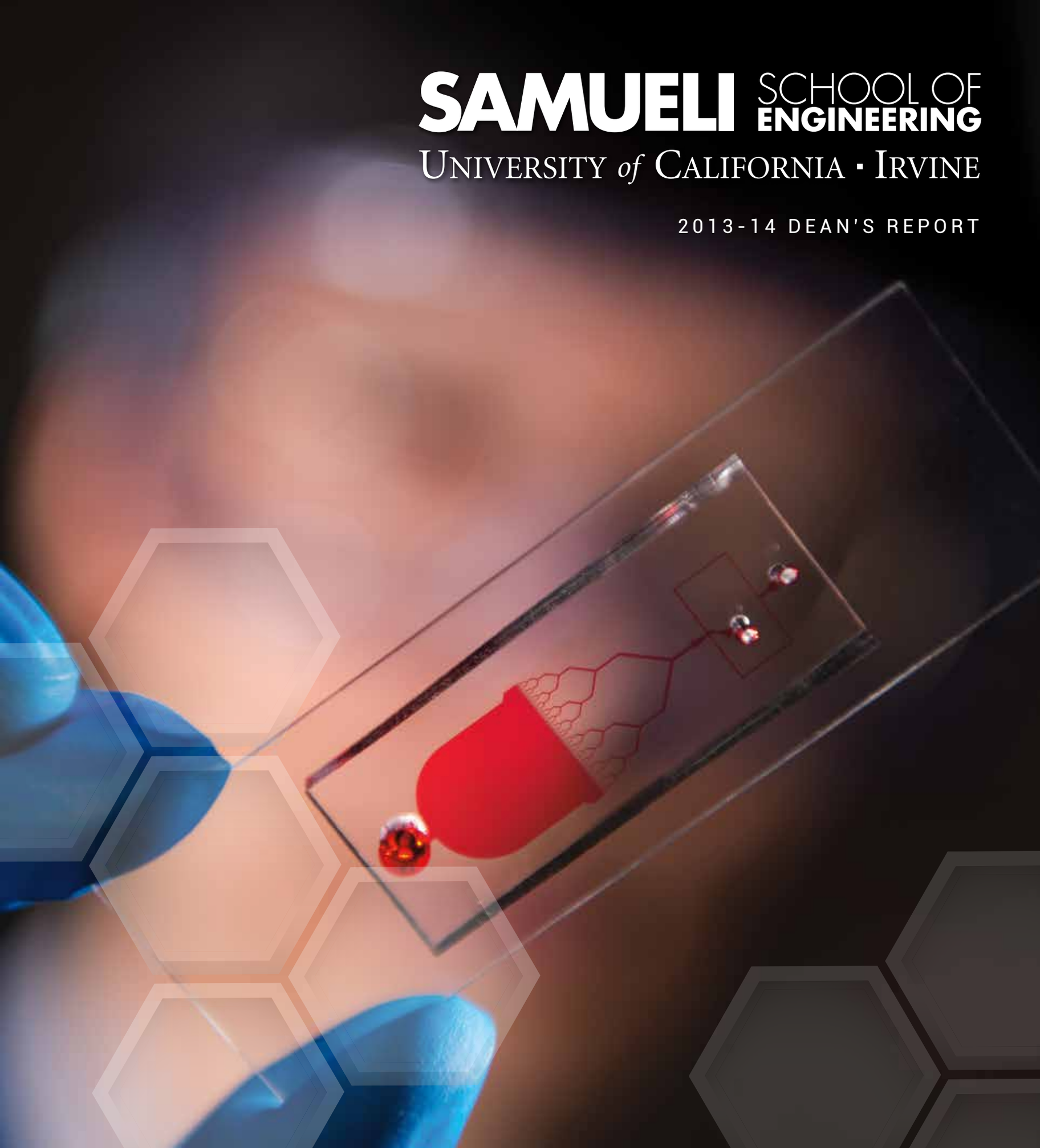
SAMUELI SCHOOL OF ENGINEERING

UNIVERSITY of CALIFORNIA · IRVINE

2013-14 DEAN'S REPORT



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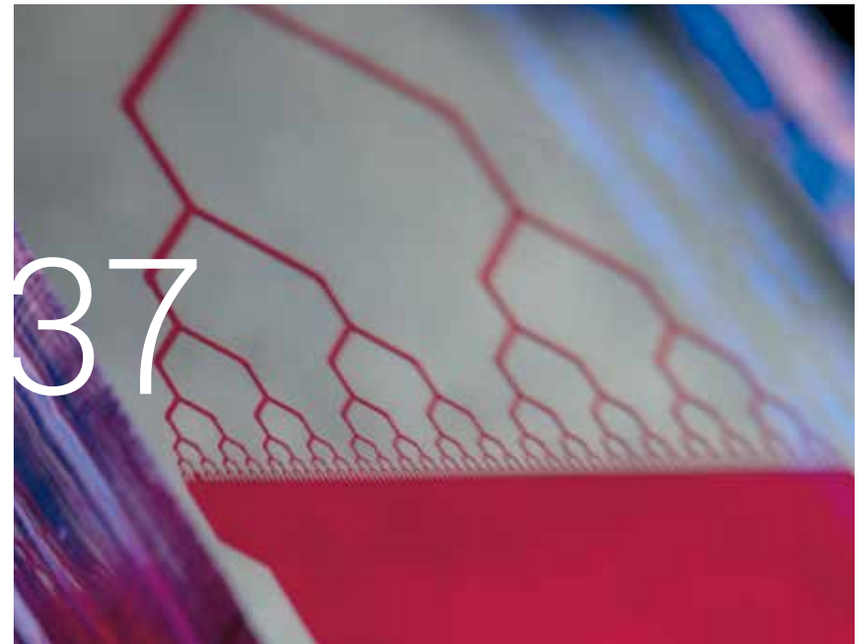

UCIrvine | The Henry Samueli School of Engineering

2013-14 DEAN'S REPORT

The *Dean's Report* is published annually in early fall by the Samueli School's Communications Department.

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COVER: *At the first National Science Foundation Industry/University Cooperative Research Center led by UCI, biomedical engineers at the Samueli School are working with industry partners to develop tools and technology for manufacturing cost-effective, user-friendly microfluidic devices. The center is the sole one of its kind in the country dedicated to microfluidics research. Story, page 37.*

FROM THE DEAN

THE ANTEATER ENGINEERING EXPERIENCE

As I reflect upon the past year, I can clearly see the progress that continues to permeate The Henry Samueli School of Engineering at UC Irvine. I want to take this opportunity to share a few points of pride, which help distinguish the Anteater Engineering experience.

We've just enrolled the smartest, most diverse and one of the largest freshman classes in the school's history: 744 students with the highest-ever average GPA of 4.05. These students will have an opportunity to participate in our freshman experiential learning program, now in its third year. Working in multidisciplinary teams, undergraduates experience real-world product development through planning, research, design, manufacturing and evaluation. The first in the UC system, this program gives UCI students a competitive advantage.

As our student enrollment grows, so too, do our faculty ranks. Seven new engineers will be joining the school in 2014-15, more than half are women and underrepresented. I am equally proud of the many notable Samueli School faculty achievements from this past year. In particular, I would like to congratulate Professor Said Elghobashi for being inducted into the National Academy of Sciences. He spent his entire academic career at UCI and exemplifies what this university is all about. He took a chance when coming here 35 years ago, and he is as much responsible for its success as any senior administrator.

It was with great pleasure this spring that we accepted a $9.5 million gift enabling the Samueli School to engage a more diverse student population. The donation will establish and support school programs that focus on science, technology, engineering and mathematics outreach; fund student scholarships and graduate fellowships; and create an endowed deanship.

In our pursuit of strategic enterprises and novel collaborations, we have formed an unprecedented number of partnerships in the last two years. These include joining with 40 early-stage companies in Orange County through Small Business Innovation Research grants. In addition, we established seven partnerships with large companies through our relatively new Corporate Partners Program.

Closing out the academic year was the highly anticipated speech by President Barack Obama at UCI's 2014 commencement ceremony. The president called out one of our seniors for his unique path to a Samueli School degree and noted several ongoing engineering research efforts for a sustainable environment, including a $2.8 million NSF project addressing rising sea levels.

Looking forward, we will continue to pursue ground-breaking research that is timely, impactful and socially responsible. Building on a strong foundation of fundamental engineering disciplines, we have identified four thrust areas to address today's global complexity. These areas engage a broad spectrum of school faculty, draw researchers from outside of engineering, attract the most talented graduate students, and focus attention and resources on the most important engineering challenges of our times. The 2013-14 Dean's Report illustrates some of our successes in these strategic thrust areas: **communications and information technology, energy and sustainability, human health, and advanced manufacturing and materials.**

Certainly, we can all be proud of our achievements at the Samueli School of Engineering. This past year's progress is due in large part to the contributions of our faculty, staff and students, as well as those from our alumni, industry partners and philanthropic friends. We look forward to furthering our efforts in making the Anteater engineering experience unique. Zot! Zot! Zot!

Gregory Washington
Dean, Samueli School

AT A GLANCE

5 DEPARTMENTS

21st U.S. PUBLIC UNIVERSITY GRADUATE ENGINEERING PROGRAMS RANKING

4.05 AVERAGE GPA OF INCOMING FRESHMEN

12 UNDERGRADUATE MAJORS

FOUNDED IN **1965**

10 GRADUATE PROGRAMS

SEVEN NSF GRADUATE STUDENT RESEARCH FELLOWS IN FY13-14

1,809 AVERAGE SAT SCORE OF INCOMING FRESHMEN

12 RESEARCH CENTERS

SAMUELI SCHOOL OF ENGINEERING
UNIVERSITY of CALIFORNIA • IRVINE

11 NATIONAL ACADEMY MEMBERS

THREE FACULTY NAMED TO 2014 HIGHLY CITED RESEARCHERS LIST

4 FACULTY NAMED IEEE FELLOWS IN FY13-14

898 LARGEST GRADUATE STUDENT ENROLLMENT AT UCI

114 TENURED/TENURE-TRACK FACULTY

3 DISTINGUISHED PROFESSORS

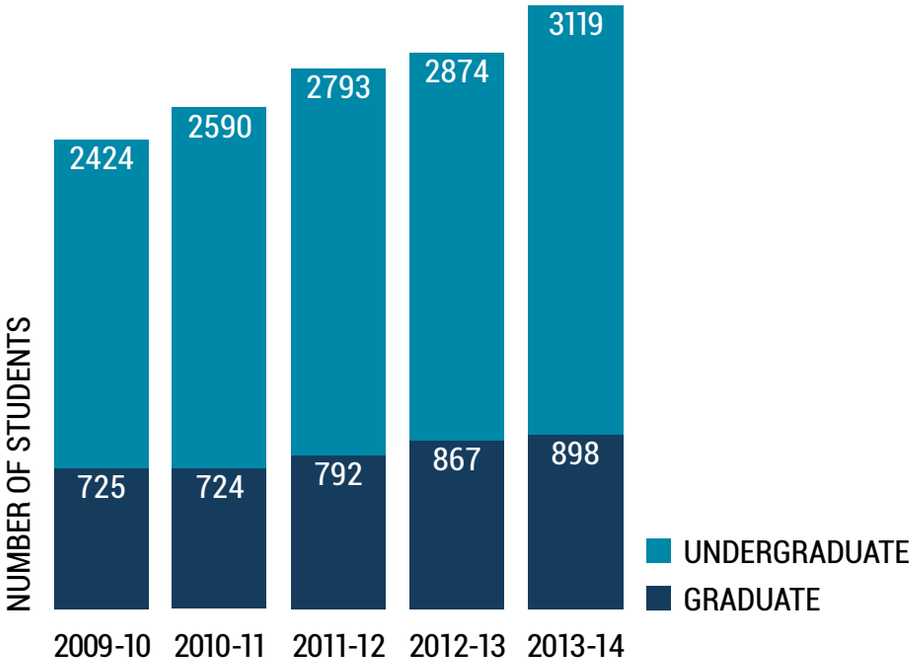
17th IN NATION FOR PERCENTAGE OF WOMEN Ph.D. GRADUATES IN ENGINEERING

16 ENDOWED CHAIRS

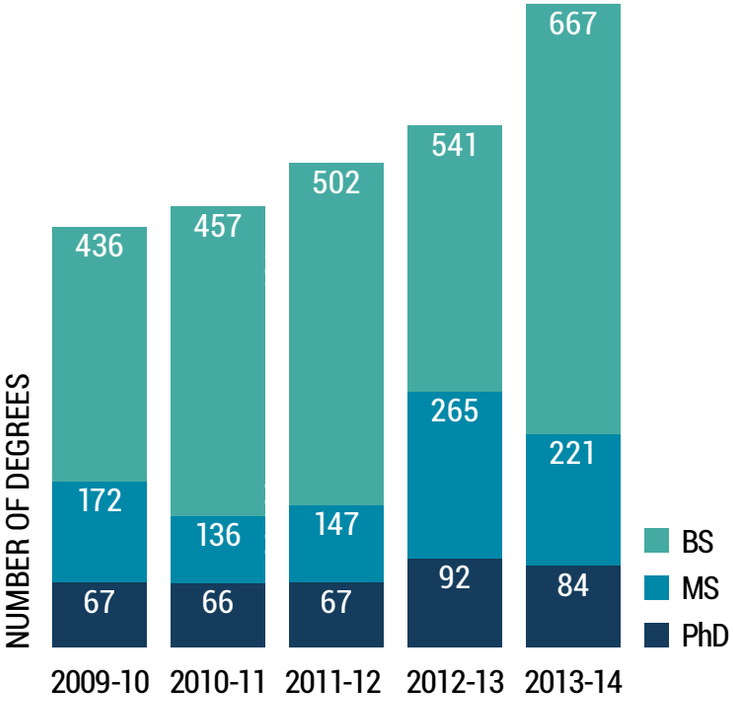
3 CHANCELLOR'S PROFESSORS

U.S. PUBLIC UNIVERSITY UNDERGRADUATE ENGINEERING PROGRAMS RANKING **28th**

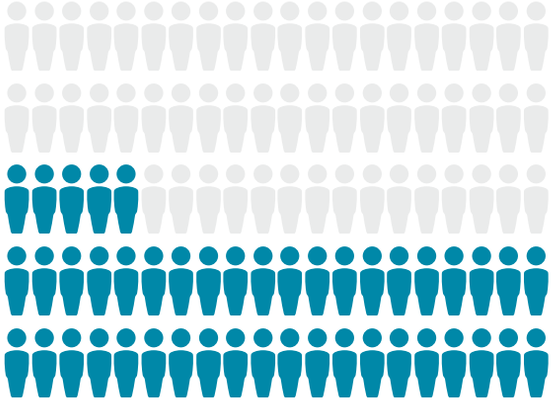
STUDENT ENROLLMENT



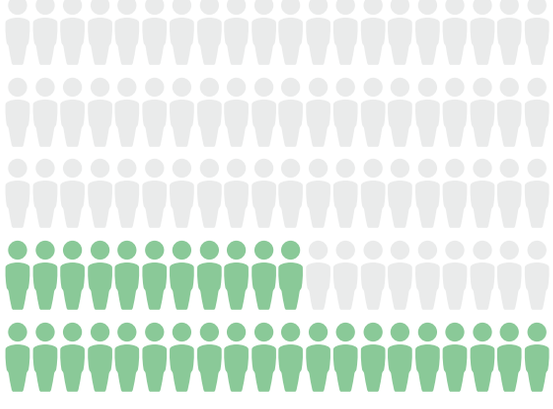
DEGREES GRANTED



INCOMING FRESHMEN

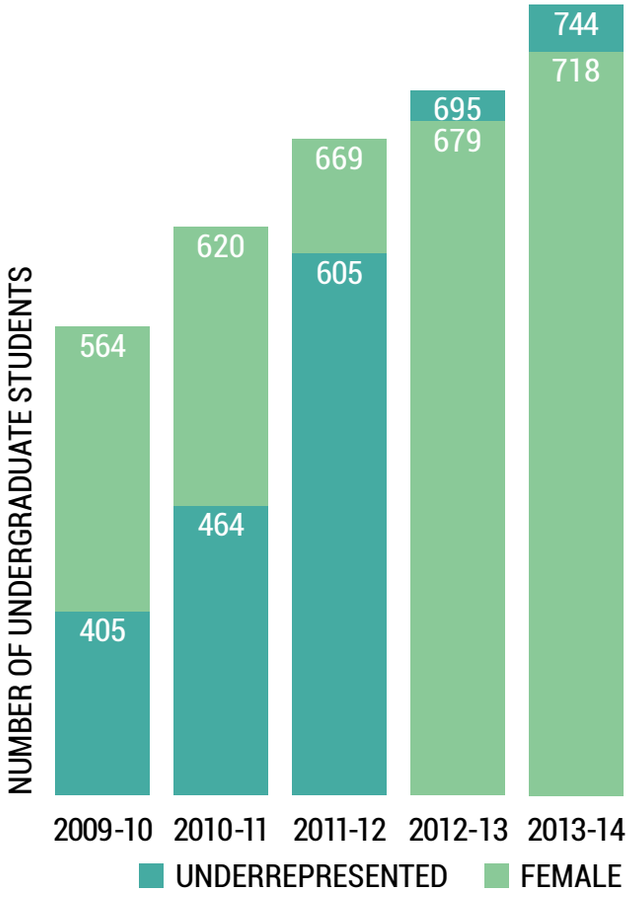


45% FIRST-GENERATION COLLEGE STUDENTS



31% FROM LOW-INCOME FAMILIES

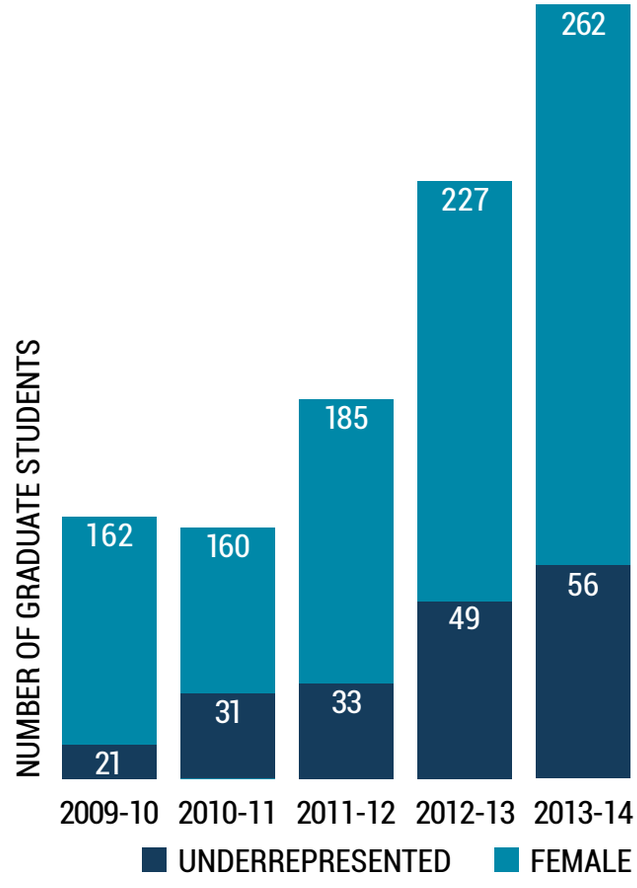
UNDERGRADUATE DIVERSITY



83%
INCREASE IN UNDER-REPRESENTED UNDERGRAD STUDENTS OVER 5 YEARS

27%
INCREASE IN FEMALE UNDERGRAD STUDENTS OVER 5 YEARS

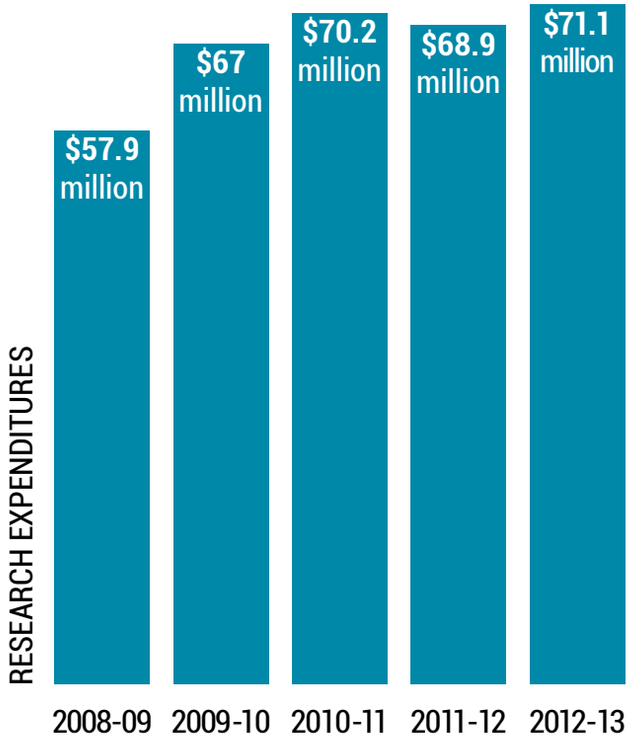
GRADUATE DIVERSITY

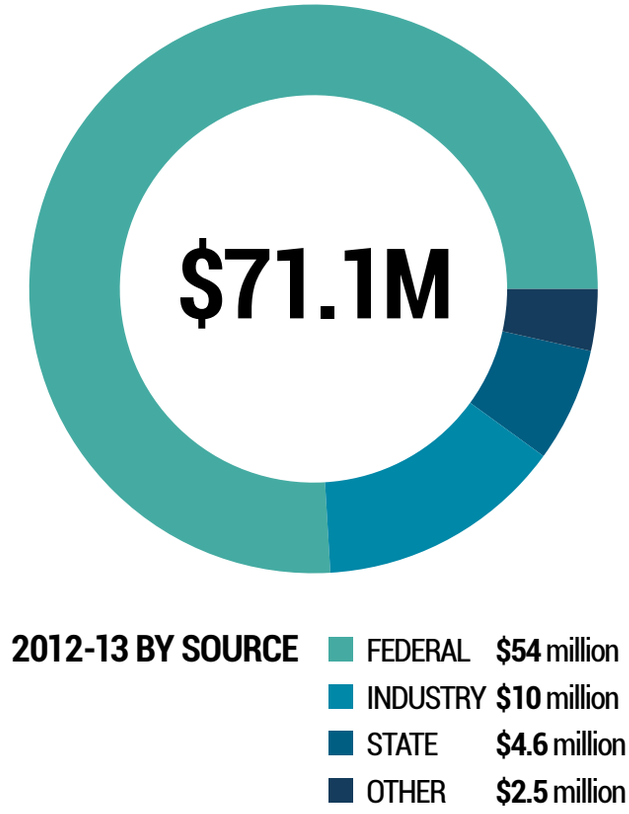


166%
INCREASE IN UNDER-REPRESENTED GRADUATE STUDENTS OVER 5 YEARS

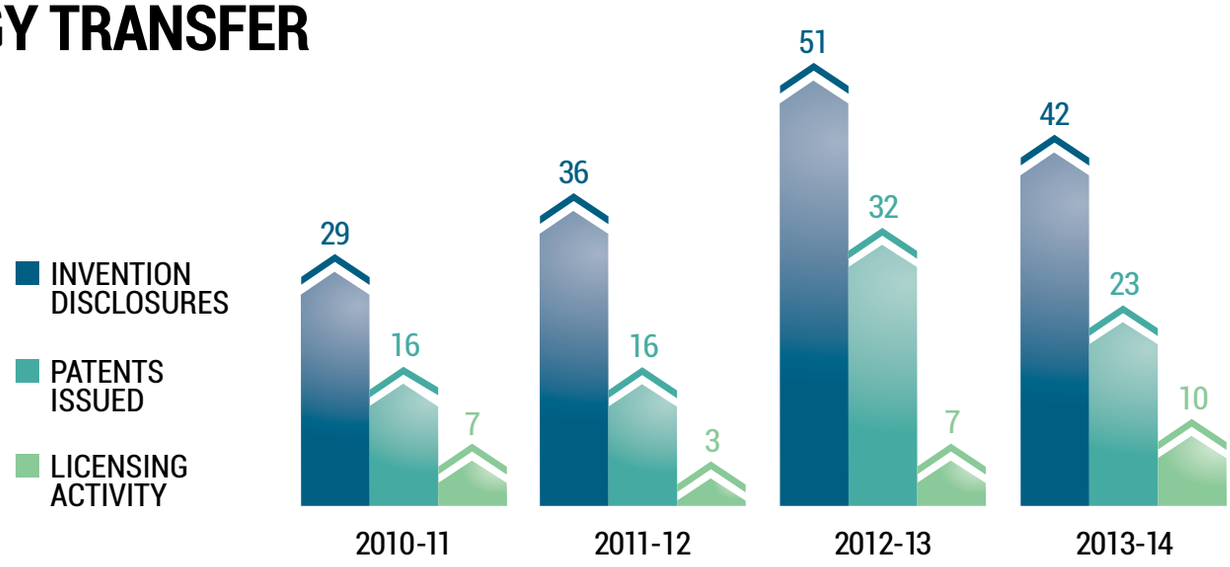
62%
INCREASE IN FEMALE GRADUATE STUDENTS OVER 5 YEARS

RESEARCH EXPENDITURES





TECHNOLOGY TRANSFER



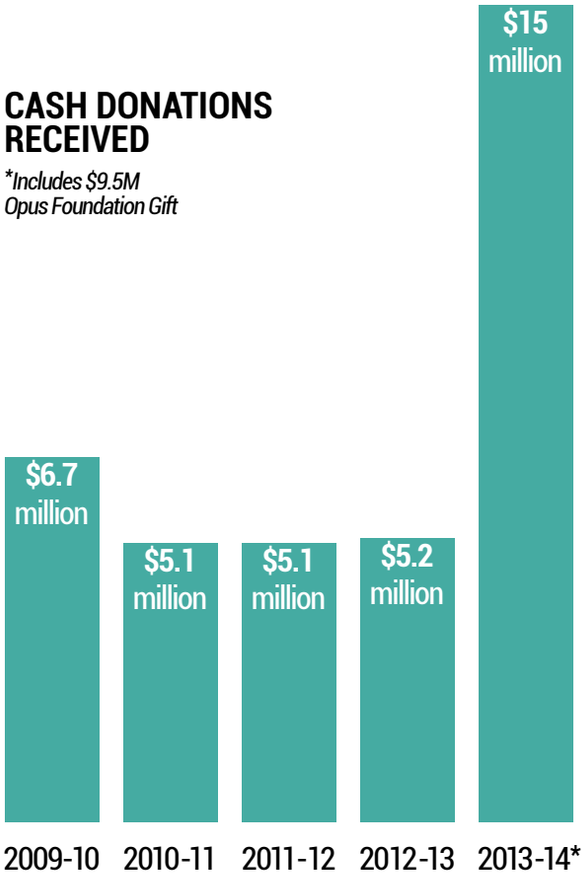
DONOR SUPPORT

2013-14 GIFT SOURCE

- FOUNDATIONS **$12,068,704**
- CORPORATIONS **$3,724,315**
- INDIVIDUALS **$228,827**
- OTHER ORGANIZATIONS **$193,102**
- ALUMNI **$18,988**

CASH DONATIONS RECEIVED

**Includes $9.5M Opus Foundation Gift*



2013-14 GIFT PURPOSE

- DEPARTMENT & PROGRAM SUPPORT **$8,575,993**
- STUDENT SUPPORT **$3,826,167**
- ENDOWED CHAIRS **$2,100,323**
- RESEARCH & INSTRUCTION **$1,651,442**
- EMERGING OPPORTUNITIES **$99,000**

2013-14 MOST NOTABLE

DEREK DUNN-RANKIN

Professor, Mechanical and Aerospace Engineering

2013 Oppenheim Prize, Institute for Dynamics of Explosions and Reactive Systems

For scientific explorations and clarifications on combustion diagnostics, electric field control of flames, sprays and atomization, and miniature combustion systems.

"I am honored, particularly because Professor A.K. Oppenheim, for whom the award is named, was something of a mentor to me from my days at UC Berkeley," says Dunn-Rankin, who is leading a $1M W.M. Keck Foundation grant to build a deep-ocean power science lab. "He was not my formal adviser, but he had a big influence on my career."

SATYA ATLURI

UCI Distinguished Professor, Mechanical and Aerospace Engineering

2014 Corresponding Member of the Academy of Athens, Greece, in the Section of Physical Sciences

For contributions in the areas of aerospace and mechanics.

"It is quite an honor to be inducted into the oldest academy in the world," says Atluri, who was recognized the previous year with India's third-highest civilian award, the Padma Bhushan.

SAID ELGHOBASHI

Professor, Mechanical and Aerospace Engineering

2014 National Academy of Engineering Inductee

For contributions to understanding and modeling of multiphase turbulent flows.

"It's a good feeling to know that your peers have read your work and then voted to bestow this honor," says Elghobashi, who has spent his entire academic career at UCI. "I woke up this morning to about 50 emails from around the world."

H. KUMAR WICKRAMASINGHE

Professor and the Henry Samueli Endowed Chair in Electrical Engineering and Computer Science

2013 Fellow of the National Academy of Inventors

For significant inventions and contributions to the field of nanotechnology and microscopy instrumentation.

"I am humbled and honored to be among this distinguished group of Nobel Laureates and National Medal Prize winners," says Wickramasinghe, who currently holds 94 patents. "The greatest thrill I get is to see some of my inventions translated to practice and in use all over the world."

SOROOSH SOROOSHIAN

UCI Distinguished Professor, Civil and Environmental Engineering

2013 Horton Medal, American Geophysical Union

For his outstanding contributions to hydrology, essentially defining the field of model calibration and shaping the course of its evolution.

"I am humbled by this honor," says Sorooshian, director of UCI's Center for Hydrometeorology and Remote Sensing. "While this wonderful recognition comes to me, it is a shared honor with all my former and current students and collaborators over the past 30 years of my academic career."

LEADERSHIP COUNCIL

The Samueli School of Engineering Dean's Leadership Council is a distinguished group of thought leaders whose industry expertise, community engagement and entrepreneurial endeavors support, inspire and promote the school's vision.

Nicolaos G. Alexopoulos
Broadcom Corp.

Tom Ambrose
Emulex Corp.

James Aralis
Microsemi Corp.

Donald R. Beall
Dartbrook Partners, LLC

Brian R. Bennett
Intel Corp.

Roger Brum
Meggitt Defense Systems, Inc.

Gregory N. Brand
'77 Electrical Engineering
DRS Defense Solutions

William C. Cain
Western Digital Corp.

Mark T. Czaja
Parker Hannifin Corp.

Feyzi Fatehi
Corent Technology, Inc.

Bruce Feuchter
Stradling Yocca Carlson & Rauth

Peter M. Fiacco
Executive Technical Consulting

Dominic Gallello
MSC Software

Robert E. Grant
ALPHAEON Corp.

Raouf Y. Halim
Mindspeed Technologies, Inc.

Michel R. Kamel
MelRok, LLC

Robert A. Kleist
Printronix, Inc.

Leo G. LaForge
Rockwell Collins

William J. Link
Versant Ventures

Wesley D. Motooka
'77 Electrical Engineering
L-3 Communications, Inc.

James Mulato
Astronics Test Systems

Michael A. Mussallem
Edwards Lifesciences Corp.

Stacey Nicholas
Opus Foundation

Daryl G. Pelc
The Boeing Company

Robert J. Phillippy
Newport Corp.

Jane E. Rady
Abbott Medical Optics, Inc.

Leila Rohani
'85 Electrical Engineering
Pacific Mercantile Bank

Stanton J. Rowe
Edwards Lifesciences Corp.

Henry Samueli
Broadcom Corp.

Frederick E. Schreiner
Thales Avionics, Inc.

Paul N. Singarella
Latham & Watkins, LLP

Gerald R. Solomon
Samueli Foundation

James P. Spoto
Sunrise Micro Devices, Inc.

Vincent L. Thomas
Rockwell Collins

John J. Tracy
Ph.D. '87 Civil Engineering
The Boeing Company

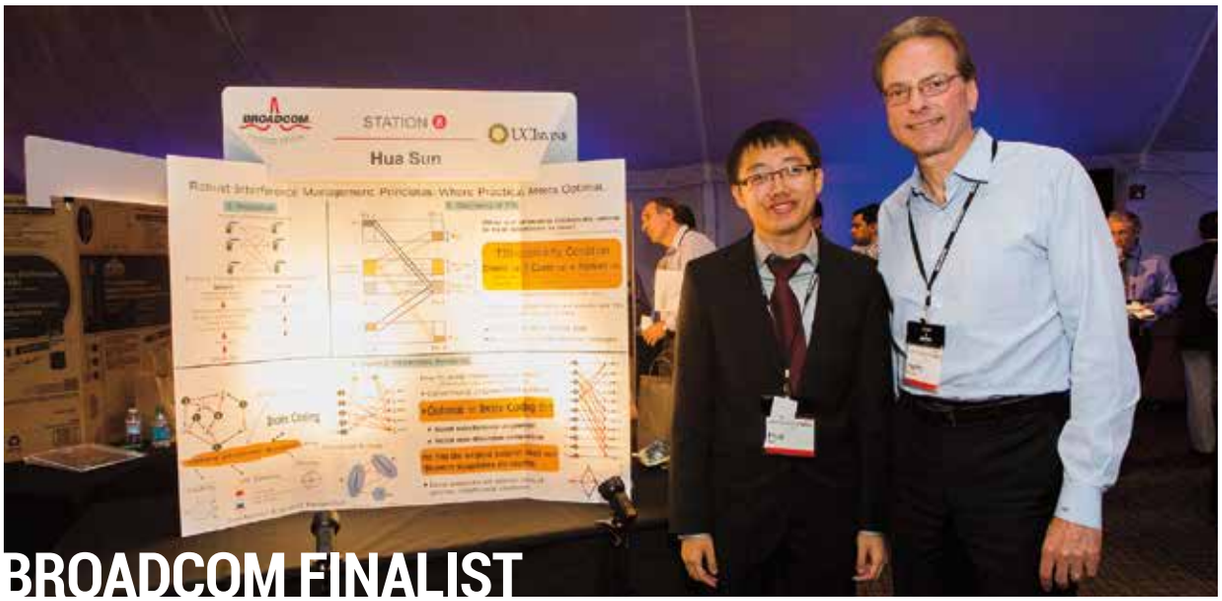
Truc Q. Vu
M.S. '88, Ph.D. '92 Electrical Engineering
Microsemi Corp.

Ruben Zadoyan
Newport Corp.

COMMUNICATIONS AND INFORMATION TECHNOLOGY

The world is becoming an increasingly connected place, not just connections among people, but between people and devices, and amid the devices themselves. Computer systems are ubiquitously embedded, and wireless communication is now a commodity. At the Samueli School of Engineering, faculty conduct leading-edge interdisciplinary research in embedded systems, emphasizing automotive, communications and medical applications; technologies for next-generation (5G) wireless systems; advanced communication algorithms and techniques for increasing capacity and reducing interference in wireless networks; and promoting technology and knowledge transfer for the benefit of the individual and society.

NOTEWORTHY



BROADCOM FINALIST

Graduate student Hua Sun presented his work on how to provide efficient, reliable wireless networks in the future at the annual Broadcom Foundation University Research Competition. Sun, who's seeking a Ph.D. in electrical engineering, was among 12 student finalists from 11 universities competing in a poster session. More than 400 distinguished engineers judged the entries. "This competition, spearheaded by Broadcom co-founder Henry Samueli, celebrates academic excellence and social awareness among students who perform extraordinary research at the doctoral level," says Paula Golden, executive director of the foundation. "The intellectual power of the finalists, who come from universities across the world, is profound, and we are honored to have them compete."

SEMINAL PAPER

UCI Chancellor's Professor Hamid Jafarkhani received the IEEE Communications Society Award for Advances in Communication. The award is given to an outstanding paper that opens new lines of work, envisions bold approaches to communications, formulates new problems to solve and essentially enlarges the field of communications engineering. Jafarkhani's paper, published in 1999, described his research on space-time block coding, a technique used today in wireless communications systems. Jafarkhani was working at AT&T Labs when he and his colleagues established the space-time block coding concept and showed how to design codes for a wireless communications system with multiple antennas, such as Wi-Fi. Today, space-time block coding is a well-established field in communications, actively researched and widely used. This paper has been cited more than 1,000 times.

3

CHANCELLOR'S PROFESSORS IN THE SAMUELI SCHOOL

126

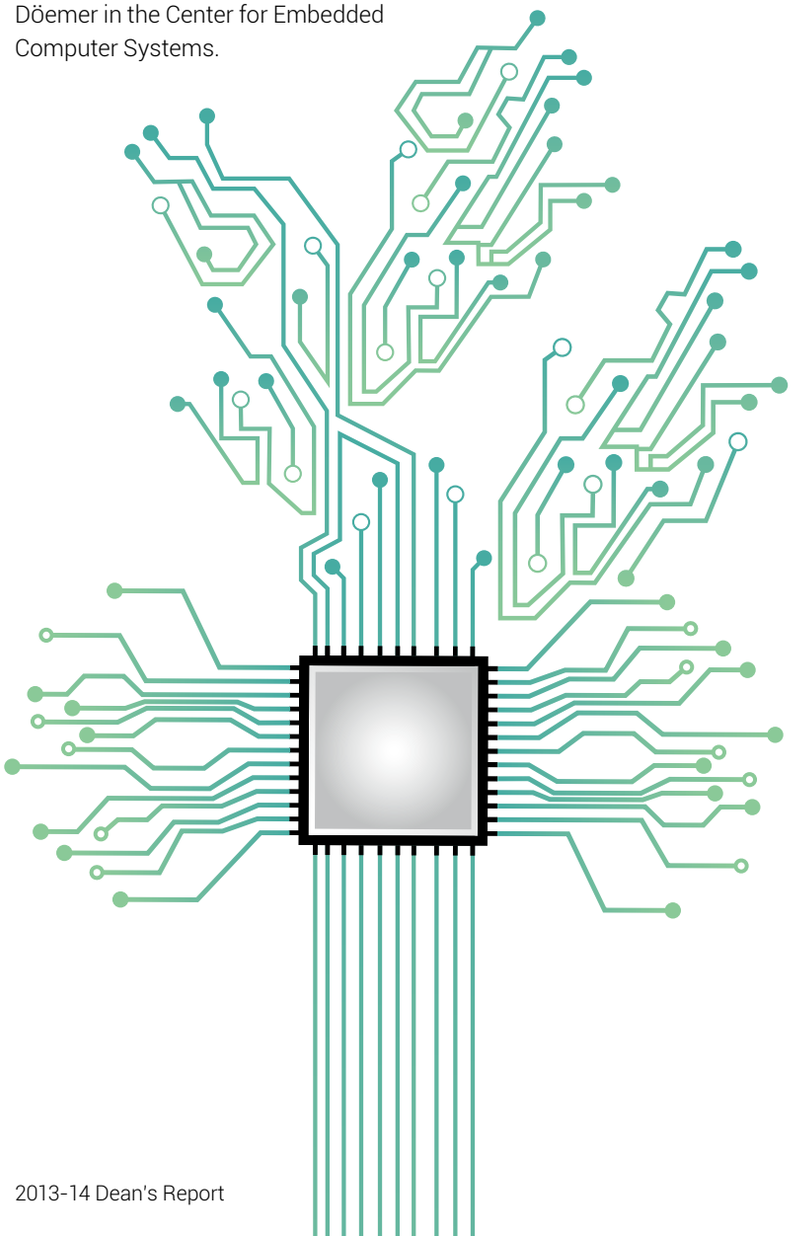
THE NUMBER OF EARLY CAREER SCIENTISTS IN NORTH AMERICA SELECTED ANNUALLY AS SLOAN FELLOWS

SLOAN FELLOW

Anima Anandkumar, an assistant professor of electrical engineering and computer science, was awarded a 2014 Sloan Research Fellowship for her work at the interface of theory and practice of large-scale machine learning and high-dimensional statistics. Bestowed annually since 1955 by the Alfred P. Sloan Foundation, the two-year fellowships go to scholars in the U.S. and Canada whose achievements and potential identify them as the next generation of scientific leaders. Fellows, who are nominated by their peers, receive $50,000 to further their work.

BEST AT DATE

Engineering professor Rainer Döemer won a Best Paper Award at the 2014 Design, Automation and Test in Europe (DATE) conference. The DATE meeting and exhibition bring together designers and design automation users, researchers and vendors, as well as specialists in the hardware and software design, test and manufacture of electronic circuits and systems. Döemer's paper, "May-Happen-in-Parallel Analysis based on Segment Graphs for Safe ESL Models," was selected out of a record number of more than 1,000 submissions. At the same conference, Samueli alumna Weiwei Chen received the Outstanding Dissertation Award. Chen earned her doctorate from UCI in 2013. Her dissertation topic was "Out-of-Order Parallel Simulation for Electronic System-Level Design." She worked under the guidance of Döemer in the Center for Embedded Computer Systems.



MARCONI SOCIETY YOUNG SCHOLAR

Graduate student Salvatore Campione was named a 2013 Marconi Society Paul Baran Young Scholar. The award is given each year to scholars age 27 or younger who have demonstrated exceptional engineering or scientific research. Campione is one of just three young researchers around the world to receive the honor this year.

An electrical engineering and computer scientist in Associate Professor Filippo Capolino's research group, Campione collaborates with a number of researchers worldwide on applying electromagnetics to nanostructures, nano-antennas, plasmonics, and metamaterials and their characterization. His research has possible applications in such fields as medical diagnostics, solar cells, molecular sensors, imaging systems, generation of coherent light sources and next-generation optoelectronic devices.

20+
PEER-REVIEWED JOURNAL ARTICLES

40+
CONFERENCE ARTICLES

2
BOOK CHAPTERS

→ **PENNED BY CAMPIONE**

ENGINEER BLENDS EXPERTISE TO IMPROVE NETWORK SOLUTIONS

PRACTICAL & THEORETICAL

BY ANNA LYNN SPITZER

(From left) Markopoulou, Le and Matijasevic explored the marketability of the Microcast project through an I-Corps grant; the project later was spun off into Shoelace Wireless.

Timing is everything – or at least for Athina Markopoulou, it was fundamental in shaping a crucial career decision.

The childhood math geek, whose parents were both math teachers, began her university studies at National Technical University of Athens in her native Greece, at around the same time the Internet was taking baby steps toward its eventual ascent to ubiquity. Technology cast its bright spell on the eager student. "At the time, engineering felt like a more happening place to be than a math department," she says of her decision to study electrical engineering and computer science.

A decade later, armed with master's and doctoral degrees from Stanford University, Markopoulou dabbled at a Silicon Valley startup and a research lab before joining the faculty at UC Irvine. Today, the computer engineer's research on networked systems contributes to a technology revolution that continues evolving at warp speed. Her original areas of emphasis – voice- and video-over-IP, network measurements and security, cross-layer optimization and network coding – continue to evolve as well, with a current focus on mobile devices and social networks.

"Today when we say mobile, we think smartphones, but that's changing fast," Markopoulou says. "There are a lot of smart wearables coming," including watches, Google Glass, fitness trackers and assorted sensorized devices; all are mini computers with challenges and opportunities somewhat different from desktops or laptops. "These devices all have networks and the ability to connect with each other, and can do more in groups and connected to the cloud than they can do alone."

Markopoulou's dual-pronged research thrust encompasses both engineering systems and software development for improving network security and performance; and data analysis, which can yield important clues about user behavior.

Much of her recent work has focused on measuring and analyzing network traffic patterns. Network data – including those from mobile and social networks – provide insight into commuting patterns, use of urban environments, power or cell tower outages, neighborhood characteristics and community ties, as well as evidence of malicious code or nascent security attacks. The data are useful for city planning and engineering; they can be used to head off potential problems as well.

Markopoulou is equally passionate about the engineering and software development aspects of her work. "We're trying to improve network speed in mobile devices, help devices cooperate with each other and build applications that people can use," she says.

Combining practical and theoretical approaches appeals to her. "I have my foot in both the engineering side and the data analysis side; it's a good combination," she says. "The things I do are application-specific, and I think the combination is more powerful than either one is by itself."

Her efforts led to this year's Samueli School's Mid-Career Faculty Research Excellence Award. Markopoulou is a senior member of the IEEE and an associate editor for IEEE/ACM Transactions on Networking, and she currently serves as the director of UCI's Graduate Program in Networked Systems. The joint effort between the Samueli School and the Bren School of Information and Computer Sciences bridges the academic gap between the two disciplines. "This program is dear to my heart and these are exactly the students I want to recruit and train," she says.

As determined a fundraiser as she is a researcher, Markopoulou has raised $5.6 as a PI or co-PI, of which $3 million was for her own work. This includes an NSF CAREER award in 2008, and a joint $2 million NSF Cyber-enabled Discovery and Innovation (CDI) grant in 2010 for research spanning computer engineering, biology and sociology. Recently, she and PI Brian Demsky, a fellow computer engineer, received a joint $1.2 million to improve network security by combining program and network analysis.

Sociology professor Carter Butts, a collaborator on the CDI grant, calls her "tough, sharp and no-nonsense," as well as generous and fun-loving. "She combines creative and rigorous science with an engineer's pragmatism, creating technologies that address important real-world problems."

WON FIRST PLACE IN THE NATIONWIDE HELLENIC OLYMPIADS IN MATHEMATICS AT AGE 14

RECEIVED THE 2008 NSF CAREEER AWARD

AWARDED A $2-MILLION NSF CYBER-ENABLED DISCOVERY AND INNOVATION GRANT IN 2010

RAISED $5.6 MILLION AS PI OR CO-PI

WON NSF INNOVATION CORPS GRANT IN 2012

RECEIVED A $150,000 PHASE 1 SBIR GRANT FOR STARTUP SHOELACE WIRELESS

In 2012, an NSF Innovation Corps (I-Corps) grant presented her team with a new challenge: exploring the marketability of an ongoing project. "Microcast" enables mobile devices near each other to share their network connections, aggregate their bandwidth and download content much faster. The researchers spun the project off last year as startup company Shoelace Wireless.

Senior Assistant Vice Chancellor for Alumni and Constituent Relations Goran Matijasevic, who's also executive director of UCI's Chief Executive Roundtable, mentored the Microcast team during its intensive six-week I-Corps program. "I admire Athina's technical brilliance and entrepreneurial spirit," he says, "but also her willingness to learn new things. These characteristics have contributed to her success so far and will make her even more successful in the future."

Shoelace, named for its ability to tie mobile devices together, is headquartered in the Calit2 TechPortal incubator on the UCI campus. Its mobile app, VideoBee, has attracted more than 20,000 users. The company also launched a software development kit for licensing so companies can build the app into their products.

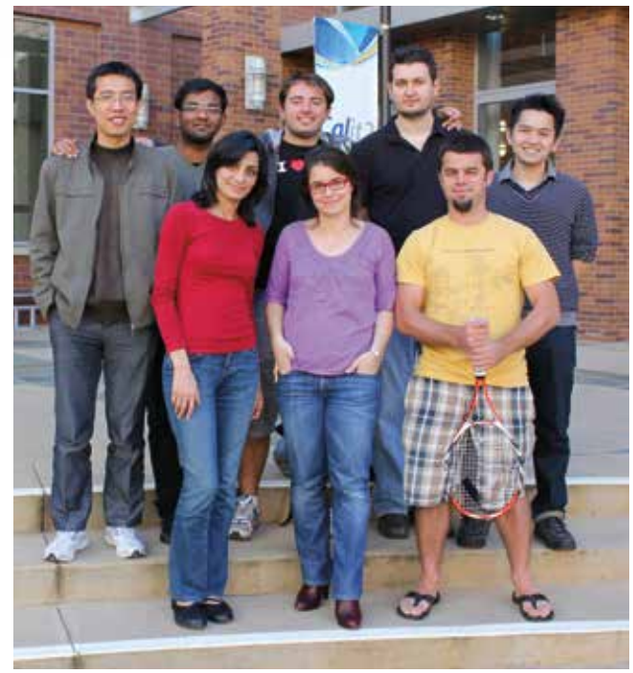
Shoelace, which was awarded NSF SBIR Phase I funding, recently hired a former Samsung executive as company CEO.

Anh Le, a former postdoc in Markopoulou's group, serves as Shoelace's chief technology officer. "Athina has great research vision, execution and delivery," he says. "She is very good at identifying great collaborators and giving them the best environment and support to perform."

In the process, she also found a way to tie together her own interests. "I like the practical aspect of building things that people can use but I also like the analytical side; you can model these networks with graphs or use different analytical tools to analyze their performance," she says. "I am lucky that I get the opportunity to do both;I can have some practical impact and I have fun doing some math along the way."

Spoken like a true math-whiz-turned-engineer.

Below: Markopoulou credits her team with much of her funding success. "After we built critical mass in the group, things just seemed to happen on their own."



"WE'RE TRYING TO IMPROVE NETWORK SPEED IN MOBILE DEVICES, HELP DEVICES COOPERATE WITH EACH OTHER AND BUILD APPLICATIONS THAT PEOPLE CAN USE."

ENERGY AND SUSTAINABILITY

The push for sustainable sources of energy sits at the forefront of the nation's scientific and engineering priorities. From new and reliable processes for electricity and alternative fuels to critical water and waste management solutions, meeting the needs of a growing world population in an environmentally sustainable way is a major challenge. The Samueli School of Engineering is a world-recognized leader in green technologies, with engineers investigating a number of energy-related topics including combustion, fuel cells, alternative fuel sources, the smart grid and electric vehicles. Researchers are also looking at the water-energy nexus for urban areas, enhancing efficient use of water resources and protecting our oceans, lakes and streams.

NOTEWORTHY

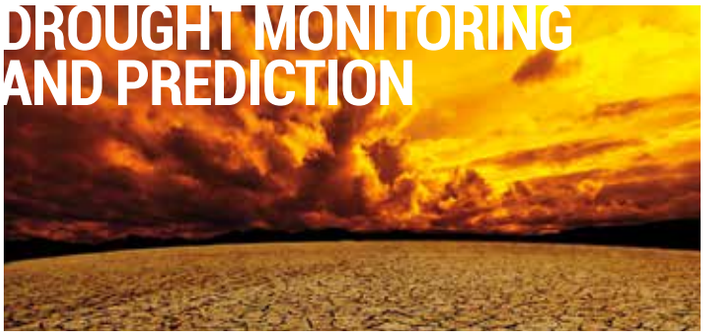
RISING WATERS

UCI researchers received a $2.8 million NSF award for their Flood-Resilient Infrastructure & Sustainable Environments – or FloodRISE – project. The aim of the four-year interdisciplinary effort is to help communities along the California coast and Tijuana River Estuary better understand and cope with rising waters and stronger storms from climate change. Civil & environmental engineering chair and professor Brett Sanders had the idea to provide the public with more precise risk estimates rather than overly broad or outdated FEMA maps. He teamed up with Richard Matthew, UCI professor of planning, policy & design, and they devised a strategy to develop climate-related flood models on a house-by-house basis, to inform potentially affected residents and local policymakers without panicking them and to help with possible solutions, from building higher seawalls to relocating if necessary.

"We're working to help communities manage risk. Engineers spend considerable time developing models of flooding, but we need to do a better job communicating the results," Sanders says. "Every community has different demographics, different economics, different factors of so many kinds. Standard engineering courses offer highly specialized skills for hydrologic analysis, and FloodRISE broadens that context to also offer something very valuable to real people."

$71.1 million

SAMUELI SCHOOL'S TOTAL RESEARCH EXPENDITURES IN FY12-13



Samueli School civil and environmental engineering researchers have introduced the Global Integrated Drought Monitoring and Prediction System (GIDMaPS) that could help farmers, commodity investors, local governments and global relief organizations react to drought. The system provides meteorological and agricultural drought information based on multiple satellite- and model-based precipitation and soil moisture data sets. The researchers published the work in Scientific Data. Developed by Assistant Professor Amir AghaKouchak's team, the GIDMaPS data significantly extends current capabilities of drought assessment systems. The GIDMaPS' seasonal forecast gives essential information for users to receive early warning of drought, enabling them to take preventive measures and plan mitigation strategies.

TEAM ORANGE COUNTY

UCI and three fellow Orange County campuses will compete in the U.S. Department of Energy's Solar Decathlon 2015, the international student competition to design and build the best solar-powered home. Chapman University, Irvine Valley College and Saddleback College will join UCI as Team Orange County to create a residence that reflects the traits of the drought-resistant, sun-loving California poppy. U.S. Deputy Secretary of Energy Daniel Poneman visited UCI in February to announce the 20 teams selected to compete in October 2015 at the Orange County Great Park in Irvine. Teams from colleges and universities across the country and around the world have begun the nearly two-year process of building solar-powered houses that are affordable, innovative and highly energy-efficient. Team Orange County is being led by UCI's mechanical and aerospace engineering graduate student Alex McDonald.

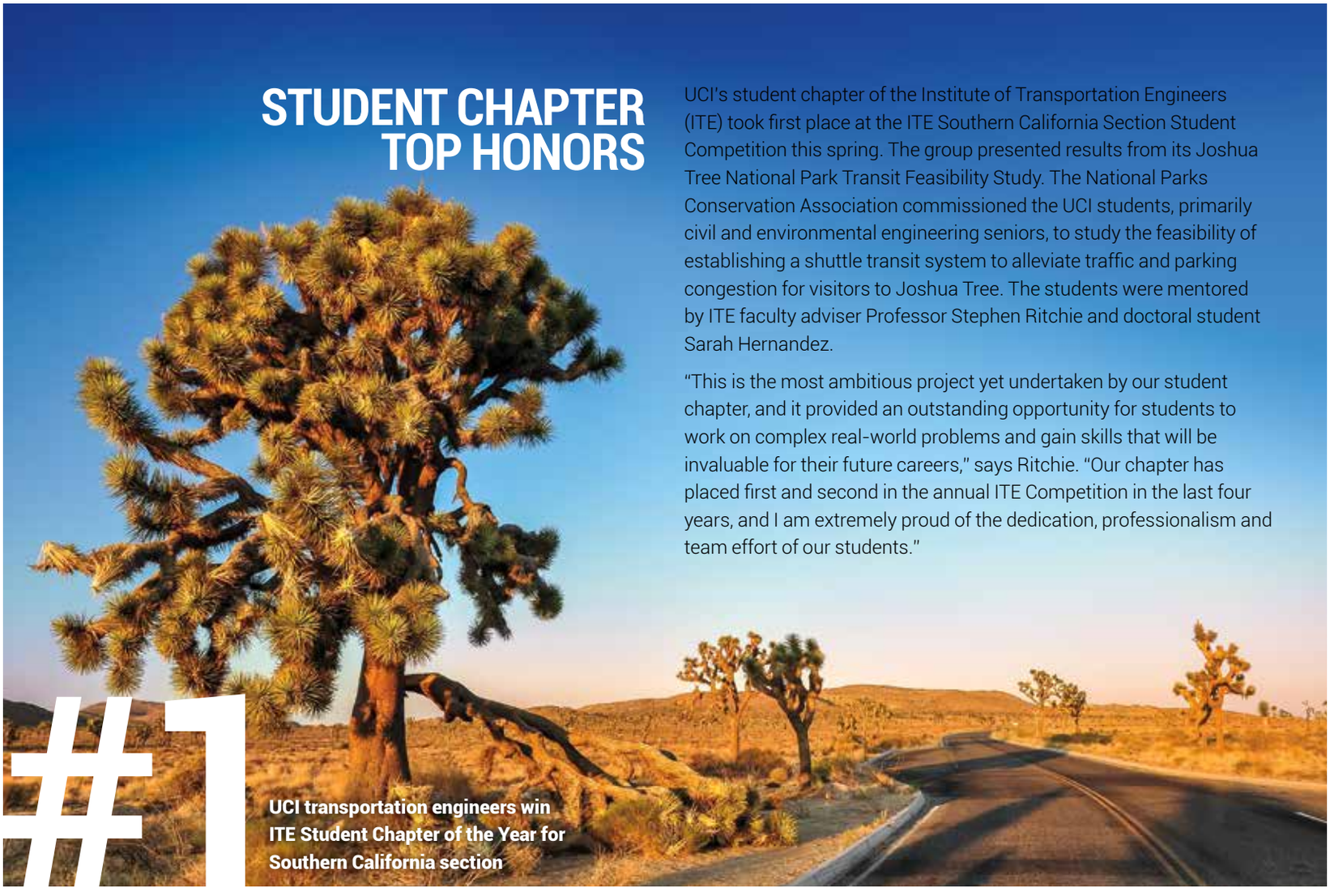
1st
TIME UCI HAS COMPETED IN
THE U.S. D.O.E. SOLAR DECATHLON

FULBRIGHT RECIPIENT

Dustin McLarty, a postdoctoral researcher in the engineering school's Advanced Power and Energy Program, will take what he's learned working on UCI's micro-grid power supply to Italy, on a Fulbright scholarship.

"UCI has one of the most cutting edge micro-grids in the world," says McLarty. "It provides the campus electricity, cooling and heating with close to 99 percent self-generated power; almost none of the energy is coming from Southern California Edison."

A micro-grid is a similar but smaller version of the traditional power grid and consists of power generation, distribution and controls such as voltage regulation and switch gears. Micro-grids integrate renewable sources of energy such as solar, wind power, hydrology, geothermal, waste-to-energy and combined heat and power systems. They can operate on their own or be connected to the traditional grid, and they have a closer proximity between the power generation and the power user. UCI's micro-grid integrates solar, fuel cell, thermal and natural gas to serve the campus's needs. With the Fulbright scholarship, McLarty will spend four months at the University of Genoa, working in its energy research laboratory.



STUDENT CHAPTER TOP HONORS

UCI's student chapter of the Institute of Transportation Engineers (ITE) took first place at the ITE Southern California Section Student Competition this spring. The group presented results from its Joshua Tree National Park Transit Feasibility Study. The National Parks Conservation Association commissioned the UCI students, primarily civil and environmental engineering seniors, to study the feasibility of establishing a shuttle transit system to alleviate traffic and parking congestion for visitors to Joshua Tree. The students were mentored by ITE faculty adviser Professor Stephen Ritchie and doctoral student Sarah Hernandez.

"This is the most ambitious project yet undertaken by our student chapter, and it provided an outstanding opportunity for students to work on complex real-world problems and gain skills that will be invaluable for their future careers," says Ritchie. "Our chapter has placed first and second in the annual ITE Competition in the last four years, and I am extremely proud of the dedication, professionalism and team effort of our students."

#1

UCI transportation engineers win ITE Student Chapter of the Year for Southern California section

CALIFORNIA CHALLENGE

Students from across the nation competed in the first-ever California Challenge hosted by the Samueli School of Engineering last fall. High school and university teams tested their skills in designing and building electric and alternative-fuel vehicles from scratch. Cars powered by methane and electricity – as well as those with efficient gas engines – participated in the two-day event, which ran in conjunction with the U.S. Department of Energy's Solar Decathlon at the Orange County Great Park in Irvine. A custom built racetrack included a high-speed section, auto-cross section and a staged idle section. The challenge: to go as far as they could on the course in one hour on $1 worth of energy. UCI's Delta took overall top honors, while a team from California State University, Northridge, earned best vehicle design.

GATES FOUNDATION GRANT

The Samueli School received a $100,000 Grand Challenges Explorations grant from the Bill & Melinda Gates Foundation for developing a solar stove that enables carbon-emissions-free cooking. The Grand Challenges Explorations initiative is intended to foster outside-the-box solutions to persistent global health and development issues. The stored-energy solar stove was initially designed by a group of senior mechanical engineering students at UCI. It permits carbon-emissions-free cooking indoors and at night, which not only reduces deforestation, labor time and safety concerns for women who leave their villages to gather firewood, but also pollutes indoor air far less than the traditional in-home cooking methods currently employed in developing countries. The technology has gone through two design iterations and, with this grant, will be further refined by a new group of senior engineering students.

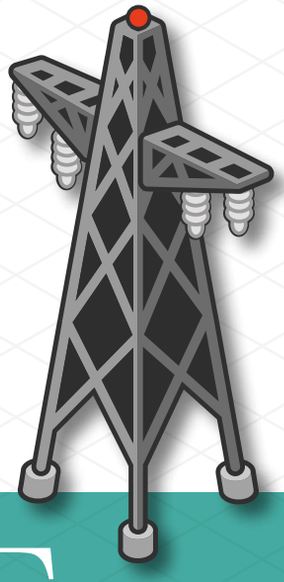
"What this grant money allows us to do is continue working on an effective thermal mechanical design to create a solution to an important global health and environmental degradation problem," says Professor Derek Dunn-Rankin, principal investigator for the project.

$12 million

SAMUELI SCHOOL'S TOTAL AWARDS FROM FOUNDATIONS IN FY13-14

PRESIDENTIAL SCHOLARSHIP

Jose Ramos, a senior in civil engineering, received a Semester at Sea Presidential Scholarship. Ramos is one of only three students selected from a pool of 120 applicants. The award, which covers full tuition, room and board for the shipboard program, was developed to identify and support extremely high-achieving students who wish to enhance their perspective and better understand their vital role as global citizens. Ramos embarked on his journey last September and sailed to Germany, Belgium, Ireland, Morocco, South Africa, Argentina, Brazil, Cuba and Florida. He studied what strategies and technological innovations ports around the world are using to address such environmental issues as air, noise and water pollution. Ramos interviewed port authorities in various countries and focused on measures taken by regional governments to promote green operations. He presented his research at the Transportation Research Board's annual meeting in Washington, D.C. earlier this year.



SAMUELI SCHOOL PLAYS KEY ROLE IN ONE OF NATION'S LARGEST EXPERIMENTS

THAT'S ONE SMART GRID

BY SHARI ROAN

Some people might balk if they were asked to slash their home energy expenditure by half or more for at least a year. But Ursula and Glenn Levine were ecstatic when they were selected as part of the Irvine Smart Grid Demonstration (ISGD), a public-private project in which the Advanced Power and Energy Program (APEP) in the Samueli School of Engineering is a key player.

A top-to-bottom endeavor, the ISGD encompasses innovative regional grid intelligence technologies, new substation and distribution circuit level technologies and individual homes outfitted with smart appliances, solar panels and electric vehicles.

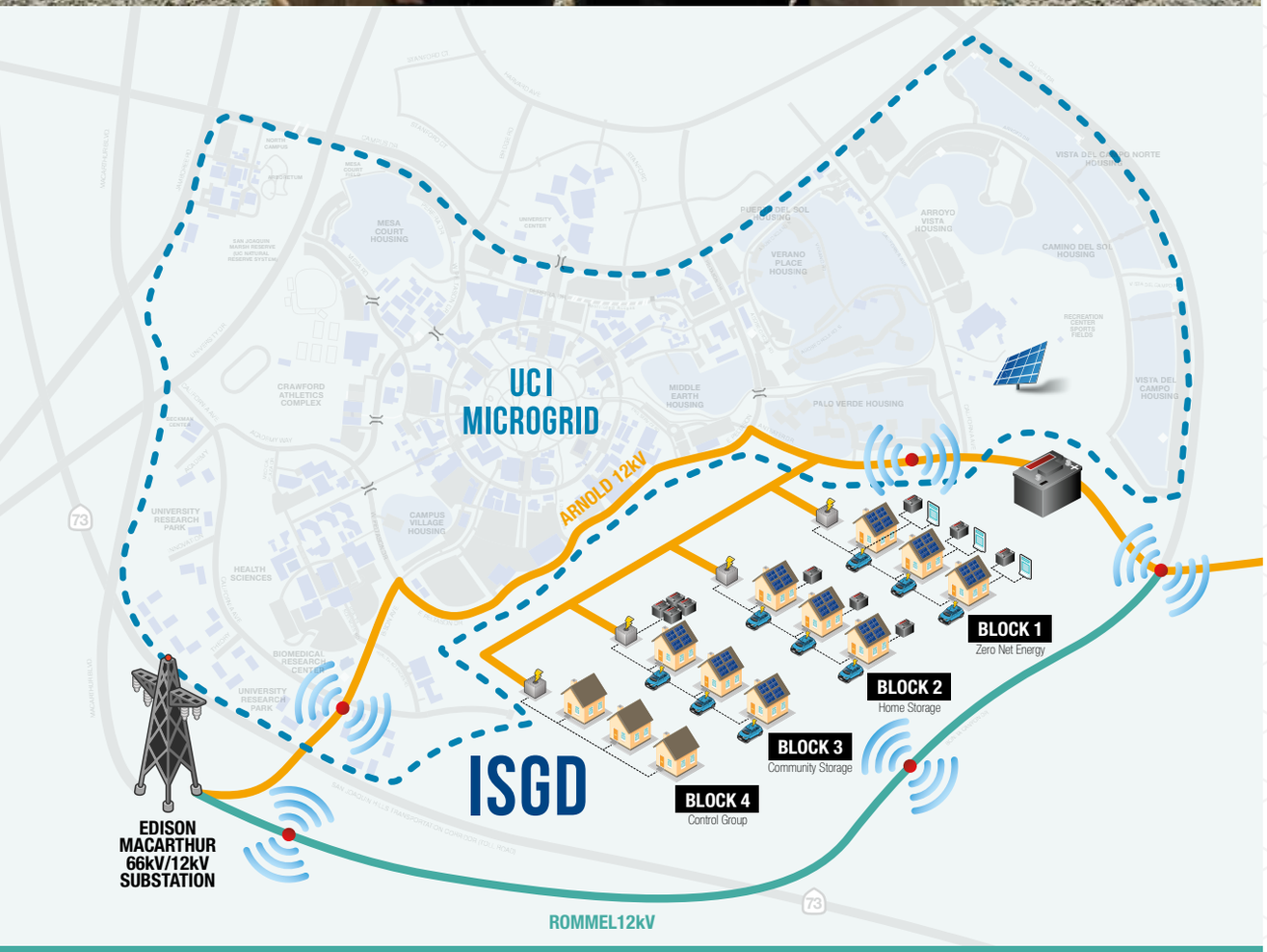
One of the country's largest smart grid experiments, the project addresses mounting concerns over greenhouse gases, rising energy demands, increased penetration of intermittent renewable wind and solar generation, and charging loads from plug-in electric vehicles. The ISGD seeks to show that regional energy providers, local utility companies and consumers can work together to produce a grid that is more reliable, secure, cost-effective, dependable and environmentally friendly than those in use today.

The traditional electrical grid that has served us for decades is a network of wires, substations, transformers and switches that carries electricity from plants where it's generated to consumers. This grid is serviced by workers who go on site to read meters, fix broken equipment, alter switches and measure voltage.

Today, however, smart grid computer technologies, such as sensors and two-way communication systems, can be used to automate the system, ushering in a range of important benefits.

A bird's-eye view of the homes in University Hills participating in the Irvine Smart Grid Demonstration project, as denoted by the photovoltaic panels on the rooftops.

Project researchers from the Samueli School and Southern California Edison are pictured at the ISGD large battery storage site on the edge of the UCI campus: (from left) Jack Brouwer, Fei Gu, Jerry Thode, Renee Cinar, Ed Kamiab and Scott Samuelsen.



UC Irvine has been ahead of the curve. "The energy program at UCI began in 1970 and evolved over the 40 years into an unusually comprehensive program, probably unique in the country in terms of its breadth and strength," says Scott Samuelsen, the HORIBA emeritus professor of mechanical, aerospace and environmental engineering and APEP director. "We developed these tools and had them ready when the concept of smart grid technology was evolving. There was a bit of fortuitous timing that allowed us to be in the right place when it was needed."

The ISGD project is led by Southern California Edison and funded by the U.S. Department of Energy. APEP is conducting core research for the project and manages, with Toyota, the deployment of electric vehicles. APEP also manages the other UCI groups that are involved, including facilities management, environmental planning, transportation services, and the 38 University Hills homes that are part of the demonstration and are located adjacent to the campus. That's where the Levine family resides.

"When we were selected and offered this, I felt like we won the lottery," says Ursula Levine, a dentist. Husband Glenn is a UCI professor in European Studies. "The project included receiving a number of new appliances—a refrigerator, dishwasher and washing machine—as well as solar panels on the roof. As a family, we are oriented toward energy savings and going green. So this was very welcome."

The demonstration project is divided into four blocks of homes,

"each with its own personality," says Samuelsen. Three of the blocks comprise 22 smart grid technology homes and the fourth block has 16 control group homes. The smart grid homes are outfitted with smart appliances, smart thermostats, plug-in electric vehicles, smart electric vehicle chargers and rooftop photovoltaic solar panels. And the homeowners have devices that allow them to monitor and manage their energy usage.

"There's a device in the home that allows you to select the economic profile you want to have for your utility cost," explains Samuelsen. "If you want your cost to be the lowest possible, the smart grid does some things on your behalf. It doesn't allow the washing machine to turn on when you put clothes in at certain [high energy demand] times. You push a button, but it says the clothes will be washed at 6 a.m., not right then at 8 p.m."

After comparing energy usage with a neighbor, the Levines made some adjustments. The couple and their three sons only do laundry during the day and pay more attention to turning off lights.

"I think it's amazing and wonderful that UCI is facilitating this," Ursula Levine says. "I'm excited about the changes to come. I can see the benefits of it. The whole family has become so much more aware of our energy usage."

As the research partner, APEP undergraduate and graduate students are using state-of-the-art computer codes, developed by UCI engineers, to model the 12 kilovolt circuits serving ISGD, the feeder circuits and transformers supporting each of the four blocks of homes, and the actual dynamic performance of the homes. The goal is not only to better understand and improve the smart grid behavior associated with the current project, but also validate the codes and models for use in research to explore the future of smart grid technology.

Increasingly, homes must be able to access renewable energy, says Bob Yinger, ISGD chief engineer at Southern California Edison. "We recognize that things are changing in the grid world," he says. "People are using rooftop photovoltaic systems and purchasing plug-in vehicles. The grid as it was designed many years ago didn't really consider any of those things."

Adds A. Edward Kamiab, the ISGD project manager at Southern California Edison: "The grid is going to go through a larger evolution in the next 10 years than it went through in the previous 100 years with all these new technologies for energy-efficiency."

For example, the ISGD is testing smart switches in feeder circuits that ferry electricity to neighborhoods. The smarter switches are designed so that if a fault occurs, only a small number of houses experience a power outage instead of a large swath of the town.

A smarter grid should also have the ability to move electricity from one area to another in an emergency.

In an earthquake or wildfire, "local communities, like the UCI campus where we generate our own electricity, can be called upon to supply electricity to hospitals or fire stations or gasoline stations in the community," Samuelsen says. "Today we can't do that. It requires a lot of manual switching of circuits. In the future, the smart grid will allow such actions to occur instantaneously."

In addition, researchers are hoping that the ISGD project, which concludes next year, will offer some insights into what it will take to reach California's goal of all new residential construction meeting Zero Net Energy standards by 2020. One block of the smart grid homes is not only equipped with the smart technologies but has upgraded building materials, including far greater insulation and high energy-efficiency windows.

"Zero Net Energy means that at the end of the year, you've generated as much electricity as you've consumed in the home," explains Samuelsen. "What we're doing in this project with Edison is seeing just how close we can come to meeting that concept."

Top: Renee Cinar, APEP graduate student, evaluates performance of a residential electric vehicle charger and (bottom) tests a home battery storage unit deployed in half of the ISGD homes; the other participants are using a community battery system (one battery that serves a block of homes).

LESSONS FROM THE SEA

RESEARCHERS TRAVEL TO REMOTE ATOLL TO STUDY NATURE OF CORAL SURVIVAL

BY LORI BRANDT

Coral reefs are among the most biologically diverse and economically valuable ecosystems on Earth. They supply food for millions; protect coastlines from storms and erosion; provide jobs based on fishing, recreation and tourism; and serve as a source for new medicines.

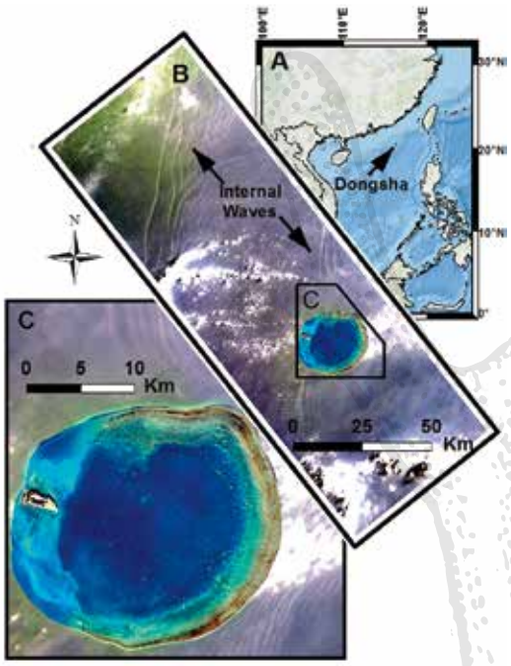
These precious natural resources around the world are being affected by rising sea levels, warmer temperatures and increasing acidity in our oceans. Understanding how this sensitive living organism adapts, or doesn't, to variables in its marine environment could help scientists determine ways to protect coral reefs from climate change.

UC Irvine civil and environmental engineer Kristen Davis led a recent field expedition to a remote coral reef ecosystem near Taiwan in the South China Sea to investigate the interaction between the area's unique ocean environment and the corals and algae that comprise the reef.

Designated as a Marine National Park and a protected area, the Dongsha Atoll is a rare example of an intact atoll, a circular coral reef enclosing a shallow lagoon. Managed by the Taiwanese Coast Guard, the atoll has a small island at one end with a research station. Access is by boat or a weekly military flight from Taiwan.

Davis, who uses fluid mechanics principles to study ocean processes that affect marine ecosystems, has studied water circulation around coral reefs in the Florida Keys, Red Sea and Gulf of Aqaba. "I'm trying to determine what strategies corals use to survive in places where there are lots of changes to the physical environment," she says. "This information could help us understand how they'll react to future climate-driven changes in the ocean."

As home to some of the world's largest internal waves, the Dongsha Atoll experiences plenty of natural variability. Internal waves are made of deep, cold, dense water rising into layers of shallower, warmer, lighter water. The differences in density cause the many layers to behave like different fluids. The interaction of tidal currents with the unique topography of the South China Sea floor produces massive internal waves. They can be a thousand times larger than the more familiar surface waves, and they can last several hours.



A remote coral reef ecosystem located south of Taiwan in the South China Sea, the Dongsha Atoll is a rare example of an intact atoll, with a diameter of 25 km, a center lagoon 16 meters deep, and a rich marine life. These satellite images are courtesy of the Hyperspectral Imager for the Coastal Ocean (HICO).

Davis' research aims to determine how the corals are affected by these underwater waves, which bring cool, nutrient-rich and lower oxygen seawater to the shallow coral communities. "Exposure to this water may enhance coral nutrition and help buffer the corals from heat-induced bleaching," she explains. Bleaching occurs when the symbiotic algae, which live on coral and provide its nutrients, are expelled. Sometimes coral will recover and attract new algae; if not, it dies.

Serving as one of the lead scientists, Davis oversaw a group of nine researchers from the U.S. and Taiwan in the month-long research expedition to the atoll. She was one of three certified scuba divers who placed instruments in and around the reef and lagoon and took samples of water and coral. They deployed a myriad of sensors to measure temperature, oxygen, pressure, currents, salinity and pH in the water.

"THIS WAS A RELATIVELY NEW APPLICATION FOR THIS TECHNOLOGY, AND IT WAS EXTREMELY SUCCESSFUL."

Because most of the reef is underwater, the team constructed a scaffolding tower on the reef platform to serve as a base for equipment and solar panels that powered their work.

The team also laid 4 km of fiberoptic cable on the sea floor, from the lagoon over the reef and out toward the ocean. With a technology called distributed temperature sensing (DTS), this cable collected temperatures every meter at 30-second intervals, allowing the researchers to track the cold water carried to the reef by the internal waves. Originally developed for use in the oil industry, DTS records a continuous profile of temperatures. In this case, it cheaply and effectively measured water temperature over a vast distance, using the same type of cable that plugs into a phone or television.

"This was a relatively new application for this technology, and it was extremely successful," says Davis.

Opposite page: Tom DeCarlo from the nonprofit Woods Hole Oceanographic Institute was one of three certified scuba divers on the field expedition.

This page: (clockwise) The research team built a scaffolding tower out on the reef to serve as a base for equipment.

(L-R) Aryan Safaie (UCI), Austin Hall (Oregon State University) and Kristen Davis proudly hoist the empty reel after laying 4 km of fiberoptic cable over the reef, from lagoon to sea.

Davis dives 20 meters down to the seabed where she secures a platform mounted with equipment – an acoustic current and wave meter, its battery, a sensor to measure pH and a couple of weights to hold it all down.

Davis attaches a temperature sensor to the fiberoptic cable. The sensor was used to validate the information being pulled from the new distributed temperature sensing technology in the cable.

UCI engineering graduate student Aryan Safaie spent two months prior to departure learning how to use all the instruments (DTS technology, four types of temperature sensors, four current meters, four oxygen and three pH sensors). He helped prepare and program all of the equipment and downloaded the data at the expedition's end.

Not a diver, Safaie spent most of his time on the boat. It was his first field experience, and he deemed it a "crucial, important and much-appreciated learning experience, but also very difficult. It was like 'bizarro' summer camp. The living conditions were tricky, the food was terrible, and the mosquitoes, rats and big spiders were a bit too comfortable with humans."

Safaie adds that the people were wonderful – incredibly friendly and hospitable. "The Coast Guard and Marine Park staff took us in like family. We stayed up late and exchanged stories."

Both Safaie and Davis are glad to be home and look forward to analyzing the data.

"Internal waves potentially make Dongsha Atoll a unique coral reef, well-suited to being resistant to the effects of climate change and ocean acidification," says Davis. "Once we understand the science of how coral survives, we can determine how to help or remove stressors."

HUMAN HEALTH

The marriage of engineering and information technology to biological sciences and medicine has enabled tremendous advances, helping improve the length and quality of human life. Artificial organs and limbs, sensors that monitor physiological functions, non-invasive imaging and miniature drug delivery systems are all examples of how engineers apply their tools and know-how to solve problems in medicine. The school's faculty works closely with UCI School of Medicine researchers and the large number of biotech industry partners in the region to stay at the forefront of bioengineering. Research at the Samueli School centers on biomedical photonics and optoelectronics, nano- and microscale systems and device fabrication, next-generation neuroprosthetics and biomedical computational modeling.

NOTEWORTHY

THE KEY TO THE DEVICE'S SUCCESS IS RESONANCE; IT OSCILLATES WITH LARGE VIBRATION AMPLITUDE ON THE TIP, EVEN WHILE USING LOW POWER, ALLOWING IT TO DISPERSE UNIFORM DROPLETS FROM TWO TO SIX MICRONS IN SIZE.

A NOVEL INHALER

Asthma sufferers and others with pulmonary disorders are well acquainted with nebulizers. They're those sometimes bulky gadgets, also known as inhalers, which disperse an aerosol stream of medication directly into the lungs. Unfortunately, though, most commercial nebulizers are capable only of poly-disbursement, meaning they disperse droplets of varying sizes. That is not useful for many pulmonary drugs, which are effective only when droplets are a specific size: two to six microns. Adding mesh screens to the commercial inhalers helps create some droplets of desirable size, but the often-viscous medicines can get stuck in the mesh, clogging the devices.

UCI Chancellor's Professor of Electrical Engineering Chen Tsai and his research team have developed a silicon, micro-electro-mechanical systems (MEMS)-based, clog-free ultrasonic nozzle. The tiny silicon device consists of multiple horn-shaped components attached end-to-end, with a silica tube running through the center. Medication is pumped through the tube to the device's tip, where strong vibrations created by a voltage at megahertz frequency and applied to a transducer at the other end causes the medicine to break apart and dispense in minuscule, precisely sized droplets. Their success was highlighted recently in Technology, a new journal that covers cutting-edge technologies from a variety of science and engineering fields.

STEM CELL DIFFERENTIATION

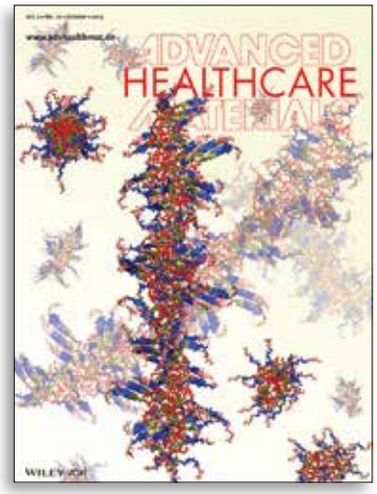
Assistant Professor Elliot Hui's promising research has been recognized by the U.S. Defense Advanced Research Projects Agency (DARPA) with its Young Faculty Award. Hui's research group employs tools such as micro-electro-mechanical systems (MEMS), microfluidics and optogenetics to control biological systems dynamically at the microscale. His interests include tumor progression and stem cell differentiation. "We plan to create a set of proteins that will activate different cellular functions in response to specific wavelengths of light," says Hui. "We'll start with the proteins plants use to steer themselves toward sunlight and then create a set of modified proteins that are sensitive to different colors of light. Ultimately, we hope to use light to steer cell migration or pattern the differentiation of stem cells."

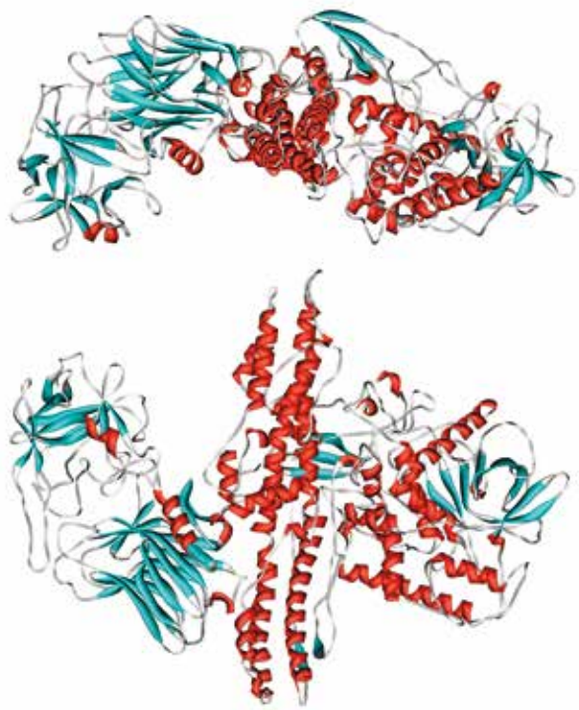
$425,000

DARPA YOUNG FACULTY AWARD OVER TWO YEARS

ON THE COVER OF . . .

An assistant professor of chemical engineering and materials science, Hung Nguyen investigates the self-assembly of biological and biomimetic nanoscale materials based on amino acids and nucleic acids. His research group's work involving peptide amphiphiles, an emerging class of self-assembling molecules, was the cover feature for the October 2013 peer-reviewed journal Advanced Healthcare Materials. He and his team, including first author graduate student Iris Fu, an NSF Graduate Research Fellow, used simulations to examine the self-assembly process in detail. The findings can potentially aid the design and development of biomaterials such as hydrogels for use in drug delivery, diagnostic medicine, tissue engineering and regenerative medicine.





FUTURE PAIN THERAPIES

Pharmaceutical company Allergan has awarded Michelle Digman a $787,000 grant to study how a subunit of botulinum neurotoxin affects cells and tissue on a molecular level. An assistant professor of biomedical engineering, Digman's research expertise involves using optical microscopy tools to track molecules and microscopic particles in living cells and tissues. She is a co-investigator of UCI's Laboratory for Fluorescence Dynamics, an NIH Biotechnology Resource for the development of fluorescence microscopy. With the grant, she is using fluorescent imaging to track the transport and diffusion of the toxin in living cells, to better understand any biochemical and physiological changes that occur. She is also studying metabolic changes in tissue at the point of injection.

"Botulinum neurotoxin is used in a variety of clinical treatments including neuromuscular diseases, epilepsy and pain-related illnesses," says Digman. "This study is important on a clinical level and will provide valuable information in the development of therapies for pain-related disorders."

$10 million

RESEARCH FUNDING FROM INDUSTRY IN FY 2012-13

NEW FACULTY HIRES

Two new assistant professors in biomedical engineering joined the ranks of Samueli School faculty in 2013-14. Michelle Digman earned all three of her degrees in biochemistry at the University of Illinois at Chicago. She came to UCI in 2006 as the scientific director of the Optical Biology Core Facility. On the tenure track, she plans to apply novel imaging techniques to understand fundamental questions related to cell migration in 3-D microenvironments, including tumor cell migration.

Beth Lopour earned her bachelor's degree in mechanical engineering from Northwestern University and a master's and doctorate in mechanical engineering from UC Berkeley. Lopour served as a UC President's Postdoctoral Fellow in UCLA's department of neurobiology, studying information processing and epileptogenic networks in the human brain. She is continuing this work at UCI, using cortical recordings in collaboration with UCI physicians in the comprehensive epilepsy program.

HAND-HELD DEVICE

Samueli School Professor Andrei Shkel has received an NSF EAGER (Early-concept Grants for Exploratory Research) Award to investigate a new approach for a high-performance magnetometer set in a 10-square-centimeter microsystem. The proposed technology would be able to detect weak magnetic fields such as those produced by the brain, heart and other organs. Shkel envisions a hand-held device for personal healthcare, on-demand diagnostic and self-monitoring of diseases. Contrary to state-of-the-art superconducting quantum interference devices, Shkel's proposed atomic magnetometer will not require cryogenic cooling and will not have any moving mechanical parts. Today's systems are large, bulky, expensive and only available in highly specialized medical facilities, dedicated military constellations or expensive mobile platforms. The accessibility of such technology for personal use in the form of hand-held devices could be revolutionary.

"There's been an increasing interest in atomic micro-electro-mechanical systems (MEMS) over the last five years," says Shkel, a mechanical and aerospace engineer. "Both chip-scale atomic clocks and gyroscopes have been developed, demonstrating the feasibility of atomic MEMS and giving reason to explore other types of microdevices where atomic detection mechanisms may be beneficial."

$300,000

NSF EAGER AWARD

NEW REPLICATION SYSTEM

The Samueli School's Chang Liu, assistant professor in biomedical engineering, has created an engineered living cell with a second DNA replication system that mutates independently of and without harming the cell's original genome. This parallel replication cell works like a two-lane highway – with a fast lane and a slow lane – for direct evolution in a lab setting. With it, biomedical engineers will be able to rapidly evolve a huge array of biomolecules with custom desired functions. Liu's lab is using the new replication system to evolve special proteins that detect disease markers as well as evolve enzymes that are important to producing biofuel. They are also using it to estimate, through rapid evolution, what changes in certain targeted genes will lead to drug resistance, thereby allowing scientists to preemptively counter resistance in the field. Liu and his research group published their work in the March 2014 issue of Nature Chemical Biology.

MICROFLUIDICS ON A ROLL

BY ANNA LYNN SPITZER

NEW I/UCRC CENTER FIRST IN THE NATION DEDICATED TO LAB-ON-A-CHIP RESEARCH

At first glance, it's difficult to discern commonalities between UC Irvine and the Technical Research Centre of Finland.

The university is located in sun-drenched, palm-dotted Southern California; VTT, as the government-funded research institute is known, calls Oulu, Finland, home. There, in the country's subarctic north, winter lasts six months, and the average yearly temperature is 36 degrees Fahrenheit, only slightly above freezing.

While the two institutions differ dramatically in scope, culture and climate, they are in complete synchronicity in pursuit of their common goal: to disrupt the future of point-of-care diagnostics. By meshing VTT's well-developed roll-to-roll manufacturing capabilities with UCI's engineering expertise and innovation in microfluidics, they are on their way to revolutionizing microfluidic lab-on-a-chip devices.

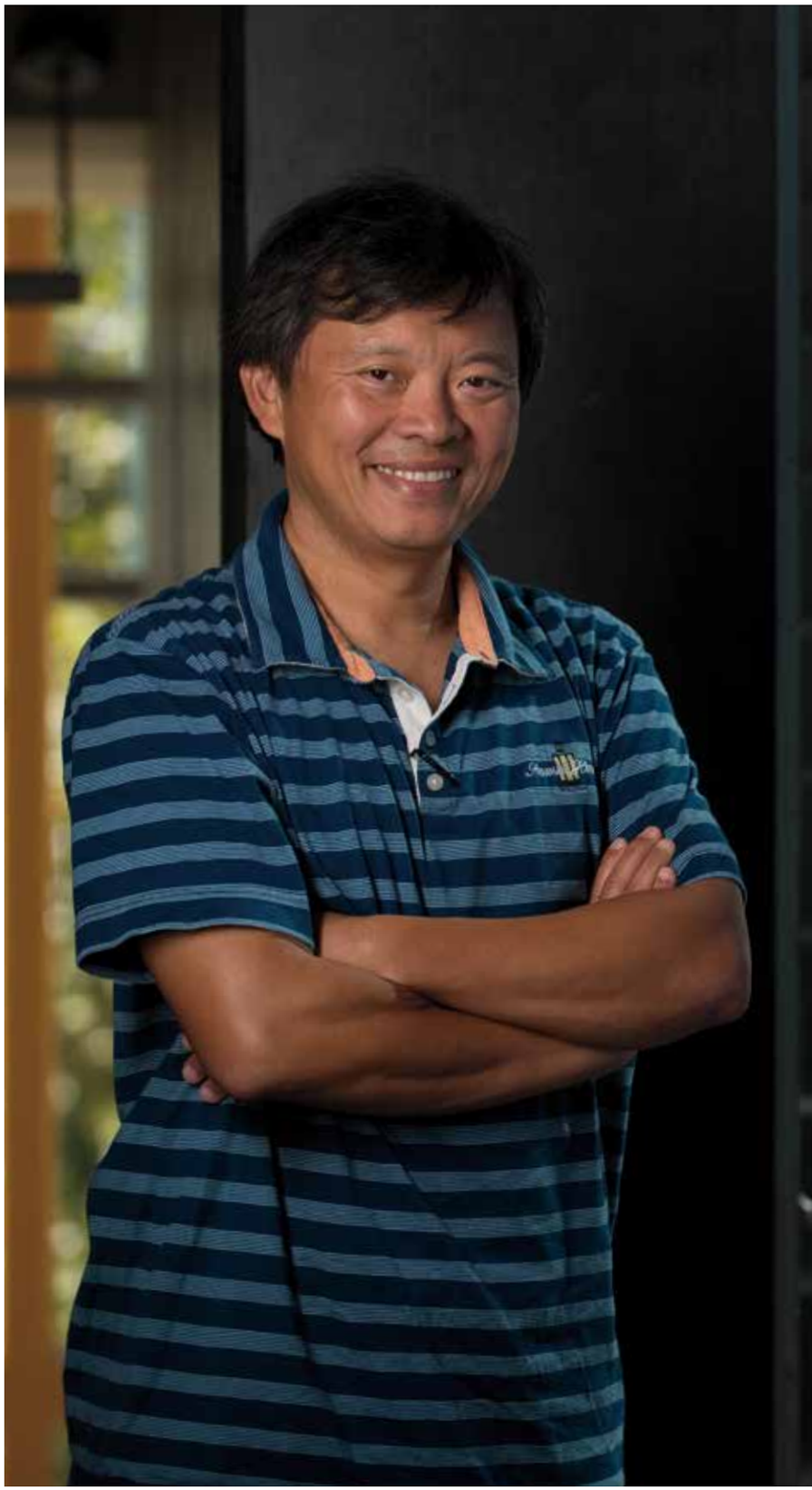
VTT was established in 1942 and develops and houses a variety of roll-to-roll pilot manufacturing equipment at its Centre for Printed and Hybrid Functionalities. The institute successfully produces electronics, solar cells, bio-batteries, LEDs and OLEDs on flexible plastics and paper. UCI's Samueli School of Engineering is home to CADMIM – the Center for Advanced Design & Manufacturing of Integrated Microfluidics – a newly formed Industry/University Cooperative Research Center (I/UCRC) administered by NSF.

CADMIM is a multipronged alliance that encompasses UCI, the University of Cincinnati, and 13 life science, diagnostics and advanced technology businesses. The center, the first I/UCRC led by UCI in the university's history, is in a unique position to effect change: out of 67 of these centers nationwide, it is the sole I/UCRC dedicated to microfluidics research.

Its mission: to develop tools and technologies for manufacturing low-power, integrated microfluidic devices that are cost-effective, fast and user-friendly for applications in environmental, agricultural and health diagnostics. The center foresees a future where completely self-contained microfluidic chips with high sensitivity and short reaction times are manufactured for mere cents, packaged and sold like Band-Aids, and recycled effortlessly.

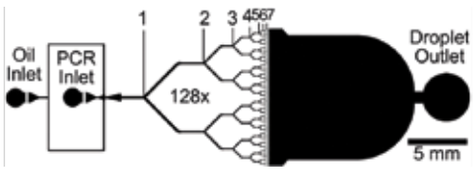
All parties firmly believe roll-to-roll techniques will unlock that future. "Roll-to-roll is not new, but it's not currently suited to production of integrated lab-on-a-chip designs," CADMIM Deputy Director Gisela Lin says. "We're trying to change that."

Until very recently, microfluidics – the science of moving, mixing, separating and processing fluids on very small chips – has involved clean-room fabrication and materials like glass and PDMS, a silicon-based organic polymer. The processes and materials, not to mention the requisite read-out equipment, are costly and inherently prohibitive to mass production. "The devices are still not cheap enough, they're not functional enough and they're not profitable enough," says UCI biomedical engineer Abe Lee, CADMIM's director and principal investigator. "There's not a sustainable market yet."



UCI biomedical engineer Abe Lee (left) and VTT research scientist Ralph Liedert are teaming up to apply roll-to-roll techniques to produce lab-on-a-chip microfluidic devices.

From a very small sample of fluid (blood, urine, saliva, sweat or tears), a microfluidic device can ascertain a great amount of data. It works like this: the sample fluid and an oil are placed in separate input channels. When the oil and sample streams meet, the oil splits the sample into millions of individual droplets. The droplets travel downstream into the holding chamber, where they collect in a honeycomb pattern and the actual analysis takes place.



But the capability of hot embossing tools on roll-to-roll manufacturing equipment is changing that. The tooling can produce the tiny channels through which liquids flow and can integrate the pumps, mixers, chambers, electronics, optics, fluorescence and detection mechanisms required for microfluidic bioassays. The roll-to-roll process also can eliminate the need for read-out equipment, because communication electronics to speed information wirelessly to cell phones or other consumer devices can be incorporated directly onto the chips.

The process moves giant rolls of pre-processed paper or plastic through a continuous web. The material is stamped, printed, pressed, laminated and sealed, producing thousands of tiny chips per foot of material. Roll-to-roll processes could fabricate hundreds of thousands of standard, one-centimeter-square devices per hour.

Ranging from a few square millimeters to a few square centimeters in size, the flexible chips provide an inexpensive way to analyze fluid samples on the fly. "We're looking for devices that can do diagnostics, or any sort of biological assessment that needs to be done quickly, in the field," says Lee, who also serves as chair of the Samueli School's Biomedical Engineering Department.

Microfluidic chips potentially can monitor air, water, the food supply and the human body for toxins, antibodies, pathogens, gene mutations and cell irregularity, all potential precursors of disease. Devices are capable of high-throughput chemical and biological assays, including single-cell and single-organism analysis, DNA assays, drug discovery, protein crystallization, chemical synthesis and single molecule detection. The technology provides the foundation for a new wave of medical diagnostics with wearable sensors that could analyze sweat, tears, blood, saliva, urine and other bodily fluids.

"MICROFLUIDIC DEVICES ARE NOT GOING TO BE THE TWO-DIMENSIONAL, VERY INORGANIC CHIPS THAT WE'RE USED TO NOW," LEE SAYS. "WE DON'T EVEN KNOW HOW TO IMAGINE THE POSSIBILITIES."

It also can play an important role in improving global health. Suddenly, medical providers may have the means to perform diagnostic tests in remote locations without extensive laboratory support.

"We can do a lot of these things today, but we're not doing them fast enough and in enough places," Lee says. "Affordability and immediacy are what we're striving for."

For years, VTT used its roll-to-roll machines primarily for electronics and optics and began experimenting about a decade ago with lab-on-a-chip microfluidic devices. Starting from very simple device formats, VTT and UCI have worked to evolve the complexity and size of diagnostic chips during their year-long collaboration. "We're pushing them; we have ideas and designs that they're beginning to implement for us," Lee says.

"VTT has already demonstrated a lot of electronics and optical components that are pretty fancy. So we decided to take what they can do and what we've developed over the years and put them together."

Ralph Liedert, a VTT research scientist who has been working with CADMIM on the project, says the hot embossing tools enable easy upscaling of manufacturing techniques. "I think very often the reason good designs and

good concepts are ending up in a drawer is they are just made out of the wrong materials, and they haven't kept this upscaling in mind," he explains.

"The biggest advantage of roll-to-roll is you can use plastic materials that are immediately suitable for mass manufacturing."

Obviously, equipment is crucial to the effort, but CADMIM itself is equally important if low-cost microfluidic device production is to become reality. The I/UCRC concept emphasizes the coordination of industry and university research efforts to maximize the commercial potential of the developed devices. "Most academics are used to working in their own way and are very different, culture-wise, from industry," Lee says. "This cooperative infrastructure helps bridge a lot of those gaps."

"Industry partners are part of the decision-making, they approve everything that goes on in the center, and they provide the guiding light for the research," adds Lin. "We're very focused on being responsive to industry."

Frank Modica is manager of systems engineering at Canon U.S. Life Sciences, Inc. A CADMIM corporate member, Canon is commercializing a microfluidic diagnostic platform that can detect molecular mutations in DNA. "Canon has a thriving R&D organization, but efforts like this CADMIM partnership widen the opportunities," Modica says. "We hope to gain access and exposure to ideas and research we would otherwise not have the human resources to pursue."

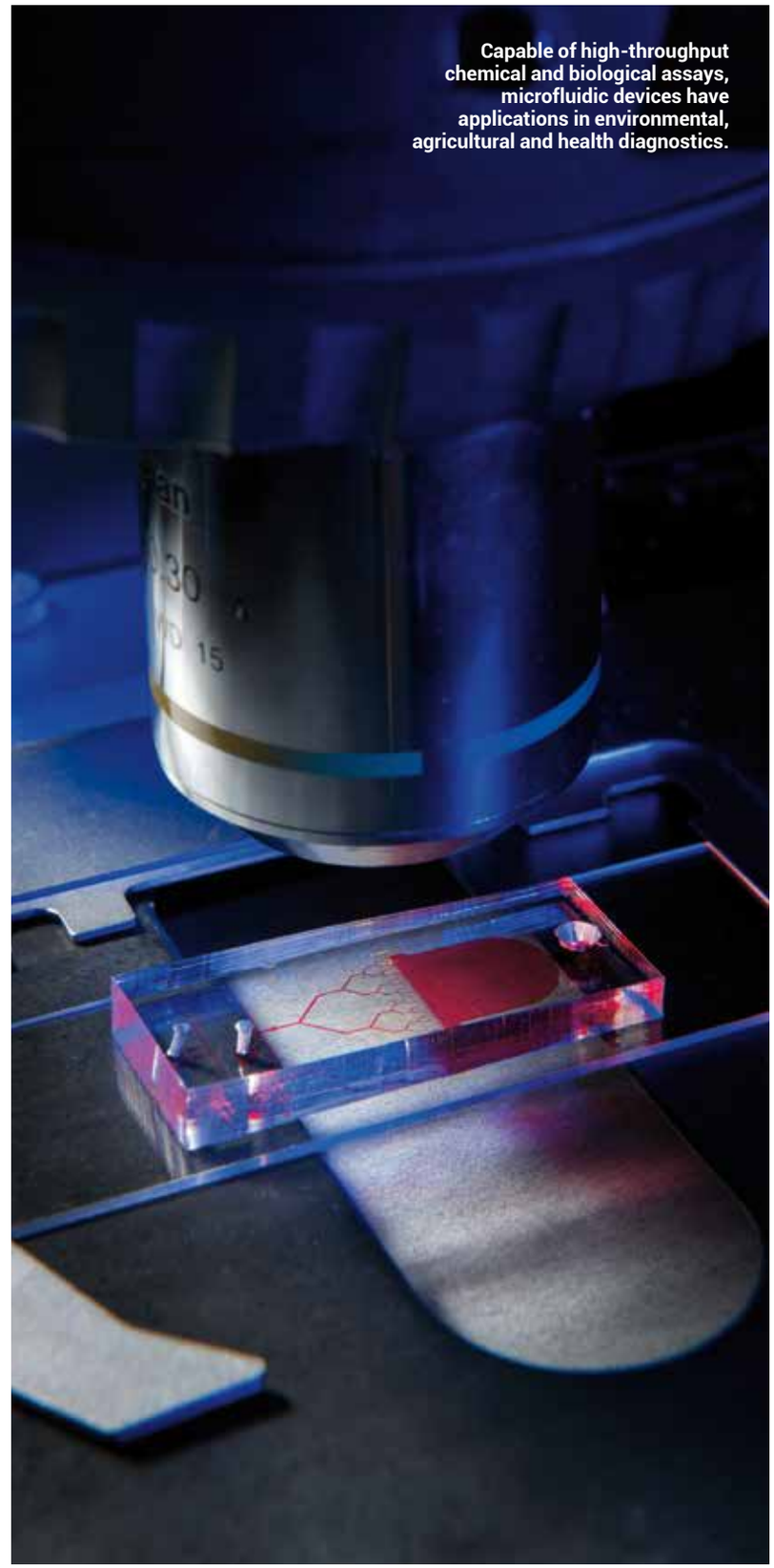
Beckman Coulter manufactures advanced healthcare instruments and systems for diagnosing infectious, cardiovascular and oncological diseases, among others. David Yang, director of science affairs, says the potential for reduced system size and improved sensitivity, along with its unique properties, make microfluidics a good fit for the company; roll-to-roll techniques can make it affordable.

"Participation in CADMIM presents a special and cost-effective opportunity for Beckman Coulter to tap into microfluidic expertise and identify possible solutions to improve patient care," Yang says.

Several projects are already underway at the five-month-old center. There's a DNA library preparation chip, which automates the current time-consuming, six-step procedure used to sequence genomic DNA, while allowing simultaneous processing of multiple samples. Another features a parallel, high-speed device that can generate tiny liquid droplets, enabling researchers to measure precise sample volumes. A third project seeks to demonstrate the integration of multiple microfluidic designs on a single chip.

Additional microfluidic applications are in line for conversion to roll-to-roll techniques, and the prospects are limitless. From wearable sweat sensors to disposable blood tests to ingestible devices that attach themselves to diseased cells, roll-to-roll microfluidics manufacturing promises to transform the world of diagnostics.

"Microfluidic devices are not going to be the two-dimensional, very inorganic chips that we're used to now," Lee says. "We don't even know how to imagine the possibilities."



Capable of high-throughput chemical and biological assays, microfluidic devices have applications in environmental, agricultural and health diagnostics.

ADVANCED MANUFACTURING AND MATERIALS

The development of advanced materials is critical to solving national problems in clean energy, human welfare and national security, and a strong manufacturing research and development effort is necessary for the U.S. to compete in a global economy. The Samueli School of Engineering is well poised as a technology leader in both areas. Researchers are recognized as pioneers in micro-electro-mechanical systems (MEMS) and nanotechnology, and have made groundbreaking developments in the design and construction of new materials. The school also houses RapidTech, an NSF-funded center for the development and advancement of advanced manufacturing and related technologies.

NOTEWORTHY

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NEW FACULTY WILL JOIN SAMUELI SCHOOL IN 2014-15

PROMINENT SCIENTIST JOINS UCI

Xiaoqing Pan, an internationally recognized researcher in the physics of materials, will join the UCI engineering faculty in January and lead a $20-million initiative to establish a world-class electron microscopy and materials science research facility.

The Irvine Materials Research Institute will help foster discovery of new properties in potentially lifesaving and technologically important materials through characterization—probing the internal structure of a material's atoms. The institute will serve as an interdisciplinary nexus for the study and development of these materials, enabling such advances as better solar cells, sustainable batteries and semiconductors, and treatments for bacterial and viral infections.

"UC Irvine is making an investment of $20 million to develop cutting-edge capabilities in transmission electron microscopy," says Howard Gillman, interim chancellor, and provost and executive vice chancellor. "Bringing Professor Pan here to lead this institute is a real triumph for us in the materials science area. The research facility will establish our national prominence in this field and broadly benefit our programs in engineering, physical sciences, biological sciences and medicine."

RAPIDTECH TRAINS

200+

COMMUNITY COLLEGE, UNIVERSITY & INDUSTRY PARTNERS

AND

CONSULTS WITH

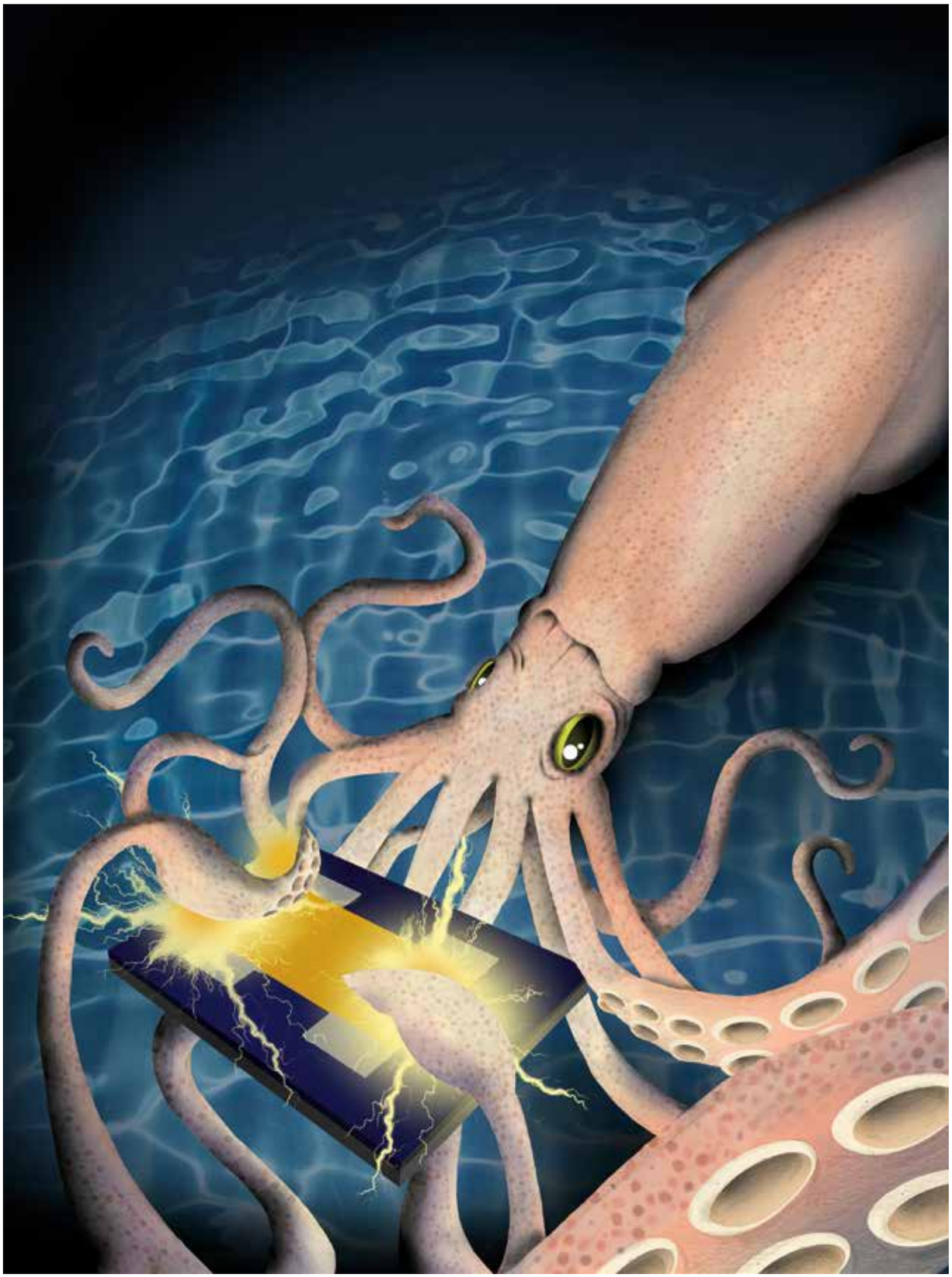
650+

COMPANIES ON ADVANCED MANUFACTURING PROCESSES

WHITE HOUSE MAKERS FAIRE

Samueli School Dean Gregory Washington, an advocate for advanced manufacturing, was among the invited guests to the White House's first Makers Faire in June. The faire spotlighted production innovation at campuses nationwide. UCI showcased its 3-D design and printing capabilities, including the engineering school's National Center for Rapid Technologies, or Rapid Tech. The nonprofit trains students in 3-D techniques and provides faculty and private businesses with efficiently produced, critically needed product prototypes. For example, engineering students have designed and made a 3-D-printed wheelchair to traverse a variety of terrains and a 3-D-printed replica of a blind U.S. Marine's skull that helped surgeons diagnose his problem and restore his sight. Washington said the event, while highlighting what has been done, will spur even greater growth.

"I commend President Obama for his leadership in establishing the Makers Faire," says Washington. "We will heed his call to action. Over the next year, we will expand our innovation infrastructure to help students and the community turn ideas into prototypes, creating a nation of makers here at UCI."



SQUID SKIN PROTEIN

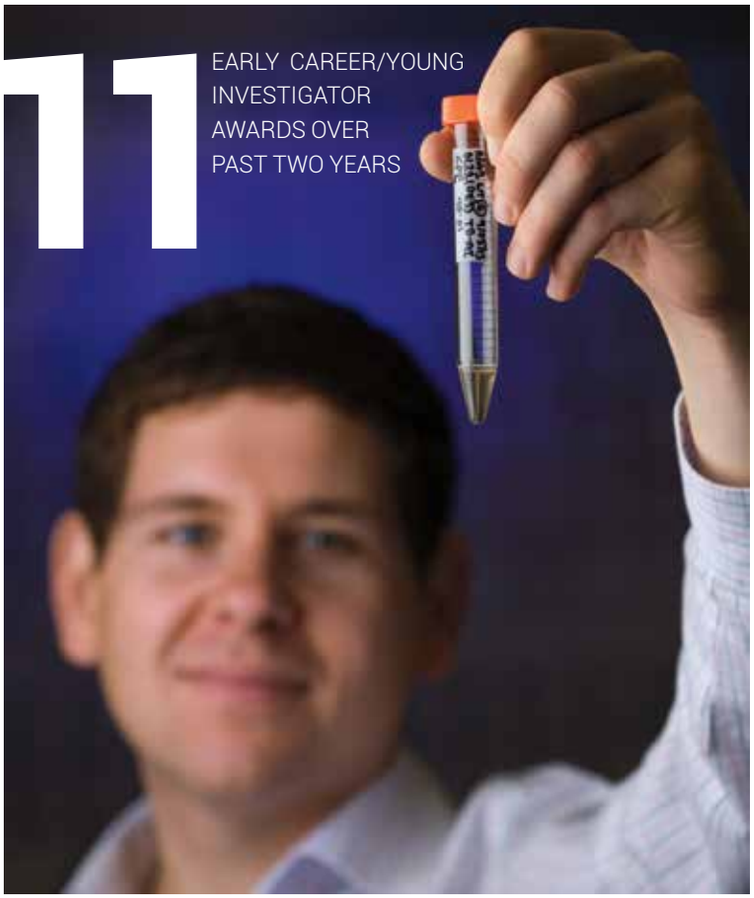
The common pencil squid (Loliginidae) may hold the key to a new generation of medical technologies that could communicate more directly with the human body. Materials science researchers have discovered that reflectin, a protein in the tentacled creature's skin, can conduct positive electrical charges, or protons, making it a promising material for building biologically inspired devices. Currently, products such as retinal implants, nerve stimulators and pacemakers rely on electrons to transmit diagnosis data or to treat medical conditions. Living organisms use protons or ions to send such signals, making the UCI discovery a potential breakthrough for next-generation biological electronics. Alon Gorodetsky, a Samueli School assistant professor, led the research team. "Nature is really good at doing certain things that we sometimes find incredibly difficult," he says. "Perhaps nature has already optimized reflectin to conduct protons, so we can learn from this protein and take advantage of natural design principles."

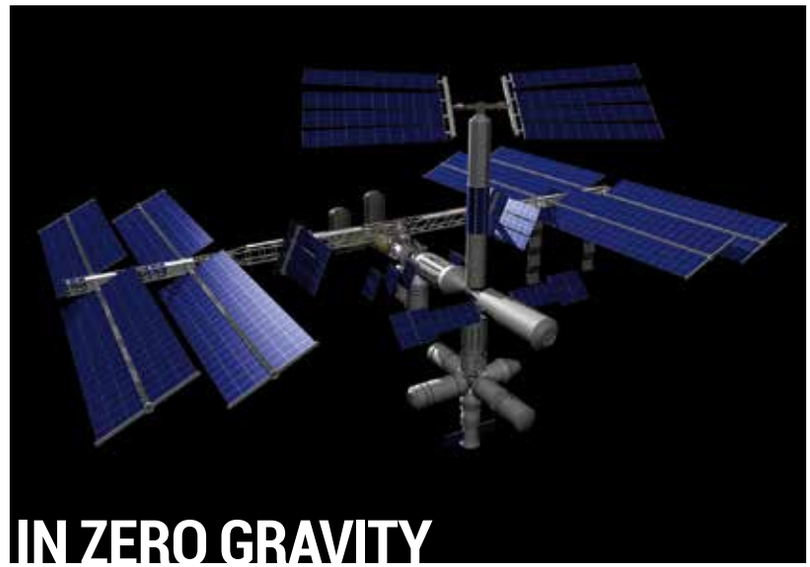
In addition, Gorodetsky and his group have been studying reflectin to discern how it enables squid to change color and reflect light. Based on that research, they were able to create a biomimetic infrared camouflage coating. Those findings were published online last fall in Advanced Materials.

CAREER BOOSTS

Alon Gorodetsky and Allon Hochbaum have been awarded Young Investigator Research Program grants from the Air Force Office of Scientific Research. Both are assistant professors in the Samueli School's Chemical Engineering and Materials Science Department. The Air Force gives scientists and engineers young investigator awards to foster creative basic research and enhance early career development.

Gorodetsky and his research group are currently exploring the electrical properties of reflectin, a protein found in the skin cells of cephalopods, or squid. The goal of his project is to use protein engineering principles to understand and enhance the conductive properties of this material. Hochbaum is investigating electrically conductive materials inspired by bacterial fibers. In addition to studying their function in organisms, his lab is characterizing their physical properties and integrating them into devices for applications in medical sensors and renewable energy technology.





IN ZERO GRAVITY

A Samueli School researcher's project is among a handful of microgravity-related proposals being funded by NASA. Ali Mohraz, an associate professor of chemical engineering and materials science, is receiving more than $520,000 for investigating the factors that affect the stability and processability of bijels, a new class of multiphase soft materials with a tunable bicontinuous microstructure. Mohraz's group is designing and testing the experiments in his laboratory, then sending samples to the International Space Station where NASA scientists replicate the experiments in zero gravity. The results are reported back to Mohraz for analysis and evaluation.

"Eliminating gravity from the equation allows us to study this complex problem in a more systematic way, which is a capability exclusively provided through this program," explains Mohraz. "The results can pave the way for the synthesis of bicontinuous composites for a wide range of applications, including tissue engineering and energy materials."

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TOTAL NUMBER OF MICROGRAVITY EXPERIMENTS SELECTED TO BE CONDUCTED ON THE INTERNATIONAL SPACE STATION

WHEN SPARKS FLY

BY JANET WILSON

MATERIALS SCIENTISTS UNCOVER A NEW HAZARD FOR GOLFERS

Engineering professor James Earthman swings a titanium alloy club against a rock and creates a shower of red-hot sparks that his team found can cause wildfires.

Professional golfers probably don't need the advice, but for weekend duffers, UC Irvine engineering professor James Earthman has a message: no titanium alloy clubs in the rough, please.

He and fellow researchers discovered that golf clubs made with the lightweight metal can cause dangerous wildfires. When one is swung and strikes a rock, it creates sparks that can heat to more than 3,000 degrees Fahrenheit for long enough to ignite dry foliage, according to findings published recently in the peer-reviewed journal Fire and Materials.

The study was undertaken after Orange County, Calif., fire investigators asked UCI scientists to determine whether such clubs could have caused the blazes at Shady Canyon Golf Course in Irvine and Arroyo Trabuco Golf Club in Mission Viejo a few years ago.

"One fire almost reached homes before they stopped it. This unintended hazard could potentially lead to someone's death," says Earthman, lead author on the work. "A very real danger exists, particularly in the Southwest, as long as certain golf clubs remain in use."

He suspected right away that the titanium heads on some clubs designed for use in "the rough" – natural areas off irrigated fairways – could be to blame for the fires. He recalled a friend from graduate school whose hand was badly burned when he reached into a jar to wipe away a titanium film that had formed.

Earthman also knew from his own time on the links that most golf clubs have stainless steel heads. However, a significant number in circulation at rental shops or in people's personal bags have titanium alloy soles. Such alloys are 40 percent lighter, which can make the clubs easier to swing. Sometimes, titanium alloy clubs are selected to hit errant balls out of tough spots. And in Southern California, those spots are often in flammable scrub brush.

The researchers painstakingly recreated in the lab course conditions on the days of the fires. Using a high-speed video camera and a powerful scanning electron microscope, they found that when titanium clubs were abraded by grazing hard surfaces, intensely hot sparks flew out of them. In contrast, standard stainless steel clubs generated no sparks.

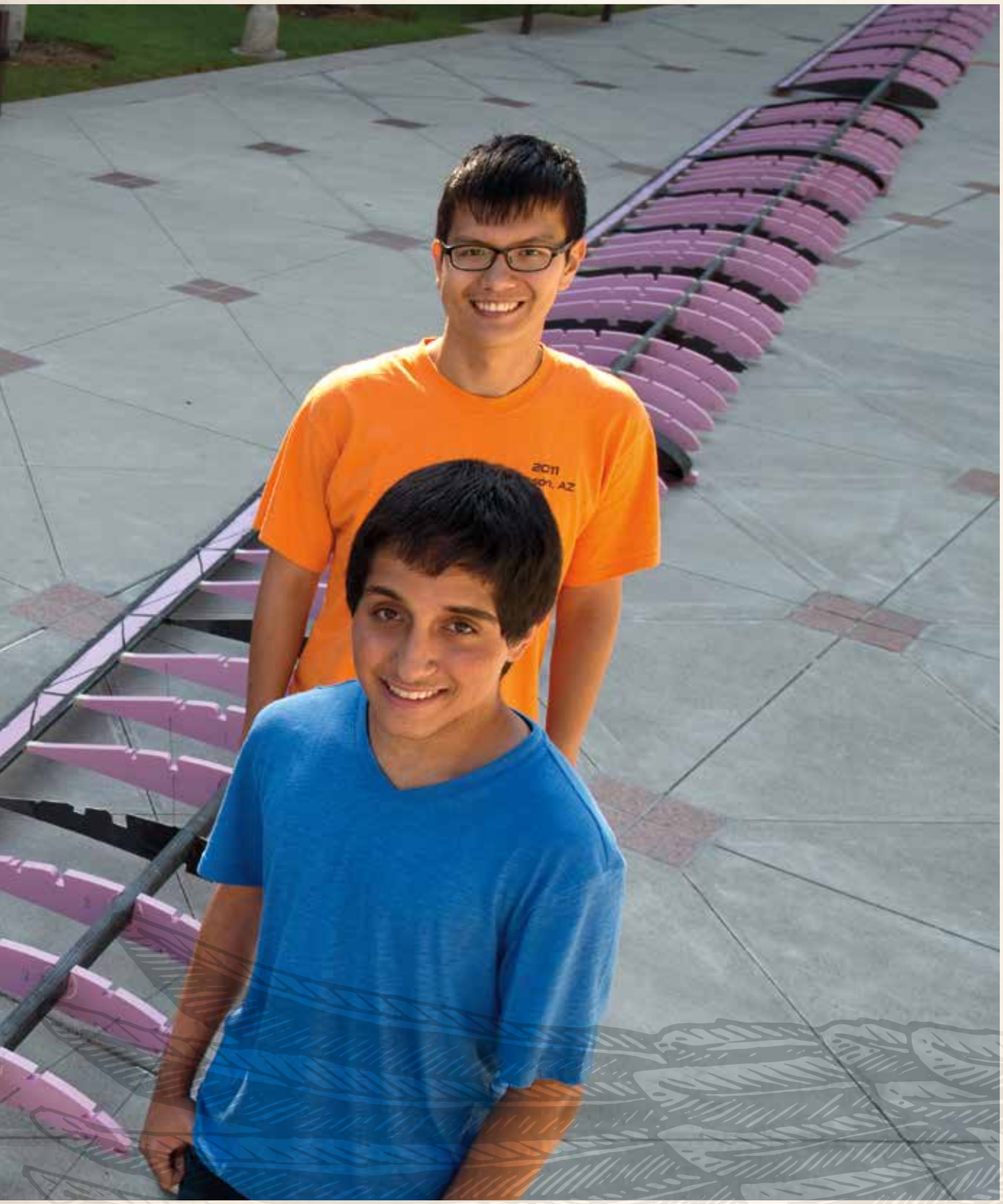
"Rocks are often embedded in the ground in these rough areas of dry foliage," Earthman notes. "When the club strikes a ball, nearby rocks can tear particles of titanium from the sole of the head. Bits of the particle surfaces will react violently with oxygen or nitrogen in the air, and a tremendous amount of heat is produced. Dry vegetation that comes into contact with the resulting sparks can ignite in flames instantly."

Hundreds of newspapers, online sites, and television and radio stations picked up news of the research when it was released this past spring. Earthman spent hours patiently demonstrating the sparks and answering reporters' questions. Being the subject of a mainstream media blitz was a first for the chemical engineering & materials scientist, who's more used to scholarly journals. But he said it was important to get the word out to the public.

"ONE FIRE ALMOST REACHED HOMES BEFORE THEY STOPPED IT. THIS UNINTENDED HAZARD COULD POTENTIALLY LEAD TO SOMEONE'S DEATH."

SPREADING THEIR WINGS

BY LORI BRANDT



In ancient Greek legend, an engineer named Daedalus was imprisoned by the king. To escape, he and his son, Icarus, made wings of wax and feathers. Daedalus flew successfully from Crete to Naples, but Icarus flew too high and near the sun. His wings of wax melted and Icarus fell to his death in the ocean.

From very early times, humankind has desired to fly. Kites crafted by the Chinese in the 5th century B.C. are thought to be the original unmanned aerial vehicles (UAV), ancestors of today's drones. The art and science of flight has seen tremendous progress since then.

For young engineers at the Samueli School, dreams of building flying machines thrive. This past year, students worked on a rocket, an autonomous drone, a small satellite, an award-winning radio-controlled aircraft, and a cargo plane. One group is close to testing a human-powered airplane (HPA).

Human-powered airplane team members (clockwise from bottom left) Jacqueline Thomas, Professor Robert Liebeck, Dat Huynh and Nima Mohseni stand next to the fully assembled 108-foot wing of their soon-to-be-tested aircraft.

The growing expertise and excitement is primarily student driven, according to Kenneth Mease, professor and chair of the Mechanical and Aerospace Engineering (MAE) Department. "Some students come to UCI with a passion to design and build things, and others develop that passion while they are here," Mease says. "It is contagious. We even have some students continue as volunteer advisers after graduating."

Three projects in particular – Design/Build/Fly (DBF), UAV Forge, and the HPA – all initiated by students, are contributing to the momentum.

HUMAN-POWERED AIRPLANE

First-generation college student Jacqueline Thomas revived UCI's HPA project after a hiatus of 20 years. It was 2011, the summer after her freshman year. She'd participated on the DBF team, but wanted to take on something different, something big. She approached Mease and DBF faculty adviser Robert Liebeck with the idea.

Human-powered aircraft remains a daunting engineering challenge, with ingenuous scientists from around the world competing for cash prizes. A group of the Royal Aeronautical Society aims to promote human-powered flight as the next Olympic sport.

"Jacquie was hell-bent on building this plane," says Liebeck, an adjunct professor in mechanical and aerospace engineering.

She had approached the right person. Liebeck builds planes for a living. A member of the National Academy of Engineering and a senior Fellow at the Boeing Company, he is a world-renowned authority in aerodynamics, hydrodynamics and aircraft design.

A determined Thomas recruited a team and secured a working area (not an easy task considering it's a plane!). For the next three years, she dedicated herself to designing, building and flying the HPA. She earned her private pilot's license at 19 and trained with cycling and triathlon teams in preparation of powering and piloting the 100-pound plane herself.

She leads a 32-member student team, along with another MAE student Joe King, chief engineer.

Jacqueline Thomas heads the human-powered airplane project at UCI along with chief engineer Joe King. Thomas, who plans to pilot the plane, revived the program after a 20-year hiatus.

"SOME STUDENTS COME TO UCI WITH A PASSION TO DESIGN AND BUILD THINGS, AND OTHERS DEVELOP THAT PASSION WHILE THEY ARE HERE."

They've created an aircraft with distinctive and what they hope are advantageous features. The fuselage and pilot are positioned at wing level, as opposed to underneath, to reduce drag. The propeller sits at the pilot's feet, for a more direct connection to its power source. And the plane sports a fully cantilevered wing with a 108-foot span (six feet shy of a 737's wingspan).

"We're using ultralight materials and advanced molding processes," says King, who as a teenager worked at a fiberglass repair shop, helping with design, fabrication and testing of the world's fastest drag boat; that experience has been instrumental to the HPA project. King, who graduated this year, is now a design engineer with aircraft prototype builder Scaled Composites. He returns on occasional weekends to advise the new crop of students.

The HPA team is planning its first test flight in early fall. Thomas, who also graduated this year and will head to graduate school at MIT, will return to power and pilot the aircraft. She hopes her team's plane achieves flight – 10 feet off the ground is the goal – and sets the stage for future students.

"Our plane is designed to be a reliable test bed to gather data and a better understanding of human-powered airplanes," says Thomas, who will have to pedal fast enough to generate at least 300 watts consistently to lift the plane off the ground.

"I believe the plane will fly successfully," says Liebeck. "When remains a key issue, and it should not be rushed."

DESIGN/BUILD/FLY

UCI's DBF team began in 2005 in a similar fashion. After class one day, MAE student Nella Barrera (now a systems engineer with Parker Aerospace) asked Liebeck if he would look at a model airplane she and a few students had built using composites.

"I brought in some engineers to talk fundamentals with the group," remembers Liebeck. "We provided quite a bit of guidance, and after three weeks, those students had something that looked like it would fly."

The UCI team entered the annual American Institute of Aeronautics and Astronautics (AIAA) Foundation DBF competition

that year and placed 12th out of 36 teams. The yearly contest asks student teams to design, fabricate and demonstrate the flight capabilities of an unmanned, electric-powered, radio-controlled aircraft that can best meet a specified mission profile.

MAE third-year student Kamil Samaan joined the project in 2008. With a hunger to win and driving enthusiasm, he and several others spent summers pouring over the previous year's flight results discerning how to improve the aircraft. They wrote a MATLAB computer code to simulate how the plane would fly and more accurately model the thrust and drag of each design tweak.

UC Irvine's Design/Build/Fly team earned its third straight top-two finish this year, placing second at the 18th annual American Institute of Aeronautics and Astronautics Foundation competition.

UAV Forge team members test their unmanned aerial vehicle, or spy drone, at the Winter Design Review.

This year's DBF team placed 2nd out of more than 70 competitors; it was its third straight top-two finish.

Samaan served as an adviser while finishing up his master's degree. He is now an aerospace engineer at AeroVironment, which manufactures unmanned aerial aircraft systems used by the military.

"It's like DBF on steroids" says Samaan about his job.

"We've gone from, 'Gee it flies,' to hard core engineering," Liebeck says. In fact, he and a few of the DBF students along with Samueli School Dean Gregory Washington traveled to China this summer to share their knowledge with other collegiate engineers. Sponsored by Boeing, the student leadership conference gathered student teams from UCI, Virginia Tech and several universities in China.

UNMANNED AERIAL VEHICLES

The most recent aeronautics project, UAV Forge, cropped up on campus in 2013.

"UAV Forge was a dream of mine," says MAE student Thomas Keith Hamilton. "I simply wanted to make something amazing fly and discover creative solutions to problems."

Originally a 2012 DARPA crowd-sourcing contest, the UAV Forge program asked do-it-yourself drone enthusiasts to create the spy drone of the future – portable, affordable drones that could perch in useful locations for several hours and provide continuous, real-time surveillance without dedicated or specialized operators. The year-long contest ended without a winner, but that didn't stop Samueli School engineering students from trying to complete the task anyway.

Hamilton met with administrators, filled out paperwork, found meeting and work space, secured funding and gathered a team. Making a UAV involves electrical, mechanical, electronic, aerodynamic, computer, manufacturing and telecommunications engineering disciplines. UCI's inaugural cohort of 16 students demonstrated a prototype at this year's Winter Design Review. In just one year, the team built a UAV that successfully took off, hovered, operated surveillance equipment and landed safely.

"We discovered strategies that didn't work and why," says Hamilton. "We've done the hard work of tilling the ground, paving the way for success next year."

A key draw for students on these projects is the opportunity for hands-on engineering.

Says Mease: "Design projects provide a challenging context for applying the theory and methods taught in the classroom, and they expose students to broader system-level issues and the importance of effective teamwork."

"The majority of them haven't done anything with their hands," adds Liebeck. "But, boy, do they jump on board. It's fun to watch."

ALUMNI AND FRIENDS

The continuing success of the Samueli School of Engineering is fueled by the involvement of influential alumni and friends who promote its visibility and help secure philanthropic support to advance its goals to unleash innovation, create opportunities and inspire ingenuity. The school's growing alumni ranks are making significant contributions to society in the fields of technology, business, academia, government, military and social causes. Alumni and friends are encouraged to be part of the many dynamic opportunities within the Samueli School, such as participating in career fairs, mentoring programs or hands-on design projects. The school is in an exciting growth period, developing innovative advancements each year that afford ample engagement.

NOTEWORTHY

AEROSPACE SEAMSTRESS FUNDS FELLOWSHIPS

Ida Melucci, a seamstress who worked for McDonnell Douglas and then Boeing, left a bequest of $1.5 million to UCI's Samueli School of Engineering to create graduate fellowships. The Meluccis were both long-standing and dedicated employees of the Huntington Beach, Calif., aerospace company. The late William Melucci worked in sealing and bonding. Ida worked on space blankets for the Delta rocket, missile bags and insulation blankets for the Space Station, and slip covers for cargo boxes carrying high-tech space tools on the Endeavor space shuttle. She learned to sew from her Italian-born mother, a master garment maker. She and her husband lived a modest life in Garden Grove, Calif. William died 20 years before his wife, who worked well into her 70s.

"My aunt was very proud of working in the aerospace industry and with engineers," says Julie Weisert. "She had very little formal education, but appreciated that the engineers consulted her and acknowledged her work. I think that's why she decided to donate her money to support engineering education at UC Irvine."

The William and Ida Melucci Space Exploration & Technology Fellowship will provide graduate support in perpetuity in memory of the couple.

PAYING IT FOWARD

A group of students from the Samueli School of Engineering and the Donald Bren School of Information and Computer Sciences participated in the inaugural Undergraduate Mentorship Program, which focused primarily, though not exclusively, on pairing up female engineering and computer science students with mentors in a variety of high-tech businesses. The proportion of women in STEM fields (science, technology, engineering and mathematics), both in academia and industry, continues to lag behind that of men.

Linda Smart, senior director of research and development informatics services at Allergan and a UCI alumna, was instrumental in the launch of the mentoring program. "I had a real personal interest," Smart says. "It's a way for me to sort of reach back in time, think about who I was as a student, and say, 'How can I give young students the benefit of my experience?'"

As part of the program, all mentors conducted mock interviews with their mentees, reviewed their resumes and engaged them in career-track discussions. Many mentors brought their mentees out for site visits at their workplaces.

42

MENTORS FROM 25 COMPANIES PARTICIPATED IN THE PROGRAM

HENRY SAMUELI ADDRESSES ALUMNI

Last fall's joint alumni event for UCI's Samueli School of Engineering and Bren School of Information and Computer Sciences doubled as an edition of the two schools' Top Trends in Tech speaker series. Attendees heard from one of the biggest trendsetters in any technology field: Henry Samueli, co-founder, chairman and chief technology officer of Broadcom Corp. Taking to the podium on the Broadcom campus — just blocks away from UCI — Samueli spoke on current technological trends and took questions from the audience. Some 120 people, most of them graduates of engineering and computer sciences, attended the event.

"We are thrilled with the turnout," says Ed Hand, executive director of development for the Samueli and Bren schools. "Events like this motivate alumni to become more engaged with all of the exciting things happening at both schools."

DOUBLE THE PARTICIPATION

A record number of students participated in the 11th annual Butterworth development competition and the inaugural Beall Student Design Competition co-hosted by UCI's Samueli School and Bren Information and Computer Sciences School. The Butterworth competition is named for, and generously supported by, Bren School alumnus Paul Butterworth; the Beall competition is made possible by a donation from the Beall Family Foundation. Where Butterworth emphasizes software, and requires that at least one team member be from ICS, Beall focuses on hardware, and requires that at least one team member be from the engineering school. The two competitions were not only concurrent and complementary, they also overlapped: Several teams entered their projects in both competitions.

Team Spero Diagnostics (pictured) took the top prize in the Beall competition for its product that addresses the dangerous, even deadly prevalence of sepsis in hospital settings. Team Sparky took first in the Butterworth competition for its smartphone app that enables professionals attending large events to easily collect contact information and later use the app to retrieve an intelligently sorted list of everybody with whom they interacted.

$30,000

IN CASH PRIZES AWARDED TO TEAMS BETWEEN THE TWO CONTESTS

JOIN THE DEAN'S CIRCLE

At the Samueli School of Engineering, we believe in meeting tomorrow's technological challenges by providing the highest quality engineering education and research rigor today. Private contributions are critical to the school's success.

This fall, the school will welcome one of the largest and smartest classes of Anteater Engineers in its history. Nearly a third of the class is identified as low income. For many students, a UCI education will change their family's future.

The Dean's Circle helps fund scholarships and fellowships that help offset the high costs of a university education. It supports curriculum development, enhanced educational environments and experiential learning. An annual gift of $1,000 or more ($250 for alumni who have graduated within the last five years) ensures the tradition of excellence known to all Anteater Engineers and will help the school continue to prepare the engineering leaders and innovators of the future.

Join the Dean's Circle by making a commitment with the attached envelope or contact the school's external relations department at (949) 824-8546.

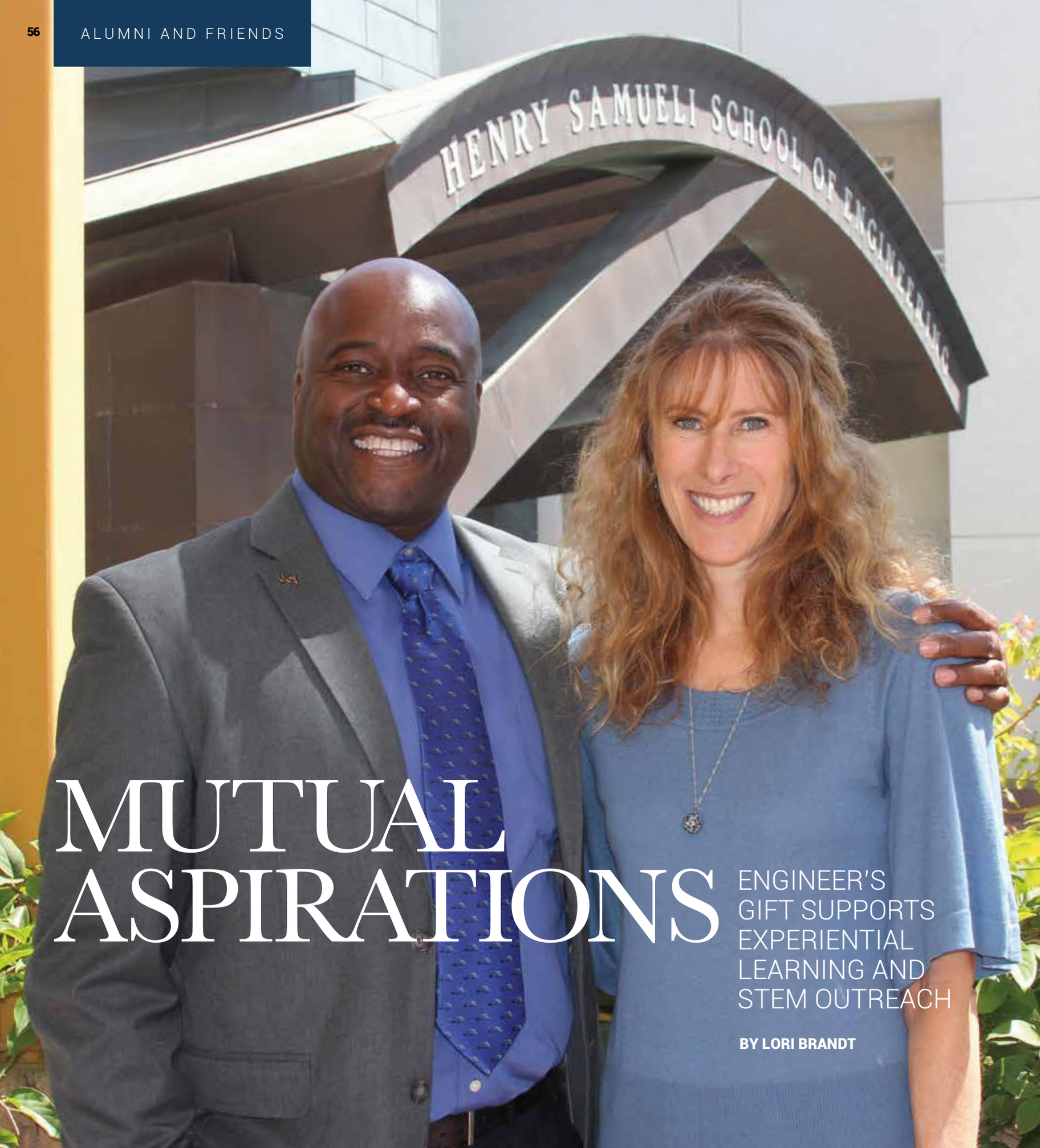
SIMULATION DONATION

For many years in product development, engineers designed on paper, built a prototype, tested it in the lab and made changes based on test results. They repeated the process an untold number of times, until the product met specifications. It was costly and time-consuming. Today, engineers design and test products on their computers with CAD and simulation software. And now, thanks to a generous donation from software company ANSYS, Inc., a new generation of Samueli School students has the opportunity to use the software simulation tools, making them ready and able to compete for jobs after graduation. ANSYS has donated more than 500 licenses that cover both electrical and mechanical engineering software packages, as well as multiphysics (multidisciplinary) simulations. The donation also includes High Performance Computing licenses for cluster computing, so that multiple computers can work together as one supercomputer to solve large-scale problems.

"We're really excited about this partnership with ANSYS," says Professor Franco De Flaviis. "Because everybody in industry uses this software, our students will be much more competitive when they graduate."

$3.7 million

CORPORATE DONATIONS TO THE SAMUELI SCHOOL IN FY 2013-14



MUTUAL ASPIRATIONS

ENGINEER'S GIFT SUPPORTS EXPERIENTIAL LEARNING AND STEM OUTREACH

BY LORI BRANDT

124

MIDDLE SCHOOLERS PARTICIPATE IN 2014 FABCAMP

40

FABCAMPERS RECEIVE FULL SCHOLARSHIPS

1,600

STUDENTS SERVED BY THE MESA OUTREACH PROGRAM

Stacey Nicholas' father had always encouraged her interest in math and science; her mother nurtured her love of the arts. Nicholas grew up to become an electrical engineer, working in aerospace at TRW, designing custom semiconductor digital chips for satellite communications and military applications, and later working as a sales director at NCR Microelectronics, a commercial application-specific integrated circuit supplier.

Today she is a full-time mother, avid cycler, pet lover and generous supporter of the arts and education. With a recent $9.5 million gift to the Samueli School of Engineering, she hopes to inspire young people to pursue degrees in science, technology, engineering and math (STEM) fields.

This generous donation, given by Nicholas' Opus Foundation (named after the family's beloved deceased cat), will establish an endowed deanship; fund student scholarships and graduate fellowships; and support school programs that focus on STEM outreach. It will also facilitate an ongoing partnership with St. Margaret's Episcopal School in San Juan Capistrano.

"This gift will allow the Samueli School to engage more students in an experiential learning approach, and that is what will ultimately give UCI engineers a competitive advantage," says Dean Gregory Washington. "We appreciate Stacey's support of our efforts."

"I am so happy and so honored to be a part of the engineering school at UCI," says Nicholas. "I greatly admire and support Dean Washington's commitment to outreach, diversity and innovation in STEM education. I am thrilled to be able to make a difference."

Nicholas first became involved with UC Irvine's school of engineering in 1995 through her former UCLA professor, Nicolaos Alexopoulos, who was the school's dean at that time. She currently serves on the school's Leadership Council and Diversity Advisory Board.

Nicholas likes maintaining a connection to the engineering community through her involvement with the Samueli School. "It helps me stay plugged in and up-to-date with what's going on in engineering," she explains. Her engineer's know-how also comes in handy when talking with her eldest son, who is studying electrical engineering at Dartmouth College.

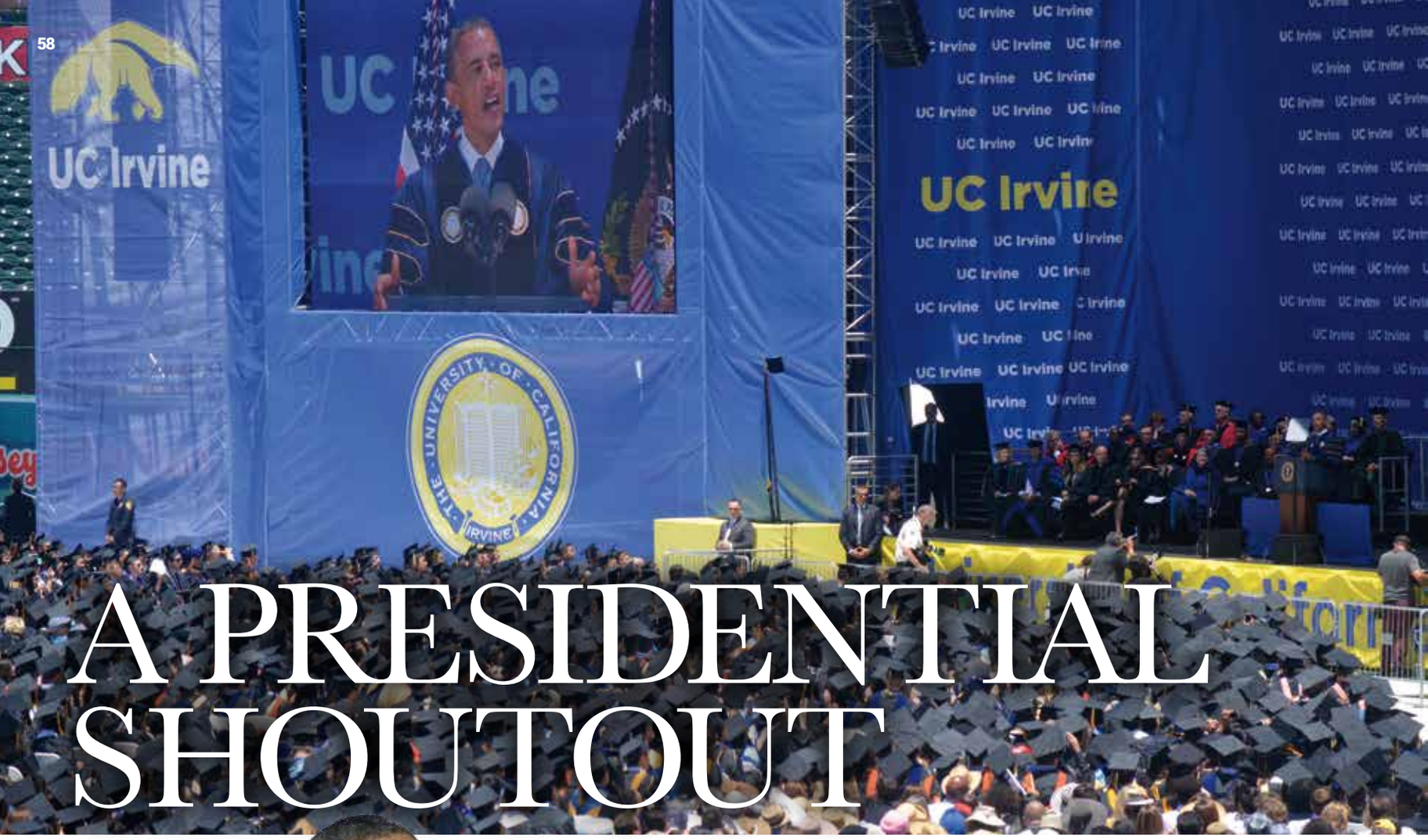
Nicholas is particularly excited about the summer internship program for high school students that she spearheaded at the Samueli School 10 years ago. The competitive program places talented high school seniors from St. Margaret's Episcopal School into UCI engineering labs under the guidance of professors and graduate students for six weeks of intensive, college-level experience.

St. Margaret's student Narumi Takagi participated in the internship program, working in the Samueli School's Advanced Power and Energy Program where she learned how to analyze data from advanced solar panels and to see their impact on the power grid. Takagi went on to become an Anteater engineer, majoring in mechanical engineering. She still works in the power and energy lab and plans to study energy generation.

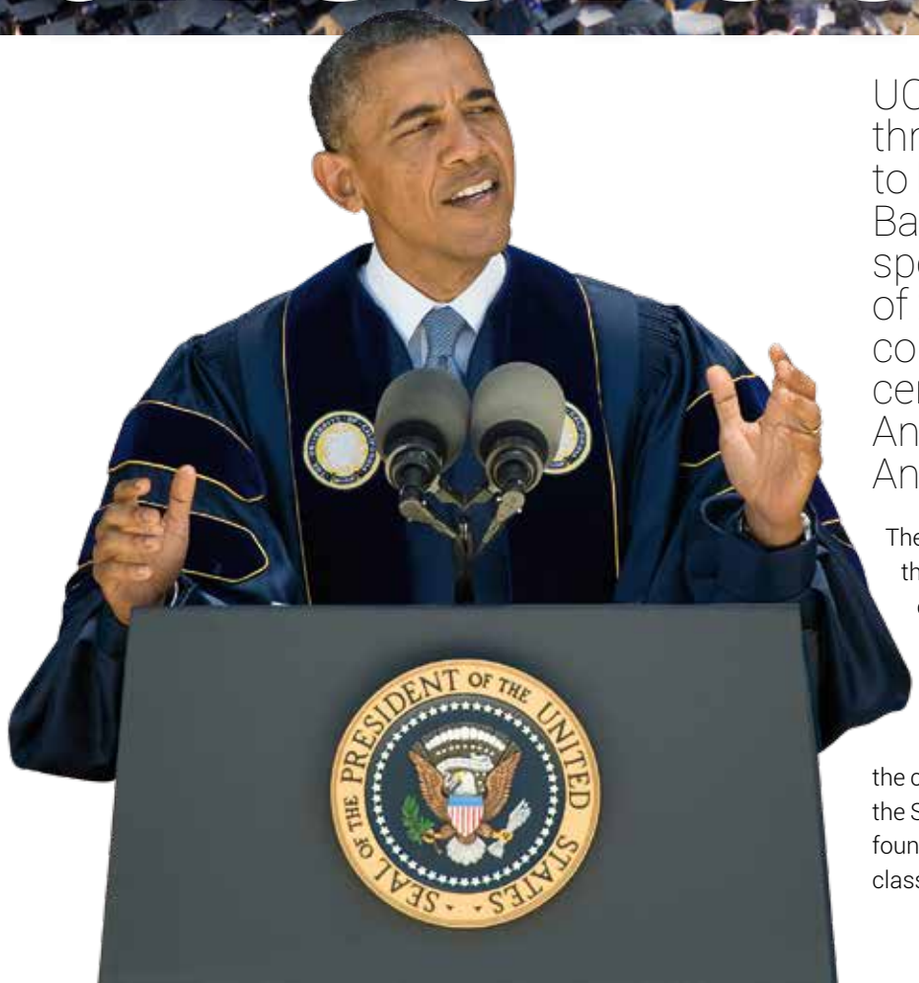
"I really enjoyed being in the lab and seeing all the projects going on around me," says Takagi. "If I hadn't done the internship, I wouldn't have worked with Professor [Scott] Samuelsen, and I would have missed out on the opportunity to work and learn at UCI."

Nicholas also serves on the Advisory Board of Breakthrough San Juan Capistrano, a national Breakthrough Collaborative site hosted by St. Margaret's. A tuition-free program, Breakthrough SJC provides academic enrichment and support for highly motivated underserved middle and high school students so that they can realize their potential to excel in high school and succeed in college. In support of the program, the Samueli School hosted two sessions of its popular summer FABcamp at the high school and has taken on two high school Breakthrough students as summer interns.

"Both UCI and St. Margaret's are close to my heart," says Nicholas. All of her three children attended St. Margaret's. "This gift supports our partnership and our common goal of encouraging students of diverse backgrounds to pursue a STEM education. I couldn't be more excited to endow these programs and make them sustainable into the future. To be able to support UCI, St. Margaret's and Breakthrough with this same gift is just extraordinary!"



A PRESIDENTIAL SHOUTOUT



UC Irvine was thrilled and honored to have President Barack Obama speak to the class of 2014 in its commencement ceremony held at Angel Stadium of Anaheim.

The historic appearance kicked off the campus's 50th anniversary celebration. In June 1964, President Lyndon B. Johnson landed in a barren pasture to dedicate the land that would become UCI. By October 1965, the campus opened its doors with the School of Engineering among its founding programs. The inaugural class included 75 students declaring engineering majors under the guidance of three faculty members.

In June, the Samueli School of Engineering graduated 972 students and was particularly proud to have one of its graduates called out by the president.

A SURPRISE ACKNOWLEDGMENT

Mohamad Abedi didn't answer at first, because the number was identified as "unknown" on his cell phone. Little did he know it was the White House calling!

Then came an email from a whitehouse.gov address. It was 10:51 a.m. Friday, June 13, the day before his commencement, and the biomedical engineering student was working in the lab of engineering professor Elliot Hui.

Turns out it was the White House communications team checking the facts on Abedi's story, which had been included in UCI's commencement press materials. Abedi immediately responded to the email and was soon speaking with the person supplying President Obama's speechwriter with information in preparation for his commencement address the following day. She thanked Abedi but cautioned that she couldn't promise he would be included in the president's remarks.

The next morning, Abedi, graduating summa cum laude, was sitting with fellow Anteaters at the commencement ceremony. Near the end of the president's remarks, he was mentioned. "Frankly after hearing my name, I couldn't hear the rest, I was in shock," says Abedi.

President Obama: "There are people here who know what it means to dream. When Mohamad Abedi was a boy, the suffering he saw in refugee camps in Lebanon didn't drive him into despair – it inspired him to become a doctor. And when he came to America, he discovered a passion for engineering. So here, at UC Irvine, he became a biomedical engineer to study the human brain. (Applause.) And Mohamad said, 'Had I never come to the United States, I would have never had the ability to do the work that I'm doing.' He's now going to Cal Tech to keep doing that work."

Abedi immigrated to Irvine after high school, where he attended community college, then transferred to UCI.

"It was while working in Professor Hui's lab that I was drawn to the idea of developing low-cost medical technologies. As a biomedical engineer, you can do something that may affect hundreds, thousands, maybe even millions of people at a time," he says.

Abedi's parents and his sister were in the commencement audience, too. They went home and watched the president's speech over and over. "My parents still can't stop talking about it, hearing their son's name spoken by the president. They've been telling everyone about it."

ENERGY AND SUSTAINABILITY

In a nearly 30-minute talk that received three standing ovations, President Obama also highlighted the significance of several environmental and alternative energy research efforts in engineering.

President Obama: "Students and professors are in the field working to predict changing weather patterns, fire seasons and water tables – working to understand how shifting seasons affect global ecosystems; to get zero-emission vehicles on the road faster; to help coastal communities adapt to rising seas. And when I challenge colleges to reduce their energy use to 20 percent by 2020, UC Irvine went ahead and did it last year. Done. (Applause.) So UC Irvine is ahead of the curve. All of you are ahead of the curve."

Samueli School of Engineering Dean Gregory Washington was among the UC delegation on the platform as President Obama addressed the audience.

UC Irvine 50 1965 2015
Bright Past. Brilliant Future.

Oct. 4, 2015, will mark 50 years since UCI's first day of classes. In the months leading up to the milestone, the campus is planning a series of celebratory activities.

HALL OF FAME

To commemorate the anniversary, the Samueli School will be launching the Anteater Engineering Hall of Fame. We will induct the top 50 alumni from the past 50 years by recognizing those who have made significant contributions to society in the fields of technology, business, government, military, education and social causes. Nominations will be accepted from any alumnus, his/her associate, friend or family member. Watch for more information via the school's social media channels, website and electronic communications.

SUBMIT A FAVORITE MEMORY

The legacy of UCI is illustrated through the stories of those who have seen or taken part in its colorful history. Submit a story, a memory, or your thoughts about your engineering school experience as we celebrate the 50th anniversary. Select contributions will be shared in the 2014-15 Dean's Report.

Submit your favorite memory by email to:
engcomms@uci.edu
or by mail to:
Samueli School of Engineering
Communications Office
5200 Engineering Hall
Irvine, CA 92697-2700

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MICROFLUIDICS IN AUGMENTED REALITY

A tiny chip with the same capabilities as a full-size laboratory? That's the science of microfluidics, also known as lab-on-a-chip. Advances in the field are supporting huge strides in point-of-care diagnostics. Employing droplet-based microfluidics, extremely small, often rare liquid samples are broken down into millions of droplets that can be tested individually.

By using your smartphone or tablet, you can download a free augmented reality app to see this microfluidic device in action. Here's how:

Step 1: Download and install the UC Irvine Samueli School of Engineering APP – scan the QR code on the left, or download it from the Android or Apple store.

Step 2: Point your smartphone or tablet over this back cover image.

Step 3: Watch the microfluidic device's amazing process.

Available on the App Store

Available on the Android Market