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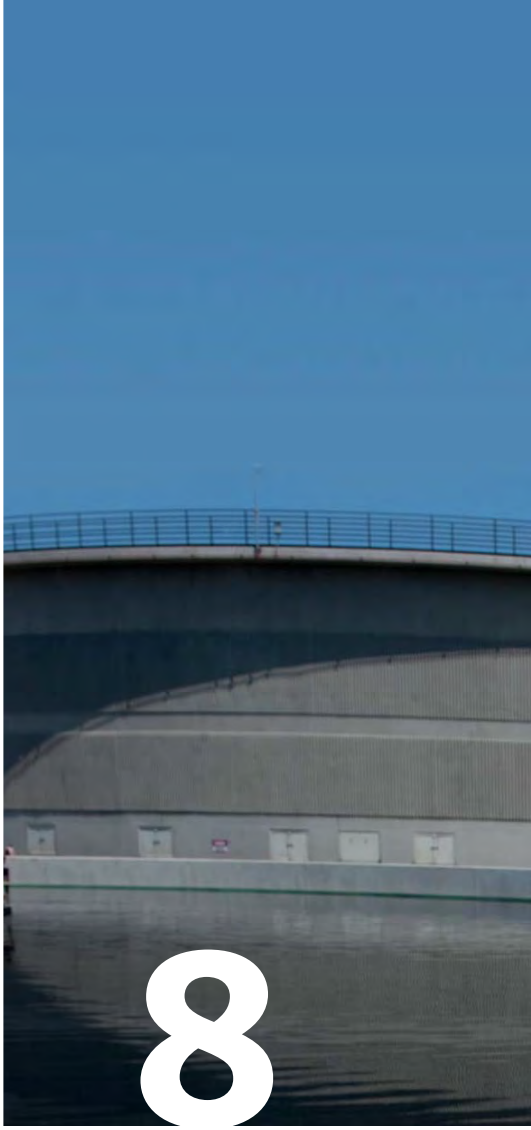
Volume 8 | Issue 2 | Spring 2013

University of California, Irvine

Illuminating Entrepreneurship



features:

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On the cover: *UCI startup company Praxis BioSciences is developing cost-effective biomedical tools from its headquarters in the Calit2 TechPortal incubator. Story, page 26.(Photo: Steve Zylius)*

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Now in its eighth year of publication, Interface has had a bit of a makeover. There's a fresh new look, a few added offerings, and we've gone green. The magazine is now printed with soy-based ink on paper manufactured by a "clean" mill with a sustainability charter. The new paper is 30 percent post-consumer waste, 55 percent recycled and FSC-certified.

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Calit2@UCI
G.P. Li *Director*

Shellie Nazarenus *Assistant Director Marketing and Outreach*

Stuart Ross *Assistant Director Research Development*

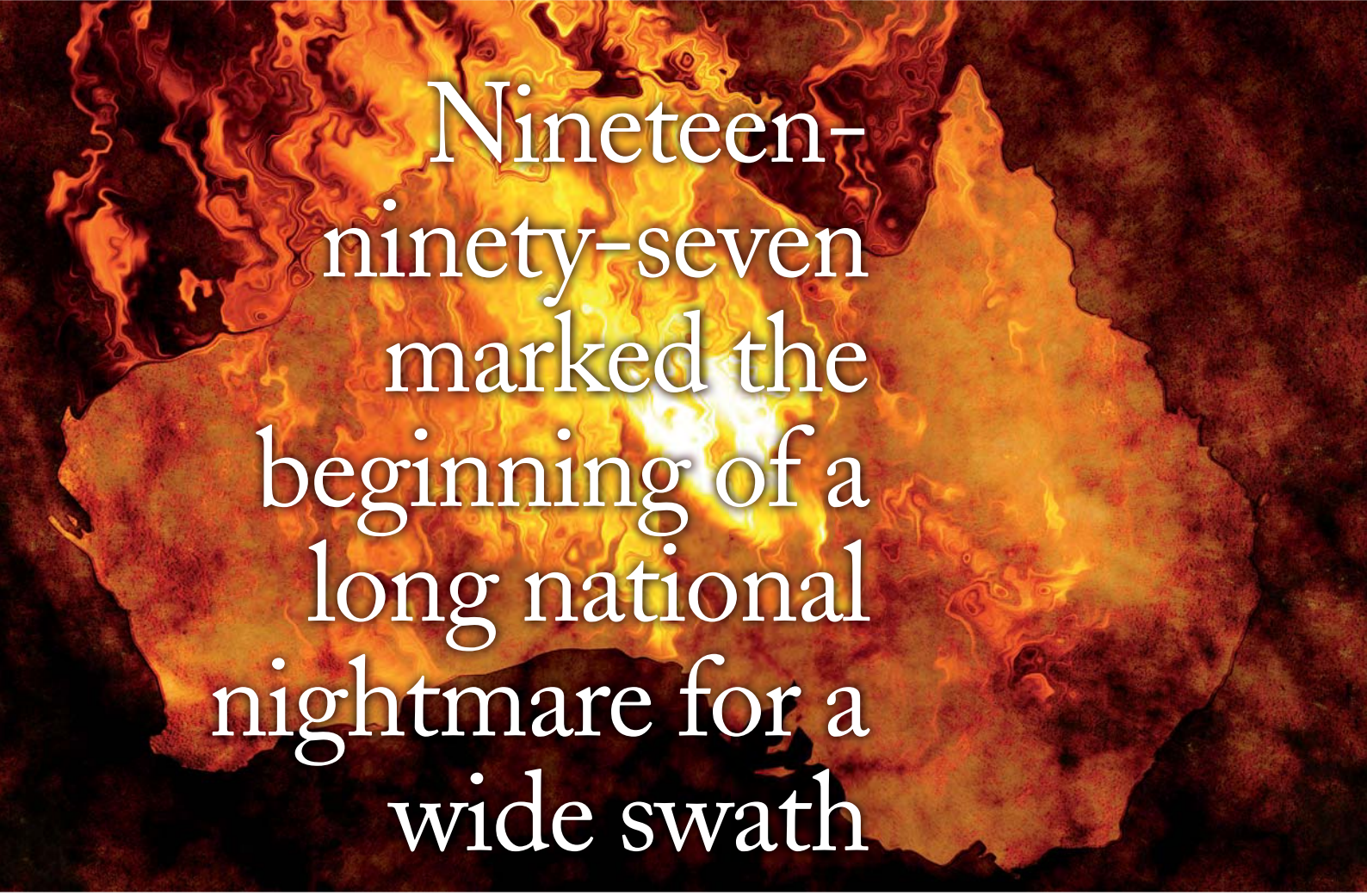
Shellie Nazarenus *Executive Editor*
Anna Lynn Spitzer *Managing Editor*
Michael Marcheschi *m2design group*
Mike Delaney *Meridian Graphics*

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


The
Big

by Anna Lynn Spitzer

Wringing wisdom from Australia's worst drought



Nineteen-ninety-seven marked the beginning of a long national nightmare for a wide swath of southern Australia.

The area, which includes the city of Melbourne, experienced the last significant rainfall it would see for more than a decade. The parched region sweated through higher-than-average temperatures as well — a deadly combination that ushered in nearly 13 years of drained water reservoirs, raging bushfires, devastating crop failures, blinding dust storms and loss of life.

The Millennium Drought – Australians called it the Big Dry – ended up being the worst drought in the continent's recorded history. Between 2009 and 2010, the situation radically reversed course in parts of the drought-inflicted area. The dehydrated landscape was pelted by torrential rain; the ensuing floods left a trail of death and destruction.

Climate scientists suggested a direct link between the region's weather patterns and ongoing climate change. Even more ominous: They warned there could be more of the same in store.

The government sprang into action. It committed $12.9 billion to fund research, improve irrigation efficiency, develop new infrastructure and fund water-conservation programs.

Australian citizens sprang into action too. They conserved water, cutting back by 37 percent from 2003 to 2008. They collected rainwater in cisterns and tanks. They built bioswales to collect storm water runoff and devised biofilters to clean it. They reused "gray water" from their sinks, washing machines and showers.

Last fall, the National Science Foundation awarded $4.8 million to a trio of Southern California universities to study the technologies and policies implemented during the drought and its aftermath. The goal: to transform Australia's successful approaches into effective solutions for the American Southwest.

Stanley Grant, a UC Irvine professor of civil and environmental engineering, leads the five-year collaboration, which includes researchers from UCI, UCLA and UC San Diego. They are partnering with scholars at Australia's University of Melbourne and Monash University.

"Australia faced an enormous challenge and came up with all sorts of innovative approaches to dealing with it," Grant says. "What can we learn from them that would help us adapt to what, almost certainly, will happen here as well?"

In addition to adopting wastewater-recycling and rainwater-capture technologies, the Aussies responded to their predicament by creating low-energy methods for treating and reusing stormwater runoff, building desalinization plants, and developing technologies to reverse the effects of stream degradation to return the hydrology to a more natural state.

The Southern California researchers are focusing on four features of low-energy water management: removing pollutants from stormwater runoff; reducing public health risks; identifying social, economic and policy obstacles to new technologies; and measuring the impact after implementation of these approaches on water supplies, water quality and the environment.

"We are leveraging an enormous amount of their research activity," Grant says. "Their national priority was to deal with this problem, and it may well become our national priority at some point."

One important research area is bio-filters, also called bio-retention systems. These manufactured structures mimic wetlands, capturing rainwater runoff and filtering it through sand or soil.

Available in different sizes and configurations, they can be deployed on a local level, capturing and treating stormwater before it gathers urban pollutants. The biofiltered water can be reused for non-potable applications like gardening, flushing toilets and washing cars.

In addition to biofilters, researchers are investigating a new approach – using titanium dioxide nanoparticles, which interact with sunlight, to treat storm runoff for reuse. "It might look like a fountain with water running over the glass but these nanoparticles are embedded in the glass," Grant says. "It's an aesthetic element but it also has a very practical side to it."

Researchers also are studying ways to preserve the natural ecosystem. Rainwater once took months to reach a stream, which, when healthy, acts much like a liver, purifying water in a process called hyporheic exchange. But paved roads and increased urbanization can cause runoff from heavy storms to deluge a stream in minutes. The powerful flow and heavy pollutants collected as rainwater surges through urban areas can damage – and even destroy – the streams' natural filtration systems.

Computer modeling is playing a role in restoring the environment by helping to create urban streams to replace those that no longer function. "You can create an ecosystem where there used to be one," says Grant. "From an environmental engineering perspective, you can design those systems so they look like natural streams."

No one disputes the importance of technology in creative water management. But without buy-in from the public, it can be for naught.

In Melbourne, the Australians instituted public-

(continued, page 7)

"Australia faced an enormous challenge and came up with all sorts of innovative approaches to dealing with it."

Orange County currently recycles about

40%

of its wastewater

education campaigns, and included the community in drought-dictated decision-making and policy-implementation processes.

"It's not so much that they know something we don't but they have applied [it] in a way we haven't," says project researcher David Feldman, UCI chair and professor of planning, policy and design. "We know there are a number of innovations that can conserve water, reuse or reclaim it. What we don't know much about, however, is how to get the public to accept these technological approaches and how to mitigate any possible impacts from them."

The Australians have implemented many of the adopted solutions, including rainwater collection systems and bio-filters, locally. "The government works with homeowners and commercial property owners to develop these things on a very small, incremental scale," Feldman says.

And that "gray water"? The Aussies clean it using low-tech filtration systems and reuse it in their gardens and plumbing systems. "These are technologies we don't have yet," says Feldman. "But it's not a technological problem; it's a public acceptance problem."

Can the Australians' techniques and methods be effective in places like the Santa Ana watershed or other parts of the arid Southwest? It's essential to "get down to ground level" to answer that question, Feldman says. "We have to see what they're doing, how they compose regulations and develop urban plans, how they consult and confer with the public.

"Secondly, we have to better understand what impediments they've encountered because it's not all smooth sailing. They're still struggling with a lot of issues, and learning how to deal with those can help us understand how to use these technologies in the U.S."

He does see some progress here at home. Efforts are underway to reclaim wastewater, implement conservation policies and recharge aquifers. Orange County currently recycles about 40 percent of its wastewater, and San Diego and Los Angeles have plans to ramp up their programs. Las Vegas recycles gray water for non-potable municipal uses.

The importance of understanding community and policy ramifications, however, can't be overstated.

Communities with a history of water, waste or energy mismanagement can harbor distrust and will resist new policies, according to Feldman. Agencies have to reach out to them, much like the Australians did. "You've got to be able to convince people that these techniques are safe and they're actually beneficial," he says.

Americans also need to better understand the true cost of water, which he believes is now "just too cheap." And they must come to terms with the fact that there are no easy solutions.

"There's got to be a fundamental change in the way we value water," he says, "and it's got to be change from the ground up. It can't be done by the government imposing a solution."

Feldman remains cautiously optimistic about our chances.

"Water is a sustainable commodity if we treat it as something that needs to be reused, recycled, conserved and used in a highly prudent way," he says. "I think the odds are pretty good that we can make some radical changes but I think we're kind of running out of time.

"We've got to figure out a way to do these things – and we've got to do it quickly."

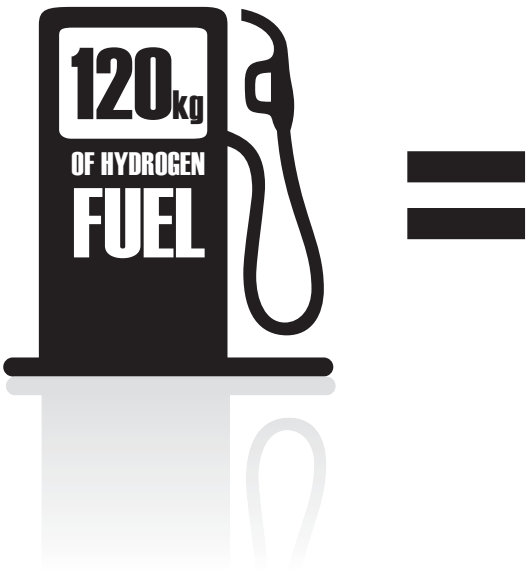
"It's not a technological problem; it's a public acceptance problem."

MIRACLE

photo: Steve Zylius

An extraordinary transformation from sewage to sustainability *at the Wastewater Facility*

by Anna Lynn Spitzer



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enough to fill the tanks of 30 cars

The concept seems a contradiction of the highest order: using raw sewage to make the planet cleaner?

It's true. At the Orange County Sanitation District in Fountain Valley, Calif., methane and other biogases are produced by sewage as it sits in concrete holding tanks. These are fed into a stationary fuel cell, which converts them into electricity and heat to run the facility, and hydrogen to fuel the next-generation of fuel cell vehicles.

Imagine: all those cars sitting bumper-to-bumper on the freeway could be getting the equivalent of 70 miles per gallon without spewing anything more harmful than water into the atmosphere, courtesy of humanity's perpetual stream of waste.

The wastewater-to-fuel idea is the brainchild of Jack Brouwer and Scott Samuelsen *(pictured, page 8)* from UC Irvine's National Fuel Cell Research Center. They figured out how to make fuel cells tri-generate — that is, produce hydrogen fuel at the same time they generate power and heat.

"Renewable fuels will be required for sustainable transportation in the future. This method of converting waste gas into a transportation fuel is one of the most efficient and environmentally sensitive methods there is," Brouwer says.

There are approximately 100 hydrogen-fueled vehicles in Southern California

The NFCRC partnered on the prototype with the O.C. Sanitation District; FuelCell Energy Inc., which manufactures ultra-clean stationary fuel cell power plants; and Air Products, a supplier of hydrogen and other industrial gases.

The first hydrogen-fueled cars pulled up to the pump at the sanitation plant a year-and-a-half ago; today, the facility produces approximately 120 kilograms of fuel each day, enough to fill the tanks of about 30 cars.

"The project is going extremely well," says Samuelsen, NFCRC director. He cites integrated operation and performance, extension of the technology to new applications and continuing awareness from all corners of the world. "This is the epitome of sustainability."

At the OCSD, where 207 million gallons of sewage are treated daily and 98 percent of solid waste residuals are recycled, bacteria in large digesters break down the sewage, releasing the methane and other gases. These pass through a pre-treatment system before flowing into the fuel cell, where they combine with heat and steam to produce hydrogen.

The fuel cell uses an electrochemical reaction to generate electricity and heat – used to run the plant – from the hydrogen. The process produces more heat and steam, which, when combined with the treated gases, generates still more hydrogen. The residual hydrogen then is purified, compressed and dispensed into fuel cell vehicles at the on-site filling station.

The amounts of electricity, heat and hydrogen produced by the fuel cell can be adjusted to meet demand. "The great thing about this technology is that you don't have any stranded assets," says Ed Torres, OCSD director of operations and management. "You dial up the hydrogen production when you have the demand from the vehicles, and when you don't, you just dial up the electricity to power the plant."

The model is the world's first but many more are expected to follow. Stationary fuel cells already are installed at many wastewater treatment plants to generate electricity and heat, and Samuelsen says they can be modified to produce hydrogen fuel as well.

Fuel cells also are in use at many manufacturing facilities. Gills Onions in Oxnard, Calif., for example, uses two 300-kilowatt fuel cells to convert up to 300,000 pounds of onion waste daily into renewable energy to power its processing plant. "They could easily produce hydrogen – and they very well may one day – because the system is retrofittable," Samuelsen says.

Hydrogen-fueled vehicles offer consumers a long list of benefits. Besides supplying three times the mileage, dollar for dollar, of their gasoline-fueled predecessors, they are quieter, more responsive and free of hydrocarbon emissions.

The domestic production of hydrogen fuel is a plus, too. "You can almost feel that our petroleum future is very shaky and it wouldn't take much to dramatically change our access," Samuelsen says.

There are approximately 100 hydrogen-fueled vehicles in Southern California, all of which are leased to drivers by the car manufacturers, and there are just a handful of filling stations. But automobile makers including Honda, Toyota, General Motors, Mercedes and Hyundai are gearing up to sell the cars within the next few years, and a hydrogen infrastructure of 68 stations is expected throughout the state by 2015 to meet the demand.

Several gasoline stations in Orange County are being modified to include hydrogen pumps, and many more are on the drawing board.

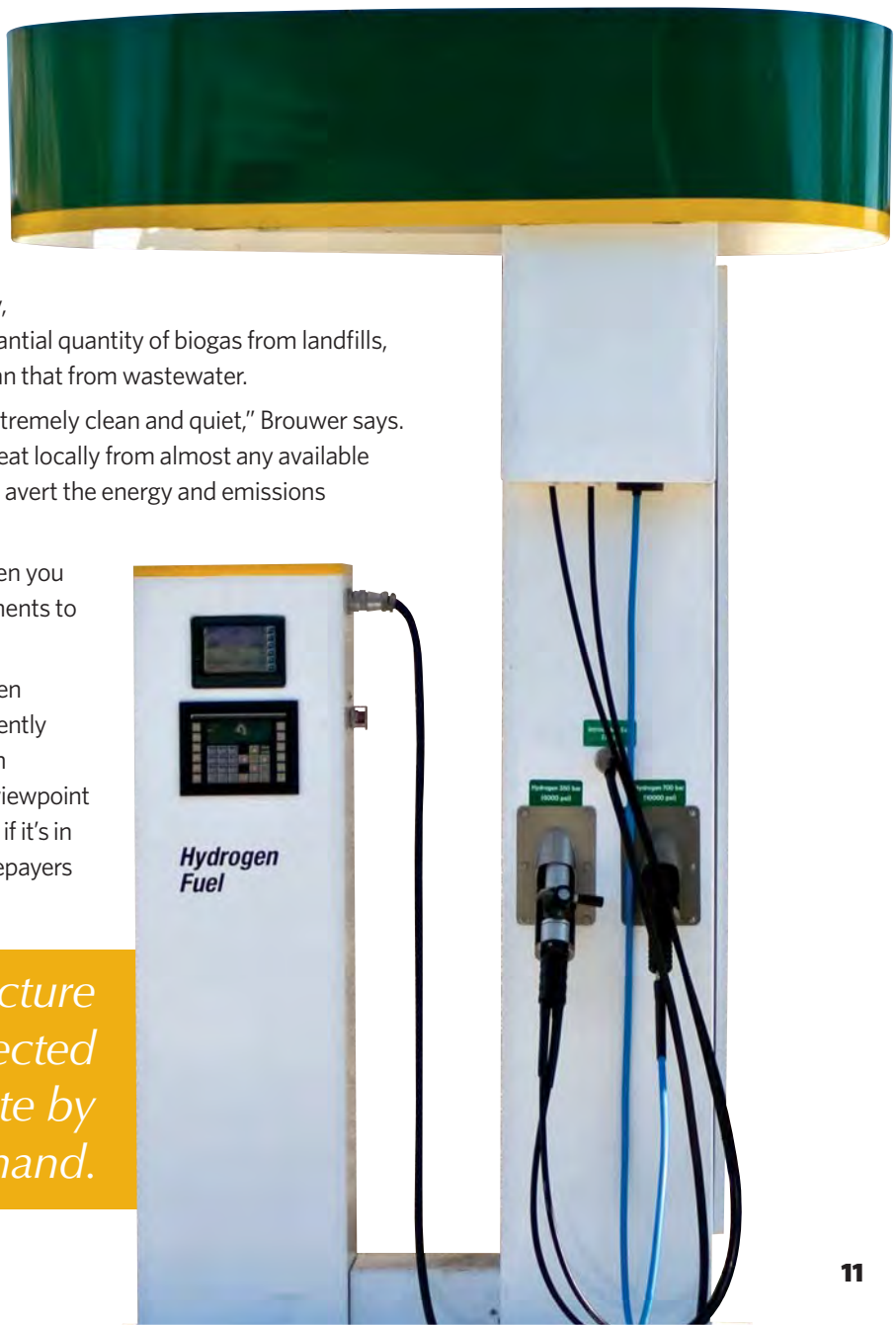
With the exception of the one at OCSD, all the stations currently dispense hydrogen fuel made from natural gas. The state, however, is requiring that a minimum of 33 percent of all hydrogen fuel sold in California must come from renewable sources so Samuelsen says "it's a good bet" that many of the new stations that come online will pump hydrogen generated through a sewage treatment system like the one at OCSD.

And instead of trucking hydrogen in from a central production facility, he believes the future holds many miles of underground hydrogen pipeline that will carry the fuel from production and waste disposal facilities. Additionally, researchers are looking at ways to process the substantial quantity of biogas from landfills, the composition of which is a little more complex than that from wastewater.

"This technology is remarkably efficient ... and extremely clean and quiet," Brouwer says. "It can be applied to produce hydrogen, power and heat locally from almost any available hydrocarbon gas at the point of need, which can also avert the energy and emissions penalties of fuel transportation."

"The future is wide open," Samuelsen says. "When you have a reliable supply of biogas there are no impediments to producing renewable hydrogen fuel."

As for the pilot project, Torres says officials are open to seeing the prototype – or a larger system – permanently adopted at OCSD when the three-year demonstration concludes. "We have an environmental stewardship viewpoint and we would definitely like to continue to participate if it's in the best interests of the sanitation district and the ratepayers we serve."



A hydrogen infrastructure of 68 stations is expected throughout the state by 2015 to meet the demand.

THE PATH TO

Richard Matthew guides war-torn countries toward improved resource management

PROMISE

by Anna Lynn Spitzer

On the West Coast of Africa, fronted by 300 miles of sparkling Atlantic coastline, lies Sierra Leone. Home to lush green forests, tropical grasslands, lazy lagoons, picturesque fishing villages and a chimpanzee sanctuary, the postcard-pretty country slightly smaller than South Carolina also boasts 7,700 square miles of diamond mines.

The inviting vistas, however, disguise scars from repeated military coups and a brutal, decade-long civil war that ended in 2002. Fifty thousand people were killed and hundreds of thousands fled their homes for neighboring countries. The diamond mines were – at least indirectly – responsible for much of the strife as competing interests struggled for control.

UC Irvine social ecology professor Richard Matthew led a series of United Nations-sponsored peace-building missions to post-war Sierra Leone. Under the auspices of the U.N.'s Expert Group on Environment, Conflict and Peacebuilding, Matthew and his international team of collaborators visited the country five times. They assessed its environment, infrastructure, health and employment circumstances, and recommended steps to achieve stability and protect natural resources.

Sierra Leone isn't so different from many other countries, where natural resources lie at the heart of civil conflict. Since the mid-20th century, studies indicate, 40 percent of intrastate disturbances have been related to natural resources or environmental stress.

For the past 16 years, Matthew, who heads UCI's Center for Unconventional Security Affairs, has advised these struggling countries in hopes of building and maintaining a secure peace. He has participated in resource assessments and related activities around the globe, in 25 countries to date, including Nepal, Pakistan, Rwanda and the Democratic Republic of Congo.

He and his team assess energy supplies, resource utilization, infrastructure, agricultural practices, water availability and other factors, including citizens' expectations. They talk to the locals in various communities to determine their priorities, they communicate with foreign companies invested in the region, and they advise government officials.

The idea is to get a "snapshot" of the area's condition so the government and other investors can make informed decisions about rebuilding.

"We know there is a remarkable tendency for areas that are vulnerable to social instability and violent conflict to also have heightened vulnerability to environmental stress," he says. "The coping mechanisms that people adopt under conditions of real adversity often are not sustainable."

(continued, page 16)

During these conflicts, infrastructure is destroyed, farms and plantations are abandoned, and terrified citizens flee to protected forested areas. Survival often means depleting those areas of resources like firewood and vegetation. After the war, residents flood home, seeking shelter, sustenance and employment.

(This page) Above left: Matthew interacts with a child on a visit to the Democratic Republic of Congo. Below left: In Sierra Leone, inhabitants of a village wait to collect water. Above right: Matthew hopes his work is helping to stabilize Sierra Leone for future generations.

(Next page) Competing interests struggling for control of the diamond mines in Sierra Leone contributed to the country's civil unrest. (All photos courtesy of Richard Matthew.)

During these conflicts, infrastructure is destroyed, farms and plantations are abandoned, and terrified citizens flee to protected forested areas. Survival often means depleting those areas of resources like firewood and vegetation. After the war, residents flood home, seeking shelter, sustenance and employment.

Reconstruction efforts, however, frequently disregard the ensuing environmental consequences. Dust chokes the air. Streams are polluted. Forests and woodlands are slashed and burned for farming or cattle grazing. And fresh water is diverted for construction. "Without a sense of the environmental situation," Matthew says, people make decisions that "prove to be really bad choices five years later."

He cites Rwanda, where residents, returning after civil strife, settled in swamps, on steep hillsides and in protected forests, creating a situation that now is extremely vulnerable to flooding and soil erosion.

"There's a lot of pressure on leaders to deal with a lot of challenges. But what we're trying to do is say that there are certain things that can be done more sustainably if you have enough information."

The goal, of course, is to avert additional environmental and societal crises. Most of the time, governments are on board; they use the impartial recommendations to apply for funding from international development agencies.

It's often a battle against the clock, though. "How do you introduce natural resource management quickly enough so you can protect areas before they become irrecoverable? How do you get in front of infectious disease before it becomes unmanageable?" Matthew asks.

"When you do it, you buy yourself a lot of time. When we fail, we see things start to fall apart pretty quickly."

That's what happened in Nepal. With its civil war ended, newly installed officials wanted to fulfill citizen expectations and give each a piece of land for farming. Matthew was unsuccessful in his attempt to explain that there wasn't enough farmland and that the government should consider other options, like eco-tourism or power generation.

Ultimately, land scarcity led 3.5 million job seekers to crowd into Katmandu, a city built for 1 million. Today, the city lacks waste management, water, energy, transportation and jobs to support its population. "Things have gotten worse and worse," he laments.

Environmental consequences and the strife they engender are not limited to the developing world. Superpowers like the United States and Canada face contention over fracking technologies to release gas and oil from shale, clearcutting of forests, and drilling and mining operations in protected areas. In these nations, however, the conflict is not likely to lead to complete collapse.

At least not right away. Part of Matthew's mission is to find ways to communicate effectively the long-term consequences of climate change to people on both sides of the development divide. CUSA's Transformational Media Lab studies the use of technology to spur civic action and social change, and he hopes these efforts will encourage people to "take ownership" and begin making changes.

"It's very frustrating for climate scientists to say, 'There's a train coming down the track toward your community. Here are a whole lot of fairly affordable things you can do to slow it down and you're not even doing those. Don't you see this train coming?'"

Unfortunately, most of us don't yet comprehend the looming dangers. "People say, 'That train? That train is 500 miles away.'"

Matthew, who has devoted his career to these issues, sighs. "It's almost immoral that we're not doing at least some of the things we know we should be doing."

COLLABORATOR IN CHIEF

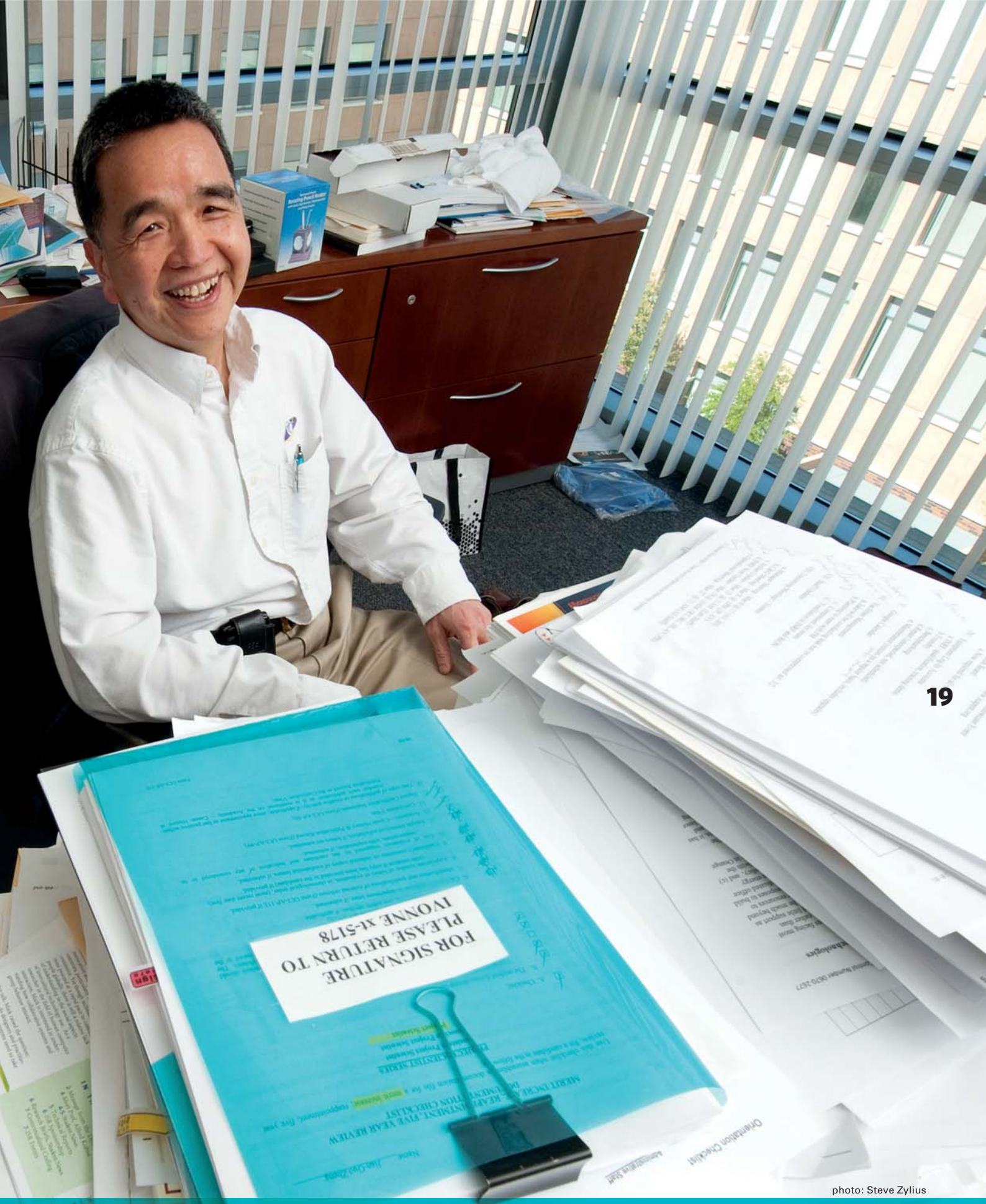
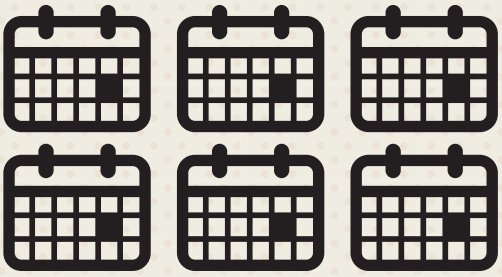


photo: Steve Zylius

Don’t let the piles of paperwork fool you.

G.P. Li has a systematic strategy for pursuing innovation.

by Lori Brandt



6 YEARS
as director of Calit2

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FORMER STUDENTS
NOW CEOs
AT SELF-FOUNDED
PUBLICLY TRADED COMPANIES

Li believes that a collaborative, multidisciplinary research experience is

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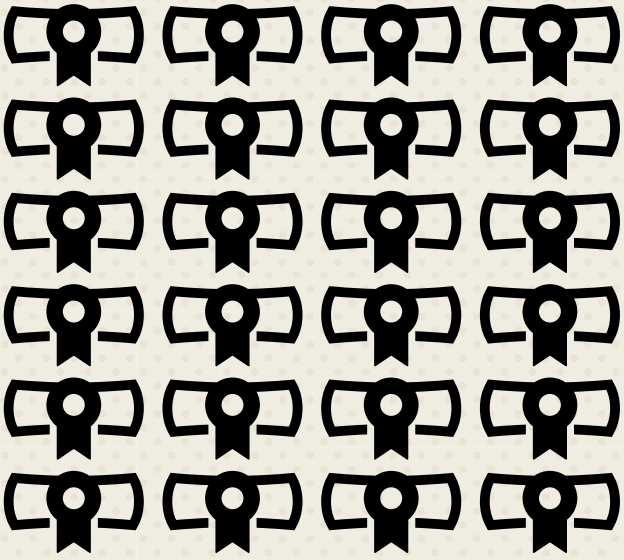


PATENTS HELD

4 COMPANIES
STARTED
BASED ON HIS INVENTIONS

G.P. Li vividly remembers his family being the first in his Taiwanese neighborhood to buy a television set so they could watch the Americans land on the moon.

At 13, he was impressed and inspired. "America was the land of opportunity, so far ahead than any other country in terms of science, technology and infrastructure," says Li. "I set my goal then and there to go to the United States and learn from the top minds of the day."

Li followed through, landing at UCLA, where he earned master's and doctorate degrees in electrical engineering.

He went to work at IBM's Thomas J. Watson Research Center in New York as a researcher and manager of the technology group, moving up quickly and becoming one of the company's youngest managers.

"I saw how IBM advanced knowledge and technology and how they worked with strategic partners," says Li, who parlayed that understanding into his current role as director of UC Irvine's Calit2.

In the late 1980s, he was recruited to UCI by Chen Tsai, now Chancellor's Professor in the Department of Electrical Engineering and Computer Science. "I take great pride in recruiting G.P.," says Tsai, adding that the school targeted Li for recruitment precisely because of his combined solid-state electronics expertise and corporate experience.

"These were desirable credentials for establishing partnerships with local high-tech industries. G.P. has acquired substantial funding from various local companies to pursue research that has been important for the growth of our department and school."

Li has served as Calit2 director for six years, the longest tenure in the institute's 12-year history.

"G.P. possesses a unique skill set," says Dr. Nancy Allbritton, a founder of UCI's biomedical engineering department and now the chair of biomedical engineering at the University of North Carolina and North Carolina State University. She and Li worked together to develop bio-nano medical devices. "He is able to work productively with different groups of people of varying personality types and bring them together to achieve a goal. It's very hard to do. G.P. has great ideas and works incredibly hard."

Under Li's direction, Calit2 has initiated several programs that leverage partnerships across disciplines, connect industry to faculty and students, spur innovation and benefit students. These include business incubator TechPortal; the California Plug Load Research Center, which focuses on improving energy efficiency; the eHealth Collaboratory, which seeks to empower healthcare and wellness with technologies; and the Multidisciplinary Design Program, an undergraduate research effort in which student teams work across disciplines on creative design projects.

Training students to become innovative future leaders who can explore technology solutions for emerging or underdeveloped markets while understanding policy and user behaviors is of utmost importance to Li. He believes that a collaborative, multidisciplinary research experience is the best way to teach innovation.

"Students need to learn how to fail, and fail fast, so they can learn to succeed," he says. "In research, there's obstacles and failure. Students have to regroup, ask hard questions and try again. And today's problems require a team approach. You cannot innovate when sitting in a silo."

Li also serves as director of UCI's Integrated Nanosystems Research Facility. The full-scale fabrication facility is devoted to micro- and nanotechnology research and development; it was founded by Li, Tsai and two other faculty members soon after Li's arrival on campus.

"The INRF is a world-class facility where engineers carry out fundamental research in microtechnology and nanotechnology. It is critical to new advances for the university and local businesses," says former engineering school dean Nick Alexopoulos, who now serves as a vice president at Broadcom Corp. "Professor Li helped the INRF become a leading force nationally and internationally."

Li's success is driven by his characteristic ability to reach out across disciplines and build teams. A professor with appointments in three of the Samueli School's five engineering departments — electrical engineering and computer science, biomedical engineering, and chemical engineering and materials science — Li holds 24 patents and has started four companies based on his inventions, all with his students.

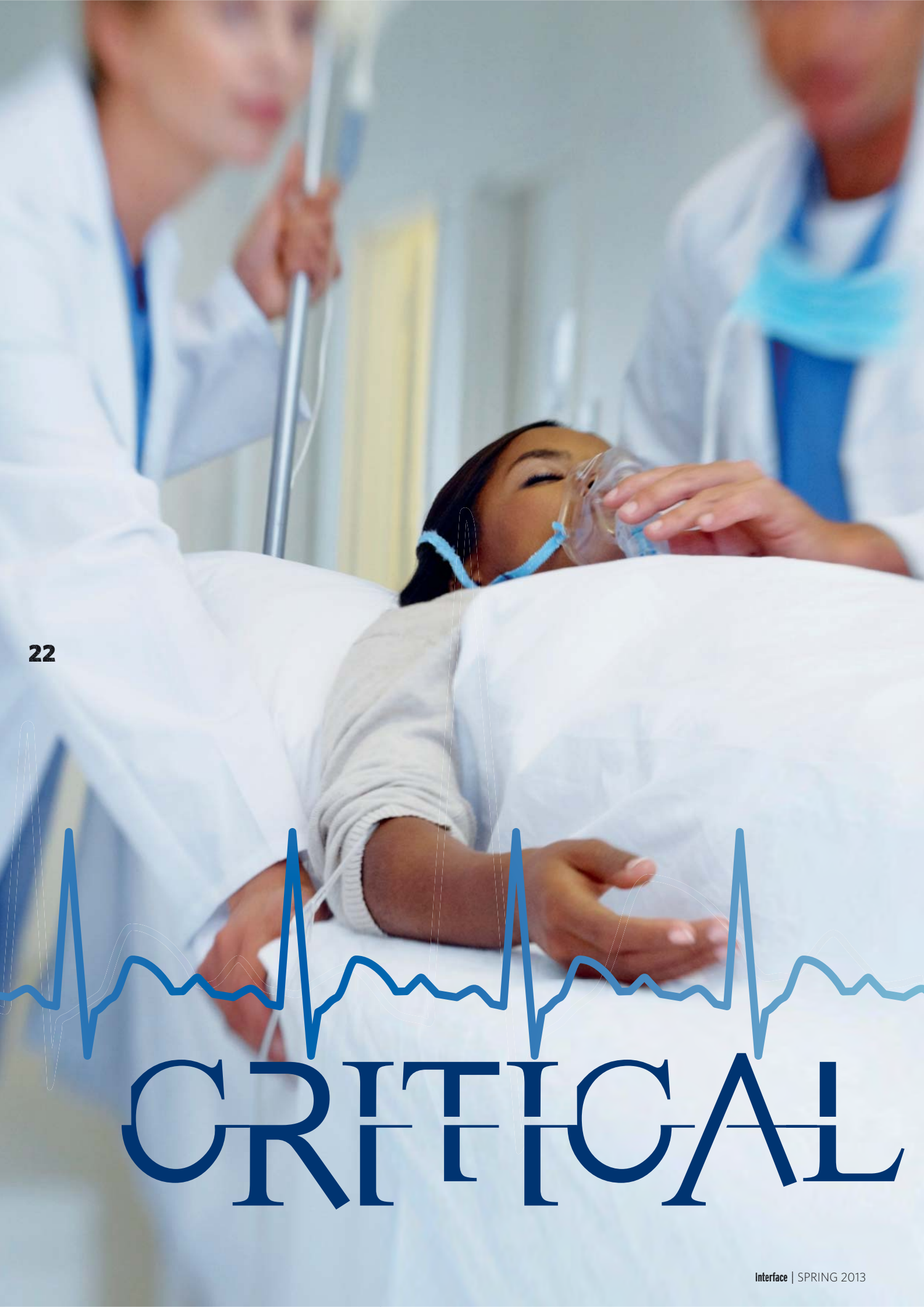
the best way to teach innovation.

But, as he has learned, there's a big difference between being an innovator and being an entrepreneur.

"A patent shows an invention, which is novel, creative, even doable, but does it have marketability?" says Li, whose startup companies have since folded. "The process from invention to market adoption can be many years, and requires that you know how to communicate your idea and earn an investor's support."

Still inspired by the possibilities of science and technology, Li measures his own accomplishments through those of his students. He proudly states that three former students are now CEOs at self-founded, publicly traded companies.

"I am honored to work with the people here," says Li. "My mission is to see them succeed; that is my reward."

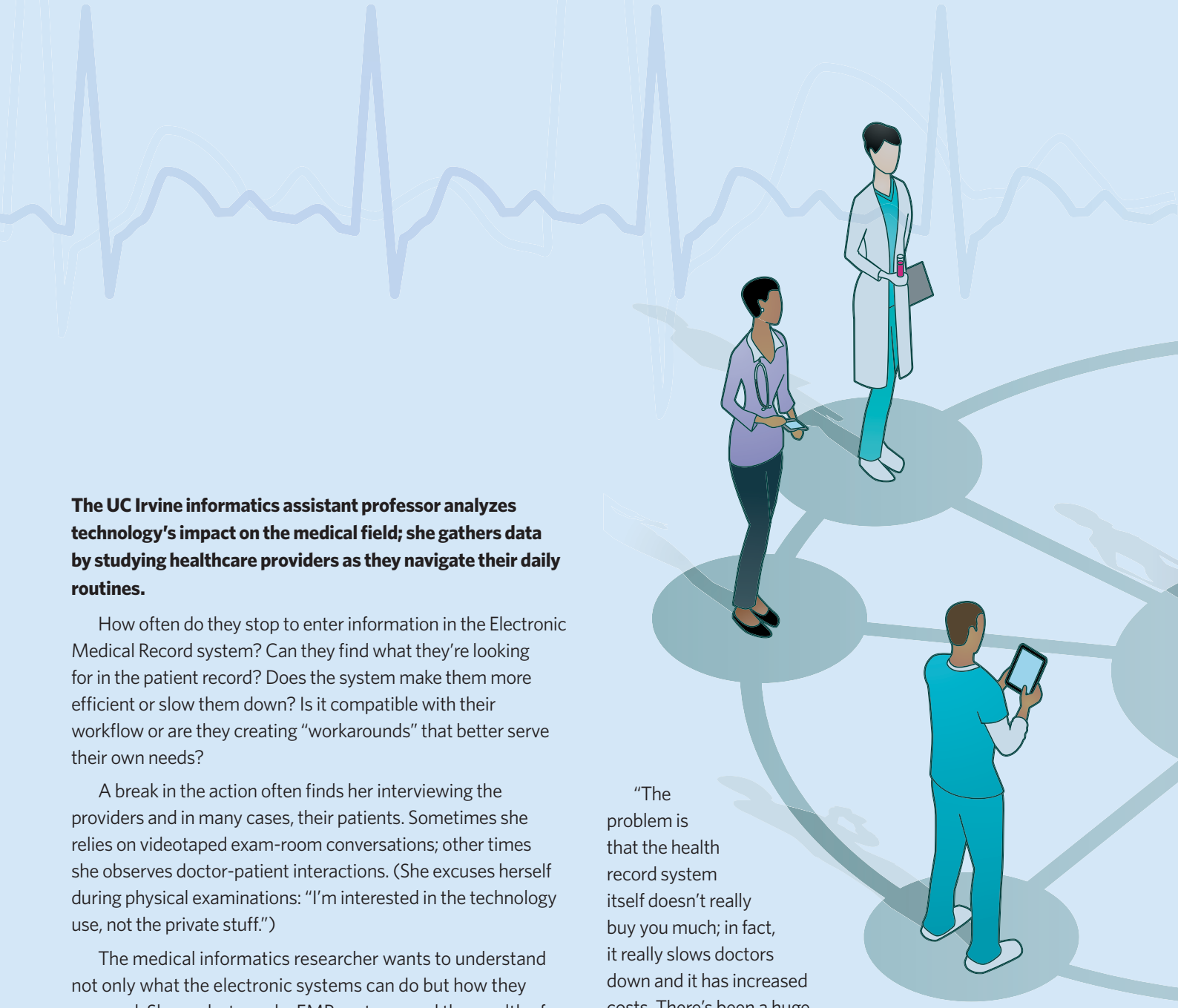


CRITICAL

As doctors and nurses rush through the busy emergency department in a large Southern California hospital, they probably don't notice the petite young woman with the dark hair and wire-framed glasses standing to the side, scrawling in her notebook. And that's fine with Yunan Chen.

DIAGNOSES

by Anna Lynn Spitzer



The UC Irvine informatics assistant professor analyzes technology's impact on the medical field; she gathers data by studying healthcare providers as they navigate their daily routines.

How often do they stop to enter information in the Electronic Medical Record system? Can they find what they're looking for in the patient record? Does the system make them more efficient or slow them down? Is it compatible with their workflow or are they creating "workarounds" that better serve their own needs?

A break in the action often finds her interviewing the providers and in many cases, their patients. Sometimes she relies on videotaped exam-room conversations; other times she observes doctor-patient interactions. (She excuses herself during physical examinations: "I'm interested in the technology use, not the private stuff.")

The medical informatics researcher wants to understand not only what the electronic systems can do but how they are used. She seeks to make EMR systems and the wealth of data they contain more responsive to doctors and nurses, as well as researchers, staff, administrators, policymakers and government officials who can benefit from the information treasure trove as well.

"The information infrastructure will fundamentally change the way medical work is practiced," she says. "It's important to know how we can design it better — to make it more intelligent and to serve multiple people."

She finds some doctors frustrated by the technology, while others worry about falling behind schedule. "It's urgent to find methods that are more effective. If people are satisfied with the system they will use it."

Dr. John Mattison has extensive experience with EMRs. The chief medical information officer in Kaiser's Southern California region has worked in multiple fields, including primary care, preventive medicine, emergency services and critical care. "Yunan's work is remarkably important ... especially right now," he says.

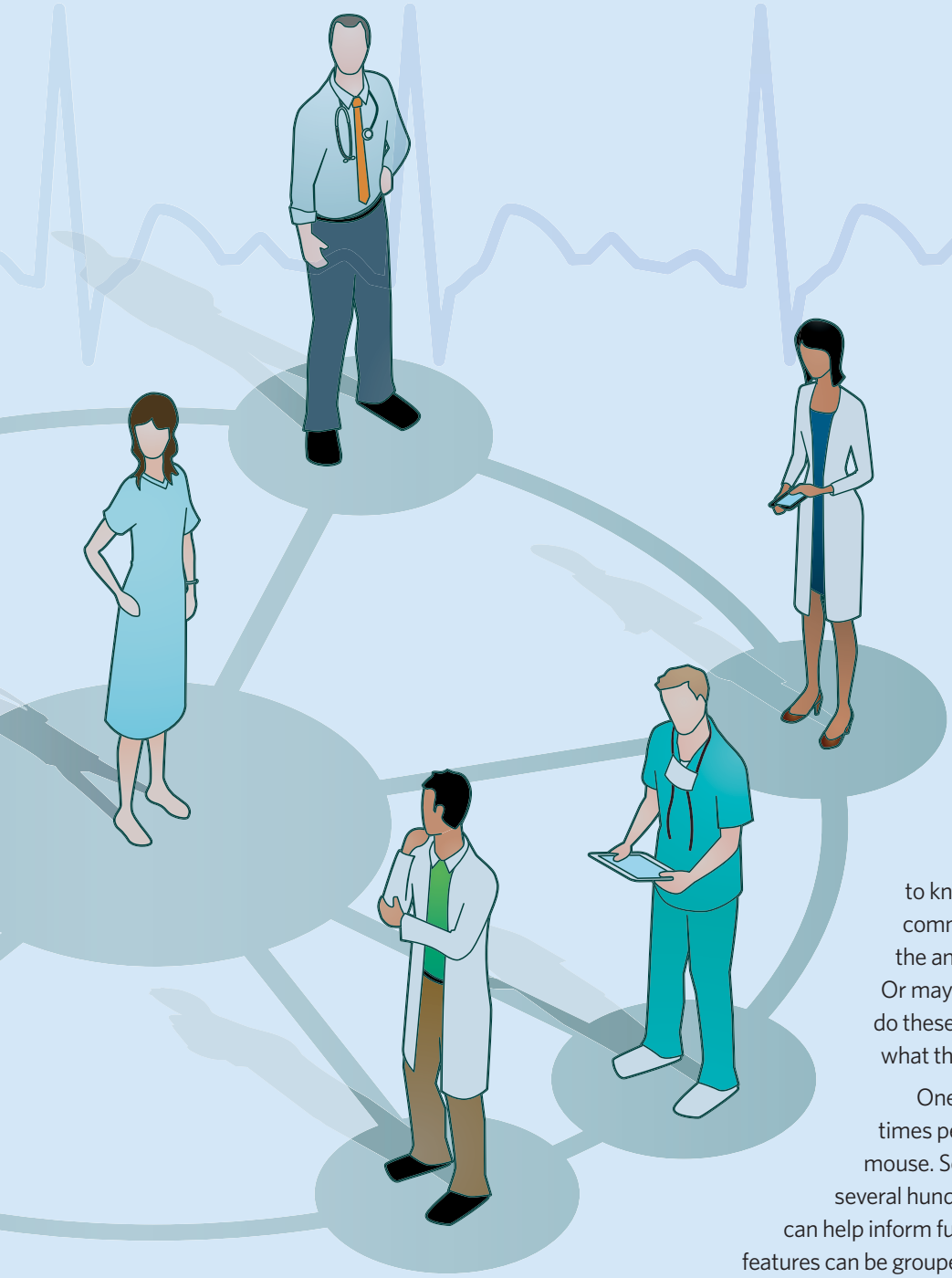
"The problem is that the health record system itself doesn't really buy you much; in fact, it really slows doctors down and it has increased costs. There's been a huge backlash and it's growing into an avalanche of complaints."

Problems are numerous. Electronic medical records must be loaded with customized content based on doctors' specialties. Information can't be shared across platforms. And workflow must constantly undergo adjustments to maximize efficiency.

"People who designed the software thought it would work one way but it just didn't work. So we have to find a way around it just to get our job done," Mattison says.

Take informal communication, for example. Despite the expensive electronic systems at their fingertips, Chen has observed doctors and nurses scribbling notes to themselves.

Doctors managing large caseloads don't have time to scroll through pages and pages of electronic patient data to locate key information. She watches them jot down pertinent facts from the EMR and carry a clump of hand-written notes with them as they meet with patients.



In addition, the EMR lends itself more easily to discrete data – diagnoses, lab orders, prescriptions and the like. But doctors and nurses still carry hand-written missives to remind themselves of tasks they need to accomplish. "These notes are not formalized enough to become part of the EMR system but they are important for the workflow. The formal system does not support this."

She hopes her research ultimately will lead to better medical practices and patient care. "When formal systems cannot support certain parts of people's work practice, what does that mean? And how can we better design technology to support that kind of practice?"

Chen's studies have also taken her to outpatient clinics, where she analyzes doctor-patient interactions around technology. "If you're a chronic care patient and you only have 20 minutes with your doctor, you want the doctor to be efficient so he has time to talk to you. You want him to be able to access the right information, ask the right questions."

Not surprisingly, patients also want to know that they – not the computer – are commanding the doctor's attention. Perhaps the answer is a new hardware configuration. Or maybe it's a novel mobile device. "Unless we do these studies," she says, "we really don't know what the critical issues are."

One of her projects tracked the number of times per task the doctor moved the computer mouse. Some tasks, Chen learned, could require several hundred mouse clicks; that type of information can help inform future systems. Perhaps certain software features can be grouped together or placed in specific patterns on the screen. "If doctors have to move the mouse back and forth 50 times during one patient visit, why can't we make something easier for them to use?" she wonders.

Mattison believes these changes can "absolutely, unequivocally" increase doctors' efficiency while reducing costs. "At Kaiser, that's already happening but we're the exception," he says. "Smaller institutions don't have the budget to [make these changes] themselves. They're struggling to get it right and Yunan's work is going to help them."

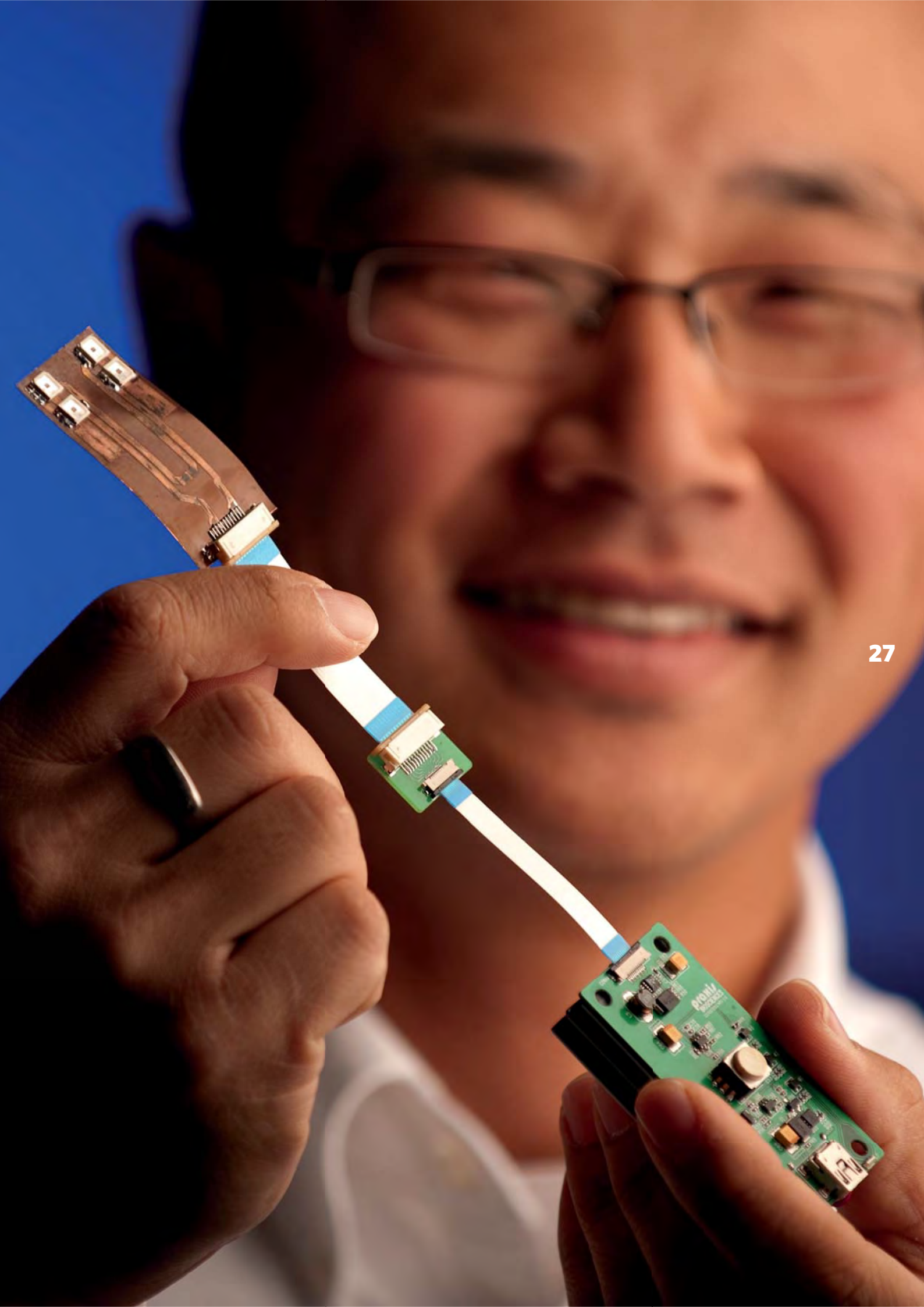
While she doubts that health practices will ever be completely paper-free, Chen does envision a technology-rich future with systems responsive to their users. "I'm hoping in 15 to 20 years there will be a sociotechnical environment that best supports the flow of information and collaboration, makes sense and allows providers to use information effectively," she says. "Whenever you need information you can access it in the format you prefer and use it in an efficient and effective manner."

the sinus ILLUMINATOR

A UCI startup makes headway into a stuffy situation

by Shari Roan

photo: Steve Zylius



It's a typically bustling day in the offices of Dr. Naveen Bhandarkar, director of rhinology and sinus surgery at UC Irvine Medical Center.

There are sinuses to examine and infections to treat. But in a tiny office tucked into one corner of the clinic, innovation is taking shape as well.

Here, research assistant James Kim greets patients with symptoms of chronic sinusitis who agree to participate in a clinical study that could someday dramatically improve the way doctors diagnose the common but often bedeviling condition.

Kim instructs each patient to sit down and to open his or her mouth so he can insert a small probe that illuminates the sinuses. Pictures are snapped. It takes about as long as a driver's license photograph at the DMV — without the long lines.

And if it sounds simple, well, that's the whole point. The device, called a sinus illuminator, is being developed by Praxis BioSciences out of Calit2's TechPortal business incubator to advance the complex art of diagnosing sinusitis. The sinus illuminator shines near-infrared light into the four pairs of sinus cavities to produce images that could be used, some day, to screen for the disorder.

"We're trying to determine if the sinus is not healthy," says Bhandarkar. "The conflict doctors face is whether a patient has sinusitis or sinus thickening that correlates with the patient's current symptoms. Or do they have symptoms that might be secondary to allergies or other causes?"

That question perplexes physicians nearly every day. Sinusitis is one of the top 20 conditions seen in primary care settings. About 31 million adults are diagnosed with it each year, according to the U.S. Centers for Disease Control and Prevention; the condition is also common in children.

Sinusitis is defined as sinuses that are inflamed and is diagnosed as chronic after 12 weeks. But the symptoms – cough, facial pain, loss of smell, congestion, ear pressure, throat drainage – can be difficult to distinguish from allergies and other conditions.

Doctors suspecting sinusitis typically treat a patient with antibiotics. But if symptoms continue, the doctor may prescribe more antibiotics or order a computerized tomography scan to examine the sinuses. The downside of that approach is that antibiotics have side effects and CT scans are expensive, time-consuming and expose patients to radiation.

That's where the sinus illuminator comes in.

"We're asking: 'Is there a better way to get the diagnosis to guide treatment without the need for a CT?'" says Bhandarkar. "Questions are being asked a lot more about the risks associated with a CT scan and the costs. We may be able to avoid an immediate CT scan in some patients."

The sinus illuminator could emerge as that easy, quick, inexpensive way to give doctors more information upon which to base treatments and order additional tests. The idea for the device was developed more than a decade ago by Dr. Brian Wong, a professor of otolaryngology and head and neck surgery, biomedical engineering and surgery at UC Irvine, who founded Praxis BioSciences with biomedical engineer Joon You *(pictured, page 27).*

"It was a long time brewing," says Wong, who is not involved in the clinical studies. "What has changed is the reduction in cost that was needed to use infrared light."

The completed device, about the size of a matchbox, contains an array of tiny LED lights. By using near-infrared light, most of the tissues in the sinus area become transparent. For example, healthy sinuses show up as brightly lit regions that represent the pockets of air. But in a patient with sinusitis, the anatomy appears much different due to swollen tissue and mucus.

"Every doctor uses light in one way or another," says Albert Cerussi, an optics expert at the Beckman Laser Institute and Medical Clinic and a collaborator on the project. "With the doctor's eyes, however well-trained, they are only looking at the surface of the tissue. Near-infrared allows you to see deeper below the surface more efficiently. That is where the novelty is."

Near-infrared technology became more affordable and accessible for biotechnology uses about a decade ago, says You, Praxis chief technology officer. Prior to that time, it was mostly confined to military gadgets. Near-infrared has wavelengths that are longer than those of visible light.

The ongoing study in Bhandarkar's office will involve 50 to 100 people. The inventors hope to develop precise algorithms to help doctors analyze the images.

The sinus illuminator "is off-the-shelf technology," You explains. "We basically designed it in a way that it would be very simple to use and fast. We don't want the operator to sit there and play around with the settings or calibrate it or anything that takes time away from their main duties."

The device is not intended as the sole means to diagnose sinusitis but as an extra tool, he says. Should the device reach the marketplace as hoped, it would represent the kind of evidence-based, cost-effective medical test that the government, health insurers and consumers are clamoring for. Moreover, You and his co-inventors are also working on technology that would transmit the images by Wi-Fi to a database or doctor's tablet.

"This is winning technology," says Wong, whose company already has several products on the market, including the EarTrumpet, an iPhone-based hearing test and sound-amplification system. "You have to match the technology with the application. This is near optimal."

Sinusitis is one of the top 20 conditions seen in primary care settings

Old Friends, New Successes

by Stuart Ross

EXAMINING WIRELESS HEALTH

The Center for Digital Transformation, located in the Calit2 Building, has received a **gift of $50,000** from the **Qualcomm Foundation** to establish "A Research Agenda for the Economics of Wireless Health." Center Director **Vijay Gurbaxani** will research three aspects of wireless health: the cost-benefit analysis of specific solutions, alternative business models for wireless health activity, and the larger sociotechnical infrastructure required for these systems.

UNDERSTANDING SOCIAL MEDIA

The Center for Digital Transformation has also received a planning grant from the **National Science Foundation** to prepare for a large multi-year venture with industry. The goal is to earn a larger grant under NSF's program of Industry/University Cooperative Research Centers. These centers bring together companies with common research interests; those companies match the NSF funding to support the university program and share in setting research priorities. The **$14,500 planning grant** will cover workshop and travel costs for UCI to collaborate with three other universities: Clemson University, which leads the group; New York University and the University of Minnesota. Called COSTA – the Consortium for Social Technologies and Analytics – the group will conduct research that accelerates understanding of social media's implications for industry and society. Letters of support for the planning effort came from Google, Emulex, Amazon and more than 25 other companies. The UCI effort is led by business school professor **Vijay Gurbaxani**. He previously managed a similar NSF center — UCI's Center for Research in Information Technology and Organizations (CRITO).

IMPROVING PREDICTIONS ONLINE

Sociology graduate student **Zack Almquist** studies with **Carter Butts**, associate professor of sociology, in the **Center for Networks and Relational Analysis** in the Calit2 Building. He is doing his dissertation work on "Dynamic Network Models for the Scalable Analysis of Networks with Missing or Sampled Joint Edge/Vertex Evolution." Almquist earned a one-year, **$15,140 dissertation completion award** from the **National Science Foundation**; Butts serves as the formal principal investigator. Almquist's work allows improved prediction for dynamic processes in social networks online — disaster-response and sexual-contact networks, for example. His dissertation also includes validation of the approach by analyzing past real-world networks, such as those developed in response to Hurricane Katrina.

A CALPLUG BOOST

CalPlug, the California Plug Load Research Center managed by Calit2, continues to recruit new corporate members, the newest of which is **FutureDash**. The company manufactures systems for giving homeowners feedback about their energy use, a topic important to Calit2 and CalPlug. Plug loads are difficult to monitor and the amount of energy they use is increasing rapidly. FutureDash has joined as an **associate member**, the category reserved for new small companies, and has already contributed to Calit2 at VIP demonstrations..

SAFETY IN NUMBERS

The Internet makes it easy to organize people to contribute to larger efforts without even knowing each other – so "crowdsourcing" is a term used for a sort of IT alternative to outsourcing. **Brian Demsky**, associate professor of electrical engineering and computer science, has received a **three-year grant from the National Science Foundation** to apply crowdsourcing to the monitoring of large software programs. This project is developing systems for monitoring software programs as they run on many different computers in different conditions, thus being able to detect misbehavior or points of weakness more quickly. Demsky and co-investigator **Athina Markopoulou**, also a Calit2 affiliate in electrical engineering, were awarded **$800,000** as part of a collaboration with UC San Diego. Their project is titled "Safety in Numbers: Crowdsourcing for Global Software Integrity."

REHAB REWARDED

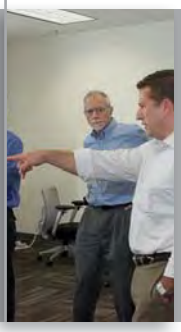
One of the new tenants in Calit2's TechPortal incubator is **Flint Rehabilitation**, a startup seeking to commercialize the MusicGlove invented by graduate student **Nizan Friedman**. In a continuation of its research program, Flint recently awarded **three subcontracts to Dr. Steven Cramer**, professor of neurobiology. Two subcontracts totaling nearly **$50,000** were made under Flint's two awards from the U.S. Department of Education's program for rehabilitation research, using a special grant mechanism for small businesses. One is for making the MusicGlove more durable for home use and for conducting more systematic trials with stroke patients. The other subcontract is for studying robotic assistance to arm exercise. Another small-business award to Flint, from the National Institutes of Health, resulted in a separate **$45,000** subcontract to Cramer for more work on the Music Glove. All three grants are part of the federal **Small Business Innovation Research (SBIR) program**.

BITS AND BYTES

A timeline of select Calit2 activities

OCTOBER

3 Southern California Edison's new manager for design and engineering services, Michael Williams, engages in demonstrations in the CalPlug Center.



15 Attendees of the annual Emerging Technology Summit in Pasadena take a field trip to the Calit2 Building to tour the CalPlug Center.

The Material Surface Engineering Center, a 40-company consortium based at

11 Kanto Gakuin University in Japan, explores research collaboration in Calit2 clean rooms.

NOVEMBER

1 After his presentation, NASA Chief Scientist Waleed Abdalati poses with UCI graduate students in front of a Hiperwall display in the Visualization Lab.

At the quarterly meeting of the Calit2 Division Council, second-term member Soroosh Sorooshian offers suggestions

9 for stimulating new research collaborations.

23 A French delegation focused on links between higher education and industry within innovative ecosystems checks out Hiperwall Inc. activities in the Visualization Lab.

30 Moderated breakout sessions enable attendees of the semiannual CalPlug set-top box workshop to focus on topics specific to their companies' interests.

UCI's Communications 2025 conference held at Calit2 culminates with an industry **17** panel discussing life in a hyperconnected world.

Director G.P. Li presents technology for empowering health and well-being at the State of the **25** Science Conference held at USC.

15 Director Li gives an invited talk at The Irago Conference organized by the Electronics-Inspired Interdisciplinary Research Institute at Japan's Toyohashi University.

29 Peering into a microscopy image, Cyrus Wadia from the White House Office of Science and Technology learns about research on new materials for clean energy.

A large audience ventures to the semiannual Calit2 Igniting Technology program focused on the "science" of crossing **27** disciplines and creating innovation.

BITS AND BYTES

A timeline of select Calit2 activities

6 A group from Calit2 participates in Frost Venture Partners' Big Data Revolution introductory meeting.

DECEMBER

Flint Rehabilitation Devices, a startup company based on work developed in the eHealth Collaboratory, moves into TechPortal.

1

Homegrown entertainment led by engineering assistant professor Mark Bachman livens up the annual Calit2/INRF holiday party.

10

10 Led by CalPlug technical manager Arthur Zhang, a group of students demonstrates the Wall of Power at a concurrent event during the Consumer Electronics Show in Las Vegas.

JANUARY

A Rigaku application scientist presents an X-ray techniques seminar for users of the new SmartLab diffractometer in the Microscopy Lab.

8

Students selected for the Multidisciplinary Design Program (MDP), now in its third year, participate in the winter quarter orientation session.

12

12 CalPlug researchers participate in an organizational meeting to establish the goals and objectives for a Southern California Energy Consortium.

Ready for the next phase of growth, Hiperwall Inc. packs up and moves out of Calit2's incubation cycle into a new 6,000-sq.-ft. location in Irvine.

14

15 Another biotechnology startup based on UCI research, Biopico becomes the newest tenant in Calit2's technology business incubator.

Director G.P. Li presents Calit2's eHealth technology solutions at the National Academies Forum on Aging, Disability and Independence in Washington, D.C.

19

17 The first in a series of classes about CalPlug research is held for members of the Osher Lifelong Learning Institute.

Winners from across the country of the Digital Media and Learning Competition on Badges for Lifelong Learning attend a two-day workshop at Calit2.

24

25 A delegation from the Orange County Department of Education experiences the first DigiPal prototype developed by CalPlug researchers.

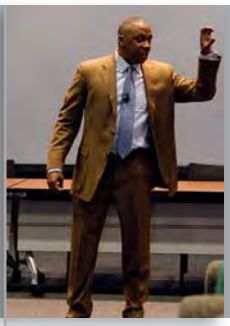
As part of the continuing education and training efforts for the Microscopy Lab, manager Jian-Guo Zheng leads a discussion on backscattered electron techniques.

30

BITS AND BYTES

A timeline of select Calit2 activities

FEBRUARY



Engineering-professor-turned-motivational-speaker Calvin Mackie delivers a strong message for working together **7** to increase under-represented minority participation in STEM.

13 FEI technician Jeff Hornbeck upgrades the transmission electron microscope, offering new capabilities for researchers in the Materials Characterization Center.

A full house turns out for a workshop on new clean-room microfabrication techniques. **14**

MARCH

Bill Tang, associate dean of research in the engineering school, shares with MDP undergraduates **1** the value of participating in team-based research.

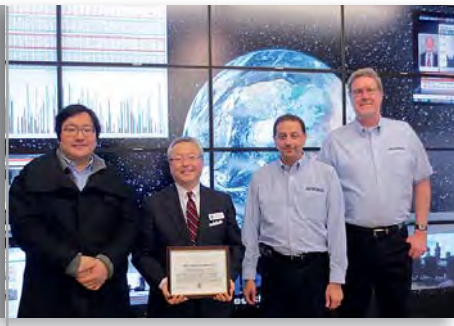
6 An Xradia nano CT machine, the first of its kind in Southern California, is installed in Calit2's Nano-Bio Metrology Lab, enabling researchers to study the interface of materials inside a sample.

UCLA Professor Asad Abidi, a member of the National Academy of Engineering, gives a distinguished lecture **8** on amplifier noise versus linearity.

15 Faculty representing four different UCI schools participate in the quarterly Calit2 Division Council meeting.

"Gradual Change" is the theme of a TEDx event in the auditorium showcasing several Calit2 projects. **19**

20 National Institutes of Health Deputy Director Sally Rocky gives a Calit2 audience some perspectives on the current state of extramural research funding.



It's official! Hiperwall Inc. opens for business in its new Irvine office and showroom. **21**

11 A delegation of senior research officers from the Association of American Universities experiences projects in several Calit2 labs as part of a campus visit.

27 A faculty mentor for MDP, Bill Tomlinson suggests that students hone their research skills by asking, "Am I doing it wrong? How can I do it better?"

The Digital Hour features UCI business school professor Mingdi Xin, who discusses the opportunities and challenges of selling software as a service. **13**

Calit2 supports a program in Riverside, Calif. on Funding the Big Ideas, offering complimentary registration to affiliated entrepreneurs. **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.

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California Institute for
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Calit2

FROM PITCH TO RICH

Five pros share their startup perspectives

Registration 5:00 pm
Presentation 5:30 pm

Register at www.calit2.uci.edu

Are you an innovator or an entrepreneur?

How do you transform a brilliant idea into a marketable concept and obtain the necessary funding?

Join us June 6 as five experts from all corners of the startup arena reveal their secrets to creating new businesses and launching them to success.

Presenters:

Jeff Greenberg, CEO of Hiperwall, Inc. Greenberg will share his company's journey from its birth in the Calit2 Visualization Lab to a firm with hundreds of customers and a new, 6,000-square-foot headquarters.

Luis Vasquez, vice president of entrepreneurship at OCTANe. Vasquez oversees OCTANe's LaunchPad, bringing together Orange County's vast network of resources and executives to evaluate, mentor and guide startup companies.

Dev Bhatia, CEO of UCI spinoff SRCH2. Formerly known as Bimaple, SRCH2, a developer of next-generation search software, hired seasoned startup guru Bhatia last year to take it to the next level.

Dr. Brian Wong, co-founder of UCI startup Praxis BioSciences. A self-professed "ideas guy," Wong, an otolaryngologist and head and neck surgeon, helped launch the biomedical-technology and healthcare-application company.

Thomas Gephart, founder and managing partner of Ventana Global Venture Capital Group. Gephart, with more than 30 years of experience in advanced technology companies, will disclose the finer points of attaining VC funding.

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

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