Welcome to the UC San Diego Electrical and Computer Engineering Department. We are excited to share what's new in ECE as we strive to develop and graduate "complete" engineers while producing world-class research.

We are proud of our history providing an undergraduate curriculum that builds on strong theoretical fundamentals, and we are excited to implement this knowledge base with courses and programs with practical applications.

This past summer we launched a Summer Research Internship Program (SRIP), which afforded our students an opportunity to join a faculty lab for the summer to participate in original research. As a result, 49 undergrads and 40 master’s students had the opportunity to enrich their program of study through the experience of participating in research in many different areas of electrical and computer engineering. Students in the inaugural SRIP worked in labs dealing with robotic locomotion, augmented reality, robotic surgery, wireless charging, modeling brain circuits, as well as acoustic signal processing, to name a few of the research topics. In addition to working with faculty in the lab, students took part in workshops on communication, technical writing and presentation skills. Our ultimate goal for the internship program is to enhance our students’ success by helping them prepare for graduate school, obtain fellowships and industry internships, and ultimately secure a job after graduation.

Our curriculum continues to grow with new hands-on course offerings and several new courses on Software Systems. With the addition of new courses and programs, we are creating a multi-faceted curriculum with threads that extend throughout the entire educational experience, beginning freshman year and continuing into advanced studies in engineering.

On the research front, we are eager to share our success in expanding activity in areas including network systems, communications systems, Internet of Things (IoT) and control theory with the addition of three new ladder-rank faculty with strong research programs that will continue our long history of innovative discovery.

Within these pages we share some of the world-class research of our faculty and graduate students. We also welcome two new faculty to our ranks. All of our new faculty are committed to creating a robust hands-on experience for our students.

Looking ahead, we are optimistic that the groundbreaking research we conduct today and the enhancements to the curriculum we continually make will shape our students into the engineers of tomorrow – researchers who will be the wave of the future.

In recognition of his full-duplex radio work, Bharadia was named a Marconi Young Scholar for outstanding wireless research. Other technologies developed by Bharadia include: a system for indoor navigation using standard Wi-Fi; wireless virtual-reality headsets; a human-motion-tracking system using wireless signals; and battery-less ECG wireless sensors.

Bharadia is a past recipient of the Michael Dukakis Leadership Award. In 2016, the MIT Technology Review named Bharadia one of its “Top 35 Innovators under 35,” and he is also a past recipient of the Sarah and Thomas Kailath Stanford Graduate Fellowship.

BEHROUZ TOURI

Behrouz Touri joined the ECE faculty in 2017 after three years as an Assistant Professor with the Electrical, Computer and Energy Engineering Department at the University of Colorado Boulder. Touri is interested in the theoretical aspects of complex networked systems such as social networks, multi-agent and robotic networks, as well as electrical power networks. He is particularly interested in applied probability theory, dynamics over random networks, distributed computation and optimization (a rapidly growing field in systems and controls that is fundamentally important in the study of fully distributed and autonomous systems such as robot swarms), as well as game theory and population dynamics. Among the latter, Touri studies language evolution, formation and learning. In addition to learning how modern languages might have come into existence, “observes Touri, “it provides insights into how we can reach deep autonomy in robotic networks and artificial intelligence.”

Professor Touri received a Young Investigator Award in 2016 from the Air Force Office of Scientific Research for his work on a structural approach to distributed optimization. In 2012, German publishing company Springer published Touri’s PhD thesis on the “Product of Random Stochastic Matrices and Distributed Averaging” in its Springer Theses book series. He was also named an outstanding reviewer for the journal IEEE Transactions on Automatic Control (the leading publication in the field of control theory) in 2014.

In addition to his research and teaching, Touri has a deep interest in engineering education, including modern techniques for effective teaching. He is also looking for motivated graduate students to join his group, particularly those who are enthusiastic about applied mathematics. Touri received his PhD in Industrial Engineering from the University of Illinois at Urbana-Champaign in 2011.

XINYU ZHANG

Prior to joining the UC San Diego faculty in July 2017, Xinyu Zhang was an Assistant Professor of Electrical and Computer Engineering at the University of Wisconsin-Madison. He obtained a Ph.D degree in Computer Science and Engineering from the University of Michigan—Ann Arbor in 2012.

Professor Zhang is a leader in millimeter-wave wireless networking—the cornerstone technology in 5G mobile broadband. He also developed the first 60 GHz millimeter-wave software radio, which put his lab in a leading position to design and evaluate potential 5G wireless protocols. Going further, Zhang’s research is focusing on two fundamental areas that underpin the Internet of Things (IoT) wireless systems, and ubiquitous computing.

In the area of wireless systems and networking, Zhang’s team has designed radical wireless architectures to realize wire-speed connectivity anywhere, anytime. One such architecture, called scalable distributed MIMO, can break the interference barrier and allow network capacity to scale as the next billion IoT devices join the wireless cloud. Zhang’s group also introduced physical-layer informed mobile applications—replacing conventional trial-and-error network protocols with an explicit inference of network status. This principle can bridge the gap between high theoretical capacity and poor end-user experience that has plagued multiple generations of wireless systems.

In the area of mobile and ubiquitous computing, Zhang designs and implements systems that augment commodity wireless devices and plain objects with ambient intelligence. This so-called “computational wireless sensing” effectively repurposes mobile communication devices as sensors, and designs computational algorithms to overcome their limited power, form factor, frequency resolution and sparse deployment. These mechanisms can remotely and continuously track human/ object activities with near-vision accuracy, paving the way for sci-fi-quality applications such as virtual keyboards, decoding sound signals through walls, and 3D orientation sensing of objects without batteries.
PROFESSORS OF PRACTICE

TODD HYLTÓN  PROFESSOR OF PRACTICE

Todd Hylton joined the ECE faculty as a Professor of Practice in 2016, when he also became Executive Director of UC San Diego’s newly-created CONNECTS Robotics Institute. His research interests include machine learning algorithms and natural intelligence, and he earned a Ph.D. in Applied Physics from Stanford University in 1997.

Prior to joining ECE, Hylton served as executive vice president of strategy and research at the Brain Corporation, a San Diego-based robotics startup. Starting in 2012, he managed a team of scientists and engineers that created the first version of BrainChip, a software platform that can turn any electronic device into a brain. He then led the team to build a low-power, embedded computing platform developed by the company and based on a neuron-inspired, RISC processor. Hylton also led a team that worked on developing a new class of machine-learning algorithms for robotics to learn online and without supervision, and to group the concept of time and anticipate how their surrounding environment will change.

Before Brain Corp, Hylton was a program manager at the Defense Advanced Research Projects Agency (DARPA), where he launched a series of high-profile projects, including DARPA’s multi-million-dollar SyNAPSE program in 2017. This program developed a neuromorphic chip whose architecture was inspired by the brain. Developed by IBM with DARPA funding, the True North chip had the same computing capacity as a supercomputer when consuming dramatically less power — just 70 milliwatts, the equivalent of what it takes to run a hearing aid. Also at DARPA, Hylton managed the Nano Air Vehicle program, which funded AeroVironment’s development of the ‘hummingbird’ drone (flew on the cover of Time magazine).

With his track record as an inventor and entrepreneur, Hylton holds 19 patents. In the early 2000s, he co-founded Affylex, a startup specializing in semiconductor equipment based on a new method for depositing nanometer-thin film onto surfaces – a process called “biased targeted ion beam deposition.”

NAMBI SESHADRI  PROFESSOR OF PRACTICE

Nambi Seshadri joined the ECE faculty in July 2017 as a Professor of Practice. He is a member of the U.S. National Academy of Engineering and a Fellow of the IEEE. He is also a Foreign Member of the Indian National Academy of Engineering, and holds, approximately 200 patents. Seshadri also sits on the Irvine Committee of startup incubator, EvoNexus. He is also a Consulting Engineer of the Indian National Academy of Engineering, and holds an Honorary DSc degree from the Indian Institute of Technology.

Seshadri spent most of his business career at Broadcom, which he joined in 1999 as the first employee dedicated to developing the company’s wireless business. As VP and CTO of the company, Broadcom and Connectivity, Seshadri was in charge of the company’s wireless Rogers, a handset chip designer, and led a team that worked on developing a new class of machine-learning algorithms for robots to learn online and without supervision, and to group the concept of time and anticipate how their surrounding environment will change.

Prior to joining Broadcom, Seshadri worked for more than 13 years at AT&T Bell Laboratories as a Member of Technical Staff and as Head of Communications Research at AT&T Shannon Labs. His research focused on developing techniques for reliable transmission of data, speech and audio for mobile communications.

Seshadri earned his Ph.D. in Computer and Systems Engineering from Rensselaer Polytechnic Institute in 1986. He completed his undergraduate degree in 1982 in what is today called the National Institute of Technology, Trichy, in the Indian state of Tamil Nadu.

DANIEL WHELAN  PROFESSOR OF PRACTICE

David Whelan joined the ECE faculty as a Professor of Practice, effective July 2017. He is a member of the U.S. National Academy of Engineering (since 2007), a Fellow of the American Physical Society, a Senior Member of IEEE, and Fellow of AIAA. He has written extensively on machine learning and natural intelligence, and he earned a Ph.D. in Applied Physics from Stanford University in 1997.

At UC San Diego, Whelan joined the ECE faculty as an Associate Teaching Professor in 2017. He is a member of the U.S. National Academy of Engineering, and holds, approximately 200 patents. Whelan also sits on the Irvine Committee of startup incubator, EvoNexus. He is also a Consulting Engineer of the Indian National Academy of Engineering, and holds an Honorary DSc degree from the Indian Institute of Technology.

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CURT SCHURGERS  ASSOCIATE TEACHING PROFESSOR

Curt Schurgers became an Associate Teaching Professor in the ECE department in July 2017. He originally joined the ECE faculty at UC San Diego in 2005 as an Assistant Professor. Eight years later he joined CalX’s Qualcomm Institute (QI) at UC San Diego as a researcher and development engineer. His background ranged widely from electronic circuits as an undergraduate in design, to wireless communications and networking as a graduate student in Electrical Engineering at UCLA before he completed his Ph.D. in 2002 and joined the QI at UC San Diego. Schurgers’ work continued to evolve more recently to include undergraduate systems and robotics.

Schurgers has taught a wide variety of courses, covering topics from embedded systems and basic circuits to networking, communications and hardware design, while also supervising student design projects and hands-on experimentation for a whole year of full-time teaching. “Teaching undergraduate students is my primary passion,” says Schurgers. “One way that is to harness learning by doing and hands-on education to supplement the mastery of theoretical concepts.” Indeed, Schurgers hopes to play a role as the department rethinks its curriculum and has to teach various topics in the most effective way.

As director of QI’s Prototyping Facility, Schurgers helped design the Jacobs Hall MakerSpace as well as the Envision Maker Studio in the Structural and Materials Engineering Building. Since summer, he has led a critical component of robotics for the California State Summer School for Mathematics and Science (COSMOS), a four-week residential summer program for high school students in STEM disciplines. Schurgers also co-directs the UCSD Engineers for Exploration (E4E) program, which enables undergraduate students to work on real-world engineering design challenges that directly impact the world of exploration and innovation. He is a recent recipient of a Fulbright U.S. Scholar Award to teach computer science for several months in the Kyrgyz Republic in 2018.
During the 2017-18 academic year, honors and awards continued to pour in for ECE faculty. Among the most notable:

Parveen Coorssen is one of sixty-seven recipients of a 2017 Pinnacle Award created by the San Diego-based business organization Athena to honor “exemplary leadership” in women in science and technology fields. Coorssen was honored with the award for Outstanding Education. “One of my goals is to inspire my new grad students to pursue careers in the university, to support women in the workforce, to mentor graduating students in accepting her award at the May gala event. “It feels wonderful to be honored by the Athena Pinnacle Award for this work that I’m passionate about.” Since her appointment as Faculty Equity Advisor for the Jacobs School in 2012, Coorssen helped in the hiring of fifteen female faculty members (out of forty-seven new hires). She also serves as co-faculty of UC San Diego’s Center for Research on Gender in Science, Technology, Engineering, Mathematics and Medicine (STEMM). Coorssen is a Fellow of the IEEE and a recent recipient of the 2016 UC San Diego Affirmative Action & Diversity Award, among other honors.

Joseph Ford and Nina Vavilova were elected IEEE Fellows, Class of 2017. Vavilova was honored for “his contributions to computer vision, image processing and multimedia.” Ford was cited for “his contributions to light-optical imaging and communication technologies.”

For his “significant research accomplishments in the field of optical engineering,” Sheng-Fa F. Forman accepted the 2017 Joseph Fraunhofer Award and Robert M. Birley Prize from the Optical Society of America (OSA). The society cited Forman’s “pioneering seminal and wide-ranging contributions to non-scanning engineering of linear and nonlinear optical materials and optical information processing systems components.” The ECE professor is one of 15 distinguished researchers to receive OSA awards at the 2017 annual meeting.

Carla Schurgers has received a Fulbright U.S. Scholar Award to teach at Kyrgyz State Pedagogical University in Bishkek, the Kyrgyz Republic. “I intend to establish research collaborations using the $60,000 award to develop better and faster algorithms that can reconstruct the evolutionary past. His lab will collaborate with biologists to apply these algorithms to genome-scale large datasets to shed light on questions ranging from the evolution of eye structures to the potential for muscle-powered machines.”

Eric Fullerton, who directs the Center for Memory and Recording Research (CMRR), was honored with the 2017 Fulbright Distinguished Chair Award. The honor enables Fullerton to spend six months at the University of Lecce in France to collaborate on new and emerging neuroscience devices. His focus is on “ultra-low-power, non-invasive neural recording approaches that can underpin new computer architectures.” Fullerton was also participating in the Future Leader of the Society of Hispanic Engineers (FLODES) 2016-2017 academic year and presented his research during the Frontiers in Nanotechnology and Science Conference. Under External. An active diversity advocate at STEM, he created new initiatives, including the First Engineers Advanced Challenge (FEAC), where students design, build and market products. More specifically, it is enabling Gilja’s research into brain-machine interfaces using neural signals to control prosthetic devices.

Eric Ho and World Cui received the 2017 Undergraduate Research Awards. Ho did research on quantifying gaze behavior in order to objectively distinguish healthy individuals from persons with autism using neural networks and computer vision. Cui completed his B.S. degree in 2017 and is enrolled in the M.S. program starting Fall 2017. Cui did research on machine learning algorithms for self-driving cars. The Jacobs School of Engineering hands out a Department of Excellence award to students in each of the school’s six departments. In 2017, undergraduate Michael Unanian accepted the award. The graduating senior focused on Electronic Circuits and Systems, and worked in the Biometrics and Electronics Systems Lab of ECE professor Drew Hart. He created software services offered to students the school’s honor society. This fell Unanian will enroll in the Ph.D. program at Columbia University, and his long-term goal is in cancer research using drug delivery systems.

During the 2017 Blog Covered Ceremony, ECE undergraduate Joel Ramirez received the 2017 IDEA Award for Community Leadership. Ramirez was Primus in the California Chapter of the Society of Hispanic Engineers (SHPE) for the 2016-2017 academic year, and participated in the IDSA chapter’s Student Affirmative Action & Diversity Award, among other honors. Ramirez was also the Electrical Systems lead for the CubeSat satellite project undertaken by Students for the Exploration and Development of Space (SEDS). He

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SECOND ANNUAL DESIGN COMPETITION

Ten interdisciplinary teams from JSDOE and Social Sciences presented prototypes of innovative products designed to improve the lives of senior citizens. The June 10 event was the culmination of the 2016-’17 Engineering Design Competition and attendees included members from the La Costa Glen senior retirement community and UC San Diego Retirees Association.

Team Kiwi took first place for its KiWi Attention Walker, which uses a machine-learning program that depicts the person’s walking pattern. The insole has nine embedded sensors for data collection and has been shown to notify the user of an obstacle. At night, the LED lights can illuminate the path to follow.

The KiWi Attention Walker was designed by a team of UC San Diego engineering students, led by a team of UC San Diego engineering students, led by Dr. Glen folks was the most rewarding part of the KiWi Attention Walker. The team was inspired by their own father’s life to get involved with the ECE Design Competition. He had a stroke in his fifties and has faced a new walker in his own life. “I want my dad to feel more independent,” explained Matesa. For both Matesa and Eco Walkers of Team Swift, the second-place team, interacting with the La Costa Glen folks was the most rewarding part of the competition. “It’s thrilling to see our students working with senior citizens on real engineering design projects. This is part of our larger Experience Engineering initiative within the Electrical and Computer Engineering program at UC San Diego. We are giving students as many hands-on engineering education opportunities as possible, and we are seeing the positive results. Our students are moving to real-world engineering design projects.”

After finishing acceleration tests and a one-mile endurance course, the TR-16s model at 25 minutes compared to the 2017 model’s 15 minutes. The team is Triton Racing’s most competitive car to date,” added Tran.

According to Triton Racing, the improved performance in 2017 benefited from a 7% shorter wheelbase, a lighter frame, and other enhancements. The streamlined 30-plus pounds lighter than the previous year’s model, and ergonomic changes improved driver comfort as well as the car’s performance at twists in the track. “The TR-16s model is Triton Racing’s most competitive car to date,” added Tran. The TR-16s model is Triton Racing’s most competitive car to date.”

At the conclusion of the Design Competition Showcase and participatory tours, go to http://www.ece.ucsd.edu/events/2016/design-competition/showcase/…

ECE DAY 2017

In April, the ECE department staged its third annual ECE Day. Organized by the ECE Undergraduate Student Council and UC San Diego students of the Kappa Nu NM and IEEE, the day-long event featured opportunities to network and explore new courses and depth sequences (the subject of a poster session while learning about potential career paths.

The meeting place, “Startups vs. Corporations,” gave students in the audience a primer on the pros and cons of working for a startup versus working for a corporation. With panelists from MaXentric, Linaro, Kneron, Qualcomm and Northrop Grumman, both sides were represented.

The morning panel, “Startups vs. Corporations”, gave students in the audience a primer on the pros and cons of working for a startup versus working for a corporation. According to Cathy Geiler, a member of the La Costa Glen advisory board, “Engineers make the things work, but it takes a whole team to make these kinds of programs work—and that’s from a teacher.”

The third-place prize went to the team Project Purple and its Caregiver Collective system. The project and networking app lets relatively new caregivers tap into a wealth of knowledge and support from experienced caregivers. It uses the boxes. Very few of these care programs still exist, and some of them are not even available. Project Purple and their Caregiver Collective system.

Attendees at the Design Competition finals in June voted for a Popular Choice award, which went to Team IndeGo. Their invention: the IndeGo Walker, rethinking the classic walker with ergonomic and safety improvements. By integrating engineering and human-centered design, the IndeGo Walker incorporates a comfortable new design, a GPS tracker, and a lighting system that makes it more comfortable to use.

Now going into its third year, the annual ECE Design Competition serves as an important application of design thinking, and engineering skills to a large population of senior citizens. According to Cathy Geiler, a member of the La Costa Glen advisory board, “Engineers make things work, but it takes a whole team to make these kinds of programs work—and that’s from a teacher.”

The insole has nine embedded sensors for data collection and has been shown to notify the user of an obstacle. At night, the LED lights can illuminate the path to follow. Electrical engineering major Genisa Matesa was a member of Team Swift. She was inspired by her own father’s life to get involved with the ECE Design Competition. He had a stroke in his fifties and has faced a new walker in his own life. “I want my dad to feel more independent,” explained Matesa. For both Matesa and Eco Walkers of Team Swift, the second-place team, interacting with the La Costa Glen folks was the most rewarding part of the competition. “It’s thrilling to see our students working with senior citizens on real engineering design projects. This is part of our larger Experience Engineering initiative within the Electrical and Computer Engineering program at UC San Diego. We are giving students as many hands-on engineering education opportunities as possible, and we are seeing the positive results. Our students are moving to real-world engineering design projects.”

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The afternoon session was focused on security. In exchange for long hours and pay of risk, startups may not be paid as much as their counterparts at big corporations, but they are typically more passionate about the project.
ECE continues to add hands-on courses to its undergraduate curriculum. Students now have opportunities to enroll in project-based courses at every grade level, and in some cases, there are multiple hands-on courses from which to choose. Here’s a quick recap of courses available. (Courses designated as NEW are offered for the first time in the 2017-2018 academic year.)

MAKING, BREAKING AND HACKING STUFF

ECE 115 is a fun, hands-on course designed to prepare ECE students to address real-world challenges by learning and applying embedded systems concepts. The class is a prerequisite for another hands-on course on Fast Prototyping (ECE 155), so students who want to take 115 in Winter 2018 are advised to sign up for ECE 115 in Fall 2017.

Students tackle the concept of hardware and software for interfacing with the world and, in particular, the trade-offs between them. Anyone studying computer science can access accurate untrusted memory storage, or speed, but developing a device in ECE always involves trade-offs and limited resources. Using C to program microcontrollers, ECE 115 students are introduced to the Python programming language to analyze data (a prerequisite for many internship opportunities). The course also introduces students to real-world sensing through the structured design and development of a controller based on electromyogram signals. In addition to Python and Arduino C, covered topics include serial communication, signal processing, and real-time control. Students complete three individual design-oriented lab projects, culminating in a final design competition in which small teams compete to design and build the best controller for a video-game.

LOGISTICS: ECE 115 will be offered in Fall 2017 and Winter 2018. Both will be taught by lecturer and three-time ECE alumnus Ramin Khosravi (B.S., M.S., Ph.D., '05, '07, '12). Lectures are scheduled for Mondays and Tuesdays in SMI 305. Prerequisites: ECE 10.

Rapid Hardware and Software Design

ECE 166 is an innovative LabVIEW programming course designed to teach students how to design and develop LabVIEW applications. This course prepares students to develop, debug and test LabVIEW VI’s, solve problems using LabVIEW, use data acquisition, and perform signal processing and instrument control in LabVIEW applications. Each class includes instruction in a series of hands-on exercises using National Instruments (NI) myDAQ and myRIO. Students work in teams to learn an elevator from laser-cut and 3D-printed parts, integrate sensors and actuators, and program using state-machine architecture in LabVIEW to form a complete system. Students have the opportunity to take the NI Certified LabVIEW Associate Developer (CLAD) exam at the end of the course to validate their LabVIEW development skills.

LOGISTICS: This course launches in Fall 2017 and will also be offered in Winter 2018. Both courses will be taught by ECE lecturer Alex Phan. Prerequisites: Computer Science 30 or permission of instructor.

ECE 188 is developed for upper-division students and taught by lecturer Rick Geosner. The software development courses launch in Winter 2018, with the second in the sequence scheduled for Spring 2018. Prerequisite: by consent of instructor.

The Art of Product Engineering

Previously taught as ECE 188 (Special Topics), The Art of Product Engineering (http://artofproductengineering.com) is becoming a two-course sequence offered as permanent components of the ECE curriculum. The two courses integrate theory with practice and provide the knowledge and skills necessary to acquire a position in a new generation’s engineering environment.

Students learn end-to-end software development, work with hardware and sensors, and build real products for real potential customers.

ECE 140A will focus on the Internet of Things (IoT), while ECE 140B exposes students to Systems Thinking. The first course will focus on software development fundamentals from an end-to-end perspective, and the second course will focus on practical knowledge and project management skills. Students will also build a “smart” plug in the lab. Built on the Raspberry Pi platform, the plug will be a sensing and communication device.

The second course in the sequence, ECE 140B, will teach students how to apply the principles acquired in the first course to add functionality and intelligence to their smart plugs. Students will compete in small teams on a design project, using their smart plugs to perform intelligent sensing in the cloud and present their complete system at the culmination of the two-course sequence. The second course also emphasizes more advanced topics, such as security, algorithms and analytics.

These two courses are designed to explore and develop essential technical skills, strong architectural intuition, elective collaboration skills, and the practical ability to deliver viable customer products in the context of a real-world product development challenge. Advanced topics will include practical hardware and software engineering. Students will learn about engineering patterns and anti-patterns, customer and user experience (UX) design, full-stack web development in the Python programming language, and best practices in building a product ecosystem.

LOGISTICS: ECE 140A is offered in Winter 2018, and ECE 140B in Spring 2018. Both courses will be co-taught by ECE lecturers Rick Geosner and Ramin Khosravi.

Idiomatic Software Development

ECE 166 features a new two-course sequence called “Idiomatic Software Development.” Designed specifically for ECE students, the course blends theory, history, and practical, hands-on exercises aimed at improving students’ conceptual, architectural and development skills. “Our ultimate goal is to help students acquire the fundamental software skills necessary to prepare them for job interviews and work in engineering organizations,” said lecturer Rick Geosner, who developed the course and teaches the inaugural series of courses.

The courses cover fundamental concepts of computer science and best practices in modern software development. Core topics include algorithms, programming paradigms, control structures, and data structures. Students gain experience in evaluating and choosing algorithms to solve problems. They also learn problem-solving methods to apply when developing their own algorithms to satisfy weekly design challenges.

Reinforcing and extending students’ understanding of object-oriented programming principles, course topics include the use of inheritance, encapsulation, polymorphism, abstract data types, interfaces, and a broad coverage of design patterns and anti-patterns to build reusable components and extendable architectures.

Students complete individual projects, collaborate in small group assignments, and participate in a class-wide final project. Through in-class exercises, examinations, and assignments, students gain valuable real-world experience reading, designing, writing, testing, debugging, evaluating and discussing software like a professional developer.

LOGISTICS: ECE 180 is developed for upper-division students and taught by lecturer Rick Geosner. The software development courses launch in Winter 2018, with the second in the sequence scheduled for Spring 2018. Prerequisite: by consent of instructor.

Engineering Hands-On Group Project

ECE 166 (https://courses.awesomelabs.com/ecs166) is a Project-in-a-Box (PiB) based course. PiB is an online boxes containing all the parts and equipment that students need to build a hands-on project. Each PiB contains instructions suitable for students at beginner, intermediate, or advanced levels. Launched in Fall 2016, ECE 166 aims to provide hands-on engineering and team-building experiences to students as they build a variety of different systems ranging from a binary clock to an internet-enabled whiteboard. They build solar trackers to power light-emitting diodes (LEDs), and in the process, students gain experience with Arduino programming, design optimization, computer-aided design (CAD) software, computer-aided engineering (CAE) software, and computer-aided manufacturing (CAM) software. Another hands-on experience engages students in laser cutting, soldering, and 3D printing of parts for a robotic arm, and for another, students construct a pedal to render guitar audio effects and learning to read schematics, construct a breadboard (on which integrated circuits are designed), and conduct Fourier analysis.

LOGISTICS: ECE 166 is offered quarterly during the academic year and open to all undergraduates. The course is taught by ECE chair Truong Nguyen.
HENG QIAO
SIGNAL AND IMAGE PROCESSING

At the 43rd IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP 2017) in New Orleans, ECE Ph.D. student Heng Qiao was up against more than 2,300 accepted papers from around the world. But in the end, Qiao and his advisor Ying Shi received the Best Student Paper Award for their work, “Unified Analysis of Optimal Communication Information for Direction of Arrival Estimation.” The paper won for “how to analyze the performance of non-uniform samplers and their co-array (difference sets) in the presence of noise and limited data.” Qiao and Pal’s response was to develop a brand-new unified framework for assessing the performance of any algorithm that attempts to exploit the co-array structure of spatial uniform samplers. They noticed that the geometry of certain co-array sets that describe the solution space of these problems could be very efficiently utilized to conduct such a unified analysis. Using properties of positive trigonometric polynomials (associated with cosets) and their representation theories, they developed universal error bounds that can be checked by very low-complexity algorithms.

The paper is part of a larger effort to develop sophisticated sampling and inference techniques for high-dimensional structured data that permit low-dimensional representations. Under Professor Pal’s guidance, Qiao has worked with statistical signal processing and sampling theory to apply ideas from statistical signal processing and sampling theory to real-world machine learning and statistical data mining problems involving properties of data.

ANUSHA LALITHA
DISTRIBUTED CONTROL AND LEARNING

Anusha Lalitha joined the Ph.D. program in ECE in 2013 to work on distributed control and learning, particularly applied to wireless networks of sensors and dynamic agents such as drones and autonomous robots. “These agents extend our ability to remotely monitor and control the physical environment,” says Lalitha. “So it is critical that future networks be agile, adaptable, reliable, as well as secured and energy-efficient, while maintaining low delays by executing their tasks.”

Lalitha works in the lab of ECE professor Tarek Javidi. She points to the example of a self-driving car whose driver uses Google Maps to navigate. For many years, Google has developed a large and urban data-analytic system. “To do this, the driver needs to learn the route and drive of data-rate demand throughout the day in order to adapt their strategy accordingly.”

In short, she adds, to meet such challenges, Lalitha is investigating reliable and speedy data acquisition/extraction/learning in a distributed manner, and designing protocols for accurate and agile control of systems, without losing the artifacts of the environment and through past observations. “Feedback can only improve system latency through adaptively and sequentially,” says the Ph.D. student. “This means activity adapting the data acquisition, communication process, and adaptively controlling the manner of learning observations and communication round. Adaptability can control the quality of learning observations and information transmitted over a channel, whereas sequentially allows for collection of more meaningful information.”

In recent work to be presented in November at the 2017 IEEE Information Theory Workshop, Lalitha and Javidi consider the case of agents choosing local actions to adaptively control their sensors in the context of learning using networked agents in wireless algorithms. Lalitha—who earned her undergraduate degree in 2012 from the Indian Institute of Technology, Delhi—argues that understanding the effect and interpretability of adaptively and sequentially is crucial. “Because control over dynamic channels requires more real-time constraints on reliability and the number of communication rounds,” responds Lalitha. “Sequential long delay due to sequentially that are translated in traditional communication systems can be highly detrimental and even result in system instability. Furthermore, communication in control of traffic is a major challenge where traditional methods of information theory are inadequate.”

Another challenge is to minimize the drones’ flight times (e.g., by avoiding inefficient flight paths), which requires accurate and agile control of dynamic agents over a wide, unstructured medium. Lalitha emphasizes that “energy and memory constraints can severely limit drones’ learning capabilities to only small regions.” Lalitha notes, “self-adapted learning based on reliable and energy-efficient sensors must be communicated to be met during minimal delay.”

BITA DARVISH ROUHANI
MACHINE LEARNING AND COMPUTER ARCHITECTURE

Bita Darvish Rouhani doesn’t have to worry about where she’ll get the money to complete her Ph.D. She is one of only two students at UC San Diego to receive a Microsoft Research Ph.D. Fellowship in 2017, and the only one from the Electrical and Computer Engineering (ECE) department.

The fellowship covers Rouhani’s tuition and fees for the next two academic years (2017-18 and 2018-19). She also receives a stipend for living expenses as a conference travel allowance. While the largest gift to date, the Microsoft fellowship is one of many honors, including a scholarship from the Computing Research Association (2016), a Richard Watson Young Scholar Scholarship (2014) and Best Thesis Award for her undergraduate thesis in electrical engineering.

The announcement of her Microsoft fellowship followed Rouhani’s first summer internship at Microsoft Research 2016, where she worked on the Microsoft Search and Correlation Research Group. She was back in Bell, VA, this summer, exploring a different direction as a research intern in the company’s Computer Architecture Research Group.

“Microsoft Research is my professional home and an exciting place to explore the link between research and making technology for the world,” observes Rouhani. “I already feel like Microsoft is my professional home away from home, and having that support for my two years at Microsoft gives me the freedom to really explore the best research areas within my field. I am very excited about working with my advisor, Prof. Koushanfar, on algorithmic research and development.”

Together with financial support, the Ph.D. Fellowship gives Rouhani the unique opportunity to collaborate with world-class researchers at Microsoft, as she also do her dissertation. The fellowship will also help her to venture into building artificial intelligence, automated computing systems for end-use and deployment of practical, real-world applications, specifically, to build solutions that both are data- and platform-aware.

“I believe there are at least two major sets of challenges that need to be addressed simultaneously. One set of challenges is related to the resource and application-specific constraints such as power consumption, design costs or memory bandwidth,” she says. “The other set of challenges is due to the complexity of the underlying learning tasks. This complexity makes it necessary to go beyond the traditional folk of polynomial analysis. If we want instead to achieve a certain level of accuracy.”

In short, to bridge the gap between theory and implementation, Rouhani works to solve problems that simultaneously reflect the high data and the intelligent computer architectures, with an eye on real-world applications. For example, she has developed a set of automated and reconﬁgurable tool and algorithms for big-data analytics and deep learning in resource-constrained systems. "In this paper, we present a parallelization framework for deep learning algorithms. Our implementation on GPU demonstrates a speedup of up to 10X compared to the state-of-the-art multi-GPU framework. The framework is designed to work with a variety of deep learning algorithms, including convolutional neural networks, recurrent neural networks, and fully-connected networks." Rouhani has her sights set on using this framework to solve problems in big-data analytics and deep learning in resource-constrained systems. "In this paper, we present a parallelization framework for deep learning algorithms. Our implementation on GPU demonstrates a speedup of up to 10X compared to the state-of-the-art multi-GPU framework. The framework is designed to work with a variety of deep learning algorithms, including convolutional neural networks, recurrent neural networks, and fully-connected networks."

IGOR FEDOROV
MACHINE LEARNING AND SIGNAL PROCESSING

Ph.D. student Igor Fedorov is entering his 4th year and anticipating that he will finish his dissertation at the end of the 2017-2018 academic year. He does so with a wealth of experience from two ECE faculty advisors, Bita Rouhani and Ting-Hsi Huang, as a member of their respective labs the Digital Signal Processing (DSP) Lab, and the Video Processing Lab.

Fedorov’s work focuses on Bayesian techniques for sparse signal recovery and dictionary learning, but he covers a wide range of topics. They include: non-negative sparse signal recovery and matrix factorization; robust sparse signal recovery with applications to face recovery and person re-identification; machine learning; dictionary learning; and single-photon extreme quantum cryptography (SPXQC).

Non-negative signals occur naturally in many application areas, including image, speech and text processing. Collaborating with fellow DSP Lab member Alinc Nakli, Fedorov develops novel Bayesian algorithms for recovering non-negative signals from compressive measurements. He has also addressed the related problem of learning non-negative representations of data. In the process, he has contributed to both the theoretical understanding of existing algorithms as well as providing a simpler framework for drawing new approaches.

Fedorov has also collaborated with DSP Lab and ECE alumni Bhikti Giri (Ph.D. ’16), who is now a Starkey Hearing Technologies. They formulated a novel Bayesian approach to sparse signal recovery in the presence of severe, non-stationary noise corruption. They applied the novel approach to the task of face recovery (face hallucination) using two different datasets that offer similar, but not identical, conditions. They also created multi-camera experiment that allows to estimate the illumination conditions of the unknown

Fedorov also posted state-of-the-art results in dictionary recovery, after he developed a novel Bayesian approach to multidiad dictionary learning. Multidiad dictionary learning refers to the task of joint learning of representations of multiple data types — a critical tool for decoding how best to learn from the growing volume of data. Fedorov has shown that his approach can be applied to multimodal data classification (e.g., images and text), and it outperforms existing dictionary-learning algorithms.


bilinear interpolation, allowing the use of more complex conditions in image-generation tasks. The program’s corresponding emphasis on networking sets the stage for students to make valuable connections that will benefit them throughout their careers.

SUMMER RESEARCH INTERNSHIP PROGRAM

One of ECE’s newest academic offerings is the Summer Research Internship Program (SRIP). A 10-week immersive that takes graduate and continuing undergraduate students behind the scenes of our campus research groups. Under the supervision of a PI or another member of a research team, students observe and participate in a wide variety of research activities in applications ranging from robotics surgery to advanced imaging technology.

A total of 85 interns participated in the program, 13 female students among them. Participants included:

- 36 M.S. Student Participants - 31 male, 5 female
- 45 Ph.D. Student Participants - 33 male, 12 female
- 20 M.S./Ph.D. Student Participants - 18 male, 2 female
- 27 Faculty Mentors - 21 male, 6 female
- 25 PI Mentors - 24 male, 1 female

SRIP research is designed to appeal to students interested in many different aspects of electrical and computer engineering, with projects that reflect the increasing role of ECE in everyday life. One example is the development of a robotic endoscope led by ECE Prof. Michael Yip. SRIP student Andrew Abd El-Messih found that “we can create a novel design for colonoscopy endoscopes that prevent patient’s bodies from being inadvertently scanned, reduced or perforated during surgery. This resulting endoscopy, in a series of discrete propulsion modules that can be individually manipulated to allow the robot to visualize, and better conform to the environment inside the body. The low-cost end allows the robot to easily navigate using the better the risk reduced module for discomfort making the task smoother, smaller avoidance in life-saving scenarios.”

“Participating in SRIP gave me the opportunity that led me to my first-time authorship,” said El-Messih, “which includes both a workshop paper and a conference poster session of the top robotics conferences. International Conference on Robotics and Automation (ICRA) and the International Conference on Intelligent Robots and Systems (IROS). More events are in the process of being developed.”

A second SRIP project this year involved the use of computer vision, machine-learning tools and eye-tracking technology to better understand eye gaze behavior in social settings. Gaze analysis in children with autism spectrum is common with many children experiencing difficulty holding expected gazes, displaying joint attention to objects and accurately time their gazes. Students Yuki Zhang and Vivian Meng worked with ECE Prof. Pamela Chou to develop a machine-learning algorithms for Parkinson’s eye-tracking glasses. The algorithm improves the speed and accuracy by which data can be collected and translated and pave the way for quantification of gaze behavior in real-world social conversations.

Research led by ECE Prof. Yulana Lee on biological devices and systems for point-of-care and precision medicine provided an opportunity for SRIP student San Hu to receive hands-on experience in small cell research, increase awareness and provide academic and professional insight to those working in the field. San, who is working on the development of implantable devices for the treatment of breast cancer, explains, "I have been working on developing nanoscale implantable devices for the treatment of breast cancer. The team developed a method for using laser-based epilation to detect the presence of amplification-free nuclear acid chip – in other words, watching and counting DNA at high-throughput and low-cost.”

Under the guidance of ECE Prof. Nano Vasconcelos, students Yulani (Vivi) Chen, Hao Zhang and George Ma worked to improve a class of machine-learning algorithms known as Generative Adversarial Networks, which can be used to determine autonomously if images are real or not. Their work forms part of a larger research group that seeks to improve the computational ability of these networks for everything from image generation to more efficient data analysis. Students in the Summer Research Internship Program are also introduced to the Winter On-Chip Systems Workshop, a series of lectures and workshops offered by the UC San Diego Quasar Institute. These interactive workshops are designed to get students thinking about how they can convey their research to those outside their labs – whether academic peers, interdisciplinary colleagues or the general public. Students put into practice the techniques they learn via spontaneous public speaking drills, slide design, research ethics and other pertinent topics. The program’s corresponding emphasis on networking sets the stage for students to make valuable connections that will benefit them throughout their careers.

"My greatest takeaway from this experience," says Electrical Engineering undergraduate Hanne Khan, “is that being exposed to proper research etiquette makes me value the importance of communicating research to others, who are just like you with similar interest.”

SRIP’s enrichment components, combined with the program’s hands-on lab training culminates in a day-long Summer Research Conference. Students give oral presentations about the research they carried out over the summer while also conveying the larger implications for such areas for the field of medical and computer engineering. Such training also provides a head-start for students to track as they apply to National Science Foundation graduate fellowships.

In 2018, the SRIP program will expand to include industry partners, who will provide pertinent student internships for the summer quarter.

"This program was developed to give both undergraduates and M.S. students additional opportunities to participate in research where they are the head of UC San Diego," says Huang. "Getting more students involved in the Electrical and Computer Engineering department at UC San Diego, "In turn, they benefit from expanded opportunities to participate in industry internships, industry projects, and future academic research. These experiences help to M.S. or Ph.D programs will be more competitive in the application process and better equipped with the skills that all top students are looking for."
OSMAN KIBAR

In 2016, Forbes magazine called Osmán Kíbar an “undeniable billionaire.” In a profile of the ECE alumnus (Ph.D. ’99) who did his doctoral under ECE professor Sadik Euerer, the publication noted that Kíbar, who founded the technology firm Samumed, has been “building for a decade, is the most valuable biotechnology startup on the planet.”

Kíbar is not just an investor. He is also a dreamer, and as the company’s Chief Executive Officer, Kíbar has an unquenchable quest to reverse aging. He is focusing Samumed on a pharmaceutical platform to advance regenerative medicine and oncology applications. Some of Samumed’s valuation is based on its ability to develop small-molecule drugs that modulate the Wnt pathway, which has been implicated in many conditions ranging from cancer and aging to blindness and arthritis.

The Wnt pathway, which controls crucial biological processes in the body, has been connected to many types of cancer, Parkinson’s disease, and age-related macular degeneration. It also plays a role in the development of vertebrate embryos, including the formation of tissues and organs in a fetus. Kíbar’s company is focused on using small-molecule drugs, which are typically easier to develop and manufacture than biologics, to modulate the Wnt pathway.

According to the scientific literature, the Wnt pathway has been implicated in many conditions ranging from cancer and aging to blindness and arthritis. The pathway is thought to be involved in the development of vertebrate embryos, including the formation of tissues and organs in a fetus, and in the repair and regeneration of tissues in the body.

Kíbar’s company, Samumed, is working on developing small-molecule drugs that modulate the Wnt pathway. These drugs could potentially be used to treat a variety of conditions, including cancer, Parkinson’s disease, and age-related macular degeneration.

In addition to his work at Samumed, Kíbar has also invested in a number of other companies, including Geron, where he served as the company’s Chief Executive Officer. He has been named to lists of the most influential people in biotechnology and has been featured in Forbes Magazine.

Kíbar’s work at Samumed is not just a career move for him. It is a personal passion that he has been pursuing for many years. He has a long-standing interest in the field of regenerative medicine and has been involved in a number of other companies that have focused on developing drugs to treat age-related conditions.

Kíbar’s commitment to advancing regenerative medicine is not just driven by a desire to treat specific diseases. It is also motivated by a broader vision of improving human health and extending life. He is passionate about the potential of small-molecule drugs to modulate the Wnt pathway, and he believes that these drugs could have a significant impact on the treatment of a wide range of conditions.

As Samumed’s Chief Executive Officer, Kíbar is focused on bringing the technology to market. He is working closely with his team to develop the drugs and bring them to patients as quickly as possible.

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CWC AND INDUSTRY PARTNERS DEVELOP FIRST-OF-ITS-KIND POWER AMPLIFIER

The ECE department has developed deep ties to industry, not only to facilitate internships and jobs for the department’s students and graduates, but also to ensure the commercialization of new technology and the large economic and societal benefits that are mutually beneficial to both sides. What follows is a brief case study that showcases the success of one effort by ECE faculty to engage with industry from San Diego and around the globe.

The envelope-tracking power amplifier consists of a broadband radio-frequency (RF) power amplifier and a single-phase buck converter; a 20% DC power converter to step down voltage (and keep up current) from its input (supply) to its output (load). Both the RF power amplifier and the buck converter were fabricated using a GaN High Electron Mobility Transistor (HEMT) from Bosch, which is considered an ideal choice for high-power amplifiers in satellite communications, radar, cellular and broadband wireless as well as defense and scientific applications.

The team demonstrated efficient operation of the power amplifier even with 80 MHz modulated LTE signals — four times wider than the signals typically used in other envelope-tracking power amplifiers. The resulting highly-efficient amplification of complex signals up to 80MHz achieved a world-class drain efficiency of 45.6 percent. The system yields less energy consumption at the base station, despite higher communication speed and capacity,” observes Aptekar. “Based on what we know now, the technology is a highly promising candidate for next-generation mobile networks.”

The team completed fabrication and integration in November 2016, and the team presented our initial results at the 2016 IEEE International Microwave Symposium in Milwaukee, Wisconsin. The team is now working on the next step of the project, which is to integrate state-of-the-art power amplifiers and controllers to operate most of the time at back-off power levels that are well below saturation levels, even though power amplifiers generally achieve their highest efficiency the closer they get to their saturation power level. Back-off levels, therefore, the result could mean significantly degraded efficiency. That is already the case with today’s fastest 4G LTE signals (with a 6dB or higher peak-to-average power ratio). Envelope-tracking power amplifiers have been studied extensively as a means to overcome this problem, but to date, the techniques have been mainly prototypes. The team’s work, however, is already the case with today’s fastest 4G LTE signals.

MALAYALAM: എജിഡി എഡ്യുകേഷനൽ നിയമന വിഭാഗം ഒപ്പം സ്കൂൾ വിദ്യാരഥികൾക്ക് നൽകുന്ന രീതിയിൽ പരിശീലനം നൽകുന്നതിന് മുൻപ് സ്വദേശി പഠനം നൽകിയത്. ഉദാ: സ്വദേശി പഠനം നൽകുന്നതിന്റെ മുഖ്യ ഉദ്ദേശ്യം പട്ടികയിൽ ഉൾപ്പെടുത്തിയത്. അൻവെത്ത് ദിയോ എഡിപി ഡി പാർമേയർ എന്ന് ചെയ്യുന്നത്.