engineering news
School of Engineering
FALL 16
SANTA CLARA UNIVERSITY

DEAN'S MESSAGE

As this newsletter goes out, our Tiny House team's 238-square-foot solar-powered home on wheels, rEvolve House, has hit the road, headed to California's first ever Tiny House Competition. For two years, this interdisciplinary undergraduate team has spent countless hours researching tiny house design and sustainable building materials and practices. From walls to water tanks, shingles to shower drains, and trailers to toilets, they've researched, purchased, and installed it all. They've kept to a budget. They've met biweekly with administrators to report progress and defend decisions. They've overcome differences of opinion, vendors' shifting timelines, and the death of a beloved mentor. They've bonded. They've grown. They've learned.

It's just this type of beyond-the-classroom learning that makes a Santa Clara engineering graduate so valuable in the workplace. For ten years we've provided open-ended projects with concrete deliverables—big opportunities for our students to take the reins and demonstrate leadership resulting in tremendous accomplishments.

This issue of *Engineering News* shares more of the big things being done by our students and faculty, in and out of the classroom. Our alumni also continue to make their mark through their engineering prowess and their desire to be agents of change and good in the world.

Happy reading! And if you're in the area, please come tour the SCU rEvolve House and the nine other entries at the competition Saturday, October 15 from 10 a.m. to 3 p.m. at Cosumnes River College in Sacramento.

Godfrey Mungal
Dean
School of Engineering



Photo: Jonathan H. Lee, Consciousimpact.org

Scott Hanson '14 on the job in Nepal.

Building a Life

Scott Hanson '14 (BS, civil engineering) was one year out of college and into a lucrative job as project engineer for a respected builder in the San Francisco Bay Area when the devastating 7.8-magnitude earthquake leveled much of Nepal on April 25, 2015. At that moment he couldn't have guessed that within a year he would be living in a tent in the hills of Nepal, working as construction manager for the nonprofit organization Conscious Impact, rebuilding a school for 75 children in the village of Bimire; but that's exactly what happened.

A lifelong practice of serving others and a trip to Rwanda to build a water system during his senior year at Santa Clara paved the way for his life-altering decision to put his knowledge and talents to work as a volunteer for Conscious Impact. "I originally intended to volunteer for two months, travel for two months, come home for the holidays, and then return to work in the Bay again. I truly planned to return to life as it was before my trip, but once I arrived in the hills of Nepal, it didn't take me long to realize that I would be gone for a while," he said.

His knowledge of sustainable building materials and practices has served him well as he's built with bamboo, stone, steel, and compressed stabilized earth blocks made from local soil, sand, and cement. He's also built a water pump system and several gravity-fed systems to serve the volunteer camp and facilitate the production of the thousands of blocks needed for construction. In June, the Siddhartha Primary School was completed. Conscious Impact is currently raising funds for a second primary school in the village; construction will begin once the funding is secured and permits are in hand. In the meantime, underway is a headquarters and sewing facility for the local women's co-op, which serves women in over 700 families.

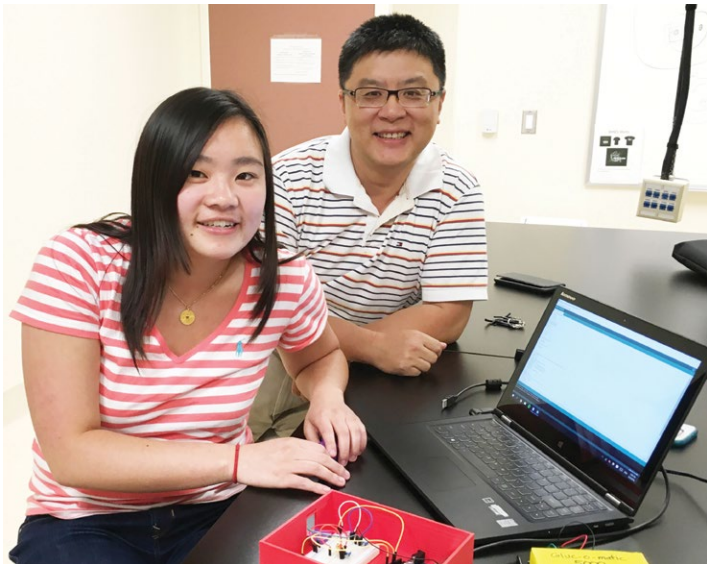
"I came to Nepal to help rebuild the lives of those who lost everything, and I've gained so much in the process—both from local Nepalis and from international volunteers from all walks of life. I followed my heart across the globe for what was originally supposed to be two months. More importantly," he said, "I listened to my heart when it told me to stay. I'm honored to be here and to be of service to the wonderful Nepali people."

Enjoy an interview with Scott Hanson at scu.edu/engineering/hanson, and read his blog buildgoodthings.wordpress.com. Conscious Impact is currently fundraising to rebuild a second school. Every dollar donated provides two bricks. Learn more: consciousimpact.org

A Bloodless Coup

For millions of diabetics the oft-repeated task of pricking a finger to check glucose level is a messy, painful fact of daily life. And it's one that bioengineering professor Zhiwen (Jonathan) Zhang hopes to change for the better. Last spring, he presented undergraduate juniors and seniors taking his Biodevice Engineering course with a problem to solve in their lab: Create a noninvasive portable glucose monitor for less than $100 that performs comparably to a standard glucose blood test.

Photo: Heidi Williams



Casey Kiyohara '17 and Jonathan Zhang demonstrate the top performing noninvasive glucose monitors in the Bioengineering Device Lab.

He pointed the students to recent progress on the topic and some reference materials, brought in colleagues from bioengineering (Emre Araci) and computer engineering (Navid Shaghaghi) to give tailored lectures on programming and control boards, and arranged for lab manager Adrian Valone and graduate student TAs Eddy Liu, Steve Long, and John Tidwell to help out throughout the quarter. Then students had to independently figure out how to engineer their own devices. "I gave them the vision and a problem and taught them sufficient scientific and engineering principles to get started, but we weren't there to hold their hands," said Zhang. "Students were required to translate what they had learned from classes into a product that is needed by a community or market. They had the freedom to play and reach the goal."

And did they? At the appointed time for their final exam, students watched as Dr. Zhang tested his blood sugar concentration using a traditional blood-drawing device and wrote his result on the white board. Within minutes, 11 teams of 23 students brought their final products forward to be tested against the standard method. One after another, each team presented a noninvasive device for measuring blood glucose. Zhang reports, "The devices came with all kinds of 'flavors.' Some of them were cute and colorful small boxes that were 3D-printed; some of them were merely shoeboxes." For the test, Dr. Zhang inserted one finger into a box and within five seconds the glucose concentration in his blood was read on their displays. "Of course," said Zhang, "each device, depending on its engineering, had different measuring speed and accuracy. The best two groups had the most accurate reading, with 99.2% accuracy."

Casey Kiyohara and her lab partner Ciara Gonzales created one of those most successful devices—an enclosed box housing a finger rest, 1,300-nanometer light and receptor, and a circuit board transmitting data to a nearby laptop. Software on the computer performed the calculation and displayed the result. "We played around with taking the reading from the earlobe, or with using a different wavelength and found out a longer wavelength infrared light would perform better because it absorbs less water and more glucose—but we had to sacrifice some accuracy to keep the cost down," said Kiyohara. "If we were to develop this further, we would want to get rid of the computer and have the device all in one clip."

Zhang agrees the $100 limit created a challenge. "Students had to be creative. They made some of their own parts in the School of Engineering's Maker Lab using the 3D printers. This pushed them to exercise their maximum capacity. There was nothing defined between presenting the project and the final test. In between they had the TAs and their teammates, but they had to figure out a lot of things themselves. This is a teaching model we find very successful at Santa Clara—putting a problem in our students' hands.

"There is so much potential for this platform. I would love to see students take it home and become entrepreneurs, expanding on the work they started here," he said. (Kiyohara notes that she actually did take theirs home and tested it on her dad while he was sleeping.)

Moving forward, Zhang would like to see other courses build on the technology—making it smaller, wearable, and maybe wireless to link up with an insulin pump to provide 24/7 patient monitoring and treatment. For now, SCU has filed the paperwork to begin patenting the research. "This is a highly competitive field [with] several competing technologies being tested currently," said Zhang. "Everyone wants to do noninvasive, but there is no commercial product out yet. It's so exciting to have our students be a part of advancing this research."

REAL TRUST IN A VIRTUAL WORLD

Photo: Heidi Williams



From left, Yuhong Liu and Yu Wang

Each day, millions of consumers slog through seemingly endless Amazon customer reviews, trusting online communities to guide them in making the very best purchases, and Yuhong Liu, assistant professor of computer engineering, helps ensure that trust is well placed.

"Overall, my research is about trust," she said. "I borrow the sociological concept of how humans build trust among each other and apply it to the computer world—human to machine, and machine to machine. As social media has grown, people have gotten used to generating online content and trusting online sources for news and information. But online product rating is not just social; today, individual users have more power and influence—they write every word, every line. People enjoy sharing their knowledge and direct experience to help others make their buying decisions." But how can you tell which reviewers to trust?

Unfortunately, a whole cottage industry has popped up to take advantage of the trust being built within the online shopping community. Companies or individuals providing "reputation services" are paid to create multiple user reviews to boost a client's rating scores or denigrate those of a competitor. "Smart people are using multiple strategies to manipulate the ratings," Liu said.

So Liu is putting machines to use to identify fake online product reviews, and she has enlisted the help of Yu Wang, a former accountant and senior auditor with PricewaterhouseCoopers in Beijing who is now pursuing a master's degree in computer engineering at SCU.

An accountant might seem an offbeat choice to add to Liu's research team, but no. "I like collaborating with people from different disciplines," Liu said. "Looking at things from a different angle enhances my research." And it didn't hurt that Wang was the top student in Liu's Intro to Algorithms class.

Together, the two have developed an algorithm that will help ferret out suspicious activity by focusing solely on numerical ratings. They start with the basic assumption that a product or company's quality doesn't change overnight. "From a statistical point of view, ratings from honest reviewers should reflect reality without showing great fluctuations. A change in rating distributions may indicate anomaly. We have developed a change detector," said Liu.

Detecting dubious ratings is just one of Liu's research projects. Her team of four graduate students and two undergraduates are also examining the hot topic of privacy issues in social media and applying trust theory in cloud computing. "Social media plays a very important role in daily life, and cloud computing has tremendous potential, but its rapid adoption heavily relies on its trustworthiness. Our research in these areas is interesting and important," Liu said.

THE METHOD FOR SUCCESS



Photo: Courtesy of Greg Method

Joseph Burke '12 and Greg Method '12 with the redesigned Continuous Passive Motion device.

Whether it's a case of nominal determinism (the theory that one's name can affect career choice) or just a delightful example of an aptronym—the matching of name to occupation—Greg Method '12 landed on a method for success.

With a keen curiosity and entrepreneurial spirit, Method seized on an opportunity during his summer internship at a physical therapy clinic following his first year as a mechanical engineering student. "I began noticing problems that weren't being addressed—there's not a lot of innovation in that field—so I teamed up with a therapist to design devices and tools for use in the clinic and I started my company, Method Therapeutic Solutions to create something to help people recover from surgery," he said. "Over time, I shifted to designing therapy aids for patients to perform in-home exercises on their own, with a focus on regaining motion and returning to a normal lifestyle."

Method knew he was onto something. "I realized I had a unique product that fills an unmet need, so I stuck with it, working on the device on the side during my years at SCU." Following graduation, he teamed up with friend and classmate Joe Burke '12, mechanical engineering major, computer science and engineering minor. "We had a lot of the same classes and we knew we wanted to pursue something together. We ultimately set out to improve on an existing antiquated product and completely redesigned the Continuous Passive Motion (CPM) device for use in post-surgical knee rehab. Joe is the go-to guy for everything software related and his involvement spurred things on; that's when it really got serious." Still, they had to pay the bills, and Joe worked full time at Clinkle as an android engineer "building the future of mobile banking," while Greg took a position at InCube Labs, an incubator for medical device manufacturing. "It was the next stage in the learning process of how to start and grow a company, and I gained valuable insight there on how to do that effectively," he said.

They spent that year fundraising and secured a Series A funding round. "Then it was off to the races," Method continued. He left his job in San Jose and moved back to his home town of Salt Lake City to set up a manufacturing facility and to start production. Joe moved out some months later. "With the help of family, we began networking with a couple of influential surgeons in Utah who helped us make good connections." One of those connections was with orthopedic surgeon and five-time Olympic speed skating gold medalist Eric Heiden. Soon, they established a relationship with a customer, Kinex Connect, and within two years were acquired by them. "We were really fortunate to network with a group of incredibly supportive surgeons who believed in our concept and wanted us to succeed," Method said.

Encouragement from Santa Clara professors played a role in Method's success, as well, and he credits his senior design project advisor, mechanical engineering Associate Professor Christopher Kitts, and physics Associate Professor Philip Kesten with helping to instill an entrepreneurial mindset. "Dr Kitts pushed us to think about commercial viability and assess industry need in creating a product that can be successful in a commercial environment, and Dr. Kesten helped cultivate the desire to keep moving forward, even when I didn't have anything other than an idea. Offering advice or just acting as a sounding board, he was a tremendous help in getting started. Those relationships are crucial. Mentorships, the support systems you find through Santa Clara—when someone believes you can do it, it helps you believe, too.

"Starting a company is not without its challenges," he continued, "and Joe and I feel fortunate now to be a part of a larger company that is moving our product forward. Still, when you've proved you can do it once, doing it again seems a lot more feasible. We do have the desire to start another company, but the problem has to be there before we pursue it." His advice for other entrepreneurs: "If the opportunity and resources are there—especially as they are at Santa Clara and in Silicon Valley where the culture is primed for entrepreneurship—and if it's something you're interested in doing, you should go for it. It's worth it because for every success, there's a failure and you learn equally from both."

Electrical Engineering Adjunct Leads by Example

One of the perks of being situated in Silicon Valley is our access to top-notch working engineers who serve as adjunct faculty in the School of Engineering graduate program. Bob Schaffer, Ph.D., senior research engineer at SRI International, is a prime example. His expertise in research and project management bring life to one electrical engineering course each quarter. But beyond his industry cred, Schaffer, as founder, president, and lead trainer for Elevate Tutoring, exhibits the Jesuit values we strive to instill in our students in the way that he leads by example outside the Santa Clara classroom as well.

"I started Elevate in March 2011 and run the organization in my spare time on nights and weekends," Schaffer said. "Our mission is to close the achievement gap by providing financially disadvantaged students with free tutoring, training, scholarship, and work experience. In a nutshell, we train financially in-need college students to be high-quality math and science tutors for financially in-need middle and high school students," he explained.

Selected college students receive 55 hours of training and then provide 155 hours of tutoring. In return, they receive a $5,500 scholarship to help defray their own education costs while gaining valuable experience and contacts along the way. "The threefold support of training, experience, and funding may give them a 'free meal' through the scholarship," Schaffer said, "but the rest of the program teaches them to 'fish' and gives them skills that can help throughout their academic and professional careers.

"Our training focuses on fostering a growth mindset in our tutees by building a strong rapport," he continued. "This allows for an academically safe environment that promotes productive failure—learning from one's mistakes instead of being punished by them." Elevate is currently partnered with Downtown College Prep where the tutors provide free tutoring at three middle schools and high schools in San Jose, and with Breakthrough Silicon Valley, a nonprofit that mentors and tutors in-need students, helping them get to college.

By the start of this school year, Elevate's 48 tutors—14 of whom have been SCU students, including two Latina engineers—had provided more than 3,200 hours of free tutoring and received over $132,000 in scholarship funds, with an equal share slated for this year's tutors. Bioengineering major Alejandra Pacheco '17, a 2014-15 tutor, had "a lot of potential as an engineer," said Schaffer, "so after she completed the program we recommended her to various internships." The experience proved to be a windfall. Pacheco said, "The Elevate tutoring committee serves as my small network of professionals in addition to scholarship donors. It is very hard for Hispanics, especially first-generation college students, to build a strong network. I was able to gain my first internship at a prominent semiconductor company and later went on to another biomedical device internship because of Elevate's help. I never expected all this two years ago when I applied to this amazing scholarship, but because of this opportunity my life has changed for the better and I am eternally grateful."

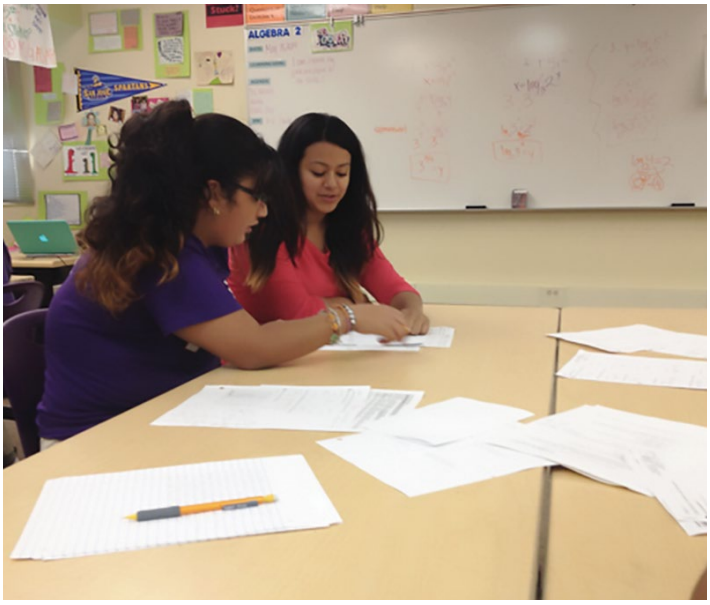


Photo: Amber Glover

Elevate Tutoring trains and pays college students to tutor middle and high school students.

Recently Elevate "soft-launched" a for-pay arm that employs tutors who have finished the program. "So, beyond just teaching them to fish, we are now trying to provide them a pond," said Schaffer.

"I never expected all this two years ago when I applied to this amazing scholarship, but because of this opportunity my life has changed for the better and I am eternally grateful."

Learn more or donate to the program at: elevatetutoring.org.

Well Begun



Photo: Courtesy of Nathan Rogers

To contribute—a mere $100 provides clean water to 30 children who can remain in class longer instead of walking miles to fetch water—visit ***wellconstructed.org****.*

Nathan Rogers '12 in Ghana.

The adage goes, "well begun is half done," but though Class of 2012 valedictorian Nathan Rogers definitely started off well as a Santa Clara graduate, he's nowhere near half-finished with all his good work in the world. As an undergraduate, Rogers focused his senior design efforts on improving sustainable design and construction methods for housing in Ghana, trading vacation time for a five-week stint in a remote village there and, along the way, finding purpose in living what he terms "a constructive life." Post-SCU, he has worked his way up the ranks at Google from operations coordinator to construction manager on the Google Fiber project in Raleigh, North Carolina, but his mission to help others continues.

In late 2015 Rogers co-founded Well Constructed, a 501(c)3 NGO dedicated to providing clean drinking water to Ghana's poorest rural regions. He took a week off from Google to launch the project in Bolgatanga, in the country's remote northeast. "The water situation is pretty bleak up there," he reported then. "I witnessed a physical altercation between three women, fighting for the last dirty water at the bottom of a dry stream. But with time, money, and effort, that can change. Our contractor completed construction and commissioned our first well, which will provide clean drinking water to about a thousand people. Drinking the fresh tested water with the community for the first time was a surreal experience." In return for his efforts, the community generously rewarded Rogers with a goat and two guinea fowl. "My three days of building a relationship with my new pets ended bittersweetly with an epic feast," he quipped.

By spring's end, Well Constructed had built seven wells serving about 7,000 people in Ghana's Upper East Region, all within 20 miles of a library built by SCU students. "Fees of about 25 cents per month per family will create a maintenance fund for the wells and can also be used for small business loans for the communities," said Rogers, who is currently taking a six-month leave of absence from Google to advance this and other projects. In October he will return to inspect the completed wells, conduct training for local volunteers, and further develop the group's operating model. "We're currently funding the wells in full, but we're considering a microfinance model where communities pay us back at a very low interest rate. It is a tough balancing act between being able to serve more communities and empowering them with a sense of ownership versus being able to serve the communities in direst need," he said.

Rogers has also helped these communities by raising interest and awareness in STEM education and careers, working with Junior Achievement Africa to create a 12-week STEM Campaign for junior high and high school students in Sub-Saharan Africa, and teaching weekly coding classes to students in a small school outside the capital of Accra.

So yes, you could say that Nathan Rogers is well begun, and not even half done!

THE 3 Rs REVISITED: REITES, RWANDA, RESPECT



Photo: Courtesy of SCU Engineers Without Borders

Field work: Following days of delays, SCU EWB students hustle to get their tile press and bicycle-driven clay mixer up and running for the tile-making cooperative in Rwanda.

Whether you knew him as Jim, Padre, Father Reites, Papa Reites, Professor Jimmy, or any number of other monikers he collected during his 41-year tenure with Santa Clara University, to know Jim Reites, S.J., was to love and respect him. When he passed away unexpectedly last April, the diminutive Jesuit left a gigantic void within the School of Engineering. He was our "boots on the ground" guy, the shepherd of many long-term, hands-on, local and global student-led projects. Over the years, he broadened students' worldviews by accompanying teams to Mexico, El Salvador, Ghana, and Rwanda for humanitarian projects in some of the planet's poorest places. His expertise, far-flung network of contacts, good humor, and can-do spirit helped get the job done. His kindness, generosity, and spirituality inspired and helped our students grow.

Knowing that, before Associate Dean of Undergraduate Engineering Ruth Davis visited Rwanda in 2014 with a delegation from TechWomen, she checked in with Jim, who told her about a fellow cleric working with PICO International to rebuild the country following its 1994 genocide. Davis learned that a group of about 40 residents from scattered villages in the district of Nyange—mostly women, and many of them widows—had formed a cooperative to make roof tiles for their own homes and as a way to generate income. But production was slow and arduous. The work was all done by hand, except for mixing the clay—which was done by foot.

Davis returned to campus inspired to get SCU involved, and a team from the student chapter of Engineers Without Borders, advised by civil engineering Senior Lecturer Tonya "Dr. T." Nilsson, took on the challenge of designing and building a tile press that would provide a mechanical advantage so more tiles could be made each day. Over several months and many Skype calls with villagers (which could only take place if it wasn't raining; no closed structures could fit the entire group), together they hashed out details and requirements. That summer, the students traveled to Nyange with Fr. Reites to test the tile press and determine what was needed next.

A clay mixer that had been identified as the next project was being completed by a new student team when Papa Reites suddenly passed away, jeopardizing the summer trip to Rwanda. Yet the energy, excitement, and commitment to this project live on. In late August, Dr. T. and the student team traveled to Nyange, where they courageously faced long days of frustration and shifting timelines as they dealt with the bureaucracy and red tape surrounding the release of their equipment from customs—never losing hope or focus on their goal. Before getting the tile press and clay mixer up and running and before training co-op members on use of the equipment, the team met with villagers and shared photos and stories of Professor Jimmy, as Fr. Reites was known there.

Former EWB chapter president Mohit Nalavadi '16, who joined both summer trips, remembered his beloved mentor fondly. "He taught us to go about the world as authentic human beings, with the wisdom of the aged, the vitality of the young, and the curiosity of a child. He left us with the deep sense of social responsibility with which he lived every day. I am grateful that we all had the experience of working with him in the past year. Together, our teams laid the groundwork for great progress in Rwandan communities, and shared beautiful, lasting memories."

Though he is dearly and daily missed, Papa Reites' legacy of caring and doing for others continues. During their trip to Rwanda, the team met with staff from the regional medical clinic and with district leaders to discuss how SCU EWB may help with the community's most pressing needs. Having witnessed firsthand its malnutrition and bleak conditions, mechanical engineering junior Josie Warren commented, "Last year I would take project delays without any major concern because I didn't know or understand how desperately the community needs this co-op to be successful, simply so that they can have enough to eat. I think one reason Fr. Reites so often visited poor communities was for the reminder of the importance of these efforts, and it's our responsibility and our goal to keep up his work."

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The Jesuit University in Silicon Valley



Photo: Joanne Lee

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MOHAMMAD AYOUBI NAMED ASME FELLOW

Mohammad Ayoubi, associate professor of mechanical engineering has been named an ASME Fellow in recognition of his significant engineering achievements in dynamics and control of aerospace vehicles, curriculum development, and service to his professional society. A distinct honor, this achievement is reserved for only 2.8% of ASME's 140,000 members. Nominated by ASME members and fellows, an ASME member has to have 10 or more years of active practice, at least 10 years of active corporate membership in ASME, and have significant achievements in the field of engineering, according to the ASME website.

Dr. Ayoubi—who joined Santa Clara University's faculty in 2008—is an expert in dynamics and control of aerospace vehicles. In addition to teaching undergraduate and graduate courses, he is the director of the Dynamics and Control Systems Laboratory, where undergraduates, graduate, and Ph.D. students advance modeling, simulation, and control of aerospace and mechanical systems, focusing on theoretical investigation of highly complex and uncertain aerospace and mechanical systems.

With this honor, Ayoubi joins fellow mechanical engineering faculty who have been honored by ASME: Fellows Christopher Kitts and Godfrey Mungal, as well as Honorary Member Terry Shoup.



Photo: Nicole Morales

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