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School of Engineering

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engineering news

School of Engineering

FALL 10

SANTA CLARA UNIVERSITY

DEAN'S MESSAGE

At a presentation by SCU's Center for Science, Technology, and Society (CSTS), I learned something interesting and disturbing: Although the developed world has benefited greatly from technology stemming from the Industrial Revolution, the developing world has not. Since the mid-1800s, the gap between the two groups has become increasingly larger, with technology jettisoning the Western economy upward, while those at the bottom of the economic pyramid have remained static.

As engineering educators at a Jesuit university, we believe it is incumbent upon us to try to do something to close this gap. And so it is that the School of Engineering is partnering with CSTS through a new focus on frugal innovation, bringing our philosophy of "engineering with a mission" and the Center's goal of "innovating for social impact" together, as you will see in the accompanying article.

It occurs to me that this edition of *Engineering News* is all about addressing gaps. Here you will read about our student researchers filling in the gaps of knowledge surrounding muscle rejuvenation and industrial algae pond health, about steps being taken at SCU to close the gap between the energy we produce versus what we use, and about how one undergraduate is filling in the gaps in his own education by adding a studio arts minor and study in Japan to his engineering major. You will also meet two new additions to the School of Engineering who have filled the gaps in our faculty. Enjoy!

Godfrey Mungal
Dean
School of Engineering

Photo: Spencer Ambauen



Students bring sustainable building techniques to Northern Ghana through a partnership between the School of Engineering and Center for Science, Technology, and Society.

FRUGAL INNOVATION COMES TO SCU

The School of Engineering and SCU's Center for Science, Technology, and Society (CSTS) are pairing up on a frugal innovation initiative, Radha Basu, former CSTS managing director, announced. "This could be a real differentiator for the University, providing us with a tremendous opportunity to innovate for social impact," she said.

Frugal innovation addresses the need for products and services in emerging, underdeveloped countries. Ruggedization, simplification, sparing use of low-cost raw materials, an emphasis on earth-friendly practices, and a philosophy that favors "good enough" over "perfection" in creating compassionate, use-centric design are features of frugal innovation.

"What's exciting about this field is that engineering or technology innovation for social benefit might seem like it's something someone does for charity work, but that is not the case anymore," said Basu. "In the next few years, emerging markets such as China, Africa, Brazil, and India are expected to account for seventy percent of the world's economic growth. For the United States to remain competitive, we must provide products and services to the growing masses, and we have to innovate to the needs of the billions of potential consumers at the bottom or middle of the income pyramid. Santa Clara, with its focus

on educating for a just world, is the perfect place to locate these efforts."

Serving emerging markets also entails a radical change in business models, distribution and supply chain partnerships, and applying mass-production techniques to service industries. Therefore, the initiative includes collaboration with SCU's Leavey School of Business to address these critical needs for emerging markets through what is increasingly known as "lean entrepreneurship."

Basu sees tremendous potential for Silicon Valley growth as companies become target-market focused. This summer, she taught a graduate-level course for the School of Engineering entitled "Engineering for the Developing World," which was met with great success. "There is a hunger in this Valley for this kind of information," she said.

"The frugal innovation initiative provides a mechanism for faculty and students to apply their intellectual rigor while working on meaningful projects that not only serve the world, but also contribute to the success of our economy here at home," said School of Engineering Dean Godfrey Mungal. "In Santa Clara President Michael Engh's inaugural address, he said 'SCU is uniquely positioned to make a significant contribution to achieving a more just and sustainable future.' This initiative is a major step in that direction."

AIR, LAND, SEA, SPACE, AND NOW... ALGAE PONDS!



Photo: Heidi Williams

From left: Thomas Adamek, Steve Li, Ketan Rasal, and T.J. Leising test sensors for RoboAlgae.

It's always interesting to check in with the graduate students in the Robotics Systems Laboratory to see what they are working on. This time, in addition to devices for land, sea, air, and space, four students are collaborating with a scientist from NASA to create a control system for RoboAlgae, an autonomous, buoyant sphere (or bot) that can be deployed in racetrack-style algae ponds to monitor conditions, disperse nutrients, and optimize the growing process for the commercial cultivation of biofuels and feedstock produced in industrial algal farms.

Thomas Adamek, Steve Li, Ketan Rasal, and T.J. Leising, all mechanical engineering master's students, are hard at work testing sensors for the wireless device to take readings on temperature, light, oxygen levels, and other criteria of importance to the algae farmer. "As the bot circulates around the pond," said Li, "we get a picture of where the nutrients are and where oxygen is showing up. We

correlate this information with the bot's position, time of day, temperature, humidity, etc." According to Adamek, "The data is collected and sent to a computer where it is plotted on a graph according to time and location."

The next step will be to develop a system to control the bots and get them to work together. Rasal noted, "The field applications and research work are fun; I really like that we're getting hands-on experience." "Or, in this case, waist-deep experience," added Leising, who enjoys working on a "real project with real customers."

Li, who received his bachelor's degree in electrical engineering and is a seasoned researcher in multi-robot clusters, enjoys the interdisciplinary collaboration that takes place in the Lab. "The kinds of skills you learn apply to a wide range of projects. Once you get into solving the problems, you see that there are similarities to something you have worked on before. You can apply your engineering knowledge to solve a wide range of problems. Who'd want to do the same thing over and over again?"

Adamek, who is the project lead on the Lab's SWATH boat research, and has also put his expertise to work on SCU's solar-powered house, agrees: "That's why I'm here at SCU, for the mechatronics program. There's always something interesting to work on. This project is in the early stages right now. We're not sure at this point what we will achieve and we have a lot of questions for the scientists. It will be interesting to see where this leads us."

BIOENGINEERING STUDENT STUDIES CELLS AT THE NANO LEVEL

With the goal of learning how to regenerate the cells found in our muscles, bioengineering senior Sandeep Kaur has been spending a lot of time with the Center for Nanostructures' (CNS) Atomic Force Microscope (AFM), a very high-resolution type of scanning probe.

"I wanted to find out what conditions are necessary to allow cells to differentiate and proliferate. How do the mechanical properties on cell culture substrate come into play? What chemical components are needed in the microenvironment? Exactly what conditions will allow cells from adult mice to proliferate into a particular type," Sandeep wondered. So she set out to answer the questions with the help of her advisor, bioengineering professor Unyoung (Ashley) Kim, electrical engineering professor and CNS director Cary Yang, and biology professor James Grainger.

Together, they developed a method of probing the flexibility of soft culture substrates using atomic force microscopy. Kaur was well-prepared for this type of research. Three years earlier she had contacted Yang looking for a project. "Sandeep expressed her interest in working on something with a mix of nanoscience and life sciences," he said. "I introduced her to a research project examining the elastic properties of carbon nanostructures the summer after her sophomore year." Teaming up with other CNS researchers, Kaur carried out the experiments, and their results were presented at the Materials Research Society Meeting in San Francisco in April 2010.



Photo: Heidi Williams

Prof. Kim and Sandeep Kaur '11 at work with the Atomic Force Microscope.

Once she was proficient with the AFM, Kaur was ready to take on a new challenge. "This is the exact project I should be working on, as it encompasses both biology and engineering," she said. "Applying engineering and physics, especially in my senior year, is great because everything comes together." Prof. Kim concurs: "With her biology background, she understands cells and chemistry. Her physics background makes her skilled in taking measurements, and she has a solid grounding in engineering principles that gives her the ability to provide a solution."

Kaur recently presented her work at a poster session held at NASA. "I believe one of the biggest misconceptions about Santa Clara is that people think students don't get involved in research the way they would at a bigger school in the U.C. system," she said. "But I've found the opposite to be true. It's so exciting for me as an undergraduate to be able to guide my own research with the help of great professors from three different departments."

SCU SMART GRID PROVIDES NEW OPPORTUNITIES FOR ENGINEERING STUDENTS

For years, Joe Sugg, assistant vice president of University Operations, has been working on an energy strategy for SCU. Now, with the support of Sustainable Silicon Valley (a consortium of businesses, governments, and civic organizations) and Valence Energy (a company founded by a group of SCU engineering alumni to optimize energy generation and consumption), the University is embarking on a Smart MicroGrid project that will maximize the efficient use of energy. The effort is meant to further the University toward its climate neutrality goals and its ability to ensure that campus energy needs are met in the event of an emergency such as a major earthquake.

Read more: scu.edu/engineering/enews/2010fall



Photo: Charles Barry

Joe Sugg, assistant vice president of University Relations.

TAKING ON A TECH TAXONOMY

When SCU's Center for Science, Technology, and Society asked computer engineering professor Silvia Figueira for help developing a taxonomy of mobile applications available to the developing world, Figueira had just the right students for the task.

Read more: scu.edu/engineering/enews/2010fall



Eva Jensen '11 and Rosalie Tolentino '11 developed a taxonomy of mobile applications for the developing world.

CIVIL ENGINEERING STUDENT LEADS THE WAY



Maria Campbell '11 takes stock of energy-related equipment on campus.

Civil engineering senior Maria Campbell stands before an aerial photograph of SCU's campus, with the facile manner and the confidence of someone twice her age, fielding questions from a trio of architecture and building professionals. Working under the direction of Joe Sugg, assistant vice president of University Operations, Campbell has spent the summer researching how to bring Santa Clara's existing buildings up to U.S. Green Building Council standards for LEED EB (Leadership in Energy and Environmental Design Existing Buildings), and she has become quite an authority along the way. "You're smart!" exclaimed Todd Jersey, an architect chosen as a consultant based on his experience with green retrofit projects.

Campbell brushes off the compliment with a quick smile as she explains the project: "Right now, we're looking at individual buildings, determining how each one is using resources, and looking for ways to reduce the ecological footprint of the building." Working with Swinerton Builders and Todd Jersey Architects, Campbell is researching how campus buildings could be more sustainable if renovations were made. "We're also looking into how normal upkeep could be more sustainable, and checking into storm water management while looking at exterior hardscapes that affect building efficiency. It's a little tricky finding ways to minimize heat gain for our campus structures while maintaining the mission aesthetic, but there are things we can do if we're creative," she said.

Unlike many of SCU's students, Campbell is self-supporting and has worked on campus in a number of capacities before taking on the job of managing SCU's LEED EB certification process. "I've learned a lot this summer," she said. "I've been studying for LEED green associate accreditation. Joe encouraged me to get my accreditation and the University is reimbursing me as part of the project, so it's been really good. This school has given me a lot—helping me with scholarships and financial aid, internship opportunities, and now this project. I definitely wouldn't be here without SCU's help, so it feels good to be working on something that gives back to the school and does something healthy for our planet, too."

AN ARTFUL EDUCATION

Dustin Han '11 had no idea of the opportunities that were available to him when he first came to SCU as an undeclared freshman. "I wanted to study art, but my parents had engineering in mind," he said. Without a clear idea of his path, Dustin made a smart move and sought the advice of computer engineering professor Darren Atkinson early in his first quarter. "I knew I wanted to be an animator and that my dream job was to work for Pixar," said Han. "With Professor Atkinson's help, I was able to get started taking core classes that addressed my love of art. In my sophomore year, I declared my major as computer science and engineering with a minor in studio arts."

"It's been so great learning a lot of new ways to do art, and I've surprised myself with the painting," said Han, whose work was displayed as part of an exhibit within the School of Engineering earlier this year. "The classes I have taken at SCU have expanded my knowledge of art such as learning color theory and drawing from life. Last year I used a bandsaw for sculpture and I thought I was going to cut my finger off, but it was fun!"

As a commuter student, Han said he felt the urge to expand his horizons. "I've lived in San Jose all my life," he said, "so I thought studying abroad would be a good idea for me to branch out and become independent." Initially choosing Australia as his destination, Han was disappointed when that program was canceled due to low registration. His only option at that point was to join the program at Sophia University in Japan, but the deadline for enrollment had already passed. Once again he turned to Prof. Atkinson for advice. "By the time I contacted our International Programs Office to ask for help, they already had things under control and Dustin was on his way," said Atkinson.

It turns out this was the perfect opportunity, and Han loved every minute of his time in Japan. "It was life changing, pretty much," he said. "I met people from all over the world and it was such a different experience for me to live in a dorm with them, learning new cultures and traveling all over. I was able to take classes in art history and religion that I have transferred back to SCU for credit, so I will still graduate within four years."

"Dustin made some very strategic choices in his selection of classes along the way," said Atkinson. "That made all the difference in allowing him to take advantage of all that SCU has to offer."

"When I first came to Santa Clara, I didn't expect to go abroad or do all this stuff. I didn't realize all these opportunities existed. I'm so glad I had the chance to do it all," said Han.

And, Pixar? "Yes, Pixar is still the ultimate dream, but I have other goals, too. I may go on to get a master's degree in computer engineering or even go to art school, but mostly I want to make my parents proud of me. They have given up a lot for me to come to SCU; I'd like them to get something out of it, too."



Dustin Han '11 beside his artwork on display in the School of Engineering.

AHMED AMER JOINS COMPUTER ENGINEERING FACULTY

The newest member of computer engineering's faculty, Ahmed Amer, loves to solve fun puzzles, and puts his expertise to work solving problems of data, resource, and energy management within what he calls "the simplified world of the computer."

At the American University in Cairo, Amer became interested in operating system software and distributed storage systems. "The goal of the operating system," he said, "is to give more with fewer resources, giving you the best performance you can get with your hardware." And, he added, with his own brand of humor, "It lies about things for you, hides the ugly truth, makes things look as good as they can be without you doing the work to make it so."

Amer's work as an IT infrastructure expert handling "ridiculously large volumes of data" for a Shell Oil company sparked an interest in data storage that eventually led to his Ph.D. research in predictive data access at the University of California, Santa Cruz.

"We predict the future; honest, we're not kidding!," he joked when asked about his work designing algorithms that can select the right piece out of the myriad pieces of data that might be requested of the operating system.

These days, the amiable professor is turning his attention to solving the problem of energy management with regard to computing. "Data centers and computers use lots of energy, and that usage can be manipulated through software. I am interested in how operating systems techniques can be applied to, and benefit from, our future management of energy—its generation, transportation, and storage. I am particularly curious to learn what our experiences with the world of computing systems can tell us about improving energy management in the real world," he said.

Now, that's a puzzle worth solving.



Photo: Heidi Williams

Ahmed Amer

MECHANICAL ENGINEERING WELCOMES DAN STRICKLAND

Photo: Michael Donohoe



Dan Strickland

As an alumnus of Seattle University, mechanical engineering's new faculty member, Dan Strickland, doesn't just "get" what Jesuit education is all about, he **is** what Jesuit education is all about.

Strickland's Ph.D. work at Stanford University focused on improving the efficiency of fuel cells by using novel methods, such as integrating wick materials to remove the excess water produced as a byproduct of the reaction. This resulted in up to a 60 percent improvement in peak power of the cells.

In the next few months, Strickland will be setting up a meso-scale fabrication laboratory on campus and sees lots of possibilities for collaboration with SCU's Center for Science, Technology, and Society (CSTS). His research program aims to leverage porous materials and innovative fabrication techniques to help enable affordable and practical energy technologies.

"I'm so happy to be at Santa Clara, where applying research toward practical solutions to the world's great needs is valued and is a hallmark of much of the work being done here," said Strickland. "SCU's strength is tying what we learn to how we use it. It's great to see students being put to work on projects that have real social benefit through programs and collaborations that institutionalize the Jesuit ethic," he said. "It's encouraging to see that our work is not disconnected from the good it can do."

Strickland is excited to be teaching fluid mechanics and thermodynamics and looks forward to developing new courses focusing on energy. "Santa Clara is exactly the place my academic career has led up to," he said, adding, "from research to teaching, all I hope to achieve is in line with Santa Clara's ethic and it's so great to be here."



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