



engineering news

School of Engineering

WINTER 19

SANTA CLARA UNIVERSITY

THE BIG MOVE IS ON: ABOVE AND BEYOND



Classroom, lab, study, and collaboration space coexist nicely in Engineering's new digs.

We've been speaking for some time in this publication and elsewhere about the many "surge" moves in progress and prospective facing the School of Engineering in preparation for the final move (now promised for fall 2021) into the magnificent new Sobrato Campus for Discovery and Innovation (SCDI). After all of the talking and planning, here is what has happened.

Summer 2018:

- Moved mechanical engineering shops and labs to "The Garage" (at the corner of Benton Street and The Alameda)
- Moved various SoE labs to St. Clare Commons (at the corner of Fremont Street and The Alameda)
- Moved the Engineering Computing Center servers to the Tech Center (in the Learning Commons)

Fall 2018:

- Moved the bioengineering research and teaching labs to Alumni Science Hall and Daly Science Center
- Moved the civil engineering labs to the newly renovated Alameda Hall 601

Christmas Break 2018:

- Moved most SoE faculty and staff offices and teaching and research labs to the newly renovated Heafey-Bergin Complex
- Moved bioengineering faculty and staff offices to newly renovated quarters in 900 Lafayette
- Moved all Engineering Computing Center teaching and research labs to the Heafey-Bergin Complex
- Moved the Center for Nanostructures to newly renovated space in Daly Science Center

With a lot of hard work on everyone's part, these penultimate moves in preparation for SCDI are now complete. Starting this spring, the SCDI will be constructed on the site occupied by Bannan Hall, Bannan Engineering, the Mechanical Engineering Building, and Bannan Engineering Laboratories (which are currently being razed.)

The University's Departments of Planning and Projects and Facilities gave their all to ensure that the various new spaces were ready in time, albeit "just in time" in many cases. Not surprisingly, many special issues were involved in moving so many people and all their equipment, furniture, supplies, and personal belongings with very tight time demands. But, thanks to everyone's engagement and some dedicated professional movers, it all came together and all people and facilities were ready for the start of the Winter Quarter on January 7.

Literally everyone went full out in contributing to this success, but the following individuals were cited by their colleagues for special recognition of efforts "above and beyond" the demands of their formal responsibilities:

- **Matthew Blanco**, Bioengineering Senior Administrative Assistant, and **Daniel Levy**, Bioengineering Laboratory Manager—"managed the almost flawless BIOE Surge moves to offices in 900 Lafayette and research and teaching labs in Alumni Science and Daly Science. These moves were characterized by great complexity due not only to the nature of the BIOE labs but also interfacing with professional colleagues from the College of Arts and Sciences already occupying shared laboratory spaces."
- **Lantz Johnson**, Engineering Computing Center Manager, and **Jason Chong**, Windows Systems Administrator—"worked all fall to assure that proper power and communications were ready for use and then supervised the move and installed and tested some 300 computers in 13 labs over the holiday break."
- **Yohannes Kahsai**, Electrical Engineering Lab Manager—"in addition to significant preparatory work, Yohannes spent all of the break between Christmas and New Year's Day assuring that the EE teaching labs were ready for full operation."
- **Pei-Min (Pam) Lin**, Computer Engineering Senior Administrative Assistant—"worked closely with the department faculty and movers to ensure that the move of this department (the largest in the SoE) went very smoothly. Pam stood out as always being there during the break, minimizing the impact of the move on 'her' faculty."
- **Donald MacCubbin**, Mechanical Engineering Machine Shop Manager—"was critical to the success of the surge move and installation of the MECH Machine Shop to the new Garage Facility."
- **Shaun Snyder**, Center for Nanostructures Laboratory Manager—"did excellent work in coordinating the CNS move to its new laboratory in Daly Science. This involved everything from working with project and contract teams, to packing/unpacking sensitive equipment and supplies, and working with movers and vendors for equipment re-installation. Achieving all this in such a short time would not have been possible without Shaun's commitment and hard work."
- **Shane Wibeto**, Director of Engineering Undergraduate Programs, and **Nicole Morales**, Director of Digital Media Technologies—"spent weekends and long days all fall in preparation and then were on site almost continually following Christmas to ensure that the move to Heafey-Bergin was complete and ready for classes."
- **Brent Woodcock**, Civil, Environmental and Sustainable Engineering Lab Manager—"was singularly responsible for organizing the successful move of all CESE department labs and equipment to 601 Alameda as that building was under construction all fall."

Given the stress associated with any move, the faculty and staff of the School of Engineering are looking forward to settling in to our new quarters. But we are mindful that the two-and-a-half year respite until the fall 2021 target will pass all too quickly.

Please visit us when you can!

A DIFFERENT PERSPECTIVE

Undergraduates Austin Colon, Shane Buck, and Steven Pretlove didn't head for college straight out of high school. Instead, they entered the military. And after serving their country, they enrolled in community college before transferring into Santa Clara University. They share all the typical student concerns of homework, midterms, and finals, but to that load these three service members add challenges like maintaining vocational rehabilitation benefits, Yellow Ribbon funding, a full-time job, and raising a family.

Here's a recap on how each made his way to SCU.

five-year commitment, he determined the Corps really wasn't for him, but he liked the work he was doing. He started to think about going back to school. While deployed, he started taking classes online.

After his discharge and a year at community college, he has now completed his first quarter at Santa Clara as a sophomore. "It's definitely more challenging and moves at a faster pace," Austin said, "but I've learned a lot and like how all my classes are directly applicable to engineering. I chose a private university because I could use voc rehab to add benefits on top of the GI Bill. It pays for

Austin hopes to work in intelligence. "For now, the plan is to do the B.S. degree, focus on communications, try for my master's, intern with the FBI or CIA to get my security clearance back, and see if I like the environment. But you never know what's going to happen. In the military, I always felt like I was punching above my weight, working on stuff I didn't fully understand and Googling things to try to fill in the blanks. I had no technical background in engineering and I hated math in high school—I thought Algebra 2 would be my last math class ever," he said with a laugh. "Now I'm taking Math 14 and Differential Equations. I understand what it's used for and I enjoy it. If I'd asked myself in high school what I'd be doing now, I never would have thought the Marine Corps would lead me to choose this path."

From E5 Mate to EE Master

After high school Shane Buck worked as a photographer at a crash test facility, where a peer got him interested in joining the Navy. Talking with a recruiter, he found an interest in nuclear power. After a couple of years in South Carolina and Virginia at Naval Nuclear Power Training Command, he served as an E5 Electrician's Mate stationed in San Diego for another four years. His job included performing calibration, vibration analysis, and thermal imaging while standing watch as load dispatcher for an aircraft carrier's electrical distribution system. Toward the end of his tour, he was recruited by Orion International to work at Vantage Data Centers' Bay Area branch, where he solves a myriad of customers' "strange problems," he says, involving harmonics on power supply, wave form analysis, cooling controls, and more.

Shane began taking classes at two local community colleges to satisfy prerequisites for transferring into Santa Clara's electrical engineering program. "I know a couple of EEs who graduated from SCU and recommend it highly, so I toured the campus and was impressed by the way it looked," he said. He's now in his second year.

He's made the most of—and even offered to others—some practical opportunities. "I've loved that the professors in some classes bring in industry guest speakers, who are normally alumni, to discuss topics from a different perspective. And we've taken field trips and toured Tesla, Facebook, Stanford Linear Accelerator, and other places. It's fascinating to see some of the stuff the general public doesn't get access to and adds a lot to the curriculum," he said. Doing his part to open some eyes, Shane arranged for a tour of his company as well.

Shane plans to start his master's program next year. "I still have time on the GI Bill, and the Yellow Ribbon program helps ends meet. Also, people at work are very supportive of me. After getting my master's, who knows?" Vantage is expanding quickly, so I expect there will be opportunities for growth there."

Completing the Puzzle

Steven Pretlove always had an interest in electrical engineering. "When I was a kid, I was extremely inquisitive and thought electricity was fascinating," he recalled. At 20, he had been studying electrical engineering for a year in New Orleans when he became a father for the first time and shortly thereafter joined the Navy, where he worked as a SONAR technician.

Time to Do the Math

At age 15, when Austin Colon decided he would join the Marine Corps and make a career of it, he pretty much quit caring about school. Too young to enlist on his own, his parents insisted he choose something besides infantry, and he wound up doing tactical signals intelligence as an electronics warfare operator/analyst. One year into his

schooling with no cap on tuition and provides supplies."

At first, SCU was only another stepping stone for him. "Originally, I thought I would apply at Stanford once I had my prerequisites taken care of," he said, "but now I think I'll stay here. This school has everything that I need, a great reputation, and I can graduate faster."



Photo: Heidi Williams

From left: Austin Colon, Shane Buck, Steven Pretlove

Creating Biomedical Robots to Help Doctors Discover and Diagnose

Turns out the Navy wasn't for him, so after being discharged, he worked in Kentucky in the pool and spa industry, diagnosing and repairing electrical/electronic control systems and electromechanical devices. Soon, he came back to California to start his own business in San Diego, where he had been stationed. Unfortunately, that was 2008, right before the economy tanked. But Steven persisted; he found a job in the same industry, worked there several years, and soon met his current wife.

Eventually, they moved to the Bay Area. Steven worked in the IT field while his wife established her career as an attorney. Five years and two kids later, he enrolled in community college. "I wanted to fill in what I could there," he said. "I was on a track toward UC Berkeley, but the commute was just too difficult. I had heard about Santa Clara, and it turned out to be a good fit. I'm going to school full-time and just finished my first quarter here. I'm very happy with the instructors. They are absolute experts in their field," he said.

Steven said his background working with electrical systems and electronics has been a big plus. "You have more confidence in your ability to absorb the material when you have practical experience to apply it to. You have a puzzle to put these new pieces of knowledge into," he explained.

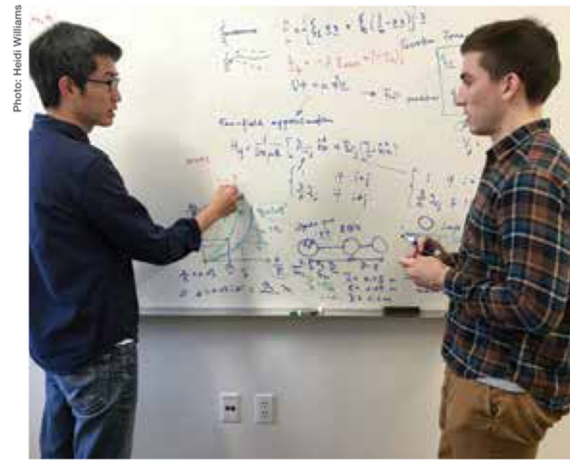
Steven's interests include electrical properties of materials and pursuing a master's degree. But for the moment he is looking to see where the curriculum takes him. He's keeping his options open.

These three Broncos who took different paths to SCU bring different perspectives, each supplying engineering excellence in his own way.

For decades, doctors and clinicians have snaked, pushed, and prodded diagnostic tools outfitted with cameras through their patients' bodies to get a look at what was happening inside, but now a team of engineers has accepted a challenge from the National Science Foundation (NSF) and is developing a new class of soft, pliant 3-D printed robots for diagnostic and therapeutic applications. Self-propelling, these tethered and untethered mini marvels (with diameters of ~0.1-10 mm) will actively wiggle and assist in their own propulsion and maneuvering along the body's natural pathways, making GI-tract exploration safer, and providing access to previously off-limits areas of the brain, the body's most fragile and complex organ.

Faculty from the lead institution, University of Utah (Jake Abbott, Kam Leang, Yong Lin Kong), teamed up with Rajesh Rajamani from University of Minnesota and Santa Clara mechanical engineering assistant professor On Shun Pak to develop this new class of MESo-C3 (magneto-electroactive, soft, continuum, compliant, and configurable) robots for medical applications across scales. The team received a \$2 million NSF grant for this collaborative project. Pak will receive \$338,440 to assist with theoretical modeling to understand the propulsion dynamics of MESo-C3 robots. The funding will support both undergraduate and graduate students to conduct the proposed research.

Pak explained, "Each of us on the team contributes his own expertise to the goal of understanding the kinematics, dynamics, sensing, and control of 3D-printed MESo-C3 robots.



On Shun Pak and graduate student Grant Mishler '18

Throughout the project, I will employ a variety of modeling tools to elucidate the propulsion dynamics and support the design and optimization of these soft robots."

The team's work will extend the capability of the doctor to diagnose and to provide more access to locations in the human body that are currently hard or impossible to reach. Soft robots are less damaging to the body, and the ability to self-propel rather than being pushed or screwed or pulled through the biological environment is a promising advancement that could fundamentally change diagnostics. "It's very exciting to work on this NSF-funded collaborative project in a team with diverse expertise," Pak said. "From theory to experiments to prototyped robots that have significant medical applications—I'm grateful to be part of the process and look forward to working with these colleagues over the next four years."

0 PIONEERS!



Photo: Heidi Williams

Faculty and students at work in their new bioengineering laboratory

To say the School of Engineering is undergoing landmark changes is definitely an understatement! In preparation for construction of the new STEM complex on campus, the Sobrato Campus for Discovery and Innovation (SCDI), nearly all engineering programs and faculty moved out of their long-time labs, classrooms, and offices and into new digs in existing buildings on campus. Some will remain in these new facilities permanently, but others, like the Department of Bioengineering—which has moved to quarters adjacent to Departments of Biology, Chemistry and Physics—will make this home for just three years or so until they move into the SCDI.

But while the move may be only temporary, the experience will be groundbreaking for these STEM pioneers. Zhiwen (Jonathan) Zhang, associate professor of bioengineering and department chair, sees the move as a golden opportunity to break free of department silos, test innovative methods of pedagogy and operation, and forge new interdisciplinary, interdepartmental, and external collaborations. "BIOE is a microcosm of STEM at SCU, and right now we are working as a guinea pig to test systems and adjacencies that could be models for other units on campus. We've been warmly

welcomed by biology, chemistry and physics, our new neighbors, and now our students and faculty have access to a lot of instruments that were previously unavailable to us," he said.

Instruments currently held within the department will be shared more freely now, as well. "Previously, we had a traditional research set-up of one lab for one professor. Now all of our bioengineering professors are living under one roof for their research spaces. We have one big 2,000 sq. ft. faculty research lab with different benches. It's highly interdisciplinary—ranging from bacterial cell engineering to gigantic bioreactor research, with the assorted dedicated electronic components now available to all. We're changing the mindset of how we do our research. It's definitely a challenge, but it's one we are willing to face. The aim of this transitional time during construction of the permanent STEM facilities is to test, to try, to experiment. It's what we do naturally as engineers in our work, but it takes some adjustment to apply the same mindset programmatically."

Zhang notes they are already seeing that new collaborations can be forged departmentally. "Before, most of the collaborations were generated on a personal level, through individual relationships. Now, we have a system where we are working more closely as a department and creating new avenues for partnerships."

Other big changes are afoot, as well. Drawing support from Silicon Valley industry, the department has implemented new focus areas in translational bioengineering and BioAI.

Hang on; back up. Translational bioengineering? BioAI? Explain, please.

Applying the engineering theory and techniques learned in the classroom toward the development of products and therapies that address specific clinical problems within the Bay Area biomedical industry is the milieu of translational bioengineering. BioAI is a broad field that encompasses everything

from using machine learning for nearly instantaneous precision diagnosis, to implementing AR (augmented reality) in the classroom to bring 2D concepts into 3D reality, or helping engineers design "smart" molecules, drugs, materials or devices.

"We have an impressive line-up of industry partners supporting our translational bioengineering focus in biomolecular, biomaterial, and biodevice tracks. Amgen, Genentech, Bayer and others will support faculty and their students, and will provide access to company resources and facilities for advanced research," said Zhang. With 10 spots pledged and more than 50 companies interested, this collaboration reaps a triple win: faculty research advances, students increase their opportunities for career placement with participating companies, and industry partners advance their R&D and gain potential new employees.

On the BioAI front, RealMax Quian recently gifted \$100,000 worth of augmented reality headsets that will be integrated into SCU's Wiegand Advanced Visualization Environment (WAVE) and used for bioengineering. The "computerless" headsets feature a wide field of vision to enhance learning. "These headsets make learning interactive," said Zhang. "Students can be in the middle of a holographic molecule. They can design a house, a molecule, a biodevice using their bare hands. Our faculty will be developing usability for this technology in collaboration with Bay Area industry from various sectors. Industry research and center grants will support our bioengineering faculty-directed research."

These are just a few of the ways the Department of Bioengineering is continuing to pursue academic excellence in STEM, Zhang said. "The next few years will certainly bring more changes to our department as we navigate the challenges and opportunities STEM at SCU bring. Sometimes change seems scary, but when you embrace it, the possibilities are endless."

Broadening Horizons

Broadening a student's worldview is what Jesuit education is all about, and study abroad at Santa Clara University is thriving! With more than 500 SCU students vying for 330 posts, it is a highly competitive field for the would-be global travelers. And while some might think an engineering course load is too demanding to allow for international study while also achieving that diploma within four years, our Broncos are bucking that misconception. Last quarter, alone, 39 undergraduates from bioengineering, civil, environmental and sustainable engineering, computer science and engineering, and mechanical engineering fulfilled their dreams and expanded their horizons through study abroad. Here, two of our students share their experiences.

Ashton Politz '19

Civil, Environmental and Sustainable Engineering Major
University College Cork, Ireland - Fall 2017

How have you changed as a result of your experience?

I feel like I have a better appreciation for the cultures in other countries. Also, I got to see some incredible engineering feats in other countries that expanded my horizons as to what I can accomplish as a civil engineer. For starters, the Eiffel Tower in Paris is absolutely incredible. Notre Dame cathedral in Paris with its vaulted ceilings and beautiful stained-glass windows was breathtaking. Also, in Amsterdam the canals running through the city that are used as a means of transportation were unique. Seeing them made me think about how flooding is controlled or, the opposite, how do they prevent water levels from getting too low? Also, what are the benefits of having canals throughout the city for transportation purposes? Why do we not have them here in the United States? I guess what they taught me about my craft is that there is so much left for

Photo: Courtesy of Ashton Politz



Ashton Politz loving the fog at the Cliffs of Moher, Ireland

me to learn. These experiences inspired me to want to learn more about how the structures were built and how they have been able to last this long. And, in today's day and age, how can we take these structures and make them more sustainable?

Ariana Haddad '20

Bioengineering Major
Lund University, Sweden - Fall 2018



Photo: Courtesy of Ariana Haddad

Ariana Haddad enjoying every minute in Lund, Sweden

Did you do much travelling or participate in other activities?

I travelled to England, Scotland, Turkey, Denmark and many, many cities in Sweden. I also had the chance to do some research in microfluidics and develop PDMS chips—Polydimethylsiloxane, a polymer used for fabricating and prototyping microfluidic chips. I had classes with local students, so I studied with them most of the time. I also participated in FemiLund which is a feminist club on campus and worked in the engineering café.

How have you changed as a result of your experience?

This will definitely change the way I approach engineering. It has given me a more holistic worldview that I will be able to carry into my future projects and endeavors. It has also taught me to be patient when it comes to solving problems and working with others.

Read Ashton's and Ariana's full interviews at
scu.edu/engineering/stories

Building Hawaii: Vince Llorin '92

As the 2018 fall quarter ended, engineering students took their last finals in SCU's Sullivan Engineering Center, and faculty and staff packed up their offices and labs as demolition day fast approached. Imminent construction of SCU's impressive STEM complex, the Sobrato Campus for Discovery and Innovation, meant a new era of engineering at Santa Clara was beginning.

But thirty years ago, the Thomas J. Bannan Building was still new when Vince Llorin '92 set foot on campus as a first-year undeclared engineering student. Circumstance played into the Hawaiian's decision to come to SCU. "I was the only child of a single mother, and I grew up in the 'hood. I came to SCU because Santa Clara had the earliest deadlines to submit applications. I found out I'd been accepted before

the process even started at USC or UOP. I guess it was destiny I became a Bronco," he laughed.

Associate Professor Reynaud Serrette, who joined the faculty during Vince's senior year and now serves as department chair, recalled, "At the time Vince was studying here, about 25 percent of our civil engineering students were from Hawaii."

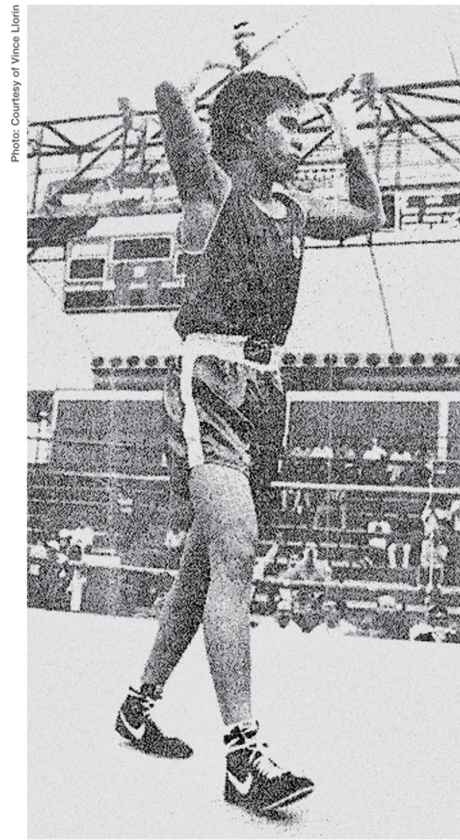
The Hawaiian connection would play a big role in Llorin's path at SCU and beyond. "I was having dinner in Benson Center one night when one of the Hawaiian guys came up to me and asked how much I weighed. When I asked why he wanted to know, he told me the boxing coach was looking for 'some little guys' and needed someone in my weight division. I joined the team, but really didn't want to compete—I just wanted to train." At 112 pounds, he

found little competition out there, anyway. He boxed in only one exhibition match before facing off against a fighter from the Air Force Academy in the National Collegiate Boxing Association's championship—which he won!

Vince boxed throughout his time at Santa Clara, chose civil engineering as his major, and excelled in both. In 1991 he was named the department's outstanding junior. "I guess I was selected for being well-rounded, not just in academics, but also for being a collegiate boxing champion. My mom was very proud; she flew out to see me get my award," he remembered.

During his senior year, another Hawaiian student, whose father owned a consulting engineering firm, told Llorin, "'If you want work, call my dad,'" he said. "I did and got a job offer over the phone. I talked to him not too long ago, and he said he hired me because of my academic award," he recalled. That offer led to seven years in private industry before he joined the State Department of Transportation highways division, where he has worked for the past 19 years.

"My first position was as bike and pedestrian coordinator and ADA coordinator," Llorin recalled. "I was project manager for Hawaii's bike plan, setting the footprint for Hawaii to become more bike and pedestrian friendly. After about five years, I became



The champ takes a victory lap.

project manager for typical highway division projects—bridge improvements, roadway widening...things like that," he said.

"It feels good putting my education to work for the benefit of Hawaii, and I love being here," Llorin said. "I just came in from surfing and am about to go back out. 'There's no other place that I'd rather be/than home in the island in the middle of the sea,'" he said, quoting a favorite island song.



Vince Llorin mugs for the camera.

REACHING FOR THE STARS, POWERED BY A DREAM

In 1998, 14-year-old Kamak Ebadi, who lived in Iran and was fascinated with astronomy and space exploration, dreamed of working at NASA. Ridiculous idea, he was told. Diplomatic relations between Iran and the United States were terrible, and getting a U.S. student visa was almost impossible, they said. Even if he got the visa, it was too expensive to study in the U.S. Besides, a job at NASA? Too big a dream, he was told.

No doubt the odds were stacked against him; yet Ebadi was undaunted. He wrote down his plans for every step of the journey in a notebook not of dreams but of plans for the future. Twenty years (and 12 notebooks) later, Ebadi proved his naysayers wrong when he became a NASA Jet Propulsion Laboratory spokesperson, giving the play-by-play to invited VIP guests during the moment the InSight spacecraft successfully touched down on the surface of Mars.

How did such an unlikely life path come about? "It was a long journey," Ebadi said, "but I planned for it, stayed focused, worked hard, and kept getting closer and closer to my dream." The electrical engineering Ph.D. candidate in robotics is now a doctoral research fellow at JPL who develops localization, navigation, and mapping solutions for a future collaborative Mars helicopter and rover mission—another unlikely feat and one that has never been achieved. Not yet, that is.

Planning made it happen for Ebadi. "At age 17, I started working at an internet service provider in Iran. For nine years I provided network engineering technical support on the night shift from 9 p.m. to 9 a.m. for different ISP and telecommunication companies," he said. During that time, he saved his money, earned his bachelor's degree in software engineering, and eventually applied for and was accepted into a master's program in computer engineering at Florida International University.

Through it all, his dream of working for NASA burned on. As a teenager, Ebadi followed all space-related news and was particularly interested in the work of Dr. Firouz Naderi, an Iranian-American scientist. Upon arriving in the U.S. and starting his master's program, Ebadi contacted Naderi, then the director for Solar Systems Exploration at NASA's JPL, to request mentoring. "I sent him 17 emails to be precise, until he finally agreed to meet with me," Ebadi said with a laugh. When Naderi suggested the young hopeful move closer to JPL for his Ph.D. program, Ebadi started applying to University of California schools. A conversation with Gabriel Elkaim, professor of electrical and computer engineering at UC Santa Cruz, led him to Santa Clara University.

"Dr. Elkaim told me, 'If your dream is to work at JPL, you'd better apply to a school that has a good relationship with them,'" Ebadi said. "Talk to Dr. Chris Kitts at Santa Clara University. He's got a good program with NASA/Ames, and that will get you closer to your dream."

For more than a decade, mechanical engineering Professor Christopher Kitts has directed SCU's Robotics Systems Laboratory (RSL) and Mission Control Center, through which SCU students operate numerous NASA small satellite programs. Santa Clara is the only university running mission ops for NASA. "I came to SCU and it was fantastic to see the RSL and satellite operations. Dr. Kitts was encouraging and motivating, and I felt really close to my dream," Ebadi said. He applied to the electrical engineering Ph.D. program, which best suited his background, and is advised by Dr. Sally Wood, and co-advised by Kitts.

On his very first day at SCU, at the graduate students' orientation, a different sort of dream instantly began to take shape. Sitting directly across the table from Ebadi was Aram Hamidi '15, a new master's student in the electrical engineering

Photo: NASA Jet Propulsion Laboratory-California Institute of Technology



Kamak Ebadi in JPL's Charles Elachi Mission Control Center, aka The Center of the Universe.

robotics program. The two immediately hit it off and began dating that day. "At Aram's graduation, I told her we had been dating for exactly 1,000 days. I said I'd like to start day 1,001 with a new mission, and I got down on one knee and proposed." Happily, she said yes. The two have been married since 2016, and Hamidi has an exciting career as a self-driving car engineer at Cruise Automation, a company that builds autonomous cars for General Motors.

Ebadi continued to rely on the advice and support of his mentor, Dr. Naderi. "When I finally got an interview at JPL," Ebadi said, "they asked me to explain one of my biggest accomplishments in life. I said, 'The fact that I'm sitting here talking to you at this moment is one of my biggest accomplishments. For 18 years I've been working toward this job interview. Many things had to come together just right, but I never let the dream go and worked for it.' I think they liked that answer," he said, laughing again.

JPL offered Ebadi a doctoral research fellowship. "There are so many paths you can follow there, and they are very open and welcoming to have you as part of a project," he said. Ebadi is now involved in multiple research projects, including the DARPA Subterranean Challenge, which develops technologies to map

subterranean environments with a fleet of autonomous mobile robots and the collaborative Mars helicopter-rover localization and mapping. "It's the first time in history that NASA will send a helicopter to Mars. With no GPS on Mars to help localize a vehicle, the helicopter needs to be able to orient itself in response to the environment and navigate safely from point A to point B." Also, Ebadi points out, because Mars is so far away, even at the speed of light it takes quite a long time to send or receive a signal, so live communication with the helicopter is impossible. "It needs to be able to fly and navigate on its own, capture images, map the terrain, and safely land—all autonomously," he said.

Ebadi's current notebook plans list defending his thesis and completing his Ph.D. this summer. And then? "Hopefully a full-time position at NASA's JPL," he said.

"My experience since joining SCU has been so rewarding. I'm getting my dream job, I met my wife.... I've always had the feeling in my heart that no dream is ever too big. Everyone should stick to their dream and follow it—no matter how big or how many people say it is impossible. If I had let my dream go, none of this would have happened. Always reach for the stars and do your best to make it happen!"

The Jesuit University in Silicon Valley



Photo: Heidi Williams

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WHAT'S GOD GOT TO DO WITH IT?



Does God have anything to do with innovation? Does innovation have anything to do with God? These two questions are the catalyst of a conversation Lanny Vincent, engineering adjunct lecturer, is avid about sparking. As a former Presbyterian pastor and consulting "innovation midwife" for Fortune 500 companies like HP, Sony, Seagate, Johnson Controls, and others, Vincent knows a thing or two about both theology and innovation.

This spring, in his new course, Innovation Theology: An Introduction (ENGR 141), Vincent will be challenging undergraduates to think deeply about where and why engineers choose to innovate. Bonus: the course fulfills an undergraduate core requirement in Religion, Theology, and Culture. Funding to develop the course came from the Kern Family Foundation through the School of Engineering's KEEN program, a network of three dozen universities dedicated to integrating innovation and entrepreneurial thinking into undergraduate engineering programs. One of the School's KEEN-related initiatives is to create courses in every core curriculum category.

"Getting an engineering degree is demanding," Vincent said—even more so at Santa Clara, where students must take religion courses. "In this course, students get a 'two-fer'—a class that is relevant to their profession which also

helps them think about their future engagement from the point of view of theological inquiry," he said.

Vincent, who also teaches the graduate course Innovation Design and Spirituality (ENGR 341), said the idea of innovation theology has been constantly bubbling up in his head and just wouldn't go away. He spent two years researching and writing 13 essays and two books on the subject. "I keep asking myself, and others—technologists, engineers, venture capitalists, theologians—"What is God up to?" and "What should we be up to?" Innovation decisions shouldn't be defaulted to Sand Hill Road," he said, referring to Silicon Valley's VC hub.

How innovation and theology intersect deserves engineers' attention, Vincent believes. Examining them in tandem can help us make sense of where and why we choose to innovate. He also hopes students in his course will aim their innovating toward the common good, not just the bottom line.

"I'm excited to start this conversation with the undergraduate students at Santa Clara," he said. "We should be lifting up the visionaries and innovation midwives, developing innovators of competence, conscience, and compassion. The engineer's role as innovator is seminal to change in the world. If we can spark within our students an interior conversation about God's place in the process of innovation—however they think about God or religion—perhaps they can drive more positive change within their own lives, companies, and communities."

More information: innovationtheology.org
scu.edu/engineering/about/innovation-and-entrepreneurship
 KEEN: engineeringunleashed.com