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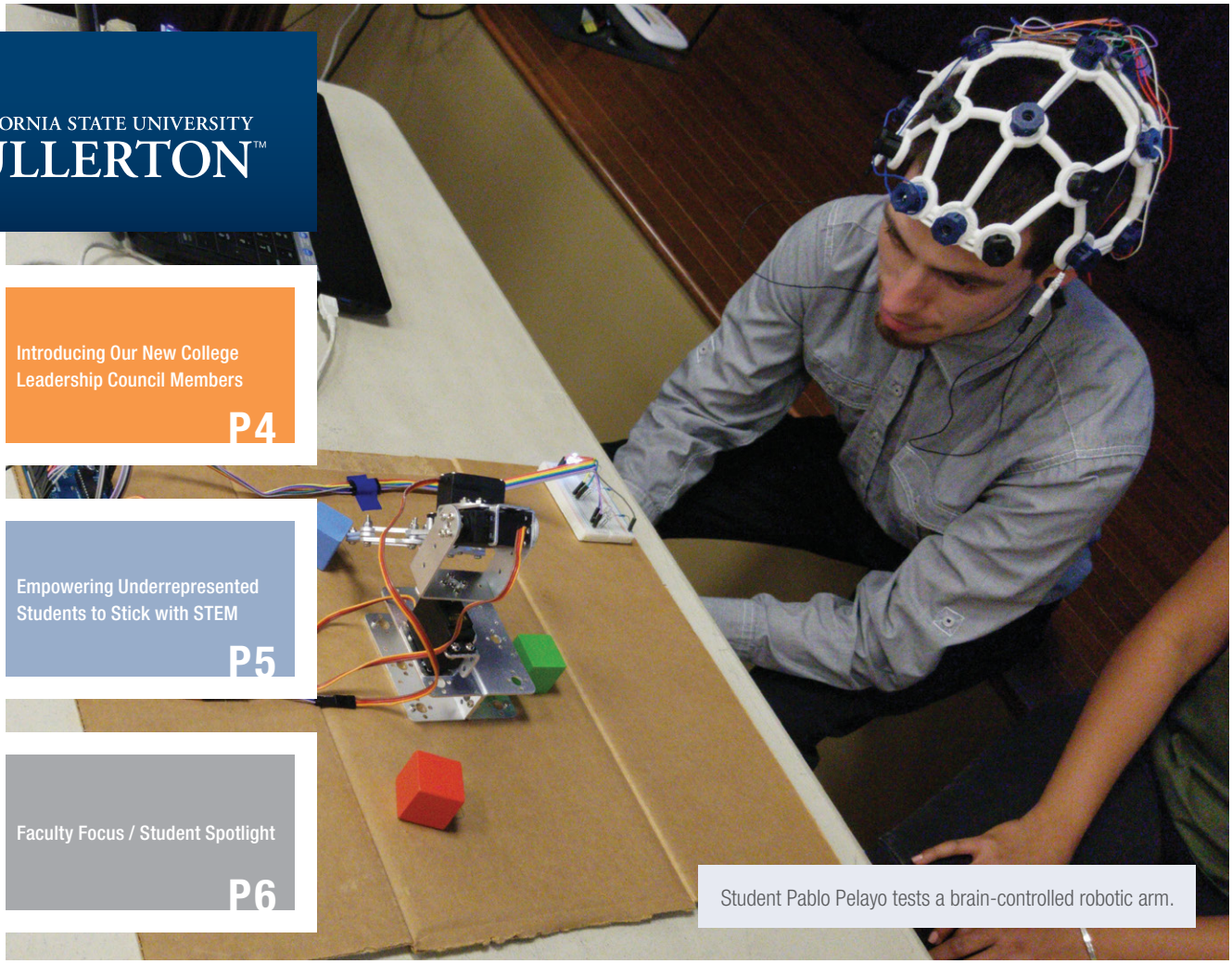

Student Pablo Pelayo tests a brain-controlled robotic arm.

CONNECTION

NEWS FROM THE COLLEGE OF ENGINEERING & COMPUTER SCIENCE

Issue Fifteen // Winter 2019

Student Spotlight: Bio-Electric Signal Based Systems Lab

For those of us who have experienced a loved one living with a neurodegenerative disease such as Parkinson's, ALS, or Alzheimer's, we know how difficult it can be. A parent who can't remember their child's name is heartbreaking for both, and the loss of motor skills many elderly people must cope with can cause a frustrating loss of independence.

Recent advances in technology have shown great promise for improving their quality of life – and some of that technology is being developed by students right here at Cal State Fullerton, in the Bio-Electric Signal Based Systems Lab run by Kiran George, professor of computer engineering.

Assisting with Facial Recognition

Growing up, computer engineering student Samuel Sisson (B.S. '19) remembers his father and grandfather telling stories about his great-grandmother. She was a smart, outgoing schoolteacher who was wonderful to be around. But later in life, Alzheimer's began to claim her memory. By the end, she could not even recognize her own son. These stories played a big part in Samuel's decision to join George's lab when presented with the opportunity, and on the projects he has chosen to pursue.

One piece of technology Samuel is working to develop is a wearable system for Alzheimer's patients to provide memory assistance. This system would allow users to press a button

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Susan Barua
Dean, College of Engineering & Computer Science

A Message from the Dean

One of our computer engineering students is developing a photo recognition system that Alzheimer's patients could wear to identify friends and family during social interactions. Others are working on a brain signal-powered computer control system to help people with motor and speech impairments control devices in their home. Teams of our young researchers have successfully built and piloted a Mars Exploration Rover and have written a professional security audit report for a self-driving car.

These are just a few examples of College of Engineering & Computer Science students who are uniquely prepared to excel in finding solutions for real-world challenges after graduation. Their innately innovative spirits, access to talented faculty with a broad worldview, and opportunities to translate ideas into life-changing realities in our hands-on learning environments are preparing them to transform their future industries and communities.

Each day, I'm amazed by and so proud of the remarkable achievements of our students, faculty, and alumni. And I'm grateful for all the support we have in our quest to provide exceptionally well-rounded educational experiences. Together, we will continue to work to give our students and their mentors the resources they need to tackle the most meaningful questions and challenges in technology, healthcare, cybersecurity, communication, space exploration, and other fields by exploring every possibility and developing solutions with the potential to change the world.

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on a Bluetooth® earpiece to take pictures with a tiny camera. Those pictures are then matched to a library of known faces on a computer the size of a smartphone, and in less than five seconds, the results are transmitted through the earpiece.

"When we demoed our system at the Morningside retirement community, a woman whose husband had dementia came up to me and talked about how he didn't like going to social events for fear of humiliation," says Sisson. "She thought a device like this could really help relieve the stress of social engagements. And there was another woman who was losing her eyesight and thought it would be great for people with macular degeneration."

While the overall design is still being improved to make it more ergonomic, the system uses several off-the-shelf components and is estimated to cost around $300. "The senior citizens we showed it to were really blown away by how small and inexpensive the whole thing is. And they immediately saw how useful it could be in making their daily interactions smoother, and in helping them avoid embarrassing or upsetting situations."

Helping People with Neurodegenerative Diseases Gain Independence

Computer engineering student Brian Luu (B.S. '19) is also a research assistant in the Bio-Electric Signal Based Systems Lab, and along with teammates Vinay Kumar Karigar Shivappa and Bradley Hansberger worked on a number of projects designed to assist those with diseases such as ALS.

Using a brain-computer interface (BCI) system, the team was able to show that people with limited motor and speech capabilities can control a variety of smart home devices such as lamps, fans, outlets, and security systems through an electroencephalogram (EEG) headset that picks up the brain's electrical activity and can translate its signals into various commands. The system also included a text-to-speech implementation that interfaced with an Amazon Alexa, which controlled the smart home devices. In another project, the team used surface electromyography (sEMG) readings with a similar setup, and added a machine-learning algorithm that helps the computer better identify the user's commands.

> "The concept has great potential to give people with these types of diseases more control over their lives, and more freedom and independence."
> **BRIAN LUU (B.S. '19)**

Jean Hedrick from the Morningside retirement community uses a brain-computer interface controlled robotic arm to lift blocks.

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Seniors at the Morningside retirement community watch students demonstrate their wearable technologies.

"For some of the trials, users were able to complete the requested tasks with an accuracy rate of 90 percent or higher," says Luu. "The concept has great potential to give people with these types of diseases more control over their lives, and more freedom and independence."

Building a Better BCI System

The two major drawbacks of current BCI systems is that they're clunky and expensive – which is why they are rarely found outside academic settings. But computer engineering student Hema Murthy (M.S. '18) is doing her part to change that.

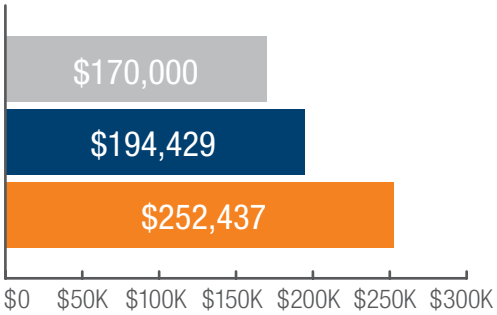
Working closely with Pablo Pelayo (B.S./M.S. '18) on a project designed to help those with neuromuscular diseases, the team showed how people with low motor abilities can control a robotic arm using only their brain. "Part of our work has been showing that low-cost devices can work just as well as expensive ones, which has given many people hope that this technology will soon be widely available," Murthy says, recounting how Morningside residents reacted when they saw Murthy's system in action. "They were amazed at how easy it was to control the robotic arm with the EEG device. Seeing the direct impact my work could have on their lives lifts me up and fuels my passion to do more research."

Hema's work as a research assistant in the Bio-Electric Signal Based Systems Lab has also given her the opportunity to attend two Institute of Electrical and Electronics Engineers (IEEE) conferences, and the International Symposium on Applied Research in Ensenada, Mexico. At the most recent IEEE conference, she presented her computer-brain interface study, and won the Best Paper Award.

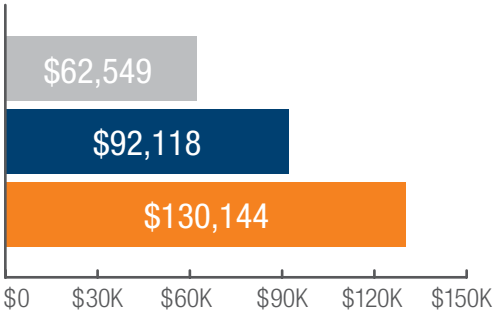
"I'm excited about the future of computational neuroscience, and look forward to pursuing my Ph.D. after a year or two in the field," says Murthy. "Recent advances in EEG technology have led to the creation of small EEG devices that place electrodes in your ear, which I'm already working with on my current project. Replacing heavy headsets with the ear EEG is going to be a game-changer, and I believe it will lead to breakthroughs that will improve the quality of life for millions of people all over the world."

ECS Student Project Funding

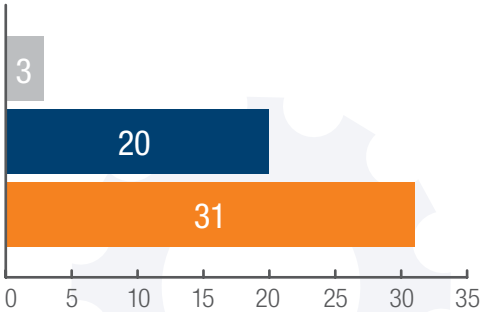
Total Funding Request



Total Amount Awarded



Corporate Partner Projects



2016-17 2017-18 2018-19

Introducing Our New College Leadership Council Members

The College of Engineering & Computer Science Leadership Council is made up of industry leaders who work closely with the dean and are instrumental in supporting faculty-led programs, research, and new initiatives. The Council recently added three new members.

MICHELLE PATRICK (B.S. '84)

Director of Raytheon's Navigation and Landing Systems

Patrick's role includes the pursuit, capture, design, development, site implementation, and long-term customer support for complex software-intensive aviation systems. Previously, she was program director for the Al Diriyah program, a $650 million Defense Clandestine Service Joint Forces Command, Control, Communications, Computers, and Intelligence program for the Saudi Arabian Ministry of Defense. Before that, she served in program management positions for U.S. Operations, Al Diriyah, and the Malaysian Air Defense Ground Environment. She also worked as an engineer on programs for Korea, Japan, Kuwait, Malaysia, and Saudi Arabia.

"I've had the chance to share my Saudi experiences with CSUF's Society of Women Engineers and participate in a speed-mentoring program, and I look forward to many more engagements with students."

BILL RUH (B.S. '83; M.S. '84)

CEO, Digital of Lendlease

Ruh leads the company's digital business platform. His role includes accelerating the digital transformation of Lendlease's businesses and projects using data, advanced analytics, and new technologies – embedding digital services, driving automation, and enhancing the company's smart cities strategy. Ruh has extensive global experience as a senior technology executive and entrepreneur across a range of industries. In his previous role with GE, he led its transformation into a digital industrial company, delivering a 2.5x increase in revenue from digital products and significantly improved productivity through digital programs. Prior to his role at GE, he was instrumental in the strategy and growth of the Cisco Services business through new innovations.

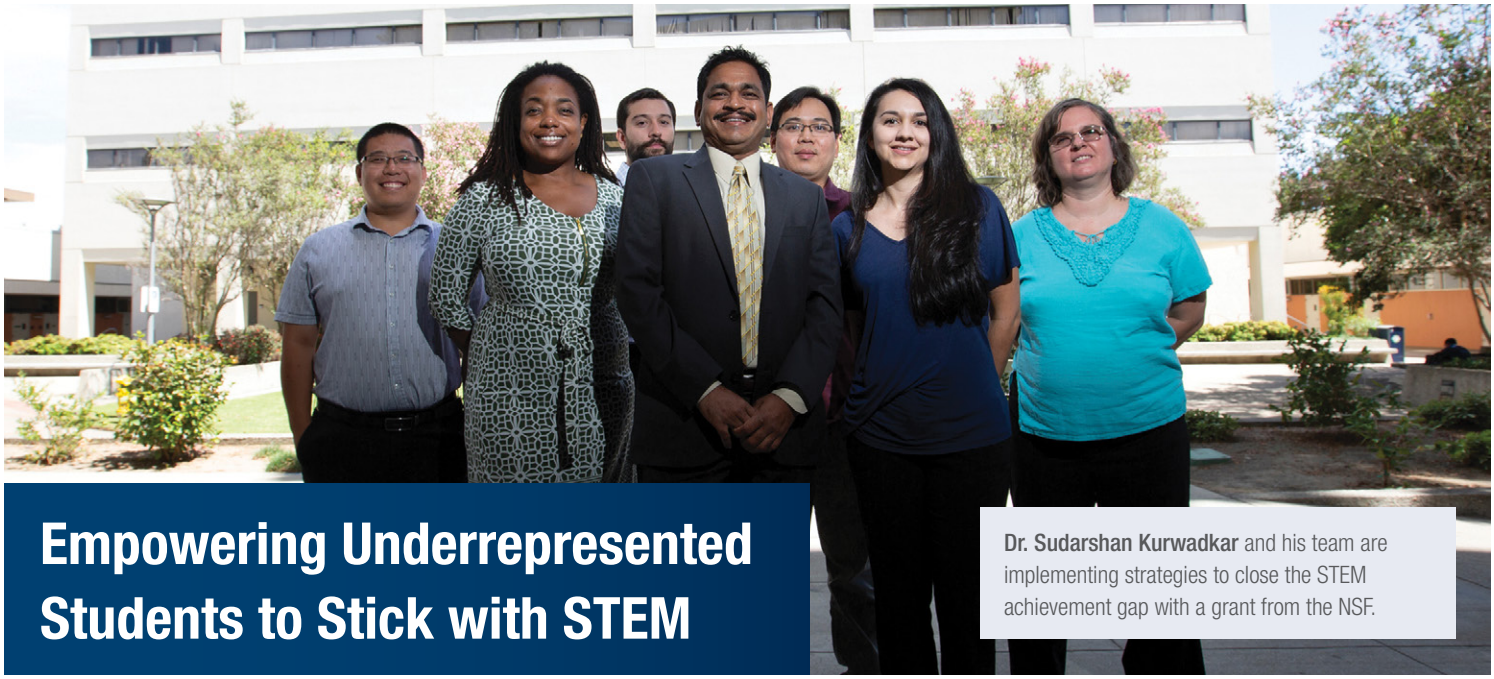
"I hope to be able to provide advice on the best use of resources to help make students more marketable and successful in their careers, advise the school and administration on their programs and challenges, and offer fundraising assistance."

RICK VAN KIRK (B.A. '82)

CEO of Pro-Dex

A CSUF business administration alumnus, Van Kirk earned his M.B.A. from Claremont Graduate University in 1991 and has worked in Southern California manufacturing industries for 36 years. He joined Pro-Dex as director of manufacturing in 2006 and was subsequently promoted to vice president of operations and then chief operating officer before becoming CEO in 2015. Prior to Pro-Dex, he served as manufacturing manager and manager of product development for the ChargeSource division of Comarco Wireless Technologies and as general manager at Dynacast.

"I am excited to be able to share some real-life experience and provide business-related feedback to students, which I really appreciated when I was in school."



Empowering Underrepresented Students to Stick with STEM

Dr. Sudarshan Kurwadkar and his team are implementing strategies to close the STEM achievement gap with a grant from the NSF.

Aimed at increasing retention and closing the STEM achievement gap for underrepresented minority students, a recent $1.5 million grant from the National Science Foundation (NSF) will help Cal State Fullerton develop strategies to reduce high repetition rates in lower-division gateway engineering courses. The grant is called "Advancing Student Success by Utilizing Relevant Social-cultural and Academic Experiences for Undergraduate Engineering, Computer Science Students."

According to Principal Investigator Sudarshan Kurwadkar, associate professor of civil and environmental engineering, the NSF grant will support early intervention strategies, build student-faculty rapport, and provide students with context-based learning experiences.

Participants will be recruited from critical "bottleneck" lower-division math, engineering, and computer science courses. The target for Hispanic student participation is 60 percent, and the target for female participation is 20 percent.

CSUF will implement curriculum enhancements in introductory courses, a Student-Teacher Interaction Council (STIC), a virtual learning community, family and community engagement, first-year research and design experiences, and summer undergraduate research experiences tailored to student needs.

"This approach addresses academic and sociocultural needs; provides formal and informal support mechanisms; and improves faculty-student interactions to effectively educate underrepresented students to be ready for the 21st-century workforce," says Kurwadkar.

Each year, 50 of the 200 student grant participants will work on year-long projects in the College of Engineering & Computer Science. These first-year research experiences will relate directly to course content and help students develop "4Cs" skills: critical thinking, communication, collaboration, and creative solutions. A mechanical engineering team, for example, may design a roller coaster using polynomials and exponentials to model track geometry and employ concepts like free body diagrams, force analysis, and curvature design. Through Summer Undergraduate Research Experiences, students will conduct laboratory and field research focused on increasing understanding of course content.

STIC activities will be designed to strengthen student-teacher relationships, increase student persistence in pursuing STEM learning, increase awareness of resources, and enhance situation-handling and coping skills. A social media–based virtual advising and learning community will enhance peer support and engagement outside the classroom.

"Repetition of lower-division courses often leads to early disengagement of underrepresented minority students," explains Kurwadkar. "These activities will improve their chances of finding success. Benefits include improved morale, self-efficacy, persistence, and career-readiness skills, all of which are essential to prepare scientists and engineers who will sustain the U.S.'s global competitiveness. Additionally, family and community involvement in enrichment activities will help us motivate generations of underrepresented students to pursue STEM careers."

> "These activities will improve their chances of finding success. Benefits include improved morale, self-efficacy, persistence, and career-readiness skills, all of which are essential to prepare scientists and engineers who will sustain the U.S.'s global competitiveness."
>
> **SUDARSHAN KURWADKAR**
> **ASSOCIATE PROFESSOR OF CIVIL AND ENVIRONMENTAL ENGINEERING**

Faculty Focus

Assistant Professors of Computer Engineering **Ankita Mohapatra** and **Juan Portillo** joined the College of Engineering & Computer Science in the fall of 2018, and **Justin Tran**, assistant professor of mechanical engineering, begins his ECS career in January 2019. Mohapatra studies signal processing techniques for implantable and controllable drug delivery systems and wearable sensors for holistic health data collection. Portillo's research is focused on improving the security and accessibility of digital devices. Tran explores how engineering connects with the medical world, including using engineering tools for medical applications.

JUSTIN TRAN
Assistant professor of mechanical engineering

JUAN PORTILLO
Assistant professor of computer engineering

ANKITA MOHAPATRA
Assistant professor of computer engineering

Student Spotlight

Cal State Fullerton's **Offensive Security Society** student team placed second at the Collegiate Penetration Testing Competition Nationals at Rochester Institute of Technology in November. The students had to perform a security penetration test for a fictitious self-driving car company, write a professional security audit report, and give a presentation. Team members included computer science students **Christopher Mills-Bowling**, **Brandon Nguyen**, **Shreepal Rawal**, **Rojan Rijal**, **Ryan Shannon**, and **Jose Urratia.**

Last spring, **Cal State Fullerton's Titan Rover** team, a collaboration of 40-plus multidisciplinary students, traveled to the Utah desert to compete in the annual University Rover Challenge, sponsored by the Mars Society. While the team didn't finish first in the international competition to build and test a Mars Exploration Rover, it placed ahead of California competitors like UC San Diego, Stanford University, and San Jose State.

The "Creative Coding" STEM Expo and Women in Computer Science and Engineering initiatives offered by the College of Engineering & Computer Science received the 2018 Inspiring Programs in STEM Award from INSIGHT Into Diversity magazine. Doina Bein, assistant professor of computer science, and **Beth Harnick-Shapiro**, lecturer in computer science, lead the award-winning programs and activities.

Support Student Success with the ECS Dean's Circle

With an annual gift of $1,000 or more, join the ECS Dean's Circle. Your generous contribution comes with opportunities to mentor students, attend special events, and receive Cal State Fullerton Titan Insider Membership, plus recognition on the ECS website and in this newsletter's Donor Honor Roll.

To become a member, contact Loida De Leon, development associate, at 657.278.3422 or lodeleon@fullerton.edu.

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Top and bottom: Student teams participate in Cal State Fullerton's 2018 Pumpkin Launch.

With its crossbow-style launcher, Cal State Fullerton's Society of Women Engineers team took home the first-place Pumpkin Trophy for the second time at the annual Pumpkin Launch on Nov. 3. The team of future engineers and computer scientists won first place in 2013 and tied for third in 2017.

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