



## Message from the Chair

Dennis Derickson

Each fall our incoming freshmen get off to a fast start in Learn by Doing: For starters, all 165 of them enter the Center for Innovation and Entrepreneurship's "Elevator Pitch" contest, pitching an idea for a product or service in 90 seconds. As if that's not fast enough, they each get their radio license, become shop certified, join IEEE, create a career plan and showcase their freshman projects using Arduino microprocessors — all in Fall quarter. Whew!

A really exciting follow-on to the first-year experience is the college's new Summer Undergraduate Research Program (SURP). Many first- and some second-year students are not successful in landing a summer internship with industry. With the SURP program, these students are offered \$2,500 to work closely with the faculty on research and projects over the summer quarter on campus. The funding from this program comes from alumni, industrial sponsors, and from the college's and department's funds. This year we had 10 SURP students in the program, and we'd like to see those numbers increase next summer. The program inspires student learning by enabling

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## Learn by Going

*Three electrical engineering professors take part in faculty exchange program with Munich University of Applied Sciences*

This past year, three electrical engineering professors got to experience [Learn by Going](#) as visiting scholars in Munich, where Cal Poly's hallmark Learn by Doing approach was right at home in one of the world's great centers of science, engineering and technology.

**Bridget Benson, Art MacCarley and Dan Malone** were part of a faculty exchange program with Munich University of Applied Sciences (MUAS), which is the second-largest applied science university in Germany. The collaboration, launched 12 years ago, was recently boosted by a \$1.4 million grant to increase joint teaching, learning and research opportunities between the two schools. The four-year grant, valued at one million euros, was awarded to Munich University by the German Academic Exchange Service (DAAD), a publically



Cal Poly Electrical Engineering Professor Art MacCarley toured some of Germany's most famous landmarks while on a faculty exchange with the Munich University of Applied Sciences.

funded, independent organization of higher education institution in Germany.

"The competitive DAAD grant recognizes our 12-year history with Cal Poly, an institution with which we have much in common, including our applied hands-on approach to student learning," said **Michael Kortstock**, president of Munich University.

Although Cal Poly and Munich University have much in common, Benson was especially intrigued by the differences.

"At MUAS, students are solely graded on a single final exam. There are no homework assignments, quizzes or midterms," she said. "Other than a specific lab or two, students don't enroll in a class at all — they enroll in a final exam. Consequently, stu-

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## CHAIR'S NOTE From Page 1

them to build their experience, confidence and portfolios. Please contact me if you are interested in sponsoring SURP opportunities for our students.

Our 30,000 square feet of laboratory space is an impressive learning environment for Learn by Doing. Thanks to all of you who are helping keep these labs current. Having seen many universities, I can attest to the fact that we have some of the best undergraduate labs in the U.S.

This year, as part of the department's advanced power system initiative, there's a special opportunity to make a big impact on our Electric Power Systems Laboratory facilities. Partial funding from REC Solar is allowing us to work on creating a new 1,800-square-foot outdoor laboratory including photovoltaic generation and energy storage systems. The focal point of this effort is the creation of a smart microgrid power system. In tandem with the physical improvements, faculty members are engaged in redesigning and updating our curriculum to utilize the new microgrid. With the help of additional sponsors and donors, we foresee a grand opening for the Advanced Power System Laboratory and curriculum in 2019.

Women in IEEE figured prominently in this year's highlights — among them EE alumna and IEEE President Karen Bartleson, who gave us a visit, and the group of enthusiastic students we sent to the IEEE International Women in Leadership Conference.

We invite you to visit and see for yourself all that's afoot. We'll give you a private tour and updates, along with a 3-D-printed souvenir. We also have department seminars every Friday throughout the year, which could be included in your visit — or, better yet, we hope you'll consider being one of our guest speakers in your area of expertise. If you can't make it here, let's catch up at one of our ongoing alumni events held throughout the state each year.

We look forward to seeing or hearing from you soon.

## LEARN BY GOING From Page 1

dents come and go to as many classes as they'd like. You never know how many students will show up on a given day — or how many class handouts to print. Although professors are required to hold one office hour a week, German students rarely drop in. The system seems to put more responsibility on the student for his or her own learning.

"I taught a class, CPE 329, that I teach at Cal Poly, but modified it to fit the German academic system. What I found to be really interesting is, despite the difference in the academic systems, the German students achieved the same learning outcomes and same distribution of grades as my Cal Poly students back home.

Living and working in a country that speaks a different language can be similarly eye opening, she observed. Even the simplest errand can be fraught with challenges.

"Finding the right store, the right item and the right words to ask for assistance or correct change is a minute-by-minute struggle," she said. "Every time I made it home from running an errand, I breathed a sigh of relief mingled with a sense of accomplishment.

"And I had it easy: I had a team of people at MAUS and from Cal Poly who were ready to help me with anything. I had friends in Munich, and I was in a country where most people understood my language. It made me appreciate the struggles of refugees who may find themselves in a different country without a job, unable to understand the language, and having no one to help them or make them feel welcome. My experience abroad taught me that among the most important global competences needed in today's world are patience and a welcoming attitude."

MacCarley, who taught a specialized course, Automotive Engineering for a Sustainable Future, marveled at the resources available at MUAS and throughout the city of Munich.

"Exemplars of the latest technologies are everywhere in the city," he said, "including companies like Linde Gas Products, a leader in hydrogen technology research, and, of course, BMW — both of whom I was able to arrange as guest speakers in my class. I drooled shamelessly when I saw the prototype BMW i8 plug-hybrid electric sports car at the BMW museum. I was amazed at the

level of automation, and the seamless integration of automation with human assembly workers at the BMW factory."

Such international influences and interactions permeated every aspect of the program, MacCarley noted.

"In collaboration with Munich University Professors Bowen and Doll, I was advisor for an industry-supported project in which we designed a modular electric vehicle range extender for a Porsche 987 platform," he said. "Students on the project included Australian, English, Russian and Spanish nationalities. I was also fortunate to develop new faculty friends from Australia, England,

Germany, New Zealand and Romania. Likewise, my hobbyist interest in motorcycles created bonds with a large number of faculty in both electrical engineering and mechanical engineering. At the urging of my daughter, a Cal Poly electrical engineering alum, I kept a [BLOG](#) of my experiences for family and friends.

International exchanges — personal, professional and academic — are increasingly important as the world becomes more global,

noted MacCarley.

"It's critical that engineering leaders in the future be able to communicate, collaborate, understand and respect their worldwide colleagues," he said. "The faculty exchange that benefited Bridget, Dan and me at the University of Munich, similarly benefited Professors **Nils Rosehr**, **Alfred Irber** and **Markus Krug** at Cal Poly, which, in turn, has benefited students from our respective schools. Such exchanges of real-world experiences open a wide world of possibilities — which is exactly what's needed as part of a competent and diverse engineering education for our students."

Participating Cal Poly students included electrical engineering majors **Jarrett Corr** and **Nicholas Tuong** and mechanical engineering major **Sara Lashanlo**.

Malone, who taught two MUAS courses, is a veteran of international teamwork, having had three work-related long-term foreign assignments while working at IBM.

"The Munich University of Applied Sciences exemplified how an international experience can enhance one's productivity, curiosity and resilience. It not only expands our sense of the world, it enlarges the capacity for personal growth, career success and community-building among students and faculty alike."

*"It's critical that engineering leaders in the future be able to communicate, collaborate, understand and respect their worldwide colleagues."*





# Message Received: Satellite Station was a Labor of Love

For their senior project last year, **Torgeir Lindborg** (W7OHH) and **Jesse Carrillo** (KK6ASN) constructed a satellite-tracking ground station capable of bidirectional communication with satellites. The station uses amateur radio equipment to communicate with amateur radio operators around North America and the Pacific islands.

The station was recently activated by the Cal Poly Amateur Radio Club to participate in Field Day, an amateur radio event where operators try to achieve as many radio contacts on the air as possible. The station was able to log a dozen conversations with other people in a single 15-minute pass of the satellite named FO-29.

The two students unabashedly describe the project as a labor of love.

“A friend and mentor of mine gave me a kind of warning when we embarked on this project,” said Lindborg. “He said, ‘A radio tower project? Those take a lot of time, but it’s totally worth it.’ He could not

have been more accurate. Between the two of us, Jesse and I sunk about 700 hours into this project.

“When we heard the dah-dit Morse code of satellite FO-29’s beacon break through the noise for the first time, we were ecstatic. I imagine this is what hearing your child’s first words feels like. After tracking a few more satellites and feeling comfortable with our listening skills, we decided to try a voice contact. Nothing. We sat back and looked at our variables; modulations, filters, RF power, mic gain, Doppler shift, EIRP, tracking accuracy, and free space loss.

“With some careful thought, a few applications of theory we picked up, and some good old-fashioned ham radio experience, we caught the next pass, heard ourselves on the downlink, and had a conversation with a ham who was at the edge of the Grand Canyon (over 450 miles away!).

“It was incredibly validating to take

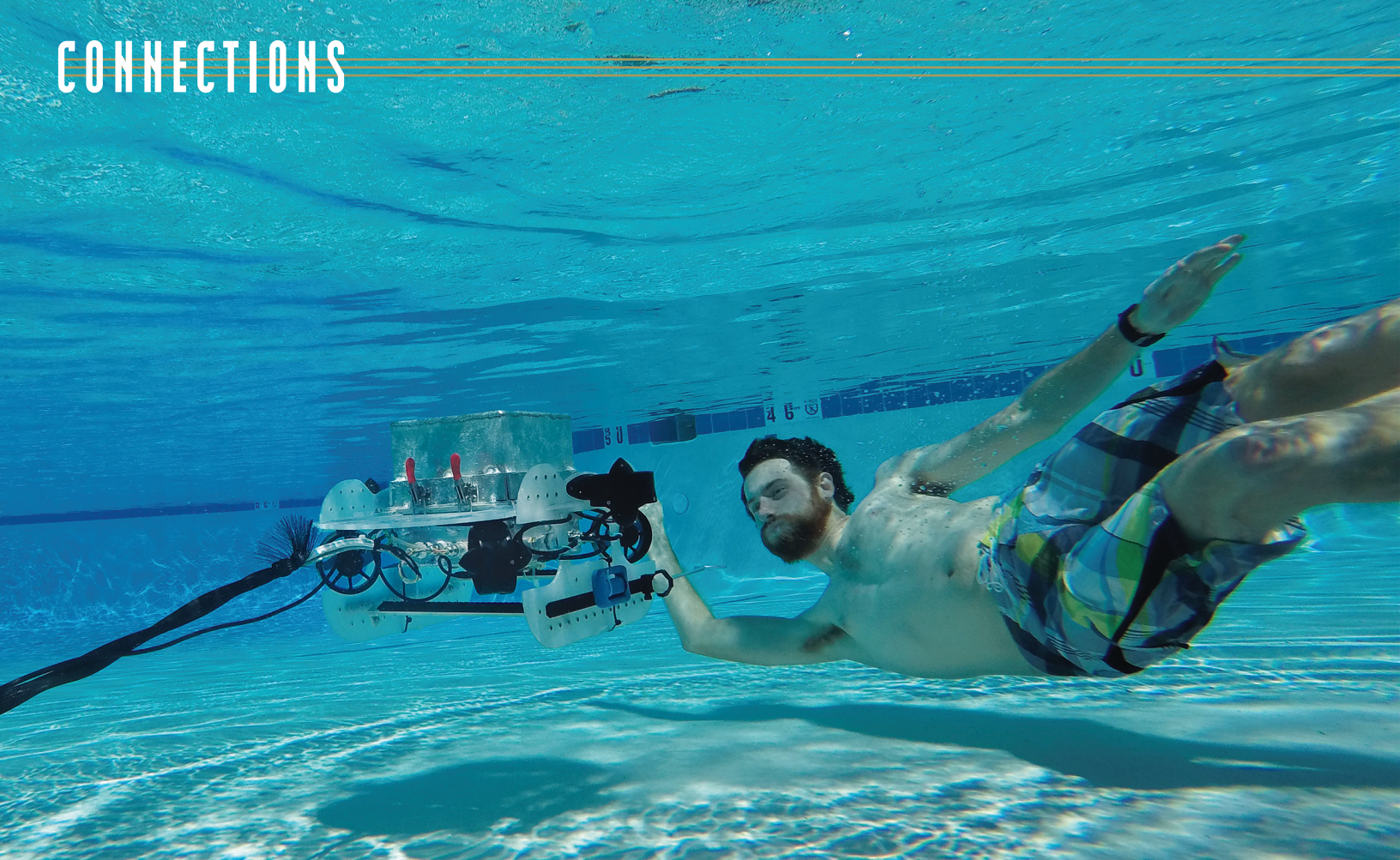


**Electrical Engineering seniors Jesse Carrillo and Torgeir Lindborg built a satellite-tracking ground station that was recently activated by the Cal Poly Amateur Radio Club.**

our club and classroom skills, apply them to this project, and get results. I can only dream of what future students will learn from this station and am proud to leave this legacy behind to be used for many years to come. “

**Related audio link** — <https://soundcloud.com/user-461123072/fo29-fd-w6bhz>





# Underwater Robots

An avid underwater roboticist, Andrew Hostler is shown conducting a full systems dive test at the international Marine Advanced Technology Education competition last year as a member of the Cal Poly Underwater Remotely Operated Vehicle team.

*Electrical Engineering senior introduces undergrads to ROVs — remote operating underwater vehicles*

Remote operating underwater vehicles (ROVs) are an increasingly vital tool in exploring and understanding the underwater environment, with applications that span the spectrum of engineering disciplines. For engineering undergraduate students, however — even at Cal Poly — getting their hands on an ROV for hands-on learning opportunities is no easy feat, primarily due to the cost of the technology.

Last year, **Andrew Hostler**, an electrical engineering senior who had accrued considerable ROV experience as an active member of Cal Poly’s Robotics Club, set about making underwater robotics more accessible to undergraduates. Approaching the challenge as a multifold opportunity, he saw the ROV as the perfect vehicle for introducing new engineering students to the joys of hands-on project

learning, teamwork and expanding their sense of what engineers can do. To that end, he designed an efficient “budget price” ROV, together with an extracurricular workshop taught by upper-division students, to introduce younger students to practical skills in the fields of engineering, robotics and marine technology.

“I started this workshop because I knew that when I was a freshman, I didn’t have much project experience of any kind,” said Hostler. “I didn’t love engineering until I saw what I could do with it, what I could build. I started this class because I wanted to give freshmen a love for building things, and to help them get more project experience on their resume.”

Helping him were mechanical engineering seniors **Joshua Warner**, **Lisa Dischinger** and **Jesse Tamborini**. Together these four upper-





classmen taught robotics design, assembly and testing to freshman and sophomore students in electrical engineering, computer engineering and other engineering majors.

Open to engineering students of any discipline, the course was fast paced. Over the course of 10 weeks, teams of four or five students went from a box of parts to a fully finished underwater remotely operated vehicle. In the process, students learned how to model 3-D designs in Solidworks, make the parts for their design in the machine shop, design and manage their electronics system, and program their robots in Arduino. The course culminated in each team testing its robot's underwater performance in a pool.

"Every team's robot swam successfully," said Hostler. "Most importantly, the students emerged with new confidence in their real-world skills of machining, soldering and programming their individual systems from our template design. So far, 14 students have taken the course and built fully operational ROVs."

Among all the cables and wires, the human connections were among the most valuable to many students.

"I learned a lot and built relationships with upper classmen who can give me advice, now and in the future," said electrical engineering freshman **Mavis Tsoi**.

Hostler agreed: "The students came away from the course with more than a robot in their portfolio. "They had gained new skills and confidence to thrive in Cal Poly Engineering's de-



manding academic and hands-on environment."

This spring, Hostler gave presentations on the making of the low-cost underwater drone and the workshop results. One, "Upper-Division Students Teaching Engineering Skills to Lower-Division Students through Underwater Robotics," was presented with faculty advisor **Bridget Benson** in Tempe, Ariz. at the American Society for Engineering Education Pacific Southwest section meeting. Another paper, "Budget-ROV: An Ultra-Low-Cost Robotics Platform for Education and Research," was presented with Benson and workshop co-teacher Warner at the Oceans Conference in Aberdeen, Scotland, sponsored by the Institute of Electrical and Electronics Engineers (IEEE) Oceanic Engineering Society and the Marine Technology Society. This summer, he worked at Schilling Robotics designing parts for an underwater robot arm that works on oil rigs. He's currently pursuing a blended applied ocean sciences and electrical engineering master's degree at UC San Diego's Scripps Institution of Oceanography, working in the **Jaffe Lab for Underwater Imaging**.

The curriculum for the workshop is open source and available at [HostlerProjects.com/Budge-ROV](http://HostlerProjects.com/Budge-ROV).



Cal Poly undergraduate engineering students work on small underwater vehicles during an extracurricular workshop developed by Andrew Hostler.

## Lynne Slivovsky Among Newest Faculty Fellows to Promote Entrepreneurial Learning

Electrical Engineering Professor **Lynne Slivovsky** is among four Cal Poly faculty members named to the university's Center for Innovation & Entrepreneurship (CIE) Faculty Fellows program, a collaborative and interdisciplinary effort to facilitate and encourage innovation and entrepreneurship across campus.

In addition to Slivovsky, new CIE fellows include Graham Doig, aerospace engineering;

**David Askay**, communication studies; and **Taryn Stanko**, management. They were selected from a pool of 13 applicants to help raise awareness of CIE programs and provide guidance to students and faculty with an interest in innovation and entrepreneurship.



Lynne Slivovsky

The foursome will contribute their varied perspectives and expertise to the startup environment, as reflected in goals that range from Slivovsky's focus on human-centered innovation and design to Doig's interest in the rapidly evolving transportation industry to Askay's accent on societal and environmental challenges and Stanko's using new curricular approaches to build budding entrepreneurs' negotiation skills.

It is the second time an electrical engineering faculty member has been inducted in the program. Slivovsky follows **Dale Dolan**, who was selected in 2014. They are part of a growing cohort that also includes **Bob Crockett**, biomedical engineering; **David Janzen**, computer science; **Enrica Costello**, art and design; **Lorraine Donegan** and **Charmaine Farber**, both graphic communication; **Mary Glick**, journalism; **Brian Granger**, physics; **Clare Olsen**, architecture; **Christiane Schroeter**, agrigusiness; **Umut Toker**, architecture; and **Lynn Metcalf**, marketing.

The CIE Faculty Fellows program grants a yearly stipend to each fellow with the goal of developing entrepreneurial curriculum and research across colleges in partnership with the CIE. Additionally, each fellow will seek to incorporate entrepreneurship into their coursework and encourage entrepreneurial involvement among the university's faculty and students. Each fellow will build on Cal Poly's teacher/scholar model by developing cross-disciplinary programs and research projects that involve students.



# Training young cyber sleuths

*Cal Poly's John Oliver designs a challenge for California's top high school computer science students*

In helping design a statewide high school cyber competition, **John Oliver**, computer engineering professor and program chair, took a page from the "CSI: Crime Scene Investigations" series to show that digital forensics can be as exciting to watch as it is to pursue.

The Cyber Innovation Challenge, hosted June 24-25 by Cal Poly at the new **California Cyber Training Complex** (CCTC) close to campus, featured 16 top teams from regional competitions throughout the state.

New to the competition was a new digital forensics challenge that Oliver helped design, where student teams vied to solve a fictitious criminal case by scouring the crime scene, collecting irrefutable evidence and finding the missing pieces to solve the mystery.

"The Digital Forensics Challenge was much more effective than having students sitting at roomful of computers," said Oliver, who had analyzed a number of events in the new world of high school cyber competitions. "We wanted to avoid passive co-working and create a dynamic of active teamwork, interaction and animated discussions that was as fun to watch as it was to experience."

"I want to excel in this field, and this was an amazing opportunity," said Ameerah Shawbke, 14, who participated as part of an all-girl team from Canyon Springs and Valley View High Schools in the San Jose area.

In another challenge, students took on a mock cybersecurity threat in the workplace. In that scenario, the teams assumed



Cal Poly Computer Engineering Program Chair John Oliver, right, poses with some of the high school students competing in the Cyber Innovation Challenge at Camp San Luis.



the role of information technology professionals tasked with identifying a small company's cyber security vulnerabilities and hardening its operating system while maintaining critical services during a 4-hour period.

"The CCTC is dedicated to developing a future workforce of ethical cybersecurity experts in California," said Oliver. "Engaging high school students in the Cyber Innovation Challenge, and introducing them to the exciting and rewarding opportunities in cybersecurity, is a big step toward realizing that goal."

Other event partners included the Governor's Office of Business and Economic Development and the CyberCalifornia coalition, a collection of businesses, state agencies and educational partners dedicated to reinforcing the state's leadership position in cybersecurity.

## About the California Cyber Training Complex

The California Cyber Training Complex is a new cyber education and training center developed in partnership with Cal Poly, the San Luis Obispo District Attorney's Office, the California National Guard and other statewide partners.

Located at the California National Guard's Camp Sa Luis Obispo, the CCTC houses the Central Coast Cyber Forensics Lab, an academic training facility, and a cyber test range with an experimental laboratory. The complex will serve as a statewide hub, providing a crucial training ground and collaboration space for current and future cyber defenders in California. For more information visit: [cctc.calpoly.edu](http://cctc.calpoly.edu).

## About the Governor's Office of Business and Economic Development (GO-Biz)

The **Governor's Office of Business and Economic Development** (GO-Biz) serves as California's lead entity for economic development and job creation efforts. For more information visit: [business.cal.gov](http://business.cal.gov).

## About CyberCalifornia

CyberCalifornia is a cybersecurity focused public-private partnership created to facilitate research and innovation, educate California businesses about cybersecurity needs and resources, and connect California's robust workforce development system with the needs of California employers. Organized in conjunction with the Innovation Hub (iHub) Network, a program administered by GO-Biz, CyberCalifornia is administered by a board of advisors from the private sector, academia and government, all working to further California's position as a global leader in cybersecurity. For more information visit: [cybercalifornia.biz](http://cybercalifornia.biz).



# Cal Poly Solar Farm to Energize EE Courses



Construction has begun on the Cal Poly Gold Tree Solar Farm located near Highway 1 at the northwestern part of campus. Engineering students, like Timothy Iafate, left, who are interested in renewable energy will benefit from a separate solar engineering lab built on campus near Building 20.

Generating millions of dollars of savings with clean renewable energy, the Cal Poly Gold Tree Solar Farm, which broke ground in late September, also promises to power Learn by Doing opportunities for the College of Engineering.

“The project will incorporate a solar engineering laboratory for students to conduct experiments with solar technology in a hands-on environment,” said **Dennis Elliot**, Cal Poly’s director of energy, utilities and sustainability. “Of course I am excited about how much this project is going to save Cal Poly over its 20-year life, but I’m most excited about the academic applications of both the solar farm and an associated solar engineering lab that will be built on campus.”

Under construction adjacent to Highway 1 on the northwestern edge of the Cal Poly campus, the 18.5-acre solar farm will include more than 16,000 individual solar panels with a capacity of 4.5 megawatts. By generating more than 11 million kilowatt-hours per year, it will provide about 25 percent of Cal Poly’s total needs. REC Solar, founded by Cal Poly graduates in 1997, will build, manage and maintain both the main facility and a separate 30-kilowatt solar engineering lab in the campus core.

Electrical Engineering Professor **Dale Dolan** said the lab would be built near Building 20 and the promise of the facility was clear. “Immediately, the solar engineering lab will be used by students in EE 420 (Sustainable Electric Energy Conversion) and 520 (Solar-Photovoltaic Systems Design) to study solar systems and all aspects of micro-grid technology,” he said.

Dolan said access to all the online data from the solar farm, which is expected to be generating power by the end of this year, would also be invaluable.

“Working with the REC Solar engineers, we will be able to study all of the factors that go into solar energy production like temperature, the angle of the panels, inverter configuration and efficiency and time of year,” Dolan said. “Ideally, it will be completed in time for winter quarter because this new lab will truly benefit all students interested in renewable energy.”

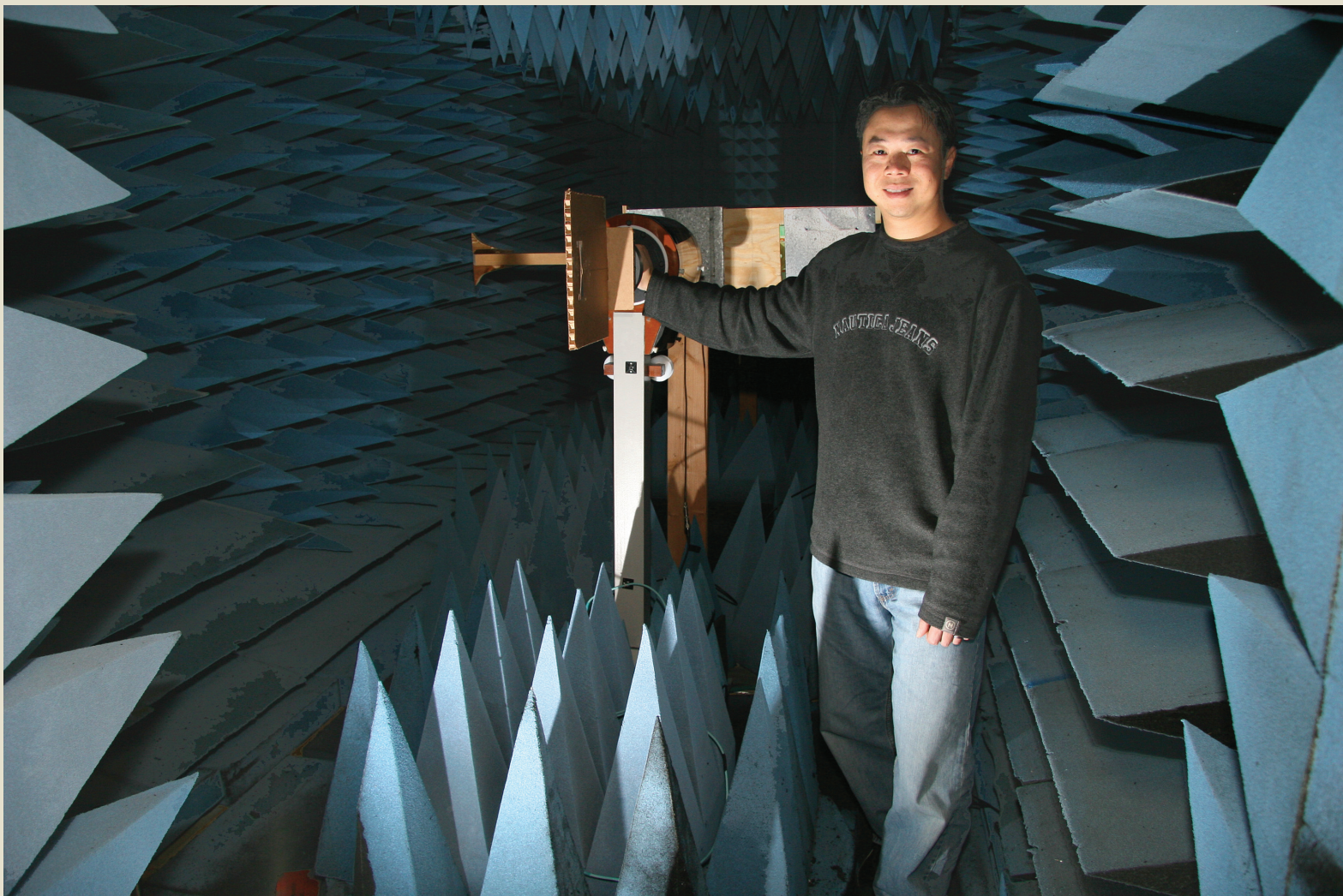
*“This new lab will truly benefit all students interested in renewable energy.”*



# CAL POLY

Electrical Engineering

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As a student, Ray Leung (EE '07) worked in the EE Department's Anchoic Chamber, which is used for studying radio frequency, emissions and antenna reception.

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