

Spring 2015

# Engineering News, Spring 2015

School of Engineering

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# engineering news

School of Engineering

SPRING 15

## SANTA CLARA UNIVERSITY

### DEAN'S MESSAGE

Convergence. It's a word that comes up often in conversation at SCU as we work toward implementation of a new integrated strategic plan for enrollment, facilities, and aspirations ([www.scu.edu/santaclara2020](http://www.scu.edu/santaclara2020)). As SCU President Michael Engh, S.J., said, "Today, the University finds itself at a remarkable intersection: the convergence of history and tradition, great new challenges, and remarkable opportunities."

One of the opportunities being advanced is the physical convergence of faculty and students in STEM-related fields (science, technology, engineering, and mathematics) to promote synergies, foster creativity, and stimulate innovation and entrepreneurship. For months, faculty and staff from the School of Engineering and the College of Arts and Sciences have been meeting to explore how scientific knowledge and technological innovation in service of humanity can be advanced via co-location of our STEM disciplines.

Plans for a new STEM complex are in the works. With an end goal of distinguishing SCU as a leader in STEM education, workshops have been going on for months to determine how best we can blend classrooms, laboratories, makerspaces, and informal gathering areas to foster convergence and enable greater collaboration between the sciences and engineering.

Of course, engineering is, intrinsically, a collaborative endeavor; convergence is not a new concept for our community. The articles in this edition of *Engineering News* are rife with examples of convergence and collaboration—students working with external industry partners, graduate engineers supporting the Department of Athletics, and engineering professors teaming up to write about spirituality. No, convergence is nothing new to engineering, but the possibilities stemming from it are exciting. Happy reading!

Godfrey Mungal  
Dean  
School of Engineering

## Making Connections

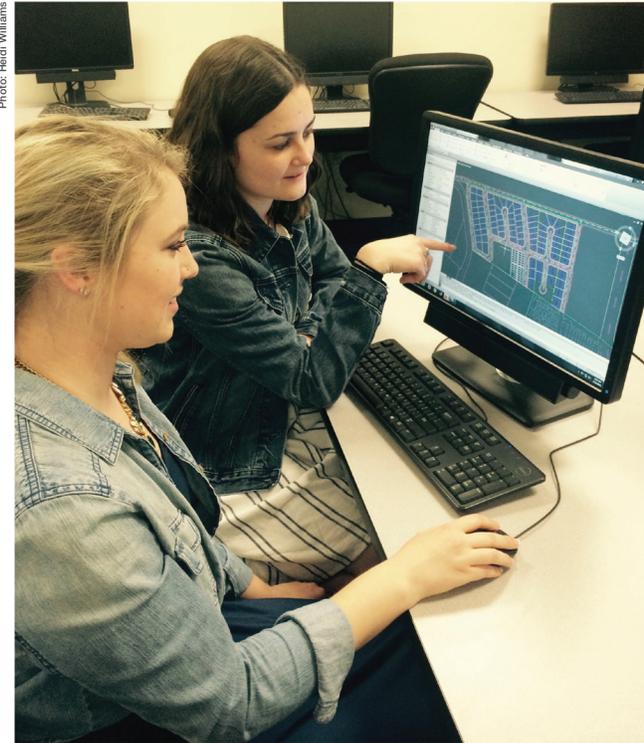
Sometimes, it's all about connections. For civil engineering seniors Ellen McKay and Kaelynn Willey, connections to faculty advisors, a fellow Bronco engineer, a local developer, and yes, even sewer lines, became paramount as they set out to plan and design a low environmental impact neighborhood district.

Their first important connections came when they selected associate professors Steven Chiesa and Rachel He as their project advisors. Chiesa, who specializes in wastewater management, and He, whose expertise is in transportation modeling, put them in touch with alumnus Chris Freitas '84, senior civil engineer for Santa Clara County, for help in finding a project they could dig into. "He showed us two plots; we chose the plot that made most sense to develop with a mix of single- and multi-family homes and an integrated commercial component," said McKay.

With their project identified, Freitas introduced them to Armintha Jensen, P.E., founding principal at Ruggeri-Jensen-Azar (RJA), an engineering, planning, and surveying firm in Gilroy, California. Jensen was enthusiastic about mentoring the up-and-coming female engineers. The pair met with their faculty and industry advisors regularly as they began plotting the streets, lots, and utilities. Their design work entailed using computer-aided software tools that went beyond the familiar AutoCAD—WaterCAD, SewerCAD, and StormCAD, to name a few.

Their proposal, which includes widening a two-lane country road, identifies where stop signs, ADA ramps, crosswalks, and bike and walking paths will best suit the community. It also lays out the sewer lines, pipe junctions, and fire hydrants.

Photo: Heidi Williams



From left: Kaelynn Willey and Ellen McKay

"We modeled using average and peak demand, turning on different hydrants to see if our plan was workable. The sewer uses a gravity system, which wasn't working with some of the initial elevations, so we learned how to fix that," said Willey.

"Through this process, we've learned that design is very iterative. If the model doesn't work, you have to change everything; it's not always right the first time and you have to be patient. We're lucky to have had the help of our advisors. When we get stuck, we talk to them and we have a new plan of attack," said McKay.

And after all, isn't fostering good connections what designing sustainable, family-friendly communities is all about?

# To Sleep— Perchance to Breathe

Bioengineering students work to bring a better night's sleep to sufferers of Obstructive Sleep Apnea.

Maybe you're one of the lucky ones who plops your head on the pillow each night and immediately conks out for a great eight hours of uninterrupted shut-eye, but for the estimated one in five adults who suffer from the serious disorder Obstructive Sleep Apnea (OSA), bedtime might not be such a bed of roses. A nighttime slumber for these nearly 18 million afflicted American adults can include repeated bouts of breathlessness for up to a minute at a time when the tongue becomes relaxed and falls back, blocking the airway. The malady can lead to side effects—memory problems, high blood pressure, depression, and even death.

suture can cause discomfort when the patient tries to swallow.”

“Siesta has the implant on the market,” Karlsen added, “but they are changing the design and material of the suture to be more comfortable, more elastic, and longer-lasting. Erik van der Burg, Siesta’s co-founder and a member of the SCU bioengineering department’s advisory board, offered us the chance to work on the project, and we’ve been testing two different designs and materials for an adjustable, self-securing suture that will eliminate the need to tether to the mandible.”

Kilkenny continued, “One of the options we’re testing is like a zip tie that is designed to lock the implant at any desired length; the other uses a notch method that sits into the tongue, decreasing the occurrence of migration. We’re also experimenting with using medical grade silicone instead of the polyester currently adopted.”

The next step is a trip to the supermarket meat counter to purchase a cow’s tongue on which they assess their sutures. More work in the machine shop evaluates the stress and strain of the materials’ elasticity. Their sutures are sent out for additional testing to mimic the effect 15 million movements of the tongue would have on an average patient over 40 years.

“I really wanted a hands-on experience with a developer for Senior Design,” said Kilkenny, “and working with an actual device is intriguing.” She and Araj will continue their studies next year as part of the five-year combined B.S./M.S. program while Karlsen, who transferred into bioengineering from chemistry in her junior year, is leaning toward medical school. All three are grateful for the support they’ve had from both van der Burg and their faculty advisor, Assistant Professor Ashley Kim. “The different perspectives they bring is so helpful,” said Araj. “Dr. Kim is awesome; we’ve taken her classes for years and enjoy her guidance. And Erik’s experience with actual product development is invaluable.”



Photo: Charles Barry

Hold your tongue: bioengineering seniors Erin Araj, Leah Karlsen, and Abby Kilkenny with Erik van der Burg are designing better tools to fight potentially deadly Obstructive Sleep Apnea.

But not if bioengineering seniors Erin Araj, Leah Karlsen, and Abby Kilkenny can help it. For their Senior Design project, these three are working with local startup Siesta Medical to improve the surgical procedure currently used to alleviate the disorder. “The way it’s done now with Siesta’s Encore Tongue Suspension System,” explains Araj, “a suture is inserted under the chin, implanted into the tongue, and tethered to the mandible, which basically pulls the tongue forward. The problem is, the

# BUILDING A BETTER NEST

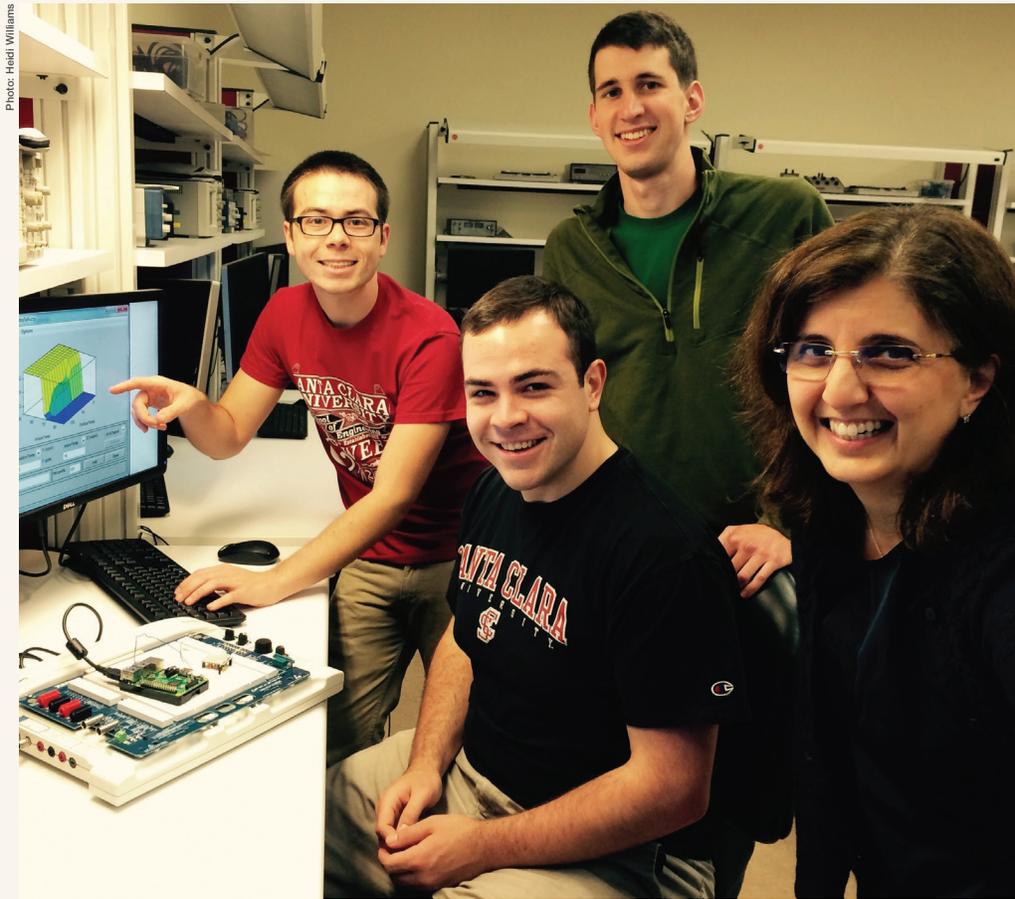
Team uses fuzzy logic to bring focus to their project.

In today's world where our cars, phones, and even items of clothing give and share information as part of the Internet of Things, it may be time to update that old chestnut about building a better mousetrap ... to something along the lines of "build a better thermostat and the world will beat a path to your door." Noticing so much popular attention paid to the Nest Learning Thermostat and facing the challenge of their year-long capstone project, electrical engineering seniors Matthew Allen, Sam Billett, and Kevin Read fixed their laser-like focus on fuzzy logic.

"We wanted to have a thermostat that can think and be more intelligent about when to turn on and off, rather than a normal programmable thermostat that operates according to a weekly schedule," said Read. "We decided to use a fuzzy logic decision-maker inside the thermostat that would not just follow patterns, it would make decisions based on what humans would want to do," added Allen.

Sounds good, except for one problem: they didn't know anything about fuzzy logic. The advanced topic hadn't been covered yet in their undergraduate classes. So they asked electrical engineering Adjunct Lecturer Maryam Khanbaghi for help. Allen: "We said, 'we like you, we like your teaching style, we want you to be our advisor.' She taught us fuzzy logic and gave us the tools to go at the guts." Khanbaghi's industry experience as a highly respected technical expert designing advanced control systems for Corning, Inc., made her a rich bank of knowledge for the team.

"We wanted to differentiate our product from Nest in ways that would be useful and valuable to the customer," said Billett, "so we've incorporated a budget mode that will allow users to specify how much they want to spend on HVAC per month. The thermostat will adjust the temperature to match that figure as closely as possible." The team also implemented a CO<sub>2</sub> sensor instead of



*Mugging for the camera, from left: Matthew Allen, Kevin Read, Sam Billett, and Maryam Khanbaghi.*

a motion detector to determine occupancy, improving accuracy while keeping the constant signal their fuzzy logic system needed.

"These guys are courageous to take on a project like this," said Khanbaghi. "They are only a group of three, but they are trying to do something better than Nest and [are] learning technologies that will be very helpful to them as they start their careers."

Summing up the team's experience, Allen said, "Taking on a subject that none of us knew anything about and learning about it has been the best!"

# FACING FEARS THROUGH VIRTUAL REALITY

While some might fear public speaking to the point of calling it a phobia, two students bravely face that anxiety by talking about their work to alleviate the fears of others. For their Senior Design project, Bryce Mariano (web design and engineering major, studio art minor) and Paul Thurston (computer science and engineering major) have developed a simulation tool for therapists to use in guiding patients through a controlled virtual world of exposure to potentially terrifying things.

conference last year," she said, "I saw a presentation about therapeutic video games by Adam Gazzaley M.D., Ph.D.—his team is seeking the first FDA approval for these games' use—and I thought this was fantastic. My students know I like to design video games, so every year I have groups that want to do capstone projects related to gaming. Developing therapeutic video games beautifully pairs a desire for a career in video game design with the SCU mission of giving back to society."

With the seed for their project planted, Thurston reports, "Our biggest challenge at the beginning was that because we're engineering students, we didn't understand the psychology side. We reached out to Dr. Kieran Sullivan [professor and chair of SCU's psychology department] and through our own research and her feedback, we decided to create a tool to treat phobias such as fear of heights or flying."

Their technique uses the Oculus Rift hardware (picture a cross between goggles and a welder's mask), a head-mounted 3D display device that tracks head orientation, allowing users to experience the virtual world from their own vantage point. Mariano, who interned as a graphic designer, worked on the simulation design, while Thurston, who helped program the control system for SCU's 2013 Solar Decathlon house, programmed the controls communication between a computer tablet and the Oculus. He also created a mobile app the therapist uses to control the session.

They started with a fear of heights simulation. As the patient takes in a 360-degree view from atop a building, the therapist can alter the virtual height and the resultant view—backing off or increasing exposure as needed according to the patient's emotional response.

While the team stresses that their tool is for use by trained therapists, not for sufferers to use on their own, Thurston notes that just knowing you can take the goggles off while immersed in the experience may make this form of treatment more approachable for some.

"Another aspect of our project that has been very important to us is to keep it affordable as well as accessible for future development," said Mariano. "By using economical hardware and developing the simulation using the Unity Game Engine, which is 100 percent free and readily available, we hoped to create a platform that would allow others to easily pick up the project where we left off and continue expanding on the library of simulations to treat the widest possible range of phobia patients."

Pantoja appreciates the interdisciplinary experience the project affords the students. "We are really lucky that we can count on the support of the College of Arts and Sciences. The help we are getting from Dr. Sullivan is invaluable. Also, for this project, and for all the video game projects I advise, I call on the expertise of computer engineering alumnus Chris Menezes '10. Chris works at Disney/Pixar and is providing us with advice on how the video game development process works in the 'real world' and how to make games more appealing to customers," she said.

Sullivan adds: "Using cutting-edge technology to create a therapeutic and safe environment for folks struggling with anxiety disorders holds incredible promise. I'm so excited that Bryce and Paul have chosen this for their project." Pantoja sees such projects as just the beginning. "There are tremendous opportunities out there that are limited only by our imagination."



*Bryce Mariano, left, and Paul Thurston show off the Oculus Rift and tablet that therapists employing their software can use to allay patients' fears.*

With a post-university goal of starting careers in the video game industry—more precisely, within the category of serious or interactive games—the pair were looking for a project that could afford the experience they'd need to follow their dreams while also providing a social benefit, preferably in the area of psychological treatment.

Fortunately, academic advisor and computer engineering Adjunct Lecturer Maria Pantoja was there to help. "At a

# Engineering the Perfect Shot

It's the last home basketball game of the season, and you can sense how much they want to be at their best. Though their outward demeanor is focused, calm, and determined, there is a palpable undercurrent of excitement for the game to get started. You can almost hear them pleading, "Put me in, Coach!"

But this isn't the players' starting lineup chomping at the bit to take the court. This is another team altogether—the devoted camera operators, mostly graduate engineering students and mostly hailing from India—who work for the Department of Athletics filming men's and women's hoops. While nearly 20 male and female graduate engineers make up the entire squad, today's game is covered by just five cameramen, including one operations management and information systems graduate student from the Leavey School of Business and a rookie, Benjamin Mullen, sophomore civil engineering student.

Cameramen Vishak Aprameya Shivakumar Kanakapura and Yash Tamakuwala are both computer science and engineering master's students. "I enjoy photography," Tamakuwala said, "and I've always been a basketball fan (I referee for intramural games). So when one of my

friends suggested I apply for this job, I decided to do it. There's nothing more fun than shooting what you want to see." Kanakapura also heard about the job through a friend. "I do photography as a hobby and have been covering events for Swades, the Indian Students Association at SCU, so this job was suitable for me. It's been great to get to go to the games and play with the camera. As an engineer, the mathematics of photography is interesting to me. I basically follow the rule of thirds, a well-known technique for composing an image, as I'm filming. The object should lead the subject viewing the frame into the shot to make the subject hold onto the frame," he said.

For Vemuluru Venkata Sri Harsha, who is working toward his mechanical engineering master's degree in robotics and mechatronics, basketball was all new. "It's a fast game and it was most challenging at first predicting when they were going to pass, but it's pretty much simple now," he said. The amateur camera operators credit their supervisors, David Gentile, video manager, and Tom Carine, videographer, with creating a supportive environment where they can learn and grow outside the world of engineering.



Ready for the big game against rival St. Mary's College—which Santa Clara won 71-70; go Broncos! From left: Benjamin Mullen, Yash Tamakuwala, Vishak Aprameya Shivakumar Kanakapura, Vemuluru Venkata Sri Harsha, Ritwek Swetank

"Filming a sport like basketball, which is full of very quick, herky-jerky bursts of action is challenging," said Carine. "These guys have keen, analytical minds; they want to know how the camera works, how to get the best shots, why do you do it like this, why not do it like that... They really absorb information like nobody's business—they're sponges and then they put the pieces of the puzzle together."

Finally, the moment has come ... the buzzer rings and the game begins. The crew goes to work—focusing their attention on the action on the court and the voice in their ears as Tom directs them from the control booth. "Camera 2, you're live on the big screen."

# High-flying Aspirations

Senior Micah Klaeser has a dream. As a sophomore, after taking the honors class Entrepreneurship for Social Justice, the mechanical engineering student pitched an idea to SCU's Center for Science Technology and Society about designing an unmanned aircraft that could be used to transport medical supplies to rural

The airframe group—Thomas Clark, Michael Dewane, Siosuia Faleta, and Robert Llanos-Hinson—“was responsible for designing and constructing the structural system, lifting surfaces, and fuselage,” said Llanos-Hinson.

Dewane holds a pilot's license, but he notes, “None of us had any experience building or flying model planes. We spent the summer building a ‘Frankenstein’ hybrid from an off-the-shelf quadcopter that we meshed with an RC airplane. The four motors allowed it to take off and land vertically and the wing helped it create more lift. We used a lot of tape and fiberglass to hold it together and practiced flying it so the controls team could see how it works.” They also studied different types of airfoils and considered structural elements, choosing foam to construct the shape they needed to create lift and evaluating the pros and cons of using carbon fiber or aluminum for the spar passing through the wing that would bear the weight of the controls and payload.

“The biggest challenge,” said Faleta, “was that it was hard to finalize our design, based on the other teams’ progress. If the payload increased, their dimensions changed, which affected our design. Communication between our three teams became really important.”

Klaeser understood that too. “Working with the multiple teams, I’ve learned a lot about project management,” he said. “While a few years ago I wouldn’t have said it was in my personality to do it, it has been an interesting challenge and I’ve enjoyed this project enough that I’ve decided I want to see it through.” He plans to hone those skills in the Engineering Management and Leadership master’s program. Looking ahead, he has high hopes for SkyPort. “I’m working with SCU business and public health majors who have contacts in Zambia, Uganda, and Ghana. I’m talking with people to get something in the works to get the UAV back in the field in a couple of years.”

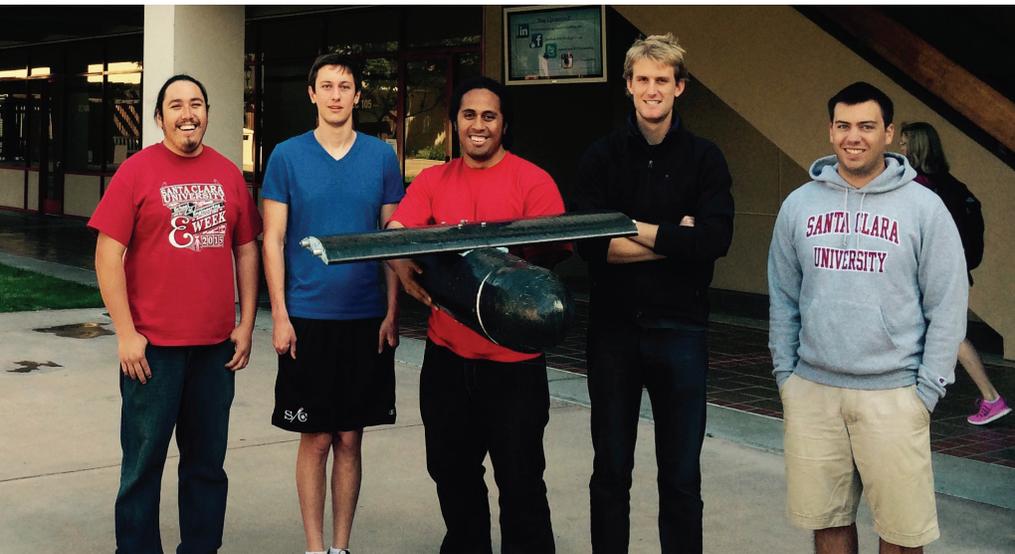


Photo: Heidi Williams

From left, Robert Llanos-Hinson, Thomas Clark, Siosuia Faleta, Micah Klaeser, and Michael Dewane with a portion of their prototype.

health providers in the developing world. That pitch led to research in his junior year with Christopher Kitts, mechanical engineering associate professor and director of SCU's Robotics Systems Laboratory, which led to a fellowship that took Klaeser to Zambia for five weeks last summer to test technical competencies and cultural reception of his prototype.

When he returned, he and ten of his fellow senior mechanical engineers got together to further develop his idea as their Senior Design project—SkyPort, a long-range vertical takeoff and landing (VTOL) unmanned autonomous vehicle (UAV). With Klaeser acting as the project manager, the work was divvied up between three teams: controls, airframe, and payload.

# LETTING THE SUN SHINE ON A BRIGHTER FUTURE

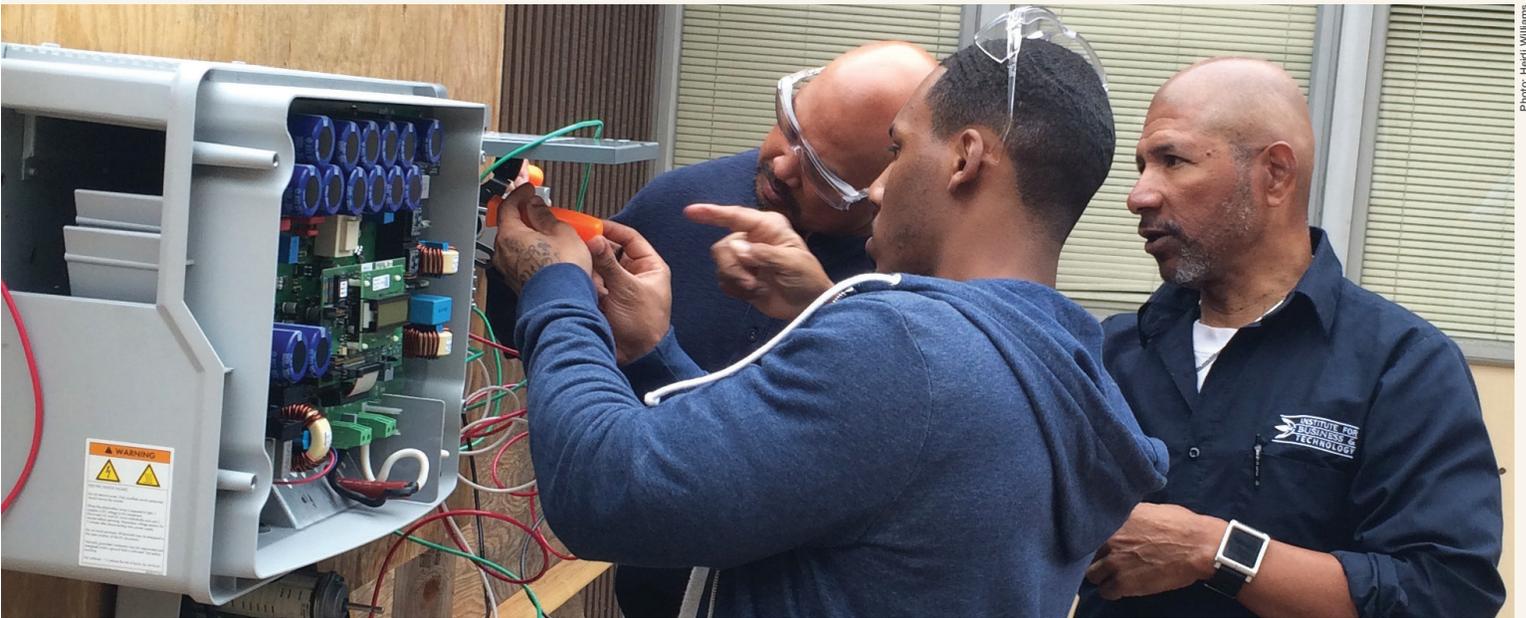


Photo: Heidi Williams

*The future looks bright for these military veterans who were on campus learning about solar electrical systems.*

SCU's School of Engineering has long been a driver in both energy education and community outreach. Recently, the two converged when electrical engineering associate professor Shoba Krishnan and solar advocate Mike Strykowski teamed up to help veterans step into solar careers. According to a recent White House press release, "The solar industry is adding jobs 10 times faster than the rest of the economy, creating a source of good paying American employment... Last year, the U.S. installed as much solar every three weeks as we did in all of 2008. In 2013 alone, the price of commercial and residential solar declined by more than 12 percent. This is driving more and more Americans to install solar panels at their homes and businesses, and is supporting tens of thousands of solar jobs across the country."

"I thought, with all the jobs that are available in the solar industry, and with all the skilled veterans who could use some help to get a foot in the door, maybe SCU could do something to help," said Krishnan. She reached out to Strykowski, CEO and co-founder of Solar Way Forward, a company committed to solar energy practitioner training and to bringing solar to the developing world. As mentor and consultant on a number of SCU energy projects, he is a frequent collaborator of Krishnan's. Together, the pair planned a module for the course, STEM Outreach in the Community, which meets the experiential learning for social justice (ELSJ) requirement for SCU undergraduates. Four mechanical engineering students signed up: juniors Hesham Naja and Peter Savoy, and seniors Jay Dubashi and Shane Hereford.

Krishnan explained: "Mike and I reached out to California's Employment Development Department and other veterans' groups to find participants. We also planned a field trip to Clean Solar, a local business that was very generous in offering us materials free of charge. Then we planned the labs for the course and determined the topics to be covered—the SCU students were responsible for researching those topics, creating curriculum, presenting the material to the veterans, and helping with the labs," she said. Strykowski added, "Students learned as many aspects of the residential solar market as we could fit in—site visits, solar modules, installation, safety, sales, and more. We also interviewed the veterans to look at their skillsets so we could incorporate materials that matched their prior military training to an application in

the solar electrical field," he said. Naja noted, "In addition to the technical material we presented over the course of the quarter, Mike gave great assistance to the veterans, including help with their resumes to aid in their job search."

Reflecting on his experience taking/teaching the class, Dubashi said, "I came into this class feeling slightly jealous of the veterans. I thought the military would give them all the skills they needed to succeed in life. The reality is completely different. Veterans do have an exceptional and unique skillset. But they aren't taught how to communicate their skills to potential employers, or how to earn certifications to prove their skills. The veterans were incredibly eager to learn. Classes like this can blaze a new trail and have a positive impact on their lives."



The Jesuit University in Silicon Valley



## CIVILS BEING CIVIL

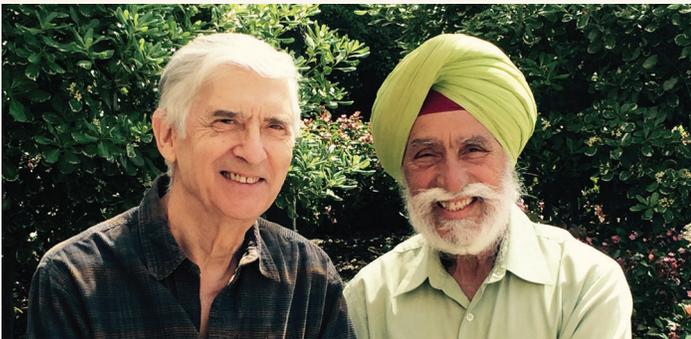


Photo: Heidi Williams

From left: John Finnemore and Sukhmander Singh

For generations, civil engineering has been known as a “people-serving profession,” so maybe it shouldn’t come as a surprise that two Santa Clara University civil engineering professors recently teamed up to publish a paper aimed at helping humankind restore inner and world peace.

Colleagues John Finnemore (now professor emeritus) and professor Sukhmander Singh share a bond beyond their chosen profession; they both have a deep interest in spirituality. And while Singh has grown increasingly concerned about the “loss of harmony between the sublime/spiritual/divine in nature and within us” that separates us from “peaceful living within ourselves and among nations,” Finnemore has been championing spirituality as a means to nobility of character leading to peace and harmony.

The result of their collaboration is “Restoring Inner Peace in a Science Dominated Society,” a paper presented at The Religion in Society Knowledge Community Fifth International Conference on Religion and Spirituality in Society, at the University of California, Berkeley, this past April.

The authors are quick to point out that their definition of spirituality has nothing to do with religion; rather, it entails the development of personal responsibility, humility, sincerity, and integrity (among other traits) in the pursuit of being a channel for good.

“This work is consistent with the SCU mission to help humanity. We should strive to be of good character, conscious of suffering, and compassionate in our desire to relieve it. When we are in harmony with nature, and when we seek to behave with honesty, sincerity, and fairness, our rewards are far greater than any ego-driven pursuits. Someone has to raise a flag and pause to think about these things; that’s why we wrote this paper,” said Singh.

Finnemore, who recently compiled *Spiritual Light: Universal Teachings from the Highest Spirit Realms* (available via [www.theusb.org](http://www.theusb.org)) adds, “As a civil engineer, my focus was on environmental protection; I see this work as society protection. As a society, we have serious difficulties resolving conflicts, helping starving populations, and protecting our planet. We need to raise consciousness among different audiences, and this work is one way of doing that.”