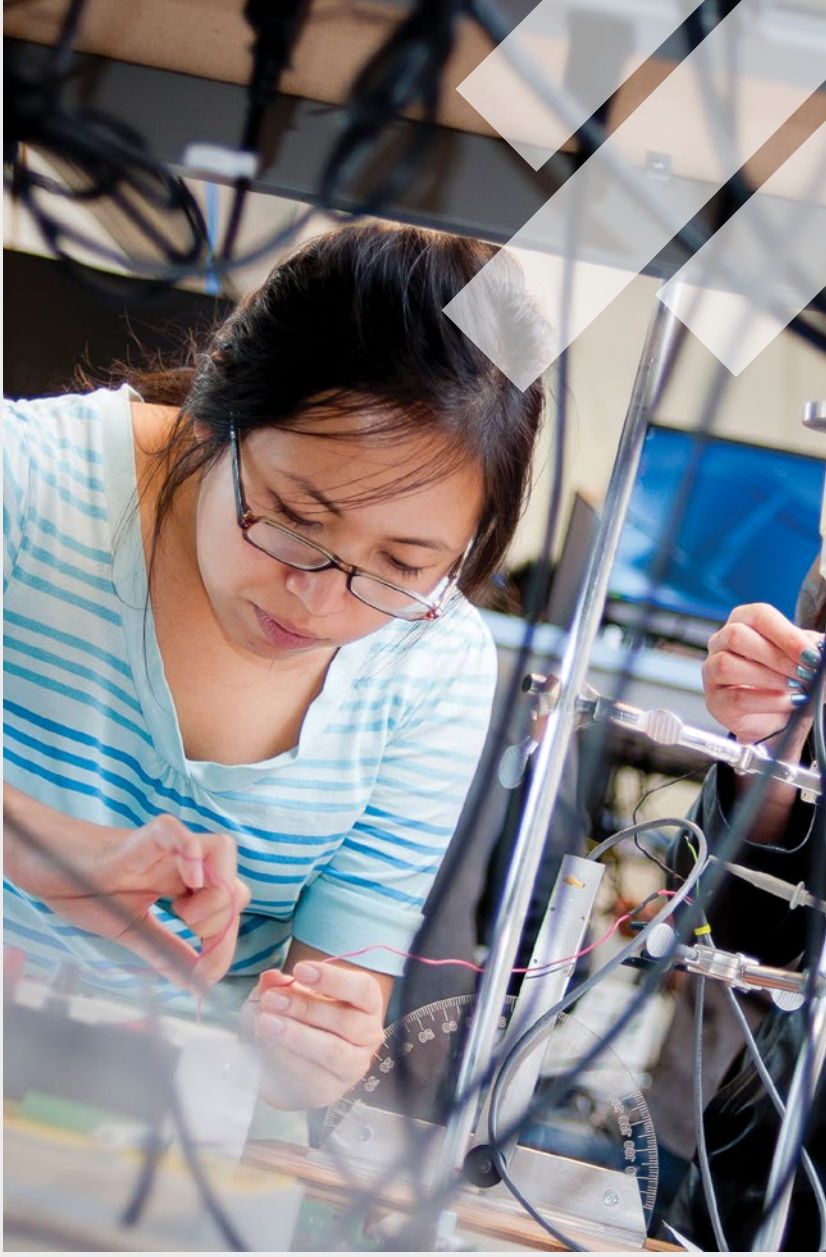


Figure: "Line waves" are confined to the infinitesimal boundary between two impedance surfaces. They have the unusual property that a forward-propagating mode is not easily scattered backward due to the symmetry of the surfaces.



GRADUATE STUDENTS

[RESEARCH + EXPERIMENTATION]

HAMED OMIDVAR

Stochastic Dynamical Systems

Ph.D. candidate Hamed Omidvar's research with Professor Massimo Franceschetti on stochastic dynamical systems is inspired by the work of economist and Nobel Laureate Thomas C. Schelling, pioneer in studying how local interactions in a social context can have global consequences that were not originally intended nor desired. Schelling studied the underlying process leading to social segregation in U.S. cities in the 1960s. While Schelling's conclusions were based on simulations, rigorous understanding of his proposed models has been an open problem for more than half a century.

Omidvar's contributions were to mathematically explain the behavior of these models for a wide range of their parameters. He was able to provide rigorous proofs that advance our understanding of the mechanisms behind community formation and social segregation. For example, while his work uses tools from mathematical engineering and systems theory, his results help us better understand how immigrants can form communities that model the social landscape of a country, and how integration can be achieved.

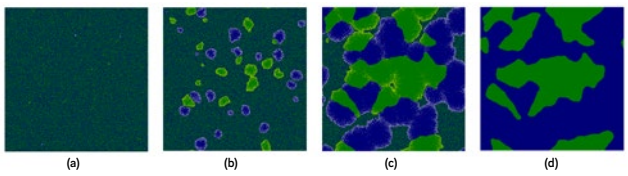


Figure: Simulation results of a Schelling-type model: (a) initial state, (b,c) intermediate states, (d) steady state. Each green or blue dot represents an agent of a given type. At the beginning of the process all agents are mixed at random and each agent interacts with a small subset of other agents in its surrounding area (i.e., its neighborhood). At the end of the process large areas of same type agents have appeared. This mechanism explains the formation of large clusters of segregated social worlds of agents of the same type.

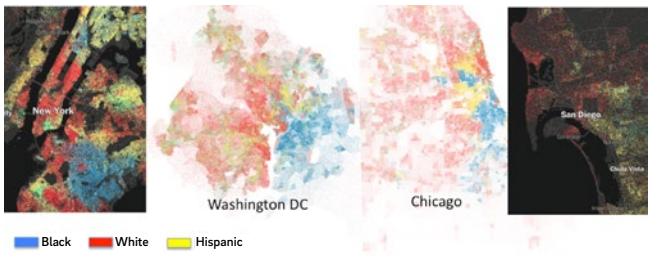
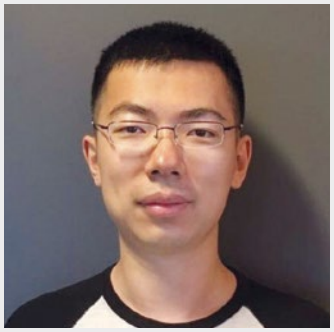


Figure: Real data showing the separation of different racial and ethnic groups into separate social worlds in U.S. cities. Source: Washington Post, 2018, https://www.washingtonpost.com/graphics/2018/national/segregation-us-cities

"UC SAN DIEGO'S TOP RESEARCHERS MAKE OUR REGION A GLOBAL LEADER IN TECHNOLOGY INNOVATION."

—REP. SCOTT PETERS



MO SHAN

Semantic Localization and Mapping

Ph.D. student Mo Shan works in Professor Nikolay Atanasov's Existential Robotics Laboratory (ERL) on semantic localization and mapping for autonomous robots. His research spans object detection, visual-inertial odometry and building semantic maps. Shan is attempting to develop an object-oriented Visual Inertial Odometry (VIO) framework that unifies metric and semantic information. His work focuses on weakly supervised convolutional neural network (CNN) architectures, capable of detecting category-specific object parts (e.g., windshield, door, wheels of a car) that don't require large amounts of annotated data.

Building a map embedded with semantic information is critical for long-term navigation. Shan is developing algorithms that could unify geometry, semantic object detection, and temporal properties in a common representation of the environment. While sparse maps consisting of geometric and semantic point features can be maintained efficiently and accurately, sparse maps do not provide sufficient information to ensure collision-free navigation. He is working to learn feature representations that could reconstruct a dense map of the environment while keeping the complexity tractable.

Figure: Visual odometry using keypoints detected on cars.

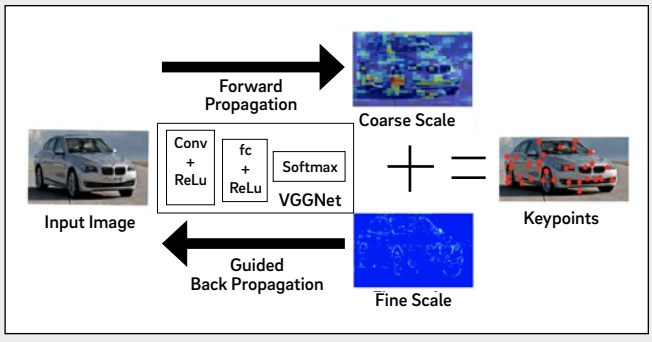
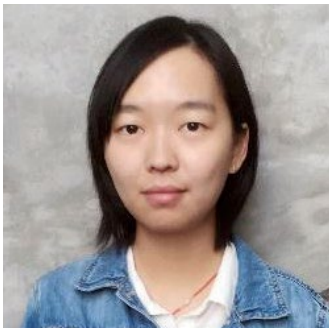


Figure: Weakly supervised semantic keypoint detection.



WENCHUAN WEI

Connected Health and Machine Learning

Wenchuan Wei has been working on a connected health project in the Mobile Systems Design Lab under the guidance of Professor Sujit Dey, that focuses on the development of a remote and personalized training, monitoring, and recommendation system for patients who need physical therapy. Wei aims to develop a remote training system that can help patients with accurate physical therapy, while letting the physical therapist track progress and compliance of their patients. The machine learning-based algorithm could be used as a virtual physical therapist, with the advantages of providing accurate, on-demand and personalized care.

The patient can train themselves at home using a cloud-based system where avatars provide visual instructions and a motion capture sensor Kinect captures their movements. A machine learning-based algorithm then understands the patient's movements and identifies errors. Based on the patient's error, a machine learning-based task recommendation model then provides automatic task update recommendations. If the model recommends a new task, it will be rendered on the cloud and sent to the patient's device for practice. If the model recommends that the patient should repeat the current task, a guidance video is rendered and sent. The physical therapist can be remote to supervise the entire process. It has the potential of significantly reducing cost and can be particularly useful for remote care.

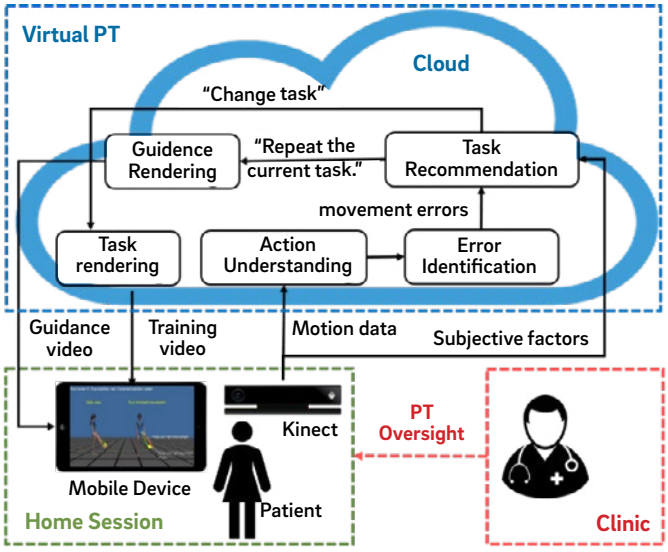
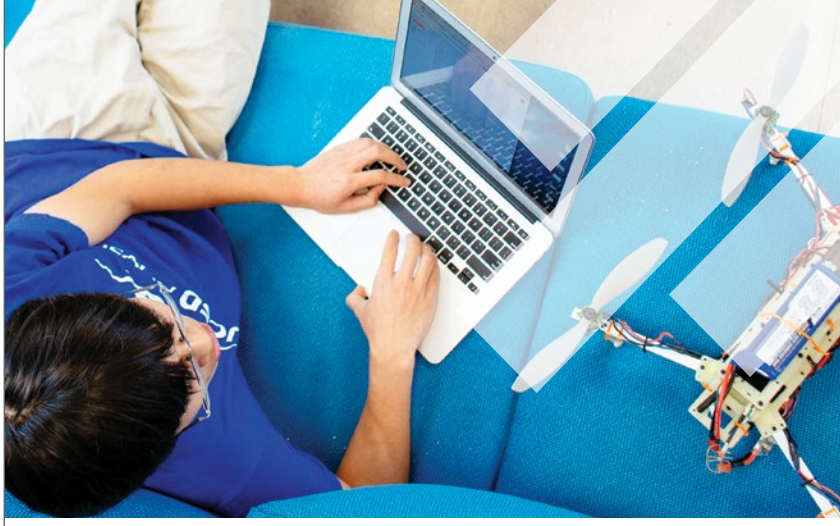
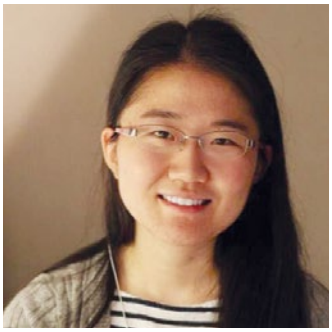


Figure: Architecture of the proposed remote training system.



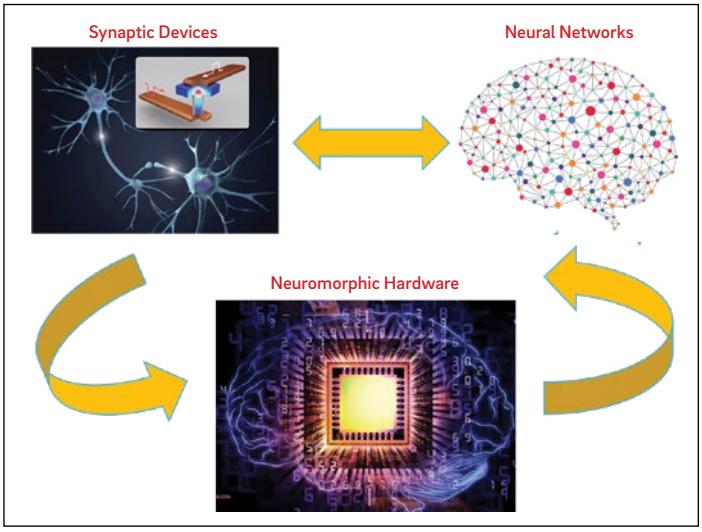


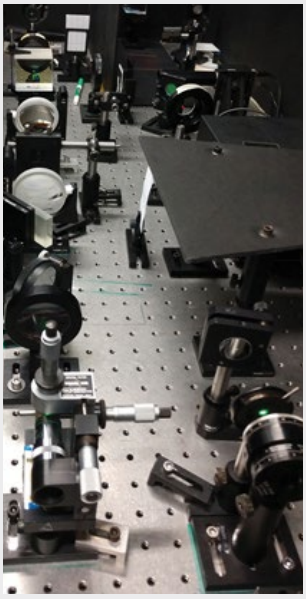
YUHAN SHI

Algorithms for Energy Efficient Neural Network Hardware

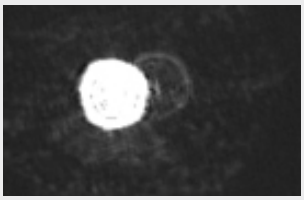
Ph.D. student Yuhan Shi works in Professor Duygu Kuzum's Neuroelectronics lab. She is passionate about her current research on algorithm device co-design for energy efficient implementation of neural networks in hardware using emerging nonvolatile memory devices. Shi has developed an alternative platform to train neural networks that don't require substantial computing power and time. Her particular interest is in on-device training using emerging nonvolatile memory devices to reduce energy and increase efficiency of computation for AI applications.

Shi's research is both hardware and software related. On the hardware end, she aims to systematically characterize the behavior of the resistive synaptic devices. She successfully built an experimental pulse programming setup and a GUI for programming the devices in different conductance regimes with multilevel states. On the software end, Shi focuses on using spiking neural networks (SNNs) for unsupervised pattern classification problems. SNNs have significant computational advantages due to sparse and event-driven updates and are therefore ideal for energy efficient hardware platforms. Her ultimate goal is to have a full hardware demonstration of using the synaptic devices for implementing on-device training.

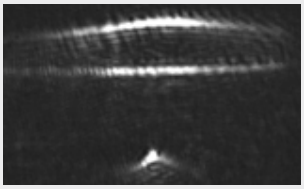




SRIP 2018 Test 1. Optical set up to produce the Gaussian spot in the picture below.



SRIP 2018 Test 2. Gaussian spot



SRIP 2018 Test 3. Line trap created by phase encoded Spatial Light Modulator

SUMMER RESEARCH INTERNSHIP PROGRAM 2018

[ENABLING FUTURE RESEARCHERS]

The 2018 Summer Research Internship Program (SRIP) for continuing ECE undergraduate students and continuing ECE MS students (including first-year MS and continuing BS/MS students) took place from June 25 to August 31, 2018.

ECE Summer Research Internships are full-time commitments in labs where interns have the opportunity to observe and participate in the activities of a research group under the supervision of a principal investigator (PI) or a member of his/her lab group. The program includes an enrichment component for students consisting of workshops on research communication, research writing, and other pertinent topics. Undergraduate students also have the opportunity to present their work at the Summer Research Conference at the culmination of the program. Students also present to faculty, staff, alumni and their families at Homecoming Weekend 2018. Research interns selected for this program receive a summer stipend and are expected to commit full-time to their internship.

This year, ECE expanded the program to include a number of companies who gave students the opportunity to work as industry interns.

Students have had great experiences in SRIP.

"Interning with Lab41 has given me huge insight into industry and has allowed me to develop a lot of technical skills. What I found most significant was how much this experience eased my doubts about the future I want. It was really motivating and made me excited to start my career. I was lucky to meet people who were very dedicated and good at what they do, but were always patient with me and invested in supporting me and helping me learn. We focused on the security of machine learning models—specifically if access to a model could allow adversaries access to private training data or other sensitive information. This may or may not sound interesting to you, but if it doesn't, I can assure you that really, it is."

—Megan Visaya, 3rd year BS student, Intern with In-Q-Tel

"The Summer Research Internship Program has been an excellent resource to learn and develop practical skills. This summer has been an excellent experience to learn many of the problems and solutions that will help make me a more well-rounded professional in the future. Having a mentor to help guide the initial thought process, as well as occasionally work alongside me, has helped accelerate my learning immensely. The opportunity to work on my own has also been invaluable to help hone my own personal problem-solving skills."

—Matt Levesque 1st year MS student. PI: S. Baghdadchi

"Working as a part of the SRIP has been a valuable experience which has taught me new skills that I never would have learned in a class. It has also allowed me to refine the skills I already had. The opportunity to have one-on-one time with a professor for over 20 weeks has given me valuable insights on industry and graduate school, and I hope the bond that we've made will last after the program."

—Ryan Lin, 3rd year BS student, PI: J. Silberman

109 STUDENTS
21 FEMALE
88 MALE

58 MS STUDENTS
14 FEMALE
44 MALE

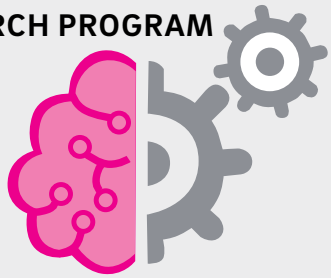
2 MS STUDENTS WORKING INTERNSHIP IN INDUSTRY

51 BS STUDENTS
7 FEMALE
44 MALE

1 BS STUDENT WORKING INTERNSHIP IN INDUSTRY

2018 ENGINEERING PSYCHIATRY RESEARCH PROGRAM

[ENGINEERING IN MENTAL HEALTH]



The Department of Psychiatry in the School of Medicine and the Jacobs School of Engineering recently partnered to launch the UC San Diego Center for Mental Health Technology (MHTech Center), which will include a new internship program for undergraduate and graduate engineering students this spring. This new program, called the Engineering and Psychiatry Research Program (EPRP), was developed out of a need for technological solutions to address mental health challenges.

According to the World Health Organization, mental disorders (depression, bipolar disorder, schizophrenia, alcohol and drug use disorders) are the leading cause of disability worldwide, but less than 50 percent of people with mental disorders are identified and treated. In this program, psychiatry faculty mentor ECE student interns in developing an engineering solution to a mental health problem.

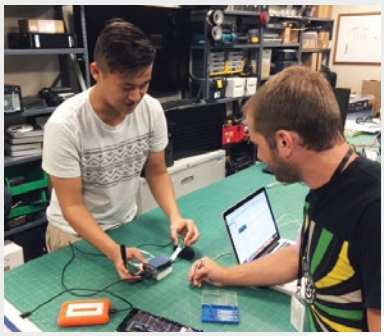
In Spring 2018, 23 engineering students enrolled in the EPRP program to work on 14 unique projects. 57 percent of the students enrolled in the EPRP for four units, while the other 43 percent enrolled for two units.

23 STUDENTS
7 FEMALE
16 MALE

19 BS STUDENTS
5 FEMALE
14 MALE

4 MS STUDENTS
2 FEMALE
2 MALE

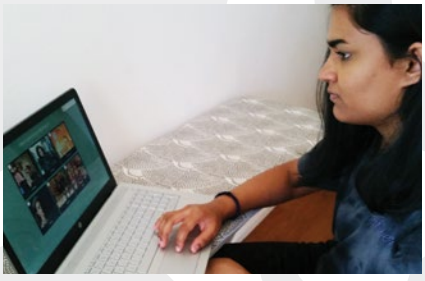
AT-HOME COGNITIVE REHABILITATION



The GoCog project, led by Raeanne Moore, a faculty member in the Psychiatry Department, uses Google Home as a two-way communication rehabilitation device. It prompts the patient to talk to Google Home to complete cognitive exercises, improve calendar usage, monitor daily routines, and participant in relaxation strategies. Two undergraduate ECE students, Victor Miranda and Yihui Yang, programmed a Raspberry Pi microcontroller with an LCD touch screen to recognize a patient's voice and trigger customized rehabilitation sessions. This project holds potential to increase the efficiency and affordability of cognitive rehabilitation programs.

ENGAGING FACEBOOK TO REDUCE SOCIAL ISOLATION

CE student Meena Kaliswamy created a platform on Facebook to increase social engagement among older persons living with HIV. "Older persons living with HIV are particularly vulnerable to socially isolating behaviors, which can have downstream negative mental and physical health consequences," says Moore. "We know many of these older adults are using Facebook, so the aim of this project is to utilize this framework and increase social activity in a fun and personalized way." Kaliswamy has created a quiz-like platform on Facebook that, based on the user's interests, suggests activities, such as local comedy plays, exercise groups, and volunteer events, in an effort to decrease social isolation.



"EPRP GIVES ME A VALUABLE OPPORTUNITY TO UNDERSTAND THE IMPORTANCE OF APPLYING MY ENGINEERING KNOWLEDGE TO REAL-WORLD APPLICATIONS AND EXPANDS MY VISION OF BEING AN ELECTRICAL ENGINEER."

—YIHUI YANG, ECE UNDERGRADUATE STUDENT

AUTOMATED PSYCHOTHERAPY FIDELITY RATINGS

Four ECE students, Wenyu Zhang, Nikhil Dutt, Daniel Coronado, Thinh Le, and two faculty mentors, Eric Granholm in Psychiatry and Hari Garudadri at the Qualcomm Institute, are working to create an automated psychotherapy session fidelity rating system. By using automated speech recognition, natural language processing, machine learning and neural network modeling, automated fidelity rating of psychotherapy sessions is possible. This could impact public health enormously by dramatically increasing the availability and quality of evidence-based psychotherapy treatments for people with mental illness.

COGNITIVE BRAIN COMPUTER INTERFACE (COGBCI) PROJECT

Led by Jyoti Mishra, the CogBCI Project evaluated how people learn to self-modulate brain signals that are important for paying attention. ECE students Yihan Hu and Sovanarung Seng conducted signal processing analytics on a recently acquired CogBCI dataset. They developed objective metrics to demarcate successful versus unsuccessful neuromodulation. Hu's research discovered that individuals who learn to successfully modulate their brain signals also show benefits in other unlearned tasks requiring attentive discrimination. The results of this project have important implications towards the engineering and translation of scalable CogBCIs as next-generation technology therapeutics for diverse mental health disorders.

MARIJUANA TREATMENT APP

Led by Kara Bagot, students worked on developing components of an app-based intervention for teens to reduce or stop marijuana use as an adjunct to traditional behavioral therapy. Students worked to "game-ify" cognitive tasks and develop an augmented reality task based on GPS to ensure/incentivize adherence to juvenile justice/court/medical/treatment appointments and school attendance.

ECE DAY

[SHOWCASING STUDENTS]

The annual ECE Day celebration showcases the department and its offerings to current and prospective students, faculty, guests, and alumni. In April 2018, the fourth annual ECE Day was co-hosted by HKN, IEEE UC San Diego Student Branch, and the ECE Undergraduate Student Council.

The day began with technical workshops hosted by members of HKN and IEEE UC San Diego Student Branch, including a PIR motion sensor with Arduino workshop and a wireless power soldering workshop. Attendees experienced soldering, simple circuit design, and learned how to wire and utilize a PIR motion sensor. During the Company Meet & Greet, students had the opportunity to network with individuals from Microsoft, Cognex, and Microduino, and see examples of projects done in one of UC San Diego's many hands-on engineering courses. Engineering student organizations showcased their projects and experiences available for members.

Professors, current graduate students, and alumni spoke at the Depth Showcase panel in the afternoon to inform the current students about the depth curriculum and possible career and research paths for each. Most importantly, undergraduate ECE students learned how to plan and customize their major and depth according to their interest.

The day closed with a keynote speech by Mark Wells, CEO of Positioning Universal. Mark discussed his personal history and lessons learned, which was incredibly insightful for young students. He encouraged students to be persistent in their pursuit of success, to take risks to gain experience, and to meet inspiring people.

SOLAR PROJECT

[EMPOWERING YOUTH]

Co-Create Change incorporates engineering, design, business, and community engagement to empower youth in rural communities by promoting sustainable community development and socio-economic mobility. With backgrounds ranging from engineering and management to social science, teams partner with youth who have a keen interests in engineering, design, and entrepreneurship. Co-Create Change's mission is to provide technical and entrepreneurship training and resources to their youth partners to succeed as entrepreneurs who provide products and services to their communities. Using human-centered design, they co-create appropriate solutions that can be locally produced and assembled. Through feedback and iteration, they create solutions that can be replicated and maintained by their community partners.

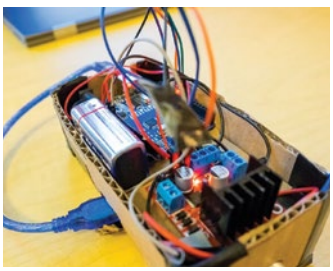
Co-Create Change currently focuses on renewable energy adaptation of rural communities. In Myanmar, they are working with a college student who aspires to be an electricity provider for his community. Together they designed solar street lamps to provide night time lighting and promote safer communities. At Casa Hogar de Maria Inmaculada, an orphanage in Tijuana, Mexico, night-time lighting was needed for theft prevention. To alleviate this issue, they designed motion-activated lights to minimize theft and provide the lighting.

The projects have given students the opportunity to apply their knowledge in a real-world setting in order to assist those who need affordable and reliable lighting. The team has been invited to attend the annual Clinton Global Initiative University meeting in Fall 2018.

H.A.R.D. HACK

[OVERCOMING CHALLENGES]

Hash out. Analyze. Research. Design. All of these are core steps of overcoming engineering challenges. HKN created H.A.R.D. Hack, an annual 24-hour hardware-based hackathon, in collaboration with IEEE UC San Diego Student Branch. Sponsored by Qualcomm, H.A.R.D. Hack provided teams of students for the DragonBoard 410c to solve problems and create solutions in the areas of Life Hacks, Improving Student Life, Sustainability, and Security. Students from San Diego State University and UC Irvine were invited to participate. H.A.R.D. Hack 2018 had 150 participants and 16 competing teams that presented many amazing projects, from a License Plate Parking Assistant for automating parking regulation, to a Landslide Advanced Detection System for detecting and warning individuals about an occurring landslide. The top teams were recognized with prizes sponsored by Qualcomm and Linaro.



HACKXX

[EMPOWERING]

The only women-centric hackathon at UC San Diego, HackXX is designed to encourage and empower women, transgender, and non-binary people in tech to build great projects in a 24-hour time span. This past year, 103 hackers participated, of which 89 percent identified as women, six percent identified as transgender and non-binary, and five percent identified as men. Students came from various majors, including bioengineering, cognitive science, computer engineering, computer science, electrical engineering, and mathematics.

Hackers attended three different types of technical workshops—Unity for VR/AR platforms, web development using Django, and learning how to CAD and 3D print! There was even a workshop on how to ace a technical interview by Northrop Grumman and a tech talk on machine learning from Cisco.

First place was awarded to a website called Any-A whose goal was to empower girls in elementary school by helping them practice math and learn about female role models in the field of mathematics. Second place went to Parsecast, a site where students enter the url to any lectured podcast and navigate through the video by only watching parts that contain the words they wish to review. Third place was given to Shadow Shifters, a virtual reality game using Unity and C# that can manipulate simple 3D objects to create a shadow by matching the shadow with the outline on the floor—the shadows would come to life!

IEEE STUDENT BRANCH

[LEARNING AND GROWING WITH EACH OTHER]

The outreach programs offered by the IEEE UC San Diego Student Branch benefit both the K–12 and undergraduate engineering students who participate by learning and growing with each other. Outreach is meant to inspire the next generation of engineers through positive and fulfilling engagement at an early age by providing opportunities to learn about a future in the field of engineering.

IEEE connects with youth by visiting grade schools and hosting events on campus where engineering students demonstrate projects, teach basic technical skills, and provide information about STEM. IEEE engaged with 1,000 students at events including the VEX IQ Competition, San Diego Maker Fair, Girls S.T.E.M. Fair, and Boy Scout STEM Merit Badge Fair.

Through hands-on activities, students learn engineering skills and gain confidence. IEEE hosted 10 workshops that covered various topics such as circuit designing, soldering, PCB design, microcontrollers, and software development. Attendees appreciated being able to take home their creation to continue tinkering.

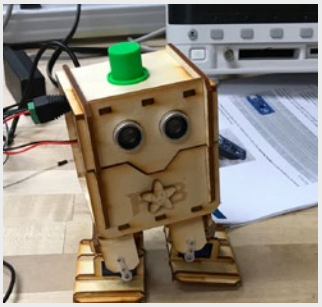
"THE ACCOMPLISHMENTS MADE HERE HAVE BEEN PIVOTAL TO INNOVATIVE TECHNOLOGIES AND CUTTING-EDGE SCIENCE."

—U.S. 53RD DISTRICT REP. SUSAN DAVIS

GIRLS STEM SUMMER CAMP

[IMPROVING DIVERSITY IN ENGINEERING]

Girls STEM summer camp, is a one-week, full-day program where 12 middle and high school girls from different schools came to UC San Diego and worked on several electronics and optics projects with the help of four undergraduate and graduate ECE students. The program introduced the girls to different fields with the long-term goal of improving diversity in engineering. They worked on several Arduino-based projects, the PIB Ladabot project, prototyping with laser cutters, 3D design and printing, light guidance with fiber optics, soft lithography, and wireless optical communications. Some of the girls took the projects back to their schools to train others to build similar devices. The Girls STEM Summer Camp will continue in 2019 with the goal of offering it to more students.



"THERE WERE MANY PEOPLE INVOLVED IN MAKING THIS PROGRAM HAPPEN INCLUDING PROFESSOR NGUYEN (ECE DEPARTMENT CHAIR), **PROFESSOR COSMAN** (FACULTY EQUITY ADVISOR AND MY MENTOR), **ALBERTO VASQUES** (UCSD-CREATE PROGRAM SPECIALIST), **PETER ILINYKH** (OPTICS LAB DIRECTOR), **RAMSIN KHOSHABEH** (MAKERSPACE DIRECTOR), **PHUONG TRUONG** (PIB INSPIRE DIRECTOR) **AND THE PROGRAM TUTORS. I COULD NOT HAVE DONE THE PROGRAM WITHOUT THEIR HELP AND SUPPORT."**

— SAHARNAZ BAGHDADCHI, ASSISTANT TEACHING PROFESSOR

OUTREACH

PROJECT IN A BOX

[ENABLING HANDS-ON INITIATIVES]

Project in a Box (PiB) is a student organization founded in 2016 with a mission to make hands-on education more accessible. Their name stems from the self-contained, concept-specific project kits that the team develops to empower students with engineering and industry-relevant skills. PiB aims to ensure that their project kits enable students to become the next generation engineer—adaptive, resourceful, and systematic.

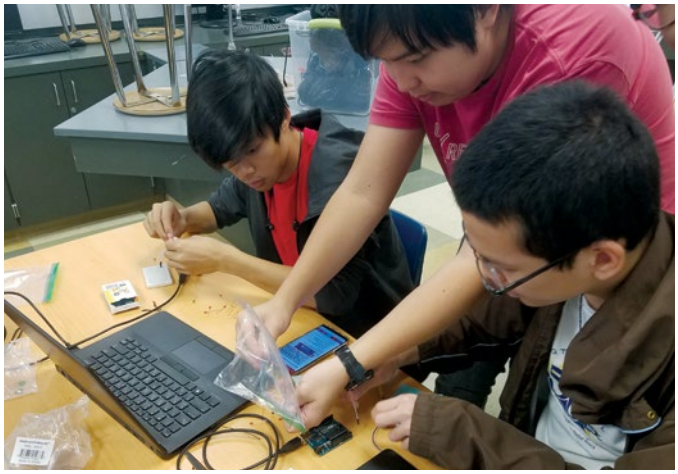
The organization and its members have helped to develop many hands-on courses introduced into the ECE department over the past few years, including ECE 196, ECE 140A and B, and ECE 144. The team has built a community centered on experimentation, teamwork, and helping students build their skillsets as young engineers. They are also actively involved in programs and workshops beyond UC San Diego and have hosted a number of outreach efforts that include collaborations with high schools and middle schools across the state. These efforts include building robotics curriculum, mentoring middle schoolers through Science Olympiad, designing AP drop-in projects, and running hands-on workshops and summer programs, such as the Alumni-Family Program.

ETA KAPPA NU (HKN)

[ENCOURAGEMENT TO PURSUE ENGINEERING]

This year marked the launch of Eta Kappa Nu's Saturday Engineering Academy. Hosted at two different high schools over two academic quarters, HKN members and volunteers led classes and activities for high school students interested in engineering. The program's goal was not only to expose students to fundamentals of engineering and design, but also to encourage them to pursue electrical engineering in college and provide them with undergraduate mentors.

Hosted at the UC San Diego Preuss School and Patrick Henry High School, students received an introduction to electrical engineering fundamentals, including lab safety and the physics behind basic circuit components. Students gained breadboarding experience and learned how to translate schematics into physical circuits. Mini Musical Keyboard and Arduino Digital Hourglass workshops gave students the opportunity to learn the applications of electrical engineering.



FACULTY-LED OUTREACH

[SCIENCE OLYMPIAD]

Saharnaz Baghdadchi initiated two outreach programs involving middle and high school students in science and engineering projects this past year.

The Science Olympiad outreach program was a collaborative effort between UC San Diego and the King Chavez Preparatory Academy (KCPA). Six ECE undergraduate students from Project in a Box Inspire group coached 12 middle school students from KCPA to participate in the regional Science Olympiad competitions. The young students and their coaches worked on projects, such as Wright Stuff (the design and prototype of a free-flight airplane), Hovercraft (the design and prototype of a self-propelled air-levitated vehicle), Battery Buggy (the design and prototype of a battery-powered vehicle), Fast Facts (listing the science terms related to the matching science categories), and Optics (light guidance using the rules of Geometric Optics). The science teacher at KCPA and Baghdadchi will continue the program in the coming academic year with the goal of involving more middle school students from other schools.

"IT WAS INCREDIBLY REWARDING TO SEE THE STUDENTS APPLY THINGS THEY HAD JUST LEARNED TO THEIR OWN PROJECTS. I HAD A FEW STUDENTS EVEN GO ABOVE AND BEYOND, USING THEIR CREATIVITY TO CUSTOMIZE THEIR DESIGNS. I REALLY LOOK FORWARD TO WHAT THEY COULD BRING TO UC SAN DIEGO."

—KELLY LEVICK, HKN OUTREACH CHAIR

NEW GRADUATE PROGRAMS

Two new graduate programs have been added to the department this year to further extend our expertise in emerging fields and prepare our students for the future of the industry.

>> APPLIED ELECTROMAGNETICS

Summary Description
The field of applied electromagnetics has roots going back to giants of electrical engineering such as Maxwell, Faraday, Hertz, Marconi, and Tesla. It has maintained a position of high importance, and, in recent years, it has expanded beyond antennas and radio wave propagation to include emerging areas such as micro-electromechanical systems, metamaterials, biological applications of electromagnetic fields, and other novel devices and structures. There is a strong need for students with skills in these areas in the industries of telecommunications, defense, microwave instruments, medical devices, and others. These industries are growing rapidly, driven in particular by the continuing expansion of wireless communications and related technologies. This program will prepare students for employment, research, and innovation in the expanding field of applied electromagnetics.

Research Projects
Research in this area includes a wide range of fields including electrically small antennas, multi-input/multi-output (MIMO) systems, micro-electromechanical systems, artificial impedance surfaces and scattering, wideband phased arrays, photonic topological insulators, nonlinear and active electromagnetic structures, plasma and vacuum devices, field and photoemission, biological effects of electromagnetic fields, and many others. Frequencies of interest span the electromagnetic spectrum, from electrostatics through radio frequencies, as well as THz, infrared, and optical frequencies.

Courses
ECE107 Electromagnetism
ECE123 Antenna Systems Engineering
ECE166 Microwave Circuits and Systems
ECE222A Antennas and Their System Applications
ECE222B Applied Electromagnetic Theory—Electromagnetics
ECE222C Applied Electromagnetic Theory—Computational Methods for Electromagnetics
ECE222D Advanced Antenna Design

>> MACHINE LEARNING & DATA SCIENCE

Summary Description
This fall, ECE is launching a new Machine Learning & Data Science graduate focus area. The program will span the spectrum from fundamental theory to practical applications. It will quickly bring students up to speed with the field's mathematical and computational foundations, continue with state-of-the-art machine-learning and algorithmic tools that undergird today's big-data analytics, and offer specialized courses that bridge the field with important branches of science and engineering.

The curriculum encompasses 12 courses that students will be able to complete in four academic quarters.

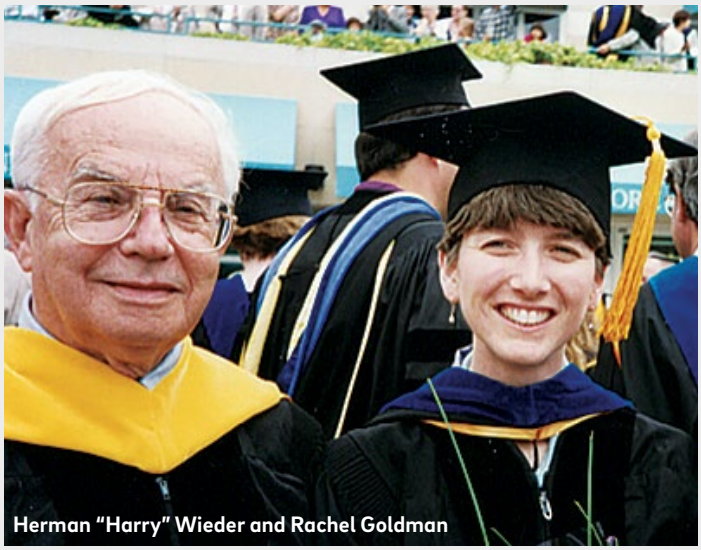
Core Coursework
ECE269 Linear Algebra
ECE271A Statistical Learning I
ECE289 Probability and Statistics for Data Science
ECE188 Programming for Data Analysis

Analytics
ECE271B Statistical Learning II
ECE273 Convex Optimization and Applications
ECE275A Parameter Estimation I

Computation
ECE226 Optimization and Acceleration of Deep Learning on Various Hardware Platforms
ECE289 Scalable Learning
ECE289 Software for Data Science
ECE289 Parallel Processing in Data Science

Applications
ECE208 Computational Evolutionary Biology
ECE209 Statistical Learning for Biosignal Processing
ECE271C Deep Learning and Applications
ECE276A Sensing & Estimation in Robotics
ECE276B Planning & Learning in Robotics
ECE276C Advances in Robot Manipulation
ECE285 Machine Learning for Physical Applications
ECE267 Security of Hardware Embedded System
ECE289 Big Network Data

RACHEL GOLDMAN



Herman "Harry" Wieder and Rachel Goldman

In 2016, the University of Michigan recognized Professor Rachel S. Goldman with a Distinguished Faculty Achievement Award for her far-reaching contributions to electronic materials through her research, teaching, and service. Goldman earned a Ph.D. in materials science from UC San Diego in 1995 and was a postdoctoral fellow in physics at Carnegie Mellon before joining U-M's faculty in 1997 as the Dow Corning Assistant Professor.

Goldman rose through the ranks to become Professor of Materials Science and Engineering in 2008. She has served as Graduate Chair of MSE and is currently associate director of Applied Physics.

Building upon her undergraduate thesis research on electrodeposition of zinc dendrites, her master's thesis research on metal-ceramic interfaces, and a summer research internship on compound semiconductors, Goldman was excited to join UC San Diego to work with two ECE Professors, the late Professor Emeritus Harry Wieder and Professor Karen L. Kavanagh.

Goldman says, "The opportunity to work with a world-renowned device physicist and pioneer in molecular-beam epitaxy (Professor Wieder) plus a card-carrying materials scientist with expertise in transmission electron microscopy (Professor Kavanagh) was unprecedented. "I will be forever grateful for their mentorship which launched my career in the materials physics of semiconductors."

A leader in electronic and photonic materials research and education, Goldman is internationally recognized for elucidating the mechanisms of nanostructure formation and developing tools to map them at atomic resolution. Goldman has also revolutionized the teaching of materials science with the creation of new courses and laboratory modules in electronic materials. Goldman has authored or co-authored more than 125 publications on processing-structure-property correlations in semiconductor films, nanostructures, and heterostructures. She holds a U.S. patent on "ion-cut-synthesis", a novel approach for simultaneous synthesis and integration of nanocomposite materials with virtually any substrate.

SAJAMA

Sajama joined Professor Alon Orlitsky's lab in 2001 where she came across interesting problems and research at the intersection of statistical estimation, machine learning, and information theory. Soon after completing her Ph.D. with a focus on Machine Learning in 2006, Sajama was hired as a researcher at the Quantitative Statistical Arbitrage group with Merrill Lynch where she developed statistical arbitrage investment strategies for U.S. and international equities, and high frequency trading algorithms to minimize transaction costs. She was then a founding member of Hedera Capital, a statistical arbitrage hedge fund started with a few colleagues from Merrill Lynch that was seeded by McKinsey Investment Office. There she helped build a high-frequency, exchange co-located investment platform and researched algorithms to invest in U.S. equities. Her experience at Hedera Capital taught her much about what is needed to co-create high performing teams.

In 2011, she worked as a researcher at Prudential Fixed Income, where she built their currency forecasting model using both macroeconomic and behavioral variables and contributed to longer horizon fundamental investment analysis for their multi-asset portfolios. She credits the results to the collaboration with her many talented colleagues, some of whom were prominent fixed income portfolio managers and traders, ex-IMF macro economists and former math and finance professors.

In 2014, she joined the San Francisco office of Blackrock, where she developed medium to long horizon, higher capacity models for forecasting individual stocks and country-level equity returns using natural language processing, macroeconomic and market variables in the Scientific Active Equity team and was the lead researcher and portfolio manager for a multi asset emerging markets fund. Last year, she joined Sensato Investors, an Asia-focused hedge fund, where she is responsible for the macro thematic insights in their multi asset portfolio.

She finds that the subjects of statistical estimation and machine learning that she were introduced to at UC San Diego and the rigorous research training in Professor Orlitsky's lab continue to be a strong foundation and help guide her career as it evolves.

PETER ASBECK

Professor Peter Asbeck retired this year after 27 years in the department. Earning his Ph.D. from the Massachusetts Institute of Technology in 1975, Asbeck worked in quantum electronics and GaAlAs/GaAs laser physics and applications at the Sarnoff Research Center in Princeton, N.J., and at the Philips Laboratory, in Briarcliff Manor, N.Y. In 1978, he joined Rockwell International Science Center and worked on the development of high-speed devices and circuits based on III-V compounds and heterojunctions. He carried out pioneering work in the area of heterojunction bipolar transistors (HBTs). In 1991, he became a Professor of electrical engineering here at UC San Diego.

His research interests include the development of high-speed heterojunction transistors and optoelectronic devices. His latest work is in advanced transistors in III-V materials and in Si, and applying them in microwave and high speed digital circuits. He was honored as General Chairman at the 1996 Device Research Conference and Engineer of the Year at the Rockwell International in 1986. Professor Asbeck was elected to the National Academy of Engineering (NAE) in 2007, for his contributions to heterojunction bipolar transistor and integrated circuit technology.

CHARLES TU

Charles Tu is a Distinguished Professor of electrical and computer engineering. He joined the ECE faculty in 1988, served as department chair from 1999 to 2003, and was appointed an associate dean of the Jacobs School of Engineering from 2003 to 2013. Tu's research interests include novel III-V compound semiconductor heterostructures and nanostructures for electronic, optoelectronic and photovoltaic devices. He was a distinguished member of AT&T Bell Laboratories technical staff from 1980 to 1988. He earned his Ph.D. in Engineering and Applied Science from Yale University in 1978 and his B.Sc. (Hon.) in Physics from McGill University in 1971. He has authored or co-authored more than 400 refereed technical journal papers.

Tu is a Fellow of the IEEE, the American Physical Society, and the AVS Science and Technology Society. He was Engineering Educator of the Year in San Diego County in 2006, the recipient of Taiwan's Pan Wen-Yuan Foundation Outstanding Research Award in 2009, the North American MBE Innovator Award in 2011, an honorary doctorate from Linköping University in Sweden in 2013, and the IEEE Region 6 Outstanding Educator Award in 2014.

Besides being an accomplished scholar and academic administrator, Dr. Tu is a dedicated educator and has devoted a substantial amount of his time to education and outreach. Since 2003 he was the Faculty Counselor for the IEEE UCSD Student Branch, which has become an award-winning student branch serving many ECE students. Since 2007, he has led the UCSD COSMOS (California State Summer School for Mathematics and Science) program, which has produced major impact on many California high school students of diverse background in their education and career.

In honor of Charles' dedication to outreach and education and embracing his vision, the ECE Department decided to establish a Charles W. Tu Collaborative OutReach and Education (CORE) ECE Endowment Fund. We set the goal of raising at least $1 million over five years to make our outreach and education commitment a sustainable effort. Twenty percent of the annual payout will go to the COSMOS program, 20 percent to the IEEE (including HKN, the IEEE honors society), 10 percent to Project in a Box, and the rest up to the discretion of the current department chair for the fund's highest impact on outreach and education.

HERMAN "HARRY" WIEDER

[1919–2018]

Herman "Harry" Wieder, Professor Emeritus of Applied Physics at UC San Diego, a condensed-matter physicist whose interests included basic and applied research in solid-state electronics, quantum wells and superlattice materials and devices, passed away on June 6, 2018. Born on June 4, 1919, in Bistrita, Romania, he immigrated to the U.S. in 1937 and became a citizen in 1941. After his service in the Army, he used the G.I. Bill to earn a B.S. degree in Applied Physics from UCLA in 1949. He was also awarded an honorary doctorate in Physics program at Colorado State University. After World War II and college, Harry got his start as a physicist with the National Bureau of Standards in Washington D.C. from 1949 to 1953, working on ferroelectric materials. He also worked as the head physicist in the Dielectrics and Semiconductor Branch at the Naval Weapons Center in Corona, California, from 1953 to 1970. From 1970 to 1973, Harry served as the head of the Semiconductor Physics Branch of the Naval Electronics Laboratory Center, and subsequently as the head of the Electronic Materials Sciences Division of the Naval Ocean Systems Center, San Diego.

He joined UC San Diego as a professor of Applied Physics (ECE) in 1981, achieving emeritus status in 1993. He was also an affiliate professor of Physics at Colorado State University. Harry was most distinguished for his range of interests in his field working in materials, film growth, interface properties, and device concepts. He has influenced the development of electronics, thermoelectrics, and electro-optic technology based on III-V materials. He was a leader in InP technology and was the first to demonstrate high quality InP metal semiconductor field-effect transistors. He was also one of the first to explore the advantages of ternary and quaternary III-V compounds based on indium for applications in fast switching and electro-optics. He was a Fellow of the American Physical Society, IEEE, and the American Vacuum Society. His awards include the Gold Medal and Medard W. Welch Award from the American Vacuum Society, the Bunshah Prize from the American Vacuum Society, and the Babbage Premium from the British Institute of Electronic and Radio Engineers. He authored multiple books and papers and was awarded 20 patents. Throughout his career, and up to his passing, Harry was genuinely engrossed in mentoring younger generations of scientists and engineers, and he always had a burning desire to discuss science at depth. Harry is survived by three children, Mark (and his wife Shauna), Jonathan (and his wife Sheryl), Daniel (and his wife Becky), and one granddaughter, Rachel (and her husband Mark).

KEN BOWLES

[1929–2018]

Ken Bowles, the first faculty member Henry Booker attracted to help form the new department of Applied Electro-Physics that became ECE and CSE, passed away on August 15, 2018. A radar expert, Ken was familiar with most areas of ECE, from signal detection, to digital signal processing and coding theory, through antenna design. The radar he built at Jicamarca in Peru in the early 1960s is still productive and was the largest single aperture antenna in the world for 55 years. His breadth of expertise was a great help in building the department.

He conceived the idea of a group of large antennas spaced by about 100 km to study solar wind. This project took him further into computer hardware and software where he quickly realized that software development was the weak link in such projects. Ultimately, he retooled his career path into what is now computer science. The solar wind project provided our first understanding of how the solar wind evolves during the 11-year solar activity cycle.

Ken was the complete electrical engineer, competent in many areas and totally unafraid to tackle something completely new. He remains an inspiration and a role model for all of us in technology.

"(KEN) IS, OF COURSE, BEST KNOWN FOR THE DEVELOPMENT OF UCSD PASCAL. UCSD PASCAL WAS A PROGRAMMING LANGUAGE, OPERATING SYSTEM, AND SUITE OF TOOLS THAT WERE ARGUABLY THE FIRST HIGH-LEVEL PROGRAMMING SYSTEM THAT WORKED ON SMALL SYSTEMS THAT WERE AFFORDABLE AND PORTABLE. ITS DEVELOPMENT WAS TRANSFORMATIVE—NOT JUST FOR UC SAN DIEGO, BUT FOR ALL OF COMPUTER SCIENCE. HE WILL FOREVER BE A PART OF THE DNA OF CSE, AND A MODEL FOR MUCH OF WHAT WE ARE STILL ABOUT—DEVELOPING TECHNOLOGY THAT CHANGES THE WORLD AND TRANSFORMS EDUCATION."

—DEAN TULLSEN, CSE CHAIR

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