

# interface

California Institute for  
Telecommunications  
and Information  
Technology



Volume 6 | Issue 1 | Fall 2010  
University of California, Irvine



Power to the People



# Table of Contents

cover story:

1



## Creative Juice

Smart systems power next-generation energy efficiency endeavors

features:

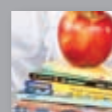
12



## Fusion

Green IT merges sustainability with digital information management

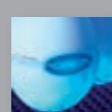
14



## Picture This

Nine undergraduates share insights gleaned from their summer research experiences

18



## TechPortal

Incubator welcomes new tenants, kicks off entrepreneurial lecture series

20



## Match Maker

Startup company finalizes prototype for instant interactive-search software

briefs:

22

## Funding Notes

24

## Bits 'n Bytes

Interface®  
Fall 2010

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  
Paul Kennedy – Photography  
Mike Delaney – Meridian Graphics

### Calit2

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

*On the cover: A novel feedback program designed by two UCI professors allows participants to monitor their homes' electricity consumption on computers or smart phones.*

# Creative Juice

## Smart Technology Empowers the Flow

by Anna Lynn Spitzer

**W**alk into the sunny living room of Sergey Nizkorodov's two-story home in University Hills, adjacent to the UC Irvine campus, and you'll see a desktop computer, 22-inch monitor, ceiling-mounted projector, surround-sound equipment and a DVD player. Like media components in many homes, all the equipment is plugged into a single power strip.

That's where similarities end. The strip in Nizkorodov's home is "smart," feeding data wirelessly every three seconds to a household hub, where it is aggregated, graphed and stored.

Six identical power strips are connected to various other appliances in the home, including the family's refrigerator, coffee maker, electric tea kettle, cell phone chargers, laptop computer, and intermittently, the vacuum cleaner and iron.

*(continued, page 2)*



The power strips blink different colors, depending on energy usage, the room's temperature level and its lighting. Occasionally, they chirp and send out a sort of musical interlude to communicate their message: "See how much energy you're using!"

The feedback allows Nizkorodov, a UCI chemistry professor, and his wife, Elena Koriakina, to better understand the nuances of their home's energy consumption and, if they choose, to make immediate adjustments that can reduce their overall expenditure.



*By monitoring their home's usage data regularly, Nizkorodov (left) and Koriakina discovered exactly how much electricity their appliances and electronics consume each day.*

The couple is participating in a novel pilot program designed by two UCI professors who believe human behavior can influence energy conservation efforts as much as the latest meters, appliances and gadgets.

Professors David Kirkby and Dan Stokols' *uci@home* project is one of several ongoing university projects and community collaborations aimed at improving consumer efficiency, decreasing electricity use and distributing power more judiciously to a ravenous nation.

Across the U.S., total residential and commercial electricity use is projected to increase 310 million kilowatt-hours per day between 2009 and 2011, while demand is expected to swell by as much as 40 percent in the next 20 years.

Increased demand, however, is only one piece of the predicament. World

events have made reducing dependence on foreign oil a priority, and most scientists believe decreasing greenhouse gas emissions is a prerequisite to heading off global warming.

Approximately 60 percent of California's electricity is generated by natural gas- and coal-burning power plants that spew carbon dioxide into the environment as a byproduct. Four years ago, the state adopted measure AB32, the Global Warming Solutions Act of 2006, which mandates that greenhouse gases statewide be reduced to 1990 levels by 2020. Without novel approaches to conservation and energy efficiency, that reduction – the equivalent of 30 percent – is irreconcilable with increasing demand.

The quest for feasible solutions has led researchers, utilities, government agencies and manufacturers to get "smart." From buildings and appliances to electric meters and the grid itself, information technology is forging a path to an intelligent, cleaner and more efficient future.

## Unlocking the Grid

The electricity that magically appears when we flip a switch is generated in power plants before being transferred via high-voltage wires to a series of substations, which distribute it to homes and businesses. These transmission lines interconnect, forming networks referred to as "the grid."

In California, construction of transmission stations is costly and time-consuming – it takes nearly a decade just to obtain necessary licensing and permits – so utilities must look to new technology to help extend the capabilities of existing systems, says Michael Montoya, director of engineering advancement at Southern California Edison.

A "smart" grid, a highly automated system that incorporates communication, computing, sensing and control technologies, can revolutionize



the way utilities and consumers manage electricity usage.

"These technologies will give us wide-area situational awareness and controls that will allow us to push the [existing] transmission system harder with the same [resources] we have today," Montoya says.

UCI is a key player in the development of this next-generation grid. Along with a consortium led by Southern California Edison, it is partnering on the Irvine Smart Grid Demonstration, funded with \$40.1 million from the Department of Energy's American Recovery and Reinvestment Act. The project comprises – on a smaller scale – construction, testing and analysis of all the components a statewide grid will one day require.

### Close to Home

UCI researchers don't have far to travel; the test grid is literally in the university's backyard. In August, SCE installed a new 12-kilovolt underground circuit that bisects the campus, running adjacent to an existing circuit. It will carry electricity from the MacArthur Substation, a

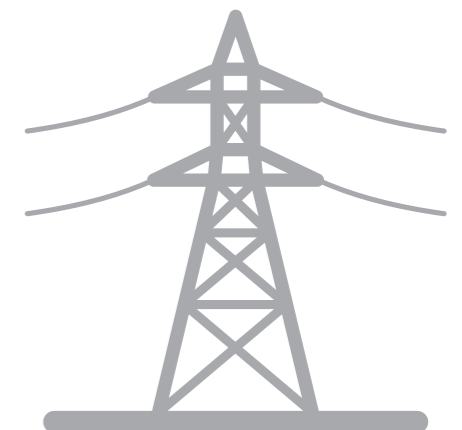
few miles down the road, to homes and businesses in the area, including the University Hills neighborhood.

High-tech, interoperable digital devices connected to the system will give the test grid the ability to incorporate renewable energy, communicate with homeowners, assess the effectiveness of storage facilities and switch delivery strategies quickly when outages occur.

UCI's participation is spearheaded by Scott Samuelsen, a Henry Samueli-chaired engineering professor and director of the university's Advanced Power and Energy Program. Samuelsen's team will analyze the operation of the smart circuits, creating dynamic models at different phases of the project to compare smart grid benefits to those of the traditional grid. "The ultimate goal is to have a more environmentally sensitive grid, more efficient utilization of electricity and a higher quality of life," he says.

The University Hills neighborhood is metamorphosing into a living laboratory. Approximately 40 homes on

*Construction crews last summer installed a 12-kilovolt underground circuit to feed electricity to the Irvine Smart Grid Demonstration project.*



*(continued, page 4)*

*“These batteries will have to be communicated to so they know what to expect. If they’re saturated they have to cry ‘help.’”*

several blocks – each block with its own transformer – are being outfitted with different combinations and quantities of smart appliances, solar panels, double-paned windows, new insulation, programmable thermostats, and even use of plug-in hybrid electric vehicles during the five-year project.

#### Instant Communication

Interoperability is critical. Electricity flows across the grid at nearly the speed of light, not giving utilities much time to react to problems. On today’s grid, a short or other fault can instantly shut down a whole circuit, disrupting service to hundreds or thousands of customers. The smart grid project, on the other hand, will include small devices similar to substation circuit breakers, which contain microprocessor relays capable of sending round-trip communication in less than 100 milliseconds. This allows the utility to immediately identify the site of a problem and shut down only that section of the circuit, simultaneously looping into the nearby circuit to keep power flowing.

“These devices will be talking to each other, so if there’s a fault, all the devices will know exactly where that is,” Montoya says.

The smart grid will also incorporate renewable energy more effectively. State policy requires utilities to generate at least 20 percent of all power from renewable sources by the end of this year. But Montoya says intermittency – reduced production due to cloudy days or other weather situations – and interconnection bottlenecks stymie current distribution efforts.

The demonstration project will explore ways to improve distribution of renewables. Photovoltaic rooftop panels on the test homes will generate solar power, while storage batteries will be located throughout the test area – at the circuit, at the

transformer and at some of the homes – to determine the most effective approaches.

In the not-too-distant future, other forms of generation, including fuel cells and microturbine generators, will add to the storage challenge, making it a critical area of research.

“These batteries will have to be communicated to so they know what to expect,” says Samuelsen. “If they’re saturated they have to cry ‘help,’ and the smart system has to somehow accommodate that in ways we don’t quite understand right now. That’s part of the research.”

The energy generated by the solar panels will not only provide electricity to the homes, it will also allow research into bidirectional distribution – the funneling of excess power back to the grid.

Several of the homes in the project will become “net-zero” energy buildings. In those homes, the amount of energy consumed does not exceed the amount of energy the house generates through renewable sources.

Achieving net-zero energy is another on the long list of state priorities. The California Energy Commission’s (CEC) goal is to achieve net-zero energy homes in all new construction by 2020 and in commercial buildings by 2030. While retrofitting existing homes is a little more challenging, the commission is researching those options as well.

#### Touch of a Button

Homes in the project will contain “smart” control dashboards that serve as decision-making centers, while

SoCal Edison “smart meters” will provide two-way communication between the homes’ smart appliances and the grid. Homeowners will choose the degree to which they want to reduce their electricity usage, input their choices into the dashboard

and the system will do the rest.

Those who choose to save the maximum amount of energy shouldn’t be surprised when their dishwashers or washing machines won’t function during peak hours. The smart appliances, all with Internet addresses, will self-activate on command when the demand for electricity across the grid subsides.

Project participants can change their dashboard settings as often as they like and if necessary, bypass the system completely. “They may want to wash their clothes at peak times once in a while, or keep the house a little cooler. The consumer will want options,” Samuelsen says.

**“Utilities around the country and around the world are looking to us for leadership.”**

Integration of electric vehicles into the grid will present a whole new challenge. The CEC estimates that 1.5 million electric vehicles will be on California roads by 2020. The electric load from one of these cars is larger than that from a home air conditioner; charging two electric vehicles is equivalent to a new home’s total load. “The transformers that feed neighborhood circuits were not designed for every home to have an air conditioner, much less an electric vehicle,” Samuelsen says.

The smart grid demo will help researchers understand possible responses. “We’re looking at design, at transformer sites and at our distribution system,” says SCE’s Montoya.

Transformers are designed to handle peak loads midday – usually 2-3 p.m. – and use off-peak hours as a cooling period, which maintains their durability. But an influx of electric vehicles, all trying to charge in the early evening, for example, would create a second peak that would disrupt this cooling-off time and could ultimately damage the transformers.

One solution: distribution of the load to off-peak hours. Homeowners who receive a car will also get a charging station installed in their garage; the smart grid will manage it, however, by staggering charging times to take advantage of low-use overnight hours.

Owners can plug in their cars when they get home at night, and rest assured that they’ll be ready to go by morning.

The Irvine Smart Grid Demonstration is a precursor to the region-wide smart grid that SCE expects to have fully operational within 20 years. By tracking usage, savings and capabilities offered by smart technologies, the project will inform the building and retrofitting of tomorrow’s energy-efficient communities.

Consumers will benefit too. By 2030, it is estimated, smart grid technologies can reduce energy usage 4 percent across the U.S., the equivalent of \$20.4 billion in savings.

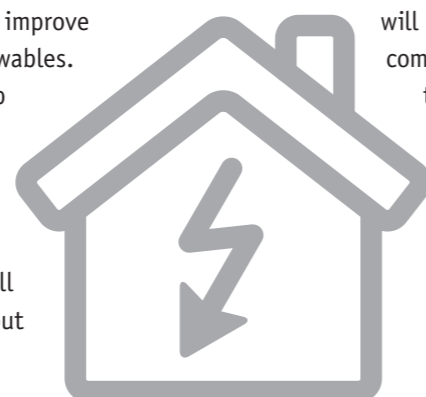
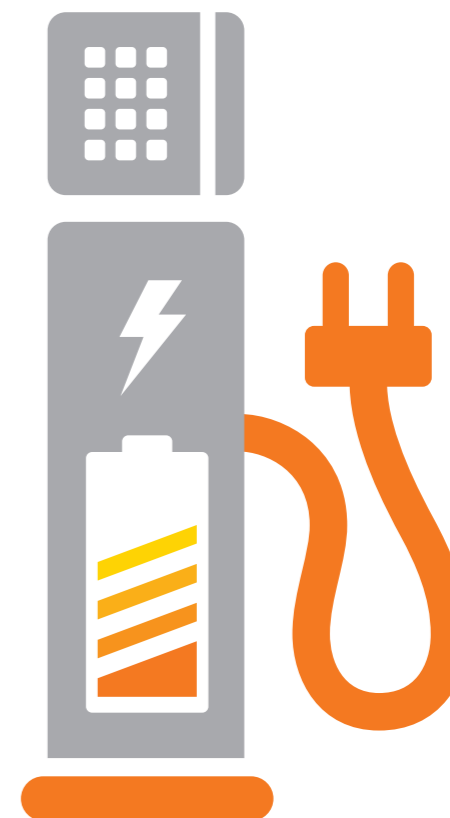
“Utilities around the country and around the world are looking to us for leadership,” Samuelsen states. “This project is very special in the world community.”

## Building Smart

Of all the energy consumed in the United States, it’s estimated that 40-45 percent is guzzled by buildings – homes, offices, commercial establishments, schools and factories.

In the 1990s, the U.S. Green Building Council began developing a set of

*(continued, page 6)*





UCI's energy-efficient, smart "green" buildings include the new Sue and Bill Gross Hall (above) and the remodeled Student Center.



environmental standards known as LEED, Leadership in Energy and Environmental Design. First published in 2000, this coveted third-party certification system verifies that buildings of all types meet strict "green" criteria.

These buildings are smart in ways that go beyond sensors and systems, says Malcolm Lewis, chairman and CEO of technical consulting firm CTG Energetics. "A lot more thought goes into constructing a green building that's holistic and integrated and simple, so from that standpoint a green building

is a smart building," he explains. Of course, many also are wired with the latest sensors, microprocessors and systems technology to additionally optimize their energy usage.

More than 6,000 buildings worldwide have earned LEED certification in four levels ranging from "certified" to "silver," "gold" and "platinum," and 24,000 more are in the pipeline.

LEED buildings typically utilize drought-tolerant landscaping; large, operable windows that let in sunlight and ventilation; efficient lighting, HVAC

and air-quality systems; and features like solar panels and recycled materials in construction and furniture.

"LEED is intended to be at the vanguard of developing best practices for the top 25 percent of the building industry that are really pushing the envelope on performance," says Lewis, who has been actively involved in the effort since its inception. "But everything trickles down and affects the other 75 percent too. LEED is committed to constantly raising the bar so it will keep evolving and encouraging the development of new technologies."

#### Taking the Lead

UCI is home to seven LEED gold-designated buildings, including the new Student Center, the Anteater Recreation Center expansion, the Anteater Instruction and Research Building and several housing complexes. "No college or university campus has more LEED gold awards than UC Irvine," says Wendell Brase, vice chancellor for administrative and business services.

In fact, UCI was recently ranked sixth on the Sierra Club's list of the greenest U.S. campuses. But Brase, who also serves as chair of the University of California's Climate Solutions Steering Group, won't rest on his laurels. He continues to seek further reductions in the university's energy usage and consequently, its greenhouse gas emissions.

One area of campus with huge potential: laboratories, which contribute

two-thirds of a typical research university's carbon footprint. Building smarter and retrofitting existing spaces can reduce laboratories' energy expenditure by 50 percent, he says.

A smart building should utilize sensors not only to control lighting, temperature and fan ventilation, but also air quality, overall ventilation and exhaust air speeds. "Many so-called 'smart buildings' are not really very smart," Brase says.

One that is: UCI's \$80 million, 100,000-square-foot Sue and Bill Gross Hall, which houses the university's stem cell laboratory. Completed this year, the building is about as smart as they come.

Sensors, controls and design parameters improve efficiency in everything from air-handler filtration speeds and air changes per hour to lab and office illumination.

Operable office windows are electronically connected to room ventilation controls, and the high-efficiency HVAC system recycles cool air in secondary spaces. Huge air ducts, approximately four times the size of ducts on comparable buildings, slow air speed down to a virtual crawl. "The slower the air is moving the less energy it takes," Brase explains.

All these energy-saving features can be applied to retrofits as well, and in the next few years, Brase plans to do just that. Every lab building on campus

(continued, page 8)

*"A lot more thought goes into constructing a green building that's holistic and integrated and simple, so from that standpoint a green building is a smart building."*



photo courtesy of UCI Design & Construction Services

Gross Hall's ultra-efficient air-exchange system employs huge ducts – four times larger than those on comparable buildings – that slow air to a virtual crawl.

photo courtesy of UCI Design & Construction Services



*This lab in Sue and Bill Gross Hall contains a myriad of energy-saving elements. All labs on campus and at the UCI Medical Center will be retrofitted with similar features.*

and at the UCI Medical Center will be updated with these ultra-efficient technologies.

“UCI is the leading campus in the country in terms of smart labs,” he says, “and the stem cell building is the model for future projects.”

One of those future projects is the Calit2 Building’s Class-1,000 clean room. Clean rooms recycle air constantly to meet purity standards and must maintain stringent temperature and humidity control requirements, so they consume a huge amount of energy per square foot.

The Calit2 lab will be outfitted with instrumentation that will sense the density of airborne particles. The sensors will automatically increase the lab’s air speed when someone enters, but slow its operation when cleanliness criteria can be attained with reduced air changes.

By decreasing the number of air exchanges needed to keep the lab uncontaminated, the system greatly reduces energy consumption. “It’s very expensive and energy intensive to push air through a HEPA filter many, many times an hour, whether it’s dirty or not,” Brase says.

#### **A Brighter Approach**

Brase recently oversaw another campus retrofit project that reduced energy usage nearly 80 percent. All parking structure lighting fixtures

were replaced by high-efficiency, bilevel lighting that idles at 35 watts, increasing to 70 watts when it detects motion from cars or people. The fixtures also incorporate daylight sensors. “These are pretty smart fixtures,” he says.

Other actions taken by UCI to decrease carbon footprint include an agreement signed in 2008 with SunEdison to build and operate a solar energy system on campus. Last year, the university began purchasing energy generated by this system, which is expected to produce enough to offset 25.6 million pounds of carbon dioxide over the next 20 years.

## **Carrying the Load**

Consumer and office electronics and appliances devour a hefty chunk of California’s energy supply. Estimates put the load from these devices at 10-20 percent of total energy use in houses and commercial establishments, and with the introduction of more and more consumer gadgets, that load continues to grow. By 2030, the figure is projected to rise to 30 percent.

Energy efficiency is the state’s first choice for meeting these future energy requirements.

In 1974, the state legislature created the California Energy Commission to forecast statewide energy needs, evaluate electricity resources, and promote energy efficiency and conservation programs. It also directs energy research programs under the auspices of PIER, the Public Interest Energy Research program.

In conjunction with its mandate, the commission adopts energy regulations for buildings and specific appliances, including refrigerators, external power supplies, compact audio-video devices, DVD players and televisions, often leading the nation in this effort. “By 2004, our standards efforts had saved us more than 12,000 megawatts of peak electricity – the equivalent of building about 24 500-megawatt power plants,” says Jeff Byron, a CEC commissioner.

“We estimate our building and appliance standards have saved consumers more than \$56 billion since 1978.”

In addition, the commission administers rebate programs to encourage the purchase of efficient appliances. In April this year, on Earth Day, it launched an appliance rebate program with \$35.2 million in funding from the American Recovery and Reinvestment Act.

---

**“Before, everything just came out of the minds of the engineers. But we want to get consumer input up front.”**

---

“Our policies are to be very aggressive on energy efficiency and on programs that save consumers money, and we are seeing enormous benefits from that,” Byron says. “But California is still a growing population and we’re seeing our demand go up on average about 1.2 percent a year, and for peak use, a little higher, about 1.6 percent a year. Business as usual is not going to work here.”

One relatively unexplored area of potential energy savings is referred to as “plug load,” the category of appliances, electronic devices and tools that consumers plug in. While certain appliances within this category have been regulated, the group as a whole has seen very few directives for energy efficiency.

A large subset of these devices share another characteristic: they consume power even when they are not in use. Charging devices, computers in standby mode and TV set-top boxes use what is known as “vampire power.” As electronic devices multiply, these vampires will consume more and more precious energy.

The CEC has its sights firmly trained on these plug-load devices.

“We’ve been working for a long time on reducing energy usage and improving efficiency of a lot of the big-load items

– air conditioners, refrigerators, heating – in the residential and commercial sector,” Byron says. “But this plug load, by 2030, is going to be almost 30 percent of the electrical consumption in the state. That’s troubling because there is a lot of energy waste going on.”

Calit2 Irvine Director G.P. Li foresees a proliferation of “smart” appliances that will begin to address these issues. He says several manufacturers are already working on solutions, but comprehensive change will require more research and collaboration. “Calit2 is thinking about how to create a research center that will work closely with governments, manufacturers, utilities, universities and most importantly, consumers,” he says.

The CEC’s Byron agrees that new approaches are necessary. “We’ll see energy reductions as a result of our programs, our standards work and greater implementation of renewables,” he states. “But we need to really see the development of innovative technologies that will reduce energy use and greenhouse gas production even more.”

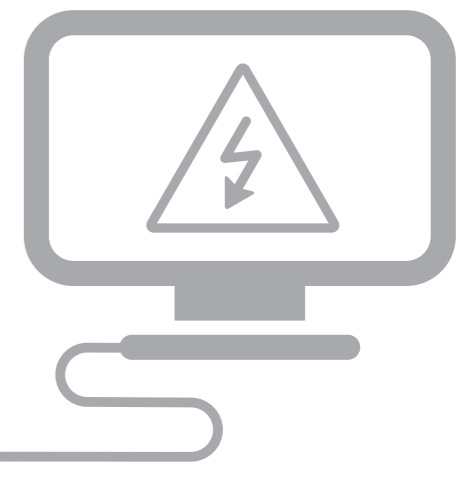
Implementing IT solutions is a significant beginning, Li says, but it is critical that efforts are extended to other areas as well: the collaborations necessary to achieve change, analyses of consumer behavior and innovative ways to educate consumers, all of which intertwine in truly effective, practical solutions. “Before, everything just came out of the minds of the engineers. But we want to get consumer input up front,” he says.

## **Buying In**

UCI professors David Kirkby and Dan Stokols are well aware of the power wielded by the consumer. That’s why they are building in human behavior attributes as they design the electricity-usage feedback system that they hope people will really want to use.

“This is not purely an engineering problem,” says Kirkby, a physics

*(continued, page 10)*



***“California is still a growing population ... business as usual is not going to work here.”***



professor who launched the *uci@home* project while on sabbatical last year. "It's people like you and me that consume energy, it's not the things you plug into the wall. I like to think of that as an opportunity."

The system's electronics and firmware were designed by Kirkby, while Stokols contributed research about effective feedback mechanisms.

Because energy is intangible, invisible and relatively inexpensive, most consumers don't spend too much time worrying about it. The CEC's Byron says only 15 percent of consumers rate energy efficiency as a top priority.

#### Talk to Me

Kirkby and Stokols aim to change that through their feedback systems. "When you give consumers even minimal feedback on their energy use, studies have shown you can achieve 5-15 percent savings on energy bills," Kirkby says. "If half of America's households cut their energy usage by 10 percent, it would be the equivalent of taking 8 million cars off the road. That's a big impact."

Stokols, Chancellor's Professor of psychology and social behavior, says ingrained behavior can be difficult to change. "Part of the problem is that a lot of this information is not salient to people; they're not thinking about it most of the day." By designing the feedback systems to blink, whir and otherwise interact, the goal is to make energy usage grab consumers' attention.

"All these different information functions capture people's attention or awareness. And once they're aware of things they have a better chance of changing their behavior than if they're mindless about it," he says.

Joerg Meyer, a *uci@home* participant, concurs. He was motivated to participate in the study after seeing his electricity bill double in one month. "One aspect I like about the study is that the project's custom-built smart strips give you different types of feedback," he says. "If you use too much energy, then a little red light flashes, telling you you're using too much on that outlet. So I basically try to keep it happy by not using too much electricity."

Meyer, who cut his electricity usage in half just by replacing his incandescent bulbs with compact fluorescent bulbs, also appreciates that the system translates abstract electric concepts into U.S. dollars, showing consumers actual costs and making the information more relevant than watts or kilowatts. "They convert it into something that really affects you and may affect your behavior," he says.

*uci@home* tailors feedback to meet specific participants' needs, based on their likes and dislikes; high-level software allows the devices to be easily configured remotely. In addition to the active feedback, the project makes it easy for participants to conveniently view their usage patterns online or via a web-enabled phone, giving them the opportunity to compare their daily,

weekly or monthly tallies to previous timeframes. Users can also set personal goals and anonymously compare usage with that of their neighbors – all mechanisms that have proven to be effective motivators, according to Stokols.

"Feedback can create a sense of satisfaction, convey social praise and convey normative information – what other people are doing – which is important because people often look to peers to gauge their own skills, abilities and attitudes," he says.

## Opening Opportunities

The push toward maximizing energy efficiency is creating a host of new markets. Paul De Martini, chief technology officer and vice president of smart grid strategy at Cisco Systems Inc., expects the next two decades will see a continuous parade of new technologies.

Implementation of the smart grid will drive development of new devices, applications, storage equipment, transmission and distribution hardware, outsourcing opportunities and pricing strategies.

The process is an evolution, says De Martini, who compares it to the journey taken by the Internet over the past 20 years. "We will increasingly see more intelligence being put into the grid infrastructure," he says, adding that the electric grid will look very different five to 10 years from now. But full implementation – the windmill-to-washer perspective, he calls it – will take 20 years.

In the meantime, within five years, he predicts, 75 percent of North America will be equipped with smart meters and synchrophasors that provide real-time measurement of electricity; distributed generation of wind and solar energy will swell; and software applications will multiply. Ten years out, electric vehicles will be more fully integrated into the

grid, energy storage devices will be widespread and new applications will complement the energy infrastructure.

"I think it's pretty clear that within a 10-15 year period, most of the basic infrastructure building blocks will be complete and most of the innovation will be riding on top of that," he says. That innovation will include new software packages in which multiple technologies converge, creating new functions and services, much the way the iPhone transformed cellular communication.

Among those services, De Martini expects to see custom payment plans, similar to those in the cell phone industry, as well as a proliferation of third-party service aggregators.

This steady development will feed exponential growth in new technology. "The innovation that's resulted to date ... has already evolved two or three generations," he says.

**"If half of America's households cut their energy usage by 10 percent, it would be the equivalent of taking 8 million cars off the road."**

Another market ripe for innovation is electronics, according to Alladi Venkatesh, a professor in the Paul Merage School of Business who researches technology use in the home. "The future is all in electronics," he says. "We live in a digital world and the technology is changing on a daily basis."

There is a lot of room for energy efficiency improvements in these devices, opening the door to new business opportunities. Two-thirds of the world lives in developing countries that are maturing into consumer societies, Venkatesh says, creating opportunity for U.S. manufacturers. "All the countries are becoming interested in energy efficiency but they don't have the technical knowledge. New products will replace the existing products, some


of them by improving on standards, some by offering new capabilities. It's a great opportunity."

#### Enlightenment

Back in University Hills, on a somewhat-smaller-but-no-less-important scale, the Nizkorodov family is doing its part for conservation. Sergey and Elena have experimented with their *uci@home* smart strips and know exactly how much electricity each of their appliances and electronics uses on a daily basis. "We now know that anything that involves heating consumes a lot of electricity so we try to minimize that," Sergey says. "If we need boiled water, it's much more economical to use the gas stove rather than the electric tea kettle."

Although they have always consumed energy austere – they don't use air conditioning and they hang their clothes to dry – now they turn off the computer and monitor when their work is done. "We were surprised to learn how much power the computer uses even when it's sleeping," Elena says.

Joerg Meyer not only returned his electricity bill to its previous level but reduced it an additional 15 percent, "just by changing my behavior a little bit and not giving up any conveniences." He's turning off lights more frequently and unplugging his cell phone charger when it's through charging. "Because it still uses power even when I'm not using it," he says.

"I knew that before intuitively but now I have an incentive: That little green light – I want to keep it happy." 



Joerg Meyer halved his electricity bill by replacing incandescent bulbs with compact fluorescents.



**"It's people like you and me that consume energy, it's not the things you plug into the wall."**

# fusion



photo: Daniel A. Anderson, University Communications

by Sherry Main,  
Donald Bren School of  
Information and Computer Sciences

**B**y 2012, Southern California Edison will have installed 5 million “smart” electricity meters in homes and small businesses throughout its 50,000-square-mile territory. The devices, which provide hourly data and can be accessed wirelessly, will enable consumers to optimize their energy usage – saving them money and conserving resources.

**Editor’s Note:** *Information technology may be the crux of smart systems but naysayers point to the industry’s own carbon footprint – approximately 2-3 percent of total greenhouse gas emissions. The Climate Group, a nonprofit international consulting organization, however, estimates that applying information and communication technology to electricity grids, building infrastructures, transportation and other social systems can reduce overall emissions by 15 percent, five times the industry’s footprint.*

This is just one example of a field called “green IT” that, according to Calit2 academic affiliate Bill Tomlinson, is emerging at the intersection of two trends: concern about the global ecosystem and the use of digital tools and techniques for manipulating information.

Tomlinson, associate professor of informatics at the Donald Bren School of Information and Computer Sciences, has published a new book, “Greening through IT: Information Technology for Environmental Sustainability,” which explores how IT can help address the environmental issues currently facing the planet.

## What are some common misconceptions about IT and sustainability?

People often don’t realize how intertwined IT systems and environmental issues are. This works two ways: First, there are the environmental ramifications of the IT systems people use every day. From the valuable black mineral coltan in mobile phones (the mining of which is implicated in profound humanitarian and ecological concerns in the Congo) to the CO2 produced by data centers (which run search engines, e-mail servers and many other data services around the world) to the vast amount of e-waste that results from the rapid obsolescence of technology (much of which is exported to Asia and Africa, where it’s processed in unsafe ways), there are some pretty dramatic problems that arise from existing IT systems.

For example, a lot of people include “Please consider the environment before printing this message” at the bottom of every e-mail they send. But given what it takes to send and store that e-mail – the hardware required, the power consumed and the CO2 emitted – it’s worth considering the impact of electronic communication as well. To quote one of my grad students, “Please consider the environment before hitting ‘Reply All.’”

Second, though, there’s remarkable potential for current and future IT systems to help address environmental concerns throughout society. By supporting efforts in a wide range of domains – from tools that help field biologists collect data more efficiently to smart power grids that enable more efficient utilization of energy – IT is likely to play a critical role in helping us fix some of the problems our species has created. This is the primary focus of the book.

## Are there environmental effects associated with virtual technologies?

Definitely, though they’re largely hidden. There have been a couple significant debates about this topic over the past few years. One was about the energy consumption of a Google search. A British reporter proposed that it was half that of boiling a pot of tea. In a rebuttal, Google claimed it was far less – only 1/70 the amount needed to boil a pot of tea. What’s interesting about this debate isn’t the exact figure; it’s the fact that most people haven’t considered that Googling has any environmental impact at all!

And there was an interesting article on the carbon footprint of an avatar in the virtual world Second Life, estimated by the author to be about equal to that of a typical human citizen of Brazil. I asked the chief technology officer at Linden Lab – the maker of Second Life – about this, and he questioned various figures the author had used. But again, what surprised me most was that an avatar’s carbon footprint is even in the same ballpark as that of many people.


## How can we be more green when purchasing electronics?

Often the best thing consumers can do is just wait a while. The average American gets a new mobile phone every 17 or 18 months; it’s this kind of rapid turnover that leads to the e-waste problem. If you need a justification to procrastinate in getting the “next big thing,” here it is. And if you do buy a new device, make sure the old one is either reused by someone or recycled properly.

## What challenges and opportunities will advances in technology present?

Right now, the IT sector produces 2 to 2.5 percent of global CO2 emissions. That’s on par with the entire airline industry. As largely invisible data systems spread throughout the infrastructure that supports our everyday behavior, this percentage is likely to grow. Therefore, a challenge for people, corporations, universities, governments and all sorts of other institutions is to become aware of our computational footprint, which is an increasingly important part of our overall carbon footprint.

However, much of this computing mitigates activities that are even more environmentally problematic.

Teleconferencing may reduce air travel; GPS devices help people plan outings more effectively. (The shipping company UPS apparently significantly reduced its fleet’s fuel consumption by using route-planning algorithms to optimize pickups and deliveries. A central strategy: eliminating left-hand turns, which waste gas as trucks wait for a break in oncoming traffic.) In such cases, computational benefits can far outweigh costs. There will be opportunities in many sectors of society to improve people’s lives while reducing their environmental impact. IT systems can ensure we make the most of these chances. 



# Picture This . . . Imagine That . .

First-person accounts from nine UCI students on how they spent their summer as Calit2 undergraduate research fellows

I am especially interested in what role online game worlds play in children's lives and the benefits there may be for spending a lot of time there. I like to joke that I had the best research project of all because I got \$3,000 to play and write about Club Penguin for 10 weeks. And you would be surprised with what children are capable of doing and coming up with in virtual worlds! By exposing myself to this research, I am considering teaching on the college level in the future.



Ana Maria Sanchez



Jonathan Chu

My project involved devices which could be put into people's homes and make a practical difference in their lifestyles. My job was to modify the wireless communications firmware of the devices. I made an RF-channel scanner to locate interference-free channels to send signals on. The most challenging part was the thousands of pages of technical manuals that I had to go through. It was gruesome, but now I know far more about embedded systems than any class could have taught me.

My role was to prepare ceramic samples for testing and imaging, in addition to learning FEM analysis software. I discovered very quickly that research requires patience, ingenuity and resilience. While some of the tasks were extremely meticulous and mundane, others involved pushing me to learn new things. Overall, I enjoyed experiencing the process of making new discoveries and I would definitely recommend this program – it's a great way to fully immerse oneself in research.



Marvin Chan



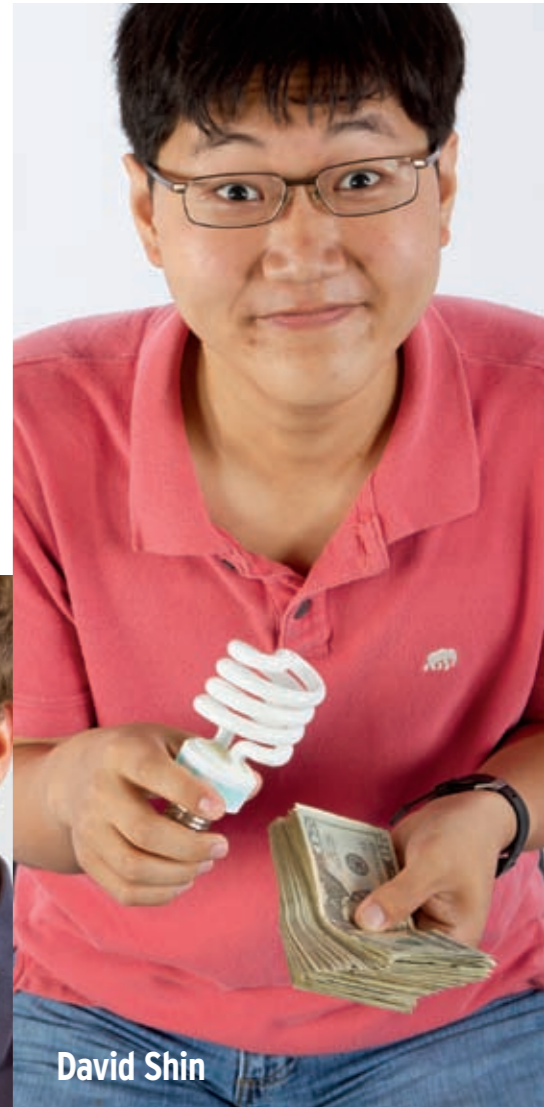
Steven Nguyen

My project was the union of two fields that I have always been interested in: the human side of computerization and the medical world. Before being in a research project, I had never really considered the amount of time it takes to plan out a study. But once everything was set, it was smooth sailing. The field work portion of the project is my favorite; there is nothing like going into the emergency room for observation and data collection. My interest in medical informatics has definitely increased.

I studied how fansubbing groups – virtual teams who translate and add subtitles to foreign media and distribute it – work together by interviewing group participants all over the world. Coordinating the interviews proved problematic and many were completed at odd hours of the night. Besides a deeper appreciation for the field of human-computer interaction, my experience has significantly reduced my anxiety about approaching professors to get involved with research that is initially unfamiliar.



Spencer DeBrosse



David Shin

I was quite interested about the mounting effects of energy consumption, and the project had much potential to improve energy savings and efficiency. I spent many hours gathering data to help develop a thoughtfully devised survey. In the process, I learned that research is 80 percent thinking and 20 percent doing. Research convinced me that ideas not only need diligence but also creativity. I had to look beyond textbook knowledge and into the depths of thinking like a researcher.

# Think Large ... DISCOVER BIG!!!

The project involved programming, which I am very comfortable with, and wireless communications, which is my primary interest in electrical engineering. I discovered that attempting to understand and manipulate a piece of software still under early development with little documentation was very challenging, as was trying to learn concepts usually taught to graduate students. I plan to enroll in independent study with my faculty mentor to continue the work I started this summer.



Howard Huang



Johnway Yih

Malaria remains a very large issue, and creating a system to diagnose the disease in a cheap and effective manner was very important to me. I gained hands-on experience in building and refining a low-cost blood analyzer device. I was able to focus my device precisely enough so that it would be sensitive to a single hair. Working in a lab and team environment, I discovered that doing research is very open-ended and requires personal drive to make achievements.

I worked on an interactive online game for children called KarunaTree, which emphasizes the understanding of global environmental sustainability. With a team of three others, I primarily worked with Web markup languages I was fairly new to. Once I was stumped on a coding problem, and when I finally got it to work, I inadvertently did a fist pump into the air. My mentor saw it and asked: "So did it work?" I smiled and said I was trying to hide my excitement. We had a good laugh.



Jason Lu

The Summer Undergraduate Research Fellowship in Information Technology (SURF-IT) is a 10-week, full-time project commitment. The program is jointly managed by Stuart Ross, Calit2's assistant director for research development, and Said Shokair, director of UCI's Undergraduate Research Opportunities Program. Professors submit potential projects for perspective students to review. Candidates are chosen based on their transcripts, essays and rankings by the professors who serve as project mentors, along with their graduate students and postdoctoral researchers. This year, nine UCI undergraduates with diverse majors were selected from a highly competitive application pool.

In addition to spending 40-plus hours a week working on their projects, the Fellows attend a series of weekly seminars where they get to know each other over a light lunch, and learn about the various work each is delving into and the role IT plays in a range of applications (*top*).

"I really enjoyed the SURF-IT presentations by the faculty mentors and the program's interdisciplinary work," Ana Maria, a Fellow from psychology, explains. "The sessions were so interesting and made me think outside of my major. I discovered that incorporating different fields and perspectives is essential for research that solves practical, real-life problems."

As the summer progresses, the Fellows' exposure to research environments and lab settings affords them experiences that they wouldn't get in a classroom. For most, SURF-IT is their first research commitment, providing an opportunity to help shape their future academic and career plans.



"It has been an excellent first research experience," says Spencer, who is starting his senior year as a computer science major. "I am more convinced now than ever before that research should play an important role in undergraduate education." Shokair concurs with that message, advising students to "go over and beyond" what they think is expected of them to get the most out of the summer opportunity (*middle*).

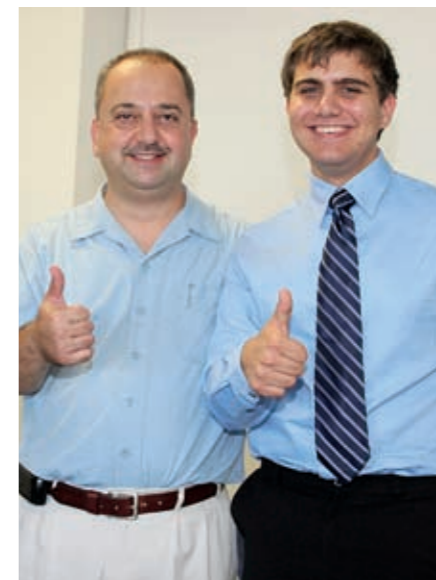
The program officially concludes at the end of August with the Fellows presenting their research activities and initial findings.

They are awarded a certificate of accomplishment, which doesn't necessarily signal the end of their work (*bottom*).

Many of the Fellows seek ways to continue their research with their faculty mentors under other funding support or for independent study credit.

"I will resume working with my mentor in the fall," indicates mechanical engineering student Marvin. "My experience with SURF-IT has given me an idea of what graduate school will be like and I am now leaning towards eventually attending. In the meantime, I hope to further challenge myself intellectually and complete my undergraduate degree."

— compiled by Shellie Nazarenus





## OPEN FOR BUSINESS

by Shellie Nazarenus

**R**esearch universities the world over seek to drive transformative laboratory discoveries into the marketplace, making it possible for these innovations to benefit society and advance the economy. The University of California system is a leader in this endeavor; UC inventions have formed the foundation for nearly 500 startup companies in the last three decades.

Calit2 and its three sister institutes for science and innovation were chartered 10 years ago to expedite this transfer of technology. The institutes work closely with their respective campuses' technology-transfer offices to help researchers turn their ideas into new firms and assist existing companies in licensing university inventions.

The tech-transfer climate has never been better, according to Jacob Levin, UCI's assistant vice chancellor for research development. "Business Week recently named Irvine the fifth best city in the country for startups based on criteria including educational level of the workforce, resources such as the university, available office space and venture capital investments," he says.

Levin was instrumental in formalizing the technology business incubator concept at UCI. He encouraged Calit2 to follow the lead of two other science and innovation institutes – one at UC San Francisco, the other at UCLA – in creating its own technology business incubator.

The result is TechPortal, which opened its doors on the second floor of the Calit2 Building last May. Within a month, BiMaple Technology Inc. signed a lease, becoming the first to call TechPortal home (see article pg. 20).

Chen Li, computer science associate professor and company founder, quickly assessed the advantages and applied for incubator space. "I jumped at the opportunity," he says. "It's on campus, it's next to my ICS building and Calit2 provides excellent services. The rate is very reasonable and they provide all the support that startups need."

After its formal launch, the incubator received a flurry of inquiries.

Prospective tenants fill out an online application, submit relevant documents and if they meet the stated criteria, are invited to make a brief presentation before the incubator's oversight committee.

"The group is very thorough in its evaluation, selecting companies for occupancy that have sound business plans and market potential," explains Calit2 Irvine Director G.P. Li, who serves as the TechPortal manager. "It's in our best interest that these startups are successful, so we try to really understand if they have done their homework."

The committee saw commercial viability in Shrink Nanotechnologies, which became the second startup to receive approval to move into TechPortal. The company, with 11 exclusive patent-pending technologies, develops products

for solar energy, medical and diagnostic sensors, and research applications. It licenses technologies developed at UC Merced by Michelle Khine, now a UCI assistant engineering professor.

"TechPortal is a tremendous opportunity for businesses based on UC technologies to gain traction outside the university," says G.P. Li.

TechPortal, billed as a one-stop shop for fledgling companies, offers bench space at market rates, access to facilities and specialized equipment, business programs and mentoring expertise. A monthly series of educational programs launched this fall, targeting the entrepreneurial-minded.

The 1,500-square-foot space, which can house as many as eight companies, has already been reconfigured based on visitors' suggestions and occupants' needs. Applications are reviewed on a quarterly basis; accepted startup companies must commit to a minimum of six months but cannot exceed a two-year stay.

"We look forward to helping more new entrepreneurs move their products from the lab into the marketplace. TechPortal is open for business," G.P. Li adds.

For more information, visit [www.calit2.uci.edu](http://www.calit2.uci.edu). 

### Leveraging the strengths of two successful programs, Calit2's TechPortal is partnering with OCTANe@UCI to offer a new twist on a popular forum.



The **TechPortal Entrepreneur Series** seeks to inspire, connect and educate those aiming to start their own technology businesses. The luncheon program offers a monthly series of topics meant to guide attendees through the entrepreneurial process. Topics, covered by leading entrepreneurs, venture capitalists, and university and industry experts, focus on the necessary ingredients to launch a successful startup. These seminars also provide a great venue for members of the OCTANe network and wider technology community to meet with entrepreneurial students and faculty researchers – some who are occupants of TechPortal and others who are considering the possibilities.

#### The 2010-11 TechPortal Entrepreneur Series

- |                    |  |
|--------------------|--|
| Friday, Oct. 8:    | Protecting Your Intellectual Property                                    |
| Friday, Nov. 5:    | Seed Funding: How to Get your First \$250k                               |
| Thursday, Jan. 6:  | Conducting a Thorough Market Assessment                                  |
| Thursday, Feb. 3:  | Staffing Your Company: What You Need and What to Look For                |
| Thursday, March 3: | The Elevator Pitch   |
| Thursday, April 7: | Writing a Successful Business Plan                                       |
| Thursday, May 5:   | Network Leverage: Why Programs Such as OCTANe's LaunchPad are Beneficial |

All presentations are held in the Calit2 Building at UCI, Seminar Room 3008. A light lunch is served starting at 11:30 a.m.; presentations begin at noon and are followed by a question-and-answer session that concludes at 1 pm.

Registration is free but required: [www.calit2.uci.edu](http://www.calit2.uci.edu).

# matchmaker

by Anna Lynn Spitzer

Google may be an industry giant but when it comes to offering the latest in instant interactive search, it has nothing on startup BiMaple Technology Inc.



Both companies offer instant results “on the fly” – start typing a search term and before you can finish, a list of results appears.

“The search pages look very similar but the back ends are very different,” says Chen Li, BiMaple founder and president.

Google relies on users’ cached historical data, while BiMaple’s software is built on an innovative (patent pending) search algorithm that provides instant “search-as-you-type,” error-tolerant results without depending on information about users’ previous search activities.

The fledgling company, whose name derives from two imposing trees outside its former headquarters, is rooted in Li’s academic research. Two years ago, the UCI computer science professor developed a research site called “PSearch.”

The online directory, which locates UCI faculty, staff and students, employs software algorithms that enable instant search of the entire directory database as users begin typing keywords. The software also recognizes certain synonymous words and “reasons through” possible errors. Type Bill Cohen into the search box, for example, and you will see results that include William Cohen and William Chen. Matches can be made with bare-bones information.

Someone searching for a professor or student might have only a first name or a nickname and department. The directory can find correct results even if there are minor misspellings in the query keywords.

Li was stunned at the response to the site. “We were getting overwhelmingly positive feedback from users,” he says. “So I thought, ‘why don’t we try to commercialize this?’”

BiMaple was incorporated in late 2008. Last June, it became the first tenant to move into Calit2’s technology business incubator, TechPortal. Li worked with interns Vijay Rajakumar and Inci Centidil over the summer and currently is finalizing the company’s first prototype. He is in discussion with several potential customers interested in beta testing.

*“Suddenly, search becomes a friendly, meaningful and convergent conversation between the user and the machine.”*

“It’s very critical for us to have our first product for people to try so they can give us some feedback to improve it,” he says.

Other projects in development include a search engine for the UCI home page and a prototype called iPubMed to support interactive search on the fast-growing MEDLINE database, which contains more than 19 million medical publications.

The software focuses on “vertical” search – deeper search on a specific domain – such as books, people or electronics. Search engines in different domains share the same core technology, and domain-specific adaptations can be integrated.

To display the power of its new technology, BiMaple compiled a database based on books, and then created an online demonstration site. Suppose a user is looking for a book and remembers the word ‘arthritis’ and the author’s name: ‘Budwig.’ As he types in those two keywords character by character, the site returns results “on the fly.”

Even if the searcher misspells the keywords – ‘arthristis badwig’ for example – the site can still provide the correct list instantly.

The goal of the company’s search technology, Li says, is real, instant search that is progressively adjustable in real time. “Suddenly, search becomes a friendly, meaningful and convergent conversation between the user and the machine.”

BiMaple’s instant search software is not to be confused with “auto completion,” a function offered by many search engines. That approach is prefix-based and treats user-entered keywords as a part of a precompiled sample search phrase.

“We do a full-text search, not a simple prefix search,” Li says, explaining the difference. “Existing techniques cannot interactively find books with a keyword in the title and a keyword in the author’s name because the two are unlikely to be in close proximity. Our software can overcome this limitation.”

In addition, its high rate of interactive speed makes BiMaple’s product “a big jump from what was available before,” Li says.

“Instant search is becoming increasingly important,” he adds, citing the recent launch of Google Instant and its huge popularity in the Web developer community. “More systems need software products that support this type of search.”

Noting that most website search engines are still “pretty old-style,” Li believes there is a burgeoning market for BiMaple’s technology. “Whenever you have data, you have information that needs search,” he says. “My goal is to make [those] search interfaces much more powerful.”



BiMaple founder Chen Li (opposite page) and intern Vijay Rajakumar are finalizing the company’s first prototype.

## Aligning Network Concepts

Many disciplines rely on concepts about networks, but their concepts and definitions are not always consistent. Calit2 has received a 4-year, **\$2 million** award to develop a common computational framework for describing and analyzing network topology and network node attributes. The project, funded by the **National Science Foundation**, advances progress within and among disciplines. Lead investigator **Athina Markopoulou** (electrical engineering and computer science), **Carter Butts** (sociology) and **Natasa Przulj** (Imperial College London) will use simulations and real data sets from different disciplines to develop general formulations of network structures and computational algorithms for sampling and extracting network properties in the data.

## Microscale Structure Study

Calit2's resources for analyzing micromechanical systems have been greatly enhanced by a new analytical instrument. **Lorenzo Valdevit** (mechanical and aerospace engineering) was awarded **\$449,000** from the **NSF** to purchase equipment that analyzes vibration and surface topography in microscale structures. The Microsystem Analyzer is unusual because it measures in-plane vibration, out-of-plane vibration and surface topography in high resolution, all without damaging or even contacting the sample. All measurements are done with light, allowing for more realistic testing of MEMS systems in their intended configurations and operating modes, in less time than previously possible.

## Robot-assisted Rehab

**David Reinkensmeyer** (mechanical and aerospace engineering) secured a 5-year, **\$1.5 million** award from the **National Institutes of Health** for a project on robot-assisted, hand-movement training for stroke victims. Self-guided exercise programs are usually not adequate and professional therapists are expensive, so Reinkensmeyer is working on designs for robot-assisted rehabilitation protocols. For example, should the robot assist movement to promote learning or resist it to increase sensation and strength? What long-term approach works best? Using a robotic program facilitates the gathering of data as well.

## Extending Nanoscale Antennas

Nanowires and nanotubes can be used to propagate electric signals and as antennas in optical, Terahertz, and radio-frequency bands. **Peter Burke** (electrical engineering and computer science) is leading researchers from several universities to further develop these antennas to push spectroscopy to highly localized, nanoscale spatial resolution. Their work has earned an award from the **Department of Defense** Army Research Office's Multidisciplinary University Research Initiative (MURI) program for **\$4.5 million** over three years. These nanoscale antennas can directly access particular molecular events and structures, avoiding problems that would occur in normal-sized samples. Potential applications include contactless DNA sequencing and antibody-based detection. Federal labs, startups and industry will participate to ensure the transition of the technology from lab demonstrations to practical applications.

## Predict and Adapt

**Nikil Dutt** (electrical engineering and computer science) and **Alex Nicolau** (computer science) will lead the UCI portion of a multi-university team that shares a **\$10-million**, 5-year award from the **NSF's** "Expeditions in Computing" program. This project will develop software that can accommodate variability and fragility in the hardware on which it runs. Although consumers often think of computers as precise machines with tight manufacturing tolerances, in reality, as circuit components get smaller and smaller, variances become more and more important. The researchers envision a new style of computing in which proactive software guides system components to monitor, predict and adapt to the variability of the hardware. Their new approach will be applicable in embedded, mobile, desktop and server-class computing machines. The team is led by UC San Diego and includes Stanford, UCLA, University of Illinois and University of Michigan.

## A Better Understanding

**Intel Corporation** has awarded a **\$100,000** grant to **Chen Li** (computer science) and **Xiaohui Xie** (computer science) for a year of software research on compression and direct querying of genomic data. Enormous genomic data sets contain not only data on the millions of DNA base pairs, but also 'metadata' on the overlapping segments created by the genome sequencing process. Compression saves storage space and transmission costs, but if the entire file has to be decompressed every time researchers want to analyze it, the advantages are lost. Li's work will create special software to query and understand the data in its compressed form. The

two researchers published the basics of their novel compression technique in 2009, leading to this award for further research.

## Improving the Odds

**Gillian Hayes** (informatics) is the lead investigator on a 2-year, **\$480,000** grant that will use IT to improve conditions for preterm infants. Hayes and a colleague from Charles Drew University of Medicine and Science are developing a program called "FitBaby" that enables the primary caregiver to record daily observations such as the baby's feeding and sleeping schedules, as well as information about the caregiver's attitudes, stress levels and feelings. These data can be recorded into a smart phone with a user-friendly interface and will be combined with sensor and camera data detailing the baby's weight and activity. Data visualization and analysis will allow the primary caregiver and healthcare professionals to detect health problems early. The grant was awarded by The **Robert Wood Johnson Foundation** as part of its program to improve systems for maintaining personal health records.

## Advancing MEMS Sensors

**Maxwell Sensors, Inc.** has funded another stage of development for MEMS-based temperature sensors coupled with RFID tags. Calit2 director **G.P. Li** and affiliate **Mark Bachman** (electrical engineering and computer science) will further analyze and design the sensor systems, intended for better monitoring the transport of temperature-sensitive



substances. The 2-year project is funded by **\$250,000** from the **NSF** to Maxwell Sensors as part of the government's Small Business Technology Transfer Research program (STTR), designed to stimulate the development and commercialization of early-stage technology.

## Telemedicine Reaches Out

**Ira Lott** (pediatrics) will manage a 2-year program that will make medical specialists available to dozens of local clinics via telemedicine. The **\$200,000** grant from the **California Healthcare Foundation** will enable UC specialists in dermatology, psychiatry and other fields to provide specialty consultations via live video and to provide continuing medical education services. Lott, associate dean and director of telemedicine for the medical school, will also explore additional ways to assist the adoption of telemedicine.



### I Get Around

Postdoctoral Research Fellow Garnet Hertz put the finishing touches on his **OutRun** project in the Calit2 Sensor Technology Lab. OutRun, which Hertz calls “the driving video game that you actually drive,” made its Southern California debut this month in Los Angeles at the Otis College of Art and Design’s Ben Maltz Gallery. The project is part of the “Make:Craft” exhibit that runs through Dec. 4, 2010, featuring artists who build and engineer unique, mostly functional devices that enable inventive ways to experience the “tactile world.” Hertz’s OutRun project combines the real world with a 1986 arcade driving game. As the player drives the vehicle – which really moves, thanks to an electric golf cart drive train – OutRun’s computer vision system projects the surrounding environment as an 8-bit video game on its windshield. The project made a Northern California appearance at the Zero One Art Festival in San Jose, and also was displayed at IndieCade, an international game festival in Culver City, and at UCI’s own Beall Center for Art + Technology.



### Plotting Sustainability

Sounding an urgent call to action, the **Institute for the Future** is joining forces with Calit2 and CITRIS, a fellow science-and-innovation institute headquartered at UC Berkeley, to develop a state blueprint for sustainability. Among the issues the group will consider: enabling energy development while protecting the environment; creating affordable healthcare; protecting water supplies; and maintaining and expanding the state’s infrastructure. The Institute for the Future is a 40-year-old nonprofit research and forecasting group, which held an inaugural workshop for the collaborative in May at its Palo Alto office. Calit2 Institute Director Larry Smarr and UCI’s Bill Cooper, a Calit2-affiliated water researcher, were among the 17 participants.

### Gateway to Commercial Viability

The semiannual **Igniting Technology** panel presentation set the scene for introduction of the institute’s new technology business incubator, which officially opened its doors to fledgling companies in May. Five presenters, ranging from entrepreneurs to investors to startup co-founders, shared their expertise with a record crowd who turned out to learn more about commercializing academic research. The event was moderated by Michael Guiliana, a partner at intellectual law firm and Igniting Technology sponsor Knobbe, Martens, Olson & Bear. Guiliana told the crowd that although Calit2 had been incubating startups since its inception, “tonight marks what we’ve been waiting for all along: for Calit2 to spawn a [formal] incubation program.”



### Bridging Policy and Research

As chair of the House Subcommittee on Water and Power, Grace Napolitano has a keen interest in hydrology research and its potential impact on decision-makers. The congresswoman, who represents California’s 38th District, accepted an invitation from **UCI’s Center for Hydrologic Modeling** to visit the campus last spring. Her first stop was at Calit2’s Visualization Lab, where several water scientists used the display technology to demonstrate their research in a compelling way. A catered lunch in the building afforded researchers and campus leaders, including Chancellor Michael Drake (pictured), an opportunity to further the dialogue. Napolitano then participated in an open forum at which students studying water-related issues from scientific and social perspectives had a chance to ask questions about policy and the political process. “It is critical for the well-being of our water supply that our scientists, students and lawmakers work closely and communicate on water issues,” she told the group. “The tremendous potential I have seen and heard today will only be realized if our brightest students know how to communicate with policy makers as they continue on in their careers.”



### Telemedicine Moves into Practice

A Calit2 research team marked a major milestone in August by taking its project from lab to real-world setting. The team’s lead software engineer, Hector Parra (pictured left), delivered a customized medical cart powered by the researchers’ Telios system to **Share Our Selves** community clinic in Costa Mesa, Calif. The system, which delivers user-friendly, real-time teleconferencing and telemedicine tools, enables the clinic’s medical staff to connect their patients to UCI specialists without travel and scheduling concerns. Telios is built on a powerful Web 2.0 platform, which eliminates the need to download and configure the system every time a new application is needed. By placing the equipment in a real-time, daily clinical practice, the researchers are hoping to learn from the end-users what works and what needs to be developed further. “This is an exciting next step for our project,” explained Parra. “The Share Our Selves staff has been eager to get this capability and we are really excited about the opportunities this partnership affords.”

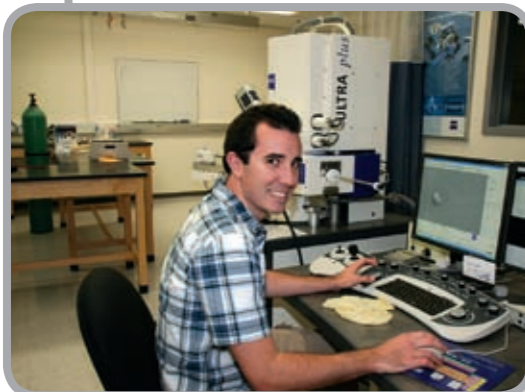
### A Plug-Load Plan

A broad range of experts with the singular goal of helping to shape a **plug-load energy efficiency research center** at Calit2 connected last spring in a day-long brainstorming session. The group of 100-plus academic, business and government representatives contributed their ideas on possible research activities and programmatic structure for the proposed center, which will focus on one of the most rapidly growing sectors of energy consumption in California. A plug load is any electrical device that ultimately receives power from an AC wall outlet, ranging from cell phones to appliances. Estimates indicate that plug load devices account for up to 20 percent of residential and commercial energy consumption. If approved, the new center will be funded primarily by the California Energy Commission.



### Award-Winning Research

A research discovery made by an undergraduate engineering student working in the Calit2 microscopy lab has earned him national recognition and a scholarship. **Brandon Saller** won \$3,000 from the Microscopy Society of America for his analysis of a titanium alloy. Working with the lab's senior microscopist, John Porter, Saller determined that instead of a random arrangement, the alloy's crystalline structure has a preferred orientation. The findings shed new light on the performance properties of the material, which is primarily used in aerospace and biomedical applications. The fourth-year student submitted an abstract to the national organization, which was presented in August at the Microscopy & Microanalysis 2010 Meeting in Portland, Ore. "Winning the MSA scholarship ... shows that my research proposal was reviewed and deemed worthy of funding by a panel of scientists outside of UCI," Saller said. "Our research has yielded promising results."



### Celebrate the Environment

The **Social Code Group** found this year's Earth Day celebration a fitting time to demonstrate its research on environmental sustainability and information technology. The group, led by informatics professor Bill Tomlinson, opened Calit2's second-floor Interactive Animation Lab for guests to drop by and experience projects that range from a carbon footprint tracker to interactive educational game platforms. The KarunaTree project, which targets children, was of particular interest to the younger open-house attendees. Led by researcher Derek Lyons (pictured right), KarunaTree helps children understand the notion of long-term environmental disasters and ways to work together to offset them. "The project's fundamental mission is to plant 'seeds' of compassion and caring with kids," Lyons explained. "We hope to teach them to consider the ways in which their actions radiate outwards to influence the environment."



### Feeding Innovation

Hoping to ignite multidisciplinary research that has potential for becoming large-scale, agency-funded projects, Calit2 partnered with UCI's schools of engineering, and information and computer sciences to seed-fund two projects. The **Large-Scale Interdisciplinary Research Ignition Initiative** awarded \$40,000 each to the iScience program and the iMove Center. The projects received half of the funding up front, and will obtain the remainder when they submit a proposal that requests a minimum of \$500,000 per year for at least three years. iScience is a program to help scientists better manage vast, complex datasets; iMove is a center that will transform people's mobility through novel approaches to information technology and robotics. A second call for proposals to be funded by this initiative will be issued later this fall.



### All That Jazz

Artistic performance and information technology tools continue to meld and shape new works at Calit2. UC faculty have been leading developments into telepresence performance, not only by implementing emerging Internet tools that enable high-quality audio and video connections among remote locations, but also by creating artistic works that explore the potential of this new medium. Last spring, artists and technologists from UCI and UC San Diego used the power of connectivity to perform "**Jazz TeleMotions.**" The concert featured original music composed and performed by two artists in a concert hall at the San Diego campus, while UCI trombonist Michael Dessen and intermedia artist John Crawford participated remotely from the eMedia Studio in Calit2. "This is the second large-scale networked production we've done this year, and I've also been a part of three others," Dessen said. "It's a quickly growing area, and we're excited about all the great progress we're making."



### A Motivating Message

In 2008, a U.S. Department of Education progress report cited California African-American 8th grade math proficiency scores in the bottom 18 percent nationwide. In an effort to turn that statistic around, parents, educators and business leaders in the Inland Empire and San Gabriel Valley banded together to create a program for young black men, who are the most at risk on every academic, social and economic index. The **Legacy Roundtable Summer Mathematics Academy** targets youth who demonstrate a math propensity, with a goal of getting them through high school calculus and into college. As part of their summer experience, participants spend a day at UCI. This year, Calit2 served as the backdrop for their field trip. The students visited labs and heard from a panel of current African-American UCI students as well as inspirational speakers, including Said Shokair (pictured), director of the Undergraduate Research Opportunities Program. "Whatever you do in life, don't be a robot and never give up on yourself," implored Shokair, whose message apparently resonated so strongly with one young man that he printed the statement in big bold letters across his notebook, underlining it for emphasis.

### See How We Move

Who says learning can't be fun? A group of high school students participating in a summer educational outreach program at UCI had quite a time while discovering how artistic expression augmented by technology can captivate an audience. They spent some time in Calit2's eMedia Studio exploring the ActiveSpace technology that lab manager John Crawford uses in a variety of projects. The students were participating in **COSMOS** – a summer school in mathematics and science for academically talented high school students, which devotes a full month to a specific course cluster. "These students are investigating the crossroads of art, cognitive science and technology," explained John Crooks, a COSMOS instructor. "They have a great time coming to Calit2 and broadening their horizons."



### Free Speech on Display

The powerful capabilities of the Hiperwall display technology gave voice last May to UCI students' thoughts on the meaning of free speech. "**Our Students Speak,**" part of a campuswide effort to impart the importance of civility, respect and appreciation for others, incorporated the wall's multiple screens in a 10-minute multimedia production open to the public. The presentation, which ran continuously for two weeks on a custom-built Hiperwall display in Calit2's atrium, featured students talking about the impact of free speech in their lives and educational experiences, while legal scholars discussed the historic significance of this constitutional right.



### Spanning the Globe

Always a popular stop for international visitors, Calit2 in the last few months welcomed **several groups from abroad**, including a 24-member delegation comprised of executives from public administrative and non-profit organizations located in **Hunan Province, China**.

The institute was contacted by the Orange County Office of Protocol, which had received a special request from Washington D.C. to arrange a visit for the delegation. The group was stopping in the Los Angeles area on its way back to China after attending an executive international training program on the East Coast. They were specifically interested in



hearing more from Calit2 Director G.P. Li about the institute's relatively new technology business incubator.

Computing trends, particularly the use of social networking and gaming in the educational and business sectors, was the topic that a group of **Korean secondary school teachers** wanted to discuss with Calit2 researchers. The teachers were enrolled in a summer program at Orange Coast College and requested a visit to UCI to learn more about its efforts in computer sciences. That brought them to the institute to see some of the game lab projects led by Walt Scacchi and his team.

Fourteen graduate students studying nanomaterials science at **England's Imperial College London** were curious about the multidisciplinary approach for which Calit2 is known. The students were attending last summer's Nanotech 2010 conference in Anaheim and requested a tour to learn more about the collaborative research efforts. After posing for a picture in front of the HiperWall with a satellite view of their U.K. campus as the backdrop, Nicholas Harrison, the college's nanomaterials program director, enthusiastically thanked the researchers for giving his students a fresh perspective. "The fact that there are so many disciplines coming together and the very close relationship between the research in the lab and the [applications of] the technology ... you're doing very fundamental research that supports technology applications very quickly," he marveled.



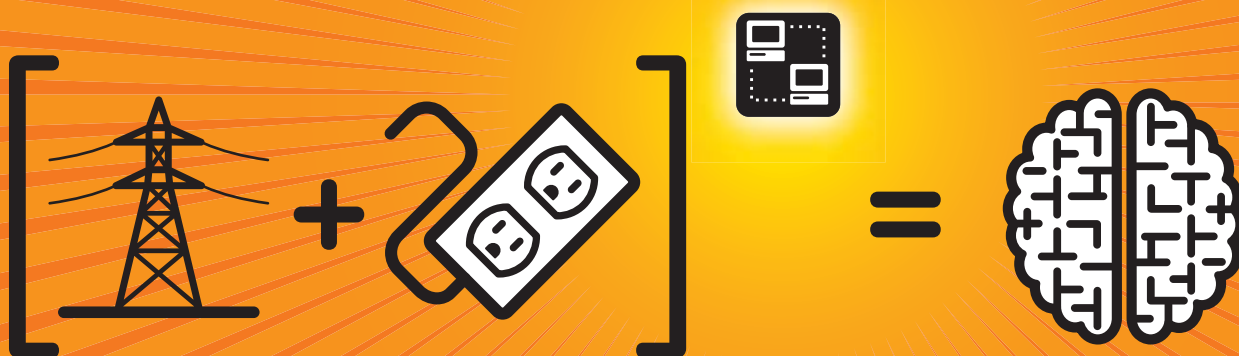
The California Institute for Telecommunications and Information Technology is a two-campus multidisciplinary research institute. In collaboration with its sister institute at UC San Diego, Calit2@UCI develops innovative projects that integrate university expertise with industry experience. The result: IT-based solutions that benefit society and ignite economic development.

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**

# Energy Empowerment: Get SMART about Efficiency



Wednesday, November 10, 2010  
5:30 – 8:30 pm

Calit2 Building, UC Irvine  
Register at [www.calit2.uci.edu](http://www.calit2.uci.edu)

**Plug-in vehicles ... electronic devices, each with its own charger ... ever-more sophisticated home entertainment centers:**

We are plugging into a dated infrastructure that cannot continue to handle the load. We are using more and more energy - as much as 40 percent more in the next 20 years. California and the nation are looking to smart technologies to vastly increase efficiency in energy distribution and consumption.

**Join us Wednesday, November 10, 2010,** to get smart about energy efficiency. You will hear from leading experts about the developing smart grid, as well as what it takes to turn your home or business into a smarter, more efficient environment. Learn about technology tools to change your behavior and discover new market opportunities.

**REGISTER TODAY: [www.calit2.uci.edu](http://www.calit2.uci.edu)**