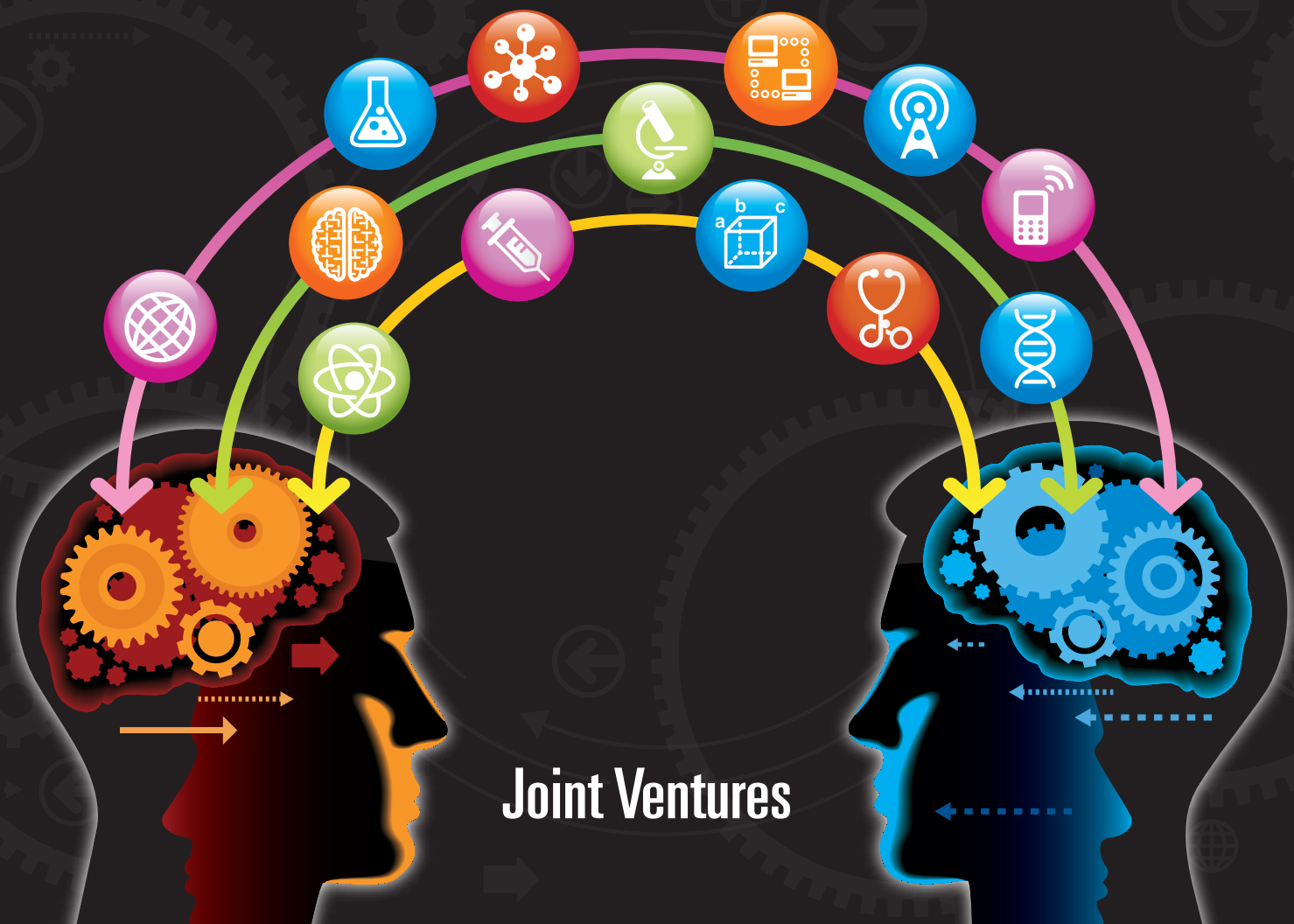
interface®

California Institute for Telecommunications and Information Technology

Volume 8 | Issue 1 | Fall 2012

University of California, Irvine



Joint Ventures

Table of Contents

Interface®
Fall 2012

Calit2@UCI
G.P. Li
Director

Shellie Nazarenus
Assistant Director
Marketing and Outreach

Stuart Ross
Assistant Director
Research Development

Shellie Nazarenus – Executive Editor
Anna Lynn Spitzer – Managing Editor
Michael Marcheschi – m2design group
Mike Delaney – Meridian Graphics

Calit2
University of California, Irvine
4100 Calit2 Building
Irvine, CA 92697-2800
(949) 824-6900
www.calit2.uci.edu
info@calit2.uci.edu

by Anna Lynn Spitzer

These lessons, handed down for generations from parents to their children, now inform a growing trend in scientific research.

Once, scientists worked alone or with others in their own fields of expertise. Today, their collaborations span disciplines, institutions and sites, thanks to advances in science and engineering, and a trend towards increased specialization.

From a few researchers working together in the same institution to a large group dispersed across geographic and organizational boundaries, teams' configurations vary widely.

Multi-, inter- and transdisciplinary research comprise a "continuum of integration," says expert Dan Stokols, UC Irvine Chancellor's Professor in the School of Social Ecology, who studies the science of team science.

Multidisciplinary research involves scientists from different fields who collaborate in a sequential way. "It's a little bit like an assembly line, where people remain anchored in their own fields," he says.

Interdisciplinary research involves closer, day-to-day, more reciprocal interaction. Team members combine concepts and methods from their respective fields, integrating their perspectives but remaining rooted in their own disciplines.

The zenith is transdisciplinary research, where integration "starts to really break new ground and transcend each team member's field through new conceptual frameworks or methodological approaches," says Stokols.

(continued, page 2)

Transdisciplinarity can spawn new fields like *psychoneuroimmunology, bioinformatics* and *translational genomics*. "What differentiates [it] is the degree of commitment and immersion in solving a common problem, and the willingness to think out of the box."

It's not a one-size-fits-all proposition. "Some questions in science may not be ready for cross-disciplinary team collaboration; they may be much more discipline-centric," Stokols explains.

Still, the model captivates. Scientists, engineers, doctors, social scientists, computer experts, policymakers and other researchers are opening their arms and their laboratory doors to new partnerships in the quest for solutions to ever-more complex challenges.

A Measure of Success

In the sometimes bumpy terrain of cross-disciplinary research collaborations, Dan Stokols is a modern-day pioneer.

The social ecology professor is an innovator in the *science of team science* (SciTS). Not to be confused with team science itself, the fledgling discipline designs benchmarks to gauge success or failure of cross-disciplinary research teams, and seeks to manage circumstances that influence collaborative effectiveness.

Says Stokols: "The question is: When does team science work well and lead to new innovations, and when does it falter?"

His research indicates that successful collaborations share a high degree of personal give-and-take; an appropriate physical environment; organizational, institutional and policy support; and a readiness to embrace new technologies.

And members of the most effective teams have a certain "behavioral repertoire" supported by key values and beliefs: among them, a strong trust in the value of inclusiveness and the integration of diverse perspectives.

Close cooperation is critical. A recent study compared the publishing output of scientists working within a large transdisciplinary initiative with those working alone or in smaller groups on the same topic.

Initially, the individual investigators published more but four or five years later, the transdisciplinary researchers had surpassed them. "There's often a lot of muddling through that happens when a team comes together in one of these initiatives," Stokols says. "But once you get that synergy going you can gain some economies of scale from

Dan Stokols: "Knowledge is getting so specialized. For someone to tackle a complex scientific or societal problem they have to combine their focused knowledge with areas that compensate for their blind spots."

Photo: Daniel A. Anderson, University Communications

it, along with some very innovative breakthroughs."

Typical indicators of scientific accomplishment only go so far when assessing multidisciplinary collaborations. One of SciTS's challenges has been to address new questions. What is the quality of cross-disciplinary integration? Are the methods and conceptual frameworks sound? How novel is the output and what might the impact be on society or science?

In addition to helping develop these new assessment rubrics, Stokols has worked with colleagues at the National Cancer Institute to create a "team science toolkit," a wiki-type online resource that supports team science collaborations, disseminates effective practices and offers tools to help teams maximize their efficiency.

Stokols' interest in cross-disciplinary collaboration goes back many years. In graduate school, he petitioned to add minors in city planning, sociology and public health to his social psychology program. "I wanted a broader, more community-oriented perspective," he says.

At UC Irvine, he worked his way up to director and founding dean of the School of Social Ecology, where interdisciplinary approaches link research and community problem-solving – "all the things I am interested in."

Also at UCI, he participated in a National Institutes of Health-funded Transdisciplinary Tobacco Use Research Center (TTURC), where he studied the participants' daily interactions, accomplishments and frustrations; he used that experience to assist the National Cancer Institute in evaluating its transdisciplinary research and training centers initiatives.

Currently, he consults with the National Academies, helping evaluate the scientific output of its National Academies Keck Futures Initiative (NAKFI) seed-grant program (see page 4).

Photo: Paul R. Kennedy

More and more, he says, large cross-disciplinary teams are the norm in the world of research. "Knowledge is getting so specialized. For someone to tackle a complex scientific or societal problem they have to combine their focused knowledge with areas that compensate for their blind spots."

Multidisciplinary, interdisciplinary and transdisciplinary research, however, are not panaceas. "I'm not a cheerleader for everybody being transdisciplinary or even interdisciplinary," Stokols says. "I think some people work better drilling down into a particular discipline and coming up with breakthroughs [that way].

"I don't feel one size fits all. You do not necessarily have to do science bigger; you have to do it smarter."

Transdisciplinary collaboration planted roots in the Calit2 Building nearly a decade ago: computer scientist Rick Lathrop (left) and molecular geneticist G. Wesley Hatfield (right) opened the Computational Biology Research Lab, where computation was used to build novel biological systems. The effort led to patents, research grants and spinoff company CODA Genomics, with CEO Bob Molinari (center) at the helm. Calit2's first incubation success, it was later renamed Verdezyne Inc., and is now headquartered in Carlsbad, Calif.

The Best and the Brightest

Biomedical engineering graduate student Nizan Friedman has learned the value of multidisciplinary research, both in the lab and in the marketplace. He helped develop MusicGlove with anatomy and neurobiology professor David Reinkensmeyer and electrical engineer Mark Bachman; they are now parlaying the effort into a startup company, Flint Rehabilitation Devices, LLC, which is housed in Calit2's TechPortal incubator. "Calit2 cultivates a unique environment to translate technology from bench-top to marketplace," Friedman says. "I attribute much of the success of MusicGlove to this truly multidisciplinary environment."

Photo: Paul R. Kennedy

Nearly 10 years ago, the National Academies saw the future – and it was interdisciplinary. The esteemed organization – comprising scientists from the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine and the National Research Council – counts among its members the most distinguished of this country's brilliant minds, including more than 300 Nobel Laureates.

The group's mandate is to help shape public policy, inform public opinion and advance the pursuit of scientific knowledge. In 2003, it decided interdisciplinary collaboration was crucial to that mission.

So it partnered with the W. M. Keck Foundation to announce the Keck Futures Initiative, a 15-year $40 million endeavor to nurture these relationships.

"Both organizations believed that catalyzing communication between people who live in different academic worlds was an important aspect of making rapid strides in advancing science," says Anne Heberger Marino, senior program associate.

The initiative, known as NAKFI, is based at the National Academies' Beckman Center on the UC Irvine campus. Each year the organization sponsors an invitation-only conference, bringing together researchers from diverse fields who might never meet.

"The intent is really to get different people together and explore difficult ideas in a way that's going to be energizing and interesting," Marino says. "It's a conversation starter of a scientific nature."

Post-conference, NAKFI supports approximately a dozen collaborations per year with seed grants from $25,000 to $100,000 apiece.

These grants fill an important void; major federal funding programs usually do not subsidize research in areas considered risky or unusual, nor do they fund early-stage research lacking in preliminary data. The NAKFI seed grants allow researchers to explore new ideas, purchase equipment, hire graduate students and acquire skills to pursue unique research approaches.

NAKFI calls it "venture science."

"People understand the term venture capital," Marino says. "That's really the mentality of the program; we want to finance these bold, promising new collaborations. There's so much discovery and an awful lot of 'eureka!' moments in science, and we're trying to give them the tools to act on that."

Photo: Paul R. Kennedy

NAKFI conferences, like last year's on ecosystem services and sustainability, are held at the Beckman Center on the UCI campus. They bring together select groups of researchers to explore difficult ideas with those from other disciplines.

Many of the seed-funded projects leverage the NAKFI grants to obtain funding from large national agencies like the National Science Foundation and National Institutes of Health.

One success story: an effort to build prosthetic limbs controlled by amputees' brains was born from a collaboration cultivated at the 2006 NAKFI conference on smart prosthetics. The collaborators – a mechanical engineer, a kinesiologist, a computer scientist and a biostatistician – last year leveraged a $75,000 seed grant into a $1.2 million grant from the NSF.

Building successful collaborations is like baking a cake, Marino says. "You can throw all these delicious things in but is it going to be delicious at the end? It's one thing to put things together; it's another to get something useful out of it."

Ten years into the 15-year grant, it would appear that NAKFI is baking a masterpiece. An executive panel recently deemed the seed grant program highly successful in funding bold, innovative research and supporting new interdisciplinary collaborations.

"I don't think we've ever had a grant where we feel that the whole thing is a waste of money," Marino says. "There's always been something interesting or surprising or special that's come out of it."

Social Services

Sandwiched between the room-sized computers of the 1940s and the smart phones currently in millions of pockets worldwide is an era of unprecedented technological advancement.

Equally significant is the associated social revolution. A new multidisciplinary center headquartered at UC Irvine will devote the next five years to examining the sometimes underestimated social impacts of the digital age.

The Intel Science & Technology Center for Social Computing, launched last June, is part of a five-campus collaboration funded by a $12.5 million grant from semiconductor giant Intel. Cornell University, Indiana University, the Georgia Institute of Technology and New York University are partners in the research.

Led by UCI informatics professor Paul Dourish, anthropology and law professor Bill Maurer, and Intel's Scott Mainwaring, the center is dissecting the social aspects of computing trends from multiple vantage points along the disciplinary divide.

By examining and building on past techno-social trends, the center is taking a giant step toward better understanding next-generation computing.

Academic and Intel researchers work side by side to provide a window into future products, platforms, policies and practices. "Our research will indicate what is happening now and what things are on the

horizon five or 10 years out that we should all be thinking about now," Maurer says.

The key message: computing involves much more than the hardware itself. Behavior and technology play tag in the march toward newer, faster and better. Technology presents opportunities that inspire certain behaviors; these behaviors continually influence the design of new technologies.

Case in point: SMS (text messaging) was created to fill small leftover spaces in digital packets. Those short messages led to Twitter's 140-character missives, which impact culture, politics and daily life in ways we couldn't have imagined.

"It's never just what the technology does nor is it just what people do," Dourish says. "They both build on the other."

Researchers say a multidisciplinary perspective is crucial to a full understanding. "Our starting point is what people are doing in the real world, and those activities are not constrained by a series of arbitrary definitions," Dourish says. "Having broader-based teams gives us much more powerful leverage."

In addition to computer scientists and anthropologists, center-affiliated researchers include cognitive scientists; engineers; culture, gender and media studies experts; and philosophers.

"We're building a network of researchers that brings together unexpected and unanticipated connections – whatever's on the edge of this broad domain we're calling social computing," Maurer explains.

Adds Dourish: "We want to allow for these interactions, these unexpected collaborations and new ideas to come out. Part of the trick over the next few years will be making sure we can leave space for the creative and unexpected to keep on happening."

Photo: Heather Wuebker, School of Social Sciences

(From left) Dourish, Maurer and Mainwaring lead UCI's effort in the five-year, five-campus collaboration, which seeks to understand the social impacts of the digital age.

Bench to Bedside

Human trials are underway for a tele-rehab application supported by ICTS. An occupational therapist uses Skype to guide stroke patients as they strengthen hand function by playing computer games in the privacy of their own homes. A collaboration among neurologist Steve Cramer, robotic expert David Reinkensmeyer, engineer Mark Bachman and computer scientist Walt Scacchi, the project recently won a prestigious $50,000 Dean's Triumvirate Grant. Before beginning home treatment, Jeanne O'Shea undergoes a baseline assessment at UCI, guided by therapist Lucy Dodakian and Cramer.

In one corner: research scientists toiling on technologies to tackle perplexing biomedical problems.

In the other corner: doctors searching for effective remedies while treating patients and juggling paperwork.

Between them: the so-called "valley of death," brimming with obstacles that impede the mutual benefit to be gained from collaboration.

The National Institutes of Health is building bridges over this barren landscape. Through its Clinical and Translational Science Awards program, it moves innovation "from bench to bedside" by connecting academic researchers with clinical practitioners.

UC Irvine's Institute for Clinical and Translational Science (ICTS) is one of 60 CTSA centers nationwide. Funded by a $20 million, five-year award, ICTS offers clinical services, workshops, grants and a host of other opportunities that facilitate collaboration between clinicians, academic researchers and the community.

Margaret Schneider, the ICTS director of evaluation and tracking, explains it like this: "Translational research is translating discoveries made at the laboratory level into innovations in patient care. You're crossing this spectrum from highly controlled experiments to making a difference to individuals in the community."

It's often problematic. "Scientists have their own area of expertise and they speak their own vocabulary. So communication between the basic scientist and the clinical researcher can sometimes be very difficult," she says.

ICTS provides help overcoming these challenges. "We try to encourage and empower individual investigators," says Director Dr. Dan Cooper. "We make sure the whole enterprise applauds and rewards innovation. We celebrate team science, where people exchange ideas in a free and open manner."

Community is crucial. At ICTS, a community action planning group comprising 25 organizations meets quarterly to plan a series of workshops as well as an annual community awards dinner.

Across the University of California, similar efforts are underway on each of the five medical school campuses. All are part of an initiative called UC BRAID (Biomedical Research Acceleration Integration and Development), that accelerates clinical and translational biomedical research across the university system.

The collaborative has developed a "Trust and Rely" arrangement that spans the campuses' Institutional Review Boards. Clinical trials approved at one campus can be conducted at any of the other four without submitting to new

Photo: Paul R. Kennedy

Photo: Paul R. Kennedy

At the Beckman Laser Institute, clinicians like Dr. Kristen Kelly (far right), who treat port-wine stain birthmarks, can see in real time how the blood vessels are reacting to the laser. The system, currently undergoing clinical trials, is built with computer video game graphics-processing cards that provide ultra-fast image rendering. Principal Investigator Bernard Choi says physicians previously gauged treatment based on visible changes on the skin's surface, "but it's better if they can see a live update while they're treating." Choi worked with graduate students Owen Yang (far left) and Bruce Yang, who is funded by an ICTS TL-1 training grant.

campus-specific institutional review procedures. UC BRAID also is developing an "honest broker" system, allowing researchers to pull relevant study data from UC medical records while keeping patients' identities confidential.

Last year, more than 500 investigators attended workshops, received grants or used an ICTS service. "We try really hard to work across boundaries," says Lisa Hinojosa, research operations director, by providing researchers a place to "come to the table and discuss things and see what can come of it."

Cooper is pleased with the center's progress, especially during these tough budgetary times. "I think we've done a really good job of creating a nimble, flexible, supportive, responsive infrastructure," he says. "We help people design studies, connect with other individuals in meaningful ways, find mentors and we help fund trainees."

Photo: Steve Zylius, University Communications

Scientists across UCI needing to view and analyze data at high resolution turned to electrical engineering and computer scientists for a technology solution. These cross-disciplinary interactions paved the way for Calit2 to secure NSF funding, giving birth to the Highly Interactive Parallelized Display Wall – HIPerWall. The effort attracted an increasingly diverse range of collaborations, leading entrepreneur Jeff Greenberg (left) to team with engineers Stephen Jenks and Sung-Jin Kim to spin out Hiperwall Inc. "This is one of Calit2's best examples of successful venture science," says Director G.P. Li.

Chip, Chip Hurray!

Multidisciplinary research and Dr. Steven George fit together like hand and glove. The UCI engineering professor also is a medical doctor by training – so he has a firm grasp of both worlds.

Last July, George received a prestigious $1 million NIH grant, one of only 17 awarded nationally by the interdisciplinary Tissue Chip for Drug Screening Initiative, which seeks to improve the process for predicting drug safety in humans.

George, director of UCI's Edwards Lifesciences Center for Advanced Cardiovascular Technology, has assembled an eight-member multidisciplinary team that is building three-dimensional perfused artificial tissue chips. These engineered microsystems will mimic the physiology and biology of cardiac and cancer tissues, and will be used for testing the safety and efficacy of cancer drugs before they are tested in people. One day they could even replace human clinical trials.

More than 30 percent of promising pharmaceutical treatments, while successful in animal testing, prove toxic in humans. Because the project's artificial tissue chips will mimic the response in human organs, they will indicate more accurately potential toxicity in new drugs, vaccines and biologic agents.

Biomedical engineering professor and project participant Abe Lee is microfabricating the chips.

"This holds great potential for the drugs to be tested at a fraction of the cost of animal testing, and consequently enhances the ability to predict the efficacy for the next pipeline of new drugs," he says.

Ultimately, George hopes to combine cancer and cardiac tissue on a single chip. Cardiac side effects often doom new cancer therapies, so "if they're on

the same platform you could see if a certain concentration of an anti-cancer drug is able to kill the cancer without damaging the heart tissue."

The chips are significantly larger than silicon computer chips – approximately 2 inches by 2 inches. They are made from a polymer called PDMS (poly-dimethyl-siloxide), in which human cells can thrive.

Molecular biologist Chris Hughes grows the blood vessels on the chips. "This collaboration allows us to think bigger and not be constrained by what is currently possible," he says. "Engineers help us to make our 'thought experiments' real, enhancing our ability to answer some of the toughest questions in biology."

George echoes the sentiment. "I think most people will tell you that true breakthroughs happen at the interface of disciplines," he says.

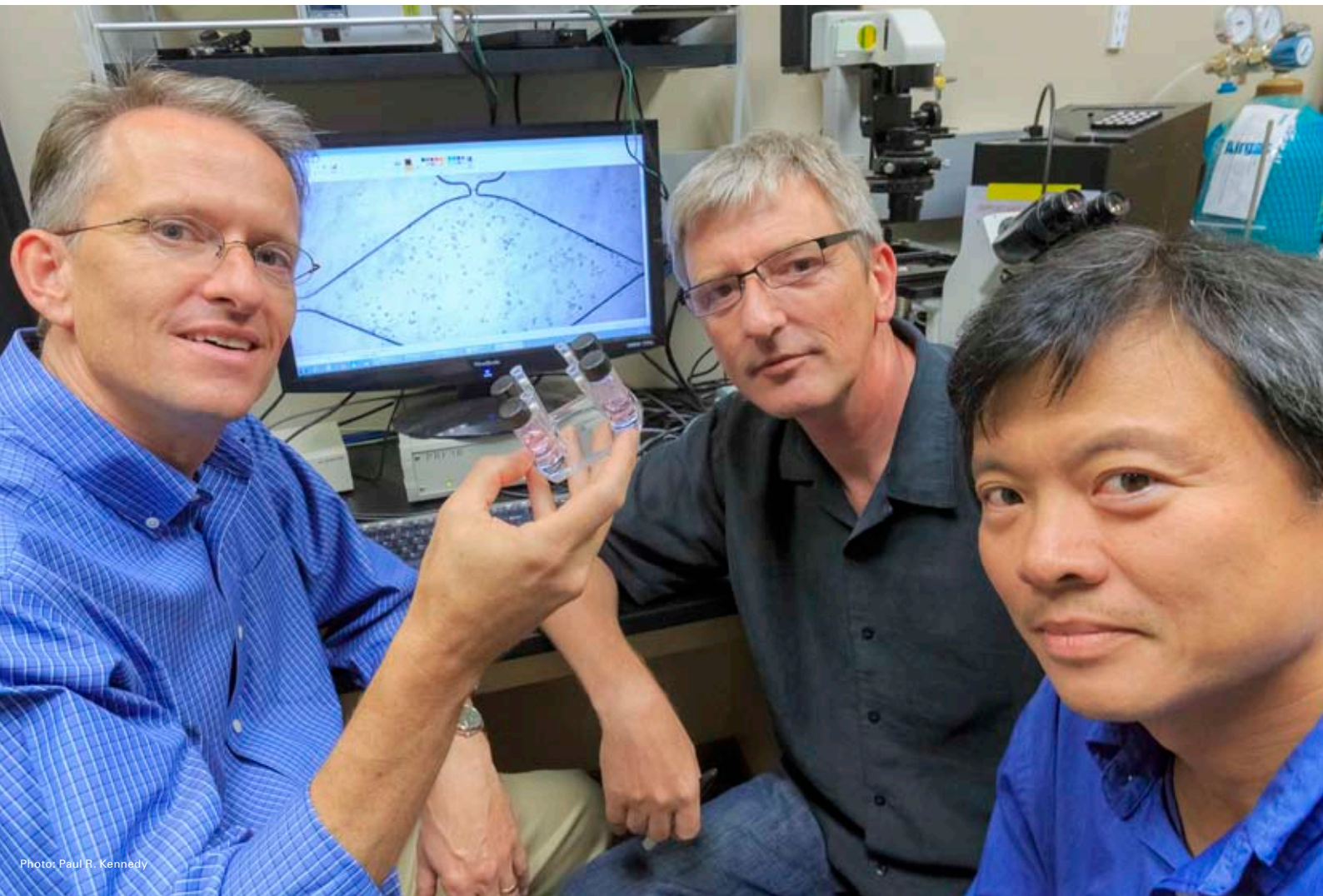
All three researchers agree that the sophistication of their project demanded a multidisciplinary approach. "The difficulty of this project cannot be overstated," Lee says. "It not only needs cutting-edge microfluidic technology, but knowledge of how to engineer physiological tissue, and how tissues create and synthesize vessels at the molecular scale.

"More importantly, it needs a true cross-fertilization of knowledge from [all] the labs."

Of the 17 NIH grant awardees, 10 are constructing artificial tissue chips representing separate human organ systems. The other seven awardees are developing stem cells and progenitor cells that could populate the tissue chips. The eventual goal is a single platform that simulates all 10 systems.

"I think we have the potential to identify organ interactions in human cells that can't currently be examined," George says. "This could change our potential to officially identify drugs that are safe and efficacious."

"I think most people will tell you that the true breakthroughs happen at the interface of disciplines."



George (left) has assembled an eight-member multidisciplinary team, including Hughes and Lee, to build a cell-based, artificial tissue chip that will help test drugs by simulating the response in human organs.

Photo: Paul R. Kennedy

Joining Forces

Not so long ago, the word 'network' brought to mind electrical engineers hunched over silicon chips.

Today, networks encompass sociology, biology, communications, public health, criminology and a myriad of other realms.

Researchers looking to unravel overlapping connections can find support at the Center for Networks and Relational Analysis, housed in the Calit2 Building.

Led by Carter Butts, a UCI sociology and statistics professor, the center provides neutral territory where sociologists, electrical engineers, computer scientists, chemists, psychologists, statisticians, public health experts and criminologists can hang their hats while they work together on network-related issues that transcend any one field.

"In all of these cases, we're dealing with complex datasets, complex analytical methods and substantive domains that vary widely," says Butts, who became convinced "that the way to move forward was not just through the social scientists who study social networks but [through] a much broader program to bring together people who look at networks from a variety of different standpoints and domains."

Cynthia Lakon, a health sciences assistant professor, is examining the connection between adolescent social networks and substance

"[We] bring together people who look at networks from a variety of different standpoints and domains."

Photo: Paul R. Kennedy

abuse. “This center is a terrific academic home for me and my research,” she says. “Being part of the center provides me with a way to connect with colleagues across disciplines, and has brought an interdisciplinary dimension to my work that has been very beneficial.”

Butts and his research team, who operate under the mantle of the Networks, Computation and Social Dynamics lab, manage several different projects. One, which includes UCI criminologist John Hipp and a University of Tennessee geographer, is analyzing a large-scale survey of social networks in the Western United States.

Dubbed the American Social Fabric Project, it examines ties between family members, social acquaintances, employers, confidantes and others in multiple communities. The social networks that emerge yield important practical information, like the best way to communicate with a particular community and how to predict crime rates more accurately.

“We’re trying to understand the large-scale structure of human social relationships,” Butts says. “In many cases, what goes on locally is affected by the social fabric of the area.”

(continued, page 14)

Butts (center) and his multidisciplinary team work on network-related issues that transcend any one field.

Another signature project, named HEROIC – Hazards, Emergency Response and Online Informal Communication – investigates the role of microblogging and other informal online communication tools in disseminating information after a disaster. "If you want to get situational awareness about a rapidly unfolding event, being able to tap into what's going on in the social media is very important," according to Butts. "That's a huge resource that emergency managers can use."

Electrical engineering and computer science associate professor Athina Markopolou has collaborated on several multidisciplinary projects. Recently, she and Butts partnered to sample online social networks, an effort she says was an "extremely productive collaboration that got a lot of visibility. It also inspired several other directions in our respective groups."

"You need all of this [different] information to get the science done. And that's not something you can do from one disciplinary point of view. "

Currently, she and Butts are collaborating with computer scientist Natasa Przulj. The three are leveraging developments in computer, social and biological networks to create an integrated, interdisciplinary approach to the study of systems with complex network structures.

Ongoing computational advances have created a rapidly changing research environment that makes the Center for Networks and Relational Analysis an important research partner, according to Butts. "We have this computer science-statistical-mathematical-IT wave of innovation that has happened hand-in-hand with substantive advances in specific disciplines," he states.

"You need all of this [different] information to get the science done. And that's not something you can do from one disciplinary point of view.

"You have to foster connections across groups and across disciplines to combine knowledge in a way that's going to lead to the next generation of scientific and technical advances."

Shokair welcomes students during MDP orientation last March. "Leave your disciplinary hats at the door," he advised.

Team Teaching

Crossing disciplines is becoming as commonplace as crossing the street.

National funding agencies devote increasingly larger percentages of their grant allocations to interdisciplinary collaborations. Scientific teams are growing in size and stature. And many industries give preference to multidisciplinary experience when hiring.

Stanton Rowe can vouch for that. The chief scientific officer at Edwards Lifesciences, an Irvine manufacturer of heart valves and hemodynamic monitoring equipment, says his company has hired 47 UCI graduates in the past two years.

Students with multidisciplinary experience are "definitely" more likely to be considered for jobs at the company.

"I always ask job seekers about their experience. If I hear 'me, me, me,' I get concerned," he says. "I want to hear about their experience working in teams, the roles they have played and how they were supportive and committed to the team's goals."

Photo: Brittany Gray, INRF

Diverse backgrounds, perspectives and expertise are critical to the product development process and improve day-to-day decision-making, according to Rowe.

"Just one of my project teams will make a thousand decisions a year as they develop a product. Multidisciplinary teams, with their diverse perspectives, have been proven to make better and more creative decisions."

So how do students gain the multidisciplinary training they need to be competitive?

At UC Irvine, the Undergraduate Research Opportunities Program and Calit2 have teamed to offer two options: MDP and SURF-IT.

"When the students begin these programs, we tell them to leave their disciplinary hats at the door," says UROP Director Said Shokair. "We don't want them to be boxed within the virtual boundary we call a major."

(continued, page 16)

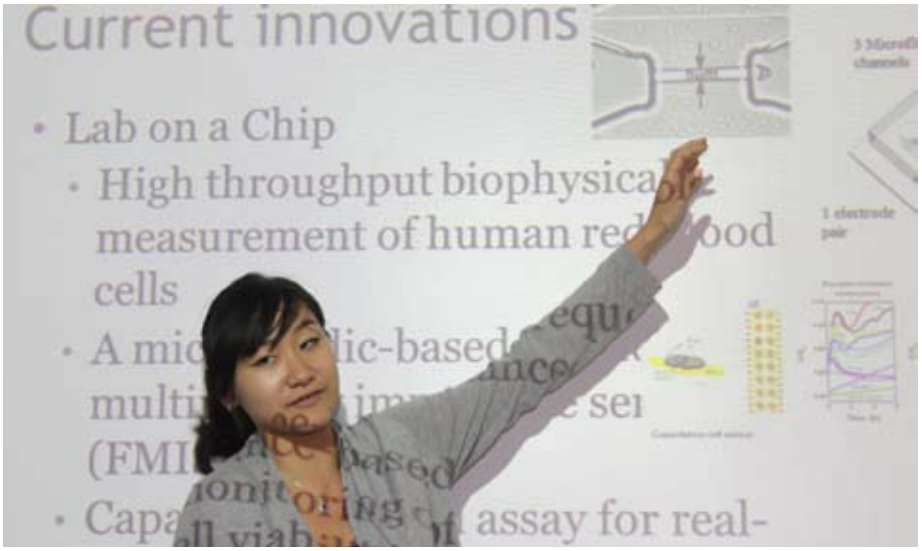
UCI's LifeChips program was designed to facilitate collaboration and train the next generation of researchers to work at the intersection of technology and life sciences. The program, funded by the NSF's Integrative Graduate Education and Research Traineeship program (NSF-IGERT), combines education and research in engineering, physical sciences, biological sciences and medicine to produce micro- and nanotechnologies that benefit human health. Started in 2007, LifeChips claims 60 participating faculty members, and has produced 30 alumni with a wide range of multidisciplinary skills.

"The project-based learning in MDP and SURF-IT will create more well-rounded researchers who view the world from this very important multidisciplinary perspective."

MDP – the Multidisciplinary Design Program – places undergraduates with other students from a cross-section of majors; each team is mentored by professors from at least two fields.

Teams, which have access to a specially designed MDP project lab on the second floor of the Calit2 Building, are charged with designing and presenting selected projects.

MDP Fellows attend seminars on project management, team building, conflict resolution and other topics, and receive academic credit.



Undergraduate Justine Chen presents her team's project at last semester's MDP final event.

"By engaging students in collaborative multidisciplinary teams, MDP allows them to explore their interests at intersecting points of disciplines, and allows them to conquer key challenges, yet develops the critical skills necessary for their 'real-world' success. MDP nurtures maximum diversity on all fronts," Shokair says.

SURF-IT – the Summer Undergraduate Research Fellowship in Information Technology – pairs students with faculty mentors in a wide range of disciplines related to IT. Participants, who are encouraged to collaborate across boundaries, work 40 hours a week for 10 weeks and attend weekly multidisciplinary presentations.

Calit2 Irvine Director G.P. Li helped design the curricula for both programs. "In the classroom, students focus only on the problems given to them by their instructors. We encourage them to think more broadly – to identify problems first and then work with their colleagues on the solutions.

"The project-based learning in MDP and SURF-IT will create more well-rounded researchers who view the world from this very important multidisciplinary perspective."

English and global cultures major Christine Bediones says MDP broadened her perspective on research "by highlighting its collaborative and innovative potential."

Her team included psychology, studio art, informatics and computer engineering students; the group designed a mobile game for elementary school students to help them understand the digestive system.

By pooling diverse talents and skill sets, she says, participants "creatively accomplished far more than we were capable of achieving alone. We gained a deeper appreciation and understanding of fields outside our own expertise."

For Kier Groulx, the only student in the program's history to have participated in SURF-IT for two consecutive summers – in different projects that spanned several disciplines – the experience was incomparable.

Groulx, who will graduate in 2014 with a major in computer science and minors in psychology of cognitive science and statistics, says, "All of the skills I gained have proven invaluable in reaching my research goals and preparing me for graduate school."

New Grant Funds Interdisciplinary Center

UC Irvine has been awarded $11.5 million over five years to further support the biologists, mathematicians, physicists, engineers and computer scientists who collaborate in pursuit of a more comprehensive and accurate understanding of complex biological systems.

The funding for the UCI Center for Complex Biological Systems comes from the National Institute of General Medical Sciences, one of the National Institutes of Health, which gave the facility initial grants of $450,000 in 2002 and $14.5 million in 2007.

At the time, the UCI center was the first of its kind in California dedicated to systems biology, an emerging field of study that employs the latest technology and computational methods to examine how networks of molecules, cells, tissues and organs interact in complex, dynamic ways to produce reliable biological functions.

"Over the past decade, we've tried to take a teamwork approach to really hard biological problems, encouraging researchers from all over the sciences and engineering to work together. This award is a clear endorsement of that strategy, especially given the current funding environment," said Dr. Arthur Lander, center director and professor of developmental & cell biology and biomedical engineering.

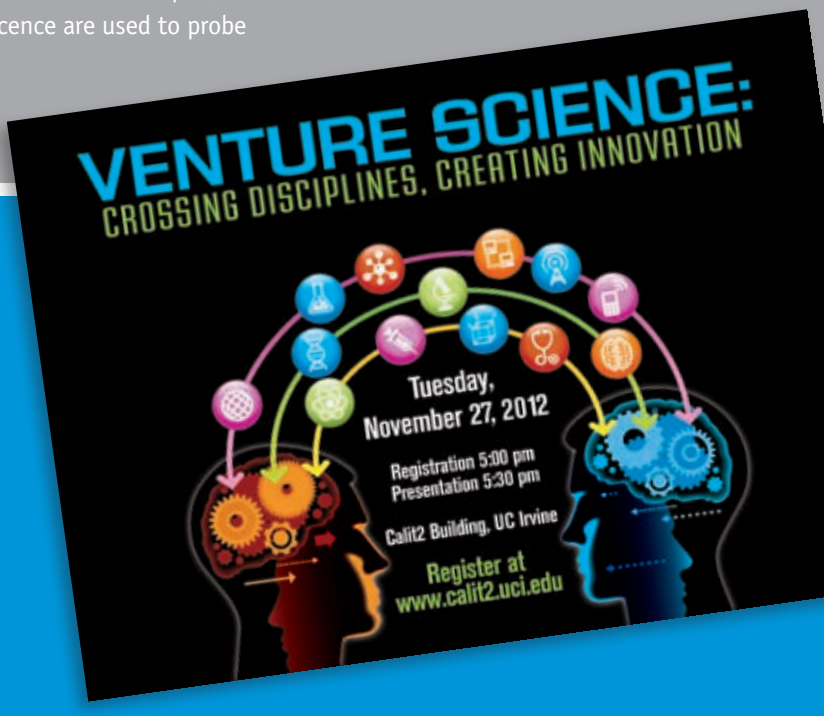
UCI's efforts focus on "spatial dynamics," or how biological systems have evolved to control what happens not just over time, but over space (in different locations within cells, tissues and organs, for instance). In researching this, the center takes advantage of the campus's considerable strengths in computation, applied mathematics and optical biology, in which microscopes, lasers and fluorescence are used to probe cells and tissues.

Additionally, the facility regularly hosts scientific seminars and symposia; offers short courses in systems biology; provides visiting scholar and research support; and administers undergraduate, graduate and postdoctoral training programs.

Founded in 2001, the center has helped UCI garner more than $36 million in federal and private aid for research, education and outreach by teams of biologists, mathematicians, physical scientists and engineers. It's currently one of 13 National Centers for Systems Biology funded by the NIGMS.

—Tom Vasich
University Communications

Moving fundamental research from the lab to the commercial marketplace requires a major team effort that crosses disciplinary boundaries. Nowhere is "venture science" more beneficial than at the intersection of science, medicine and technology. **Join us Nov. 27** to learn how these bold collaborations are producing innovative solutions to society's challenges. **Register at www.calit2.uci.edu.**



Presenters:

Steve Cramer, professor of neurology, will share his team's rehabilitative device research and the multidisciplinary approach that enabled it to move from concept to clinical trials.

Steve George, professor of biomedical engineering, will explain how his eight-member multidisciplinary team is engineering microsystems to test the safety and efficacy of cancer drugs.

Bill Link, co-founder of Versant Ventures, will discuss the real and perceived gaps in translating research outcomes to the marketplace and ways to overcome the challenges.

Madeleine Pahl, associate professor in medicine, will present UCI's Institute for Clinical and Translational Sciences' effort to connect researchers with clinicians to test novel biomedical solutions in the community.

Stanton Rowe, corporate vice president for advanced technology at Edwards Lifesciences, will talk about why industry values cross-disciplinary approaches and benefits from employees with that experience.

Dan Stokols, Chancellor's Professor in social ecology, will present the science of team science and the significance of the distinctions among the several types of cross-disciplinary collaborations.

Igniting Technology is a semiannual program sponsored by Knobbe Martens Olson & Bear LLP.

DESIGN, MAKE, PLAY

Photos: Sam Gangwer, Orange County Register

What if you could turn a knob and dial down a friend's Twitter feed, fading those tweets into the background rather than rudely "unfollowing" him? Called AmpDamp, this conceptual product is an analog interface that allows users to filter their digital information stream, diplomatically managing the problem of too many voices.

—the Multidisciplinary Way

by Lori Brandt

Or, what about a toy line designed to re-channel boys' aggressive and competitive impulses? Pitched as "modern toys for mannered boys," Boys 2.0 playthings are made to appeal to kids, while encouraging empathy, collaboration and responsibility.

And for couples, there's STRING, an interface for emotional connection. Carry around a short piece of conductive string in your pocket or purse; let your significant other know you are thinking of her by touching the string, which sends an abstract visualization to her computer screen. STRING challenges the dichotomy of the virtual and the physical in a "discreet, yet interpretive and beautiful way," according to its design team.

These are three of the six original product ideas created by doctoral students from across North America and Europe who gathered over the summer to participate in a "Values in Design" workshop at UC Irvine. The workshop, developed and directed by informatics faculty members Geoffrey Bowker, Judith Gregory and Cory Knobel, illustrated the powerful imagination and creative problem-solving that comes from multidisciplinary collaboration.

Values in Design is an emerging field in which scholars integrate human values – privacy, community, trust, dignity, security, respect and freedom from bias – into technological innovation. It unites researchers and practitioners from computer science, engineering, science and technology studies, anthropology, communications, law, philosophy, information science, and art and design.

Bowker, a pioneering scholar in this new field, explains, "In a world where information systems increasingly mediate our social and business interactions, we want to be sure that they reflect – not distort – our values."

(continued, page 20)

Opposite (top): University of Maryland student Jes Koepfler (and an LED) light up at her project's success.

(Bottom): UCI's Garnet Hertz (center) helps students at the workshop, which promoted a values-based approach to technology design.

At the workshop, 36 doctoral students, divided into six teams, spent an intense week designing and building technologies that embody a set of social values.

"You don't realize how hard it is until you really start doing it," says University of Maryland participant Jes Koepfler. "Our group spent all week arguing; it was engaging and fun. I was able to completely absorb myself in the experience, and I've begun thinking about values in my own work."

Thomas Lodato, from Georgia Tech, was impressed with how the students were grouped, by disciplines and interests, and with the results. "It was like we were glimpsing the future of design as a disciple moving across disciplines."

Bowker, Gregory and Knobel will be sharing their design philosophy with the UCI community through the EVoKE (Emerging Values in Knowledge Expression) Lab in Calit2's eMedia studio. The lab offers an open space where students are encouraged to drop in and learn how to design things while thinking about values.

"We have a deep commitment to theory, but also a strong sense of play," says Knobel, who is the EVoKE Lab executive director. "Design is a process of problem-solving that applies to every field, and we want to engage people in creative ways. We're planning a space where people can't help but make something before they leave."

"Our group spent all week arguing; it was engaging and fun. I was able to completely absorb myself in the experience, and I've begun thinking about values in my own work."

(Top) Doctoral students from across North America and Europe convene at UCI for a "Values in Design" workshop. Georgia Tech student Thomas Lodato (center) said: "It's like we were glimpsing the future of design …"

(Bottom) UCI electrical engineering major Nick LaJeunesse (left) and computer science major Vahan Hartooni hail DAT Space – Design, Art and Technology makerspace – as a place where students can develop their creativity and cultivate innovation.

Bringing people together to make something is also the goal of DAT Space, a Design, Art and Technology makerspace founded last year by a group of undergraduates. Offering a physical space where students can meet and work together on creative projects, DAT Space aims to lower the barrier for students to advance in their creative projects and drive them to innovate. Workshops, geared toward students of all levels and abilities, have included soldering, espresso brewing, mini-terrarium building, and programming with Max (a multimedia, electronic music and sound design software).

"We feel that hands-on skills and self-made projects aren't encouraged as much as we'd like in a university setting where knowledge skills are given higher priority," explains Vahan Hartooni, DAT Space founder. "We advocate developing skills that allow students to be more expressive and creative with technology."

These students are inspired by "maker subculture," a technology-based extension of the DIY (Do it Yourself) movement. Wired Magazine Editor Chris Anderson argues in his new book "Maker," that "making" is the new Industrial Revolution and has the power to revive manufacturing in America.

Garnet Hertz, artist in residence and informatics research scientist, is an advisor to DAT Space and associate director of the EVoKE Lab. "The process of solving multidisciplinary problems often becomes a bricolage of technologies, knowledge, locations and people that require individuals and teams to go beyond their comfort zones and figure out new things," he says. "This process of discovery often does not have a formal framework or infrastructure; in this way, innovation is a DIY practice."

SURF-IT

compiled by
Shellie Nazarenus

The Summer Undergraduate Research Fellowship in Information Technology (SURF-IT) program offers undergraduate students challenging research opportunities under constructive guidance by faculty mentors and their graduate students. In its eighth year, the program has provided an ideal infrastructure for exchanging ideas and driving innovation. Often, collaborations extend well beyond the 10-week summer experience, with Fellows continuing to work with their mentors. Participants in this year's 10 projects share the challenges and rewards of advancing their research efforts.

Load Signature Study for Home Energy Management

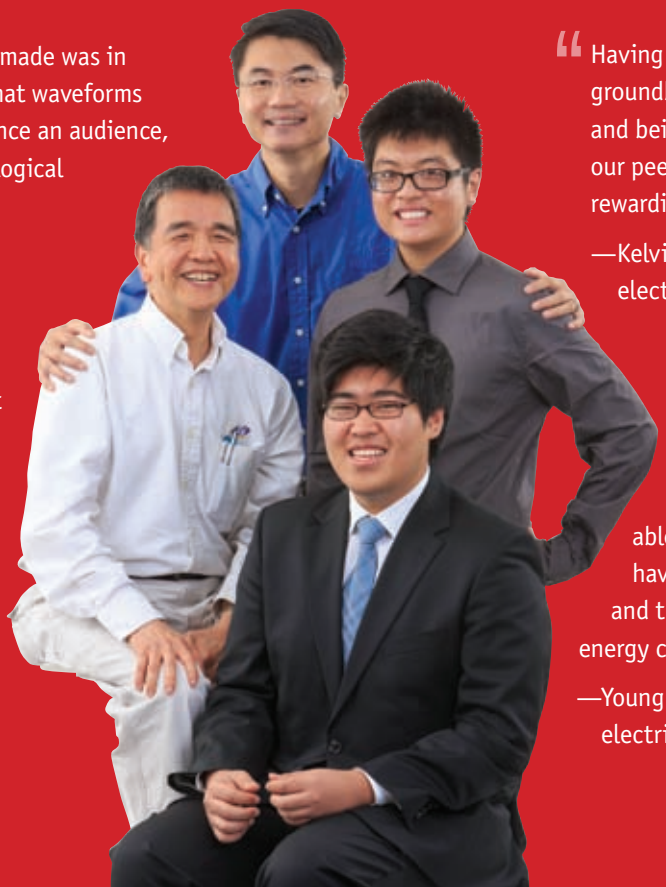
Plug-load devices include appliances, electronics and tools – anything that plugs into an electrical outlet. They are responsible for as much as 20 percent of electrical consumption in homes and are expected to consume 30 percent by 2030. Consumers need an energy-management system to monitor and control their plug loads. We have developed a prototype system that allows us to gather waveforms and control plug-load devices, enabling smarter decision-making for energy consumption.

"The greatest improvement they made was in communication. They learned that waveforms and diagrams alone won't convince an audience, but their conclusions based on logical reasoning will."

—Arthur Zhang,
CalPlug techology manager

"In a classroom setting, we don't allow the student to fail. But in project-based learning, they are allowed to fail quickly, find the mistake and learn a different approach. That is the value of undergraduate research."

—G.P. Li,
electrical engineering and computer science professor



"Having something meaningful and groundbreaking come from the research and being able to present that to our peers and mentors was the most rewarding feeling."

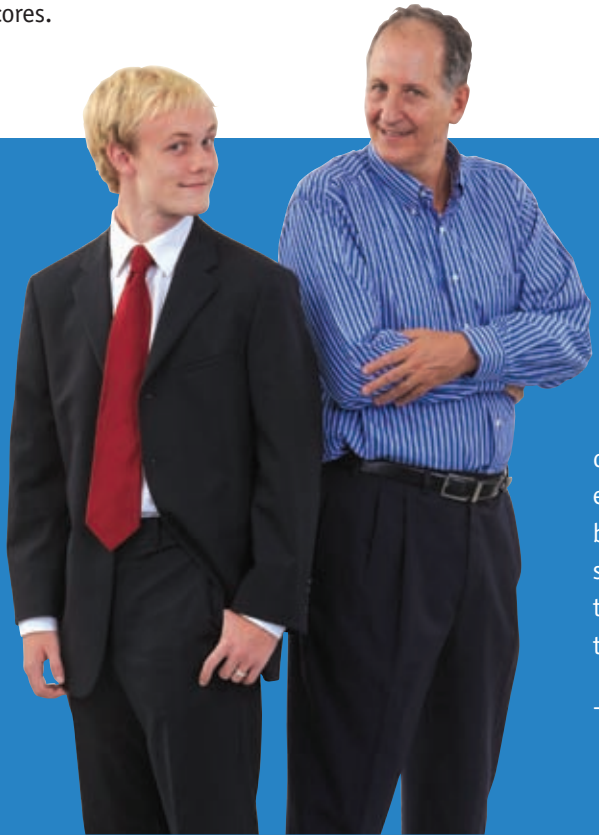
—Kelvin Liang,
electrical engineering major

"The most rewarding aspect has been the fact that I was able to apply the material that I have studied in my previous courses, and that my research contributes to energy conservation."

—Young Min Kim,
electrical engineering major

Cloud-based Writing in K-12 Schools

This project investigates the use of Google Docs to facilitate collaborative writing in middle school classrooms. Our initial findings indicate that students enjoy composing and editing on Google Docs more than word-processing software, or paper and pencil, hence the cloud-based program may help improve student writing. We plan to expand the study to see how collaborative writing may affect standardized test scores.



"My mentor was communicative and accommodating. Professor Warschauer always told me what he expected, kept me constantly updated and urged me to get as involved as possible with the different aspects of the research group."

—Kier Groulx,
computer science major

"Our research team principally consists of people in the field of education, with varied technical background. As a computer science student, Kier brought technical expertise to the project, which nicely contributed to the research."

—Mark Warschauer,
education professor

Design of Oxygen Sensors

Failure of a car's oxygen sensor is the primary cause of the "check engine" warning due to the sensor's problem with thermal shock. Yttria Stabilized Zirconia (YSZ) is the oxygen-conducting ceramic that is likely to crack due to thermal shock. In this project, we introduced a Mullite additive to the YSZ to test thermal shock resistance and ionic conductivity, the property that allows the sensor to read the air/fuel ratio. The results were mixed but promise new material advances.

"By the end of this summer, Rochelle showed me some new approaches she had developed on her own; the learning experience goes both ways, and faculty get as much out of the interaction as the students."

—Martha Mecartney, chemical engineering and materials science professor

"What you give is what you get. The actual research is just part of the SURF-IT experience and I know I learned just as much by talking to the graduate students and other Fellows as I did running tests and calculating data."

—Rochelle Parker,
mechanical engineering major

"Rochelle was very inquisitive and a real self-starter. She would take the opportunity to learn about things other than her project, like how to draw a wiring diagram or solder an extension cord."

—Jesse Angle,
materials science graduate researcher

Difficulties of Migraine Management and Technology Design Implications

Studies have shown that migraine affects at least 10 percent of the world's population, yet migraines are often underdiagnosed and undertreated. In our study, we examine migraine management experiences in order to find successful practices and to determine explanations for the large gap in recognizing and treating symptoms. Our study provides some design opportunities for mobile technology applications to aid patients in better managing migraines in their daily life.

"My mentors' friendliness was definitely a helpful characteristic because I like working in a positive environment. Still, they pushed me to really try to do things myself and made me feel like I was an important part of the team."

—Melissa Mayr, nursing science major

"I enjoy working with undergraduate researchers. They bring fresh opinions to our research team, work hard and listen intently. Melissa contributed significantly to our project and will continue working with us."

—Yunan Chen, informatics professor

"Melissa had to learn how to work collaboratively with others who came from different backgrounds. I think SURF-IT provides a good opportunity for students to gain valuable interdisciplinary experience."

—SunYoung Park, informatics graduate researcher

Program Characterization and Optimization for Completion Time vs. Power Consumption

Techniques for reducing processor power consumption help to increase the processor's lifespan. Hardware modifications are commonly used, but compiler and software optimizations can potentially provide additional power savings. In this project, we conjecture that compiler optimizations can have a positive effect on power consumption while providing little performance degradation. Preliminary testing metrics supported the theory in general.

"My SURF-IT experience was more intense than I was expecting, but it built good habits. My mentor, Rosario, guided me to think differently about how problems are approached and to create meaningful documents."

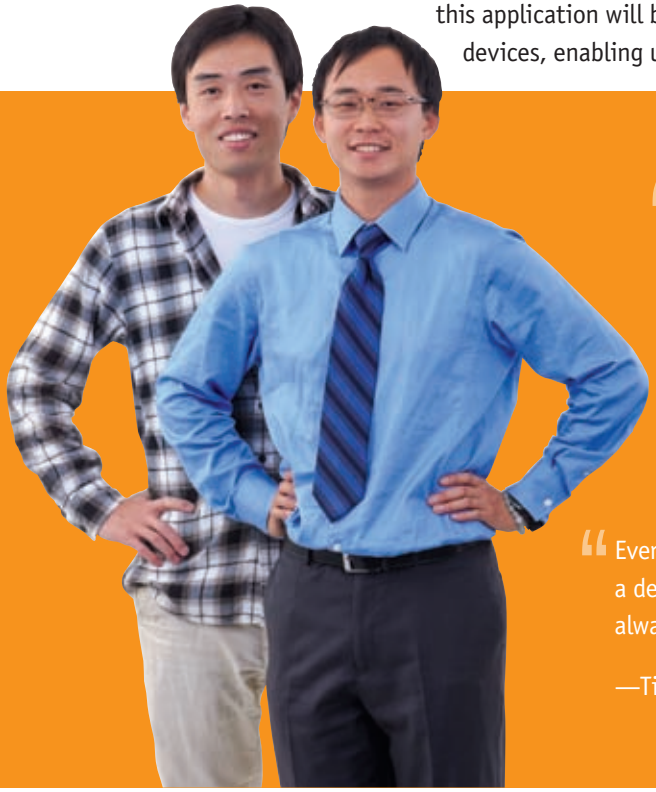
—Andrew Martin Del Campo, information and computer science major

"What a nice opportunity to learn skills that are fundamental in the life of any researcher, professor or professional. In the future, Andrew will benefit from the communication, interpersonal and technical skills he developed during the program."

—Rosario Cammarota, computer science graduate researcher

Study, Simulation and Implementation of a Network Monitoring Capability for a MANET Formed by Software-Defined Radios

The wireless exchange of information through mobile devices can lead to problems with intermittent connectivity. Our research is developing an Android-based application to monitor connectivity on a mobile operating system. For now, our application receives only the simulation data from the server but this application will be beneficial for future progress in collecting real-time data from mobile devices, enabling users to simply open the application and know their network status.



"It definitely was a valuable mentoring experience and I enjoyed working together with Tim on this challenging project. He is a fast learner and showed great potential to be a successful engineering researcher."

—Weihong Hu, Calit2 graduate researcher

"Every time I finished a critical point in my project, I would schedule a demonstration day with my mentor and discuss new updates. He always had great ideas and suggestions to improve my research."

—Tim Kang, computer engineering major

Information Technologies to Enhance Stem Cell Analysis and Isolation: Use of DEP to Sort Neural Stem Cells

Manipulation of cells using dielectrophoresis (DEP) is based on the electrical properties of cells and how they move in a non-homogeneous electric field. We are interested in explaining why cells experience differences in DEP forces that enable sorting. Through the summer, we ran various simulations and determined the effects of cell membrane thickness and surface area on the crossover frequency of human neural stem/progenitor cell subpopulations.

"My mentors always told me to be patient. They told me that the answers aren't always going to come from your first try and that experiments fail sometimes. They created a wonderful new way for me to look at cells as an electrical engineer."

—John Louie, electrical engineering major

"We had a project at the interface of biology and engineering that was in need of some IT input. The program gave us an opportunity to obtain that input and mentor a promising undergraduate student at the same time. It was a win-win situation for the entire group."

—Lisa Flanagan, neurology professor

Design of Adaptive Challenge Software for Game-based Hand Rehabilitation

The purpose of our study is to find the optimum difficulty level for learning motor tasks by using a sensor-laden device called the MusicGlove. Participants receive audio/visual feedback as they wear the glove to make certain hand grips, synchronized to songs of varying degrees of difficulty. The results are recorded to quantify the user's hand dexterity; eventually we hope to develop an effective rehabilitative device for stroke patients.

"Dedication, time commitment and pushing through roadblocks are Greg's strengths. Rather than coming up with an excuse explaining why something does not work, he derives another path in order to come up with a solution. His technical skills improved greatly over the summer."

—Nizan Friedman, biomedical engineering graduate researcher

"I have learned skills such as populating circuit boards under a microscope, soldering, sewing and video game editing. It is very rewarding to conduct successful experiments with human subjects using all of the equipment I built and the video game I designed."

—Gregory Zambrano
mechanical engineering major

Simulation and Its Discontents

Modeling and simulation is not a new technique, but it has undergone rapid changes since the emergence of the computer. By analyzing the collective successes and failures of modern simulations, we have established a better understanding of what simulations can and cannot do. We investigate how simulations can be used for better university management, and we look at a working example, Virtual U, to determine how it could better achieve its creator's goals.

"Professor Krapp encouraged me by never letting me get stuck. At every point in the summer there were always new questions to answer, new directions to explore or new opinions to consider."

—Paul Lowood, German studies major

"The project unfolded in several phases, from data gathering to fieldwork and from thought experiments to outlining results. On one occasion, we visited a flight simulator and spent an afternoon being trained by Air Force reservists."

—Peter Krapp, film and media studies professor

Manipulation of Mechanical Devices in Video Games

This study examines how people use mechanical devices – keyboards, mice, controllers, etc. – to interact with video games. Our goal is to understand the role of the mechanical device in enabling or hindering the user's interaction with software and to develop a method to evaluate the efficacy of the devices. Study participants were interviewed and observed using devices to interact with a game; initial results could lead to developing more intuitive device interfaces.

"I decided to participate because research is important to me, I fit the study criteria, and I never pass up an opportunity to talk someone's ear off about video games. It was valuable because I learned a few things about myself I had previously taken for granted."

—Alexander Nicholas Brown, serious gamer and study participant

"I was able to explore what I thought was worth investigation so that I could really develop as a researcher. Because I did a lot of the groundwork leading up to collecting the data, I felt true ownership and am genuinely excited about what comes out of it."

—Katherine Lo, mathematics major

A Thumbs-Up Experience

In addition to research, SURF-IT participants attend a weekly lunch seminar where they get to know one another better and find out about the various projects each is contributing to.

"I did not expect that the things I learned and the relationships I developed would be as much fun as they were," explains Fellow Paul Lowood. "Listening to the presentations of the other projects was always interesting; I don't think most undergraduates realize just how many cutting-edge developments are occurring every day at UCI."

The Fellows' participation in program activities offers experiences they wouldn't get in a classroom, helping to shape their future academic and career plans.

"The process of discovery is actually more exciting than I imagined since my research expanded beyond the data I 'expected' to get," says Katherine Lo. "I want to pursue research further and perhaps, in the long run!"

SURF-IT officially ends the last week in August with the students presenting their project highlights. Adds Melissa Mayr: "The most rewarding aspect is connecting with peers doing other types of research, sharing our experiences and learning about their project outcomes."

Fabricating the Future

by Janet Wilson
University Communications

RapidTech trains tomorrow's workforce in advanced manufacturing technologies like 3-D printing

Ed Tackett whirls through the fourth floor of UC Irvine's Engineering Hall, showing off tiny toy figurines, a bright-red leg bone, a waxen skull and more.

"We're just finishing the housing for a 'non-squish' breast cancer detector," he says, looking at freshly painted soft-pink components. Student intern Garritt Ong, 20, of Saddleback College looks on, hefting

Photo: Daniel A. Anderson, University Communications

> **"After the digital revolution, mechanical engineering shops on campuses fell out of favor. They were considered dirty, lowbrow. Now those attitudes are changing."**
>
> —Marc Madou
> *Chancellor's Professor of mechanical and aerospace engineering*

Photo: Daniel A. Anderson, University Communications

a block of resin to begin a project of his own. "I love it; I'm learning everything about everything," he says enthusiastically.

All of the items on display and hundreds more have been designed on computers and produced via three-dimensional printing at the National Center for Rapid Technologies, or RapidTech, the only nonprofit in the U.S. dedicated to hands-on training of community college and university students in the next wave of advanced manufacturing.

Forget the Industrial Revolution and tool-and-die factory assembly lines. While custom 3-D printers are gaining popularity in home handyman projects, the printers here are industrial-strength, and so is the mission.

It's a campus version of the supply chain of the future, academics and other experts say, and key to bringing full-fledged manufacturing back to this nation. President Obama is seeking $1 billion in next year's federal budget to make the U.S. a world leader in advanced manufacturing.

The National Institute of Standards & Technology is hosting multi-agency workshops around the country to gather public input. One workshop was held Thursday, Sept. 27, at the Arnold & Mabel Beckman Center of the National Academies of Sciences & Engineering, on the UCI campus.

"This is an extraordinarily exciting time, characterized by many as a third manufacturing revolution. Technologies like additive manufacturing are changing the rules," says Mike Molnar, director of the new interagency Advanced Manufacturing National Program Office. "Just as computing evolved from mainframe data centers to personal devices, in the future, if you have an idea, you will be able to make it."

"Having RapidTech on campus is a real plus," says Gregory Washington, dean of UCI's Henry Samueli School of Engineering. "We hope to be one of the few universities capable of providing engineers with an understanding of their individual disciplines and, on top of that, who have an understanding of how things are made – literally from doing it themselves – so they can walk into companies and be commercially productive from Day One."

Bringing real-world mechanical engineering shops back to universities and colleges is critical, says mechanical engineering professor Marc Madou, one of the first to sound the alarm on the need for more U.S. engineers capable of producing what they design. About 600,000 manufacturing jobs in the U.S. are currently unfilled.

"After the digital revolution, mechanical engineering shops on campuses fell out of favor. They were considered dirty, lowbrow. Now those attitudes are changing," says Madou, who teaches an advanced manufacturing class for upper-level undergraduates and graduate students.

"This is an extraordinarily exciting time, characterized by many as a third manufacturing revolution."

In 2005, he co-authored "Micromanufacturing," which looked at the future of manufacturing worldwide. All his students also take a practicum at RapidTech each year, to learn how to turn theories into prototypes and finished products.

Tackett, director of RapidTech, is blunt: "We have advanced engineering students come in who don't know what a Phillips-head screwdriver is."

The facility has more than 20 printers and other large pieces of equipment that help both academia and industry use modern technologies for engineering, biology and even arts projects. RapidTech has already produced everything from medical devices to architectural models to drum sets, as well as servicing such traditional sectors as aerospace and automotive.

Students from Saddleback College are employed as interns, and UCI doctoral students and researchers come knocking with project designs – as do Boeing, the U.S. Coast Guard, the U.S. Army and hundreds of smaller companies and academic laboratories.

"We're so glad that RapidTech is here. It's just essential to have that kind of fabrication facility at a major university," says Bruce Tromberg, professor of biomedical engineering and director of UCI's Beckman Laser Institute & Medical Clinic. He and fellow researchers have spent more than 20 years working on a laser breast scanner that's less painful than traditional mammography machines and may be far more effective with denser breast tissue.

Once they nailed down the advanced physics principles, they needed to figure out a way to craft a patient-friendly device containing their pioneering laser technology. Tromberg's doctoral students modeled a handheld version out of Play-Doh and walked across campus to RapidTech with it, getting a testable prototype within days instead of months.

Photo: Paul R. Kennedy

Swati Sharma and Giulia Canton, graduate students of Madou's, have been laboring for months on nanoscale carbon wires for biomedical devices that could sense more cheaply and quickly than traditional tests how a drug is metabolizing or whether a disease is present in DNA. For them, Madou's class and RapidTech are vital.

"They help me learn how to do things, not just study them," Canton says.

Top: Ben Dolan, RapidTech engineer, digs out a model created by a 3-D printer from two-dimensional medical imaging files. This additive manufacturing technique provides quick, inexpensive parts for concept modeling.

Bottom: Graduate student Swati Sharma is framed by a view of the highly magnified nanoscale carbon wires she has worked on in RapidTech.

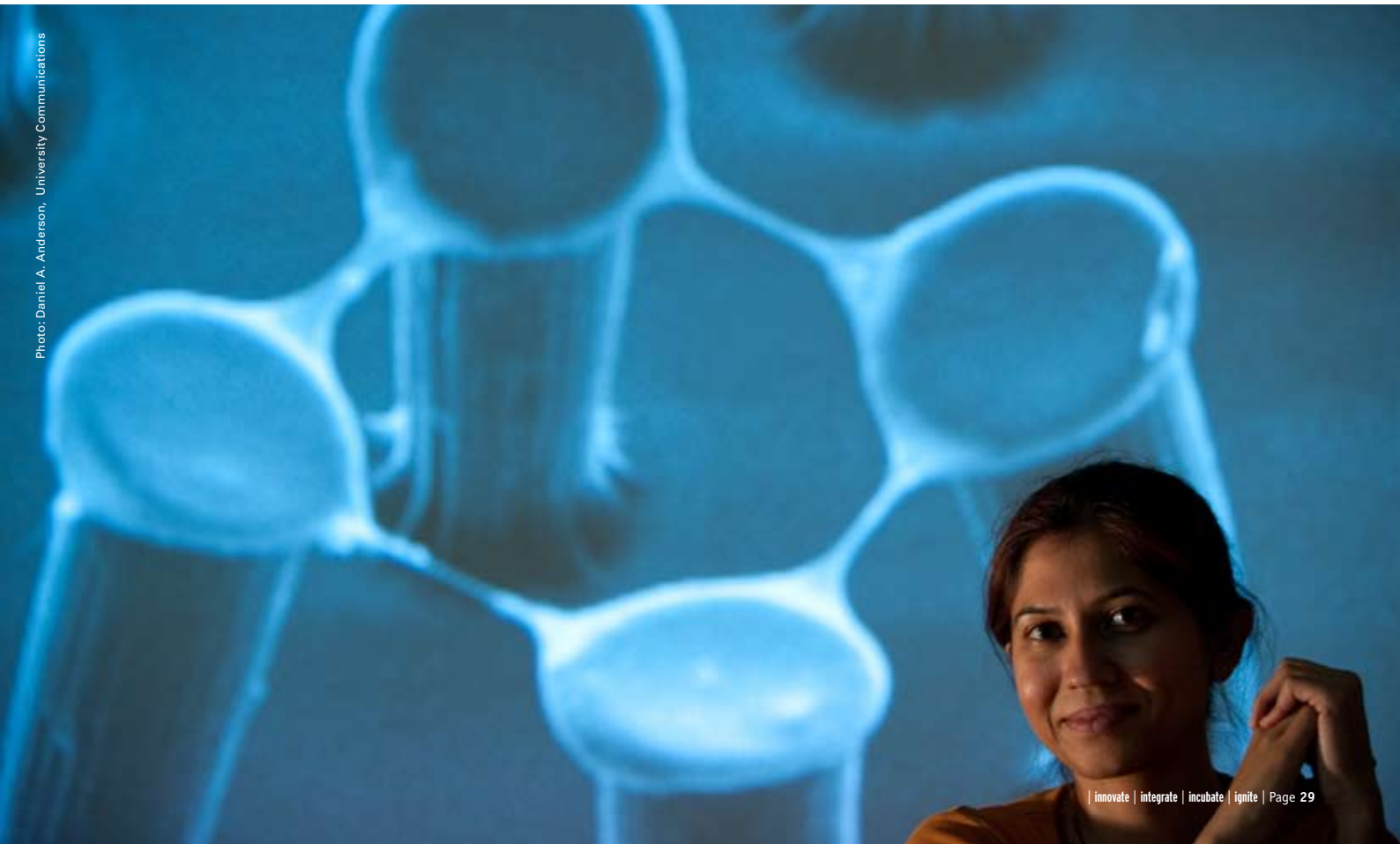


Photo: Daniel A. Anderson, University Communications

FUNDING NOTES

by Stuart Ross

Multi/Inter/Trans:
New Projects Join the Mix

The Calit2 Building has always been host to a blend of disciplines and approaches in projects sustained by external funding. Here are the most recent:

"Keep this to yourself, Henderson, this will fund our research for the next ten years!"

Accelerating Particles

Beams of heavy ions – nanodroplets – are used for many purposes: to coat, erode or change a surface, or even to provide propulsion for space travel. One way to form and direct such beams is to accelerate the particles with electric fields, in a process called electrospraying. The **U.S. Air Force** recently funded **Manuel Gamero-Castano**, assistant professor of mechanical and aerospace engineering, to conduct systematic studies of electrospraying for intermediate-sized particles and droplets – those bigger than simple ions but smaller than one micron. His project, which includes subcontracts to an engineer at Yale and a materials scientist at MIT, will receive **$726,000** over three years. Calit2's electron microscopist, **Jian-Guo Zheng**, is a co-investigator; he will analyze surfaces that have been bombarded by energetic nanoparticles.

Connecting Social Relations

Studies of substance abuse by teens rarely venture into mathematical theories, but in the Calit2 Building such things do happen. **Cynthia Lakon** was awarded **$227,000** by the **National Institute of Abuse and Addiction** for her work on "Cascades of Network Structure and Function: Pathways to Adolescent Substance Abuse." Lakon is an assistant professor of public health who works with Calit2's Center for Networks and Relational Analysis (see page 12). Lakon researches the social ties of adolescents and how those ties may promote or discourage substance abuse.

Instrumenting Nano Effects

CT (computerized tomography) scans are used widely in medicine, but less so in engineering. **Lizhi Sun** has been awarded funding to purchase equipment that will extend the capabilities of CT scans on nanoscale effects inside inorganic materials. Sun, a professor of civil and environmental engineering who has worked with Calit2 on many projects, received **$555,000** from the **National Science Foundation** in the competitive 'MRI' program – Major Research Instrumentation. The funding also will support the development of additional attachments and algorithms for studying nanosize volumes in the interior of a sample. The new instrument will be housed in the Calit2 Building, and four other institute affiliates are co-investigators: **Albert Yee, William Tang, Lorenzo Valdevit and Timothy Rupert**, representing three different engineering disciplines.

Boosting Efficiency

Calit2's energy efficiency program was given a boost when **DirecTV** signed on as a corporate sponsor of the **California Plug Load Research Center**. CalPlug conducts studies of efficiency in electronic devices and other appliances, including user-behavior studies. DirecTV, a leader in producing increasingly efficient set-top boxes for receiving and displaying satellite television broadcasts, joined CalPlug at the 'Partner' level of **$25,000** per year; the company also contributed the installation of satellite TV equipment in the Calit2 Building.

Supporting Bright Minds

Calit2 Director **G.P. Li** secured a three-year, **$399,000** award from the **U.S. Department of Education** to support graduate fellowships in the schools of biological sciences, engineering and physical sciences in a program called "LifeChips." The program follows a similar one funded by NSF, with the difference that this program is designed especially for the recruitment and retention of graduate students with financial need. Three students will be supported each year. Each student will work toward a Ph.D. in his/her own department but the students will work together in interdisciplinary core courses and seminars, using the laboratory facilities in the Calit2 Building for their research.

Exploring Entrepreneurship

Athina Markopoulou, associate professor of electrical engineering and computer science, was awarded a **$50,000** grant under a new program designed to improve the transfer of innovations into commercial practice.

NSF's "Innovation Corps" (I-Corps) is designed to train and support NSF-funded scientists in exploring the commercialization potential of their research, and is limited to investigators whose innovation already has agency support; Markopoulou has three current NSF awards administered by Calit2. The UCI I-Corps team consists of Markopoulou; entrepreneurial lead Anh Le, a Calit2 postdoc; and technology transfer mentor Goran Matijasevic, executive director of the UCI Chief Executive Roundtable. The innovation, which grew out of Markopoulou's NSF CAREER project, promises to expand the capabilities of a group of mobile devices by implementing all available networking and processing resources in a collaborative way. This is UCI's first I-Corps grant.

Treating Wounded Warriors

Calit2's capabilities in eHealth have been recognized by the **Samueli Institute**, which awarded a **$203,000** subcontract to **Mark Bachman**, assistant professor of electrical engineering and computer science, and **G.P. Li**. The institute has engaged Bachman to further develop three of Calit2's signature innovations: the MusicGlove, the Stability Sole, and Telios, the Web-based platform designed for health monitoring. Telios, still based on Web 2.0, will be reconfigured to run health applications, including the glove and the sole. Samueli Institute, a nonprofit research center whose mission is to transform healthcare through the science of healing, won the contract from the Department of Defense to develop improved methods for treating traumatic stress disorder and traumatic brain injury.

BITS AND BYTES

A timeline of select Calit2 activities

APRIL

2 The Calit2 Governing Board Executive Committee meets to discuss the 10-year-review committee's evaluation and the ensuing two-campus response.

10 Led by CEO Jim McCluney, a group from Emulex visits the institute to learn about progress on several research fronts.

Installation of the SmartLab X-Ray Diffractometer in the first-floor microscopy lab gives users an intelligent interface for analyzing thin films and other advanced materials.

3

MAY

2 Attendees at a half-day symposium in the auditorium gain insight into initiating collaborations and funding opportunities with national laboratories.

10 Thomas Peterson, assistant director of the NSF Engineering Directorate, sees firsthand the campus's investment in the first-floor microscopy lab.

Satellite TV providers attend an invitation-only workshop to discuss set-top-box energy efficiency progress and investigate areas of collaboration with CalPlug researchers.

4

LifeChips Fellow Trisha Westerhof is named a finalist in an NSF student competition for her work on a micropallet array that could lead to personalized treatment for breast cancer.

17

16 DirecTV becomes the first member of CalPlug, supporting the center's efforts at the partner level.

23 A cochlear implant being developed by Professor Fan-Gang Zeng gets a closer inspection from a Samueli Foundation visitor in the eHealth Collaboratory.

An information session about plug-load energy efficiency projects draws undergraduate **11** students interested in research credit opportunities.

The 1kWh Challenge is launched, encouraging students to test their **21** awareness of electronic device energy usage and potential savings.

21 Congresswoman Loretta Sanchez visits various Calit2 labs, including eHealth, where researchers have transformed UCI mascot Peter the Anteater into a therapeutic music device.

22 WOTZ, a companion smart-meter app developed by a UCI team, earns student grand prize in the U.S. Energy Department's "Apps for Energy" competition.

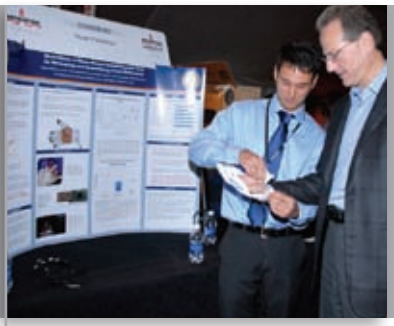
The digital transformation's effect on the ways we work, live and play is vetted by five experts from various viewpoints in the semiannual Igniting **22** Technology event.

BITS AND BYTES

A timeline of select Calit2 activities

5 Final presentations are delivered by multidisciplinary undergraduate student teams working spring quarter on a wide range of design projects.

JUNE



Ongoing campus contributions to the first-floor microscopy facilities spur (former) UCI Provost Michael Gottfredson to visit and view the progress. **4**

Making the top-12 finals in Broadcom Foundation's University Research Competition, doctoral candidate Nizan Friedman presents his MusicGlove to company founder Henry Samueli. **6**

19 One of China's top universities sends a delegation of doctoral candidates from every field of study to learn more about Calit2's multidisciplinary approach.

JULY

Students participating in CalPlug's 1kWh Challenge are eager to jump-start their portion of the energy-consumption educational contest. **18**

7 Calit2 Advisory Board meets at the UCSD division to discuss "The Path Forward" plan and fundraising efforts.

15 An unsuspecting engineering team from Microsemi discovers a research visit to the eHealth Collaboratory can be quite the workout.

25 Introductions, lunch and orientation prepare a new round of summer undergraduate research Fellows, who are anxious to dive into research.

A delegation from Smart Utility Systems, led by CEO Deepak Garg, tours CalPlug and discusses partnership opportunities. **13**

A brainstorming workshop on technology-based solutions to reduce healthcare costs and improve patient outcomes is led by UCI hospital CEO Terry Belmont in the auditorium. **19**

23 With a stroke of his hand, Nish Acharya, senior advisor to the U.S. Secretary of Commerce, discovers the challenge of conserving energy.

California's newest Energy Commissioner, Andrew McAllister, takes time to visit CalPlug and listen to student research teams present their projects. **20**

Energy and environment research efforts grab the attention of guests from the Los Angeles Department of Water and Power as they visit Calit2's Green-IT lab. **26**

BITS AND BYTES

A timeline of select Calit2 activities

AUGUST

7 In week seven of the SURF-IT seminars, Professor Peter Krapp guides an attentive audience through the history of simulation and computational innovation.

"Patient Connect" collaboration launches with participants from Cox Communications, CHOC, OC Department of Education and Calit2.

6

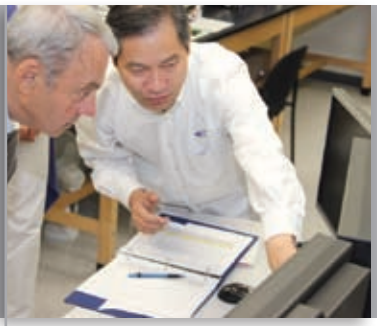
With a shared interest in advancing IT solutions for health, the CEO and COO from Vista Life Sciences view prototype developments in the eHealth Collaboratory.

9

10 A distinguished professor from Tsinghua University, Professor JingLong Li, meets to discuss collaborations with Calit2 researchers.

21 In the second of a seminar series, microscopy users learn about the multifunction capabilities of the scanning electron microscope and focused ion beam system.

SEPTEMBER



During a tour of Calit2, International Marconi Award recipient Gottfried Ungerboeck takes a close look at an image in the microscopy lab.

7

Serving on a panel at the 23rd annual "Envisioning California" conference, Director G.P. Li addresses the Golden State's creative mind and advancing innovation.

14

13 The National Research Foundation of Korea sends delegates to learn about Calit2 in an effort to encourage creative research and researcher development.

21 Robots and computer gaming platforms for rehabilitation, presented by SURF-IT mentor Dave Reinkensmeyer, is the final topic in the Tuesday lunchtime series.

Reading paper books requires different skills than reading digital devices, spurring research from numerous angles, explains **14** Professor Mark Warschauer in his SURF-IT seminar.

Researcher Arthur Zhang demonstrates early-stage development of the **29** "Patient Connect" platform to collaborators from several organizations.

27 A manufacturing innovation reception with demonstrations is held at Calit2, following a day-long federal government workshop at the Beckman Center.

Mike Molnar, chief manufacturing officer for the National Institute of Standards and Technology, gives a Calit2 audience his perspective on future innovation. **26**

Director G.P. Li gives an invited presentation on convergence of MEMs and packaging technology at the IUMRS-ICEM 2012 conference in Japan. **28**

Calit2@UCI is a multidisciplinary research institute that develops information technology-based innovations. By integrating academic research with industry experience, the institute seeks to benefit society, incubate new technology companies and ignite economic development. Calit2 focuses on the digital transformation of healthcare, energy, the environment and culture.

University of California, Irvine
California Institute for
Telecommunications and
Information Technology
4100 Calit2 Building
Irvine, CA 92697-2800

NONPROFIT ORG.
U.S. POSTAGE
PAID
Santa Ana, CA
Permit No. 1106

Calit2

Yes, I (S)can

The RapidTech center in UC Irvine's Engineering Hall uses laser scanning techniques when it needs a non-contact approach to reverse engineering, taking measurements and verifying digital shapes. Cameras record laser measurements from several angles as they change shape across an object, and data is stitched together to create a replica. The center has used the process in the rapid manufacture of sports, food and entertainment products.

This NextEngine HD laser scanner captures Giulia Canton, a mechanical and aerospace engineering Ph.D. candidate and member of Professor Marc Madou's research group. Canton holds a 3-D print made from a previous scan, which could be used to create a mold that would allow her to reproduce her likeness in a variety of materials. See page 27 to learn more about RapidTech and UCI's advanced manufacturing efforts.