interface

California Institute for Telecommunications and Information Technology

Volume 1 | Issue 3 | Summer 2006

What Lies Beneath

University of California, Irvine

interface-2-face

Building on Progress

Calit2 has come a long way in a short time. I've been involved since the beginning, both as vice chancellor of research and graduate studies, and – from 2002 to 2004 – as the Irvine interim director. I take special pride in the institute's many accomplishments.

In its short history, I have seen Calit2 evolve from concept to reality. It has grown from a skeleton staff to a robust entity, and it has moved from temporary quarters into its high-tech new home.

In the early years, I helped identify UCI faculty who wanted to participate in the bold, new collaborative effort. Today, large corporations like Carl Zeiss SMT are realizing the benefits of Calit2 partnerships. Zeiss saw the institute's adaptable research space, multidisciplinary environment and local industry participation as ideal components for its Center of Excellence, which opened in the building this spring.

Many other diverse projects and labs reside in the new building. From ResCUE (Responding to Crises and Unexpected Events) and the Center of GRAVITY (Graphics Visualization and Imaging Technology) to the EcoRaft and the Computational Biology Research Lab, collaborative research is flourishing. And UCI student researchers are gaining important experience that will benefit them in their post-graduate careers.

Calit2's innovative future looks equally bright. The institute is pursuing an integrative, complex research agenda that will lead to new products and systems. Calit2's pioneering, collaborative approach is enabling research teams to ignite IT solutions that will improve our daily lives.

William Parker
Vice Chancellor for Research
Dean of Graduate Studies
Professor, Physics

Interface
Summer 2006

Calit2@UCI
Albert Yee
Director

Lorrie Minkel
Assistant Director
Operations

Shellie Nazarenus
Assistant Director
Marketing and Outreach

Stuart Ross
Assistant Director
Research Development

Interface Staff
Shellie Nazarenus – Executive Editor
Anna Lynn Spitzer – Managing Editor
Rob Sexton – S2 Design
Stuart Ross – Contributing Writer
Fran Tardiff – Contributing Writer
Debbie Nielsen – Corporate Relations

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

Imaging the Future

Photo: Paul Kennedy

MINUSCULE IS THE NEXT BIG THING. Nanotechnology – the science of engineering functional systems at the molecular scale – was wishful thinking just 10 years ago. Today, it is poised to make a profound impact on society.

by Anna Lynn Spitzer

Carl Zeiss Center of Excellence Brings Advanced Microscopy to Calit2 and Southern California

Experts say it will change the face of health care, electronics, packaging, pharmaceuticals, environmental protection, homeland security and much more; in fact, in the near future, nanotechnology is expected to affect 30-plus industries to the tune of more than $61 trillion.

One-Millionth of a Millimeter

Nanotechnology is the science of small. A nanometer is one-billionth of a meter, which is equal to one-millionth of a millimeter. How small is that? A human hair is roughly 70,000 nanometers in diameter.

For scientists to build tiny nanosystems, they must be able to slice, dice and examine the minute pieces comprising them. That's the job of the three new scanning electron microscopes in the Carl Zeiss Center of Excellence, which opened in the Calit2 Building this year.

While 70 percent of the lab's research involves nanotechnology, the Zeiss lab also will be used by biologists, physicists, engineers, geologists, chemists, and even archeologists and anthropologists. Any faculty member

(continued, page 4)

Photo: Paul Kennedy

This page: Doctoral candidate Lynher Ramirez views samples on the Ultra 55 under the tutelage of project scientist John Porter.

Page 1: Dan Mumm (top) helps doctoral candidate Grace Qin on the EsB CrossBeam® workstation, while Ramirez (center) and postdoctoral researcher Wayne Zhou work on the Ultra 55 and EVO, respectively.

The ABCs of SEMs

Conventional microscopes use a series of glass lenses to bend light waves and create a magnified image. Scanning electron microscopes use electrons instead of light waves, allowing more detailed images at higher magnifications.

In scanning electron microscopes, a beam of high-energy electrons travels through a series of magnetic lenses that focus them into a fine beam. A set of scanning coils moves the focused beam back and forth across the specimen. As the electron beam hits each spot on the sample, secondary electrons are knocked loose from the surface and counted. The final image is constructed from the number of electrons emitted from each spot on the sample.

The three microscopes in the Zeiss lab differ in several ways from standard scanning electron microscopes and each serves a specific purpose.

A standard SEM pumps air out of the specimen chamber, creating a vacuum, to prevent the electrons from colliding with air molecules. If scientists were examining a living specimen or a wet specimen in a solution, creating a vacuum would dehydrate and destroy it.

The Zeiss EVO®, with its environmental chamber pressure capability, allows specimens to be examined with reduced pressure, but with enough air and water to prolong the life of a cell or wet specimen. This allows specimens to be imaged in their native environments.

The Ultra 55, conversely, requires a high vacuum, so it's not suitable for wet specimens. It has higher resolution, however, than the EVO® – to 0.8 nanometers.

It also uses lower voltage without decreasing final image resolution. Combined with an array of unique detectors, it is ideal for very high-resolution characterization of both insulating and conducting materials.

The third instrument, the 1540 EsB CrossBeam® workstation, is a combination scanning electron microscope and focused ion beam. The beam uses gallium ions, which are much larger than electrons, to knock particles off the specimen's surface. The ion beam is easy to focus and packs a lot of energy. This feature allows scientists to engrave trenches in or "mill" the hardest materials, with nano-scale precision. It is also used for fabricating nanometer-sized systems or precisely preparing specimen surfaces for imaging. These processes are closely monitored with "live" electron-beam high-resolution imaging.

"We wanted an environment that makes a strong and genuine statement of innovation, technology and excellence. Calit2 exactly matches this requirement."

on campus – and affiliated researchers – can be trained to use the microscopes.

"It's truly fostering multidisciplinary research on campus," says Albert Yee, Calit2 Irvine division director. "There are other electron microscopes on campus, but they can't do the job as well."

Advantageous Alliance

The center is a partnership between Calit2@UCI and Carl Zeiss SMT, a global semiconductor and nanotechnology instrument manufacturer. The strategic alliance is providing a Southern California regional center for nanotechnology and biotechnology research, as well as advanced materials development and innovation.

Zeiss supplied the three state-of-the-art electron microscopes, including: the EVO® multi- purpose scanning electron microscope with variable chamber pressure capability; the Ultra 55 CDS ultra-high-resolution field-emission scanning electron microscope; and the 1540 EsB CrossBeam® workstation, a combination of ultra-high resolution field-emission electron beam technology and focused ion beam (FIB) technology. All three instruments, which have a combined value of $2.5 million, are considered leading-edge technology in their respective fields.

Shared Benefit

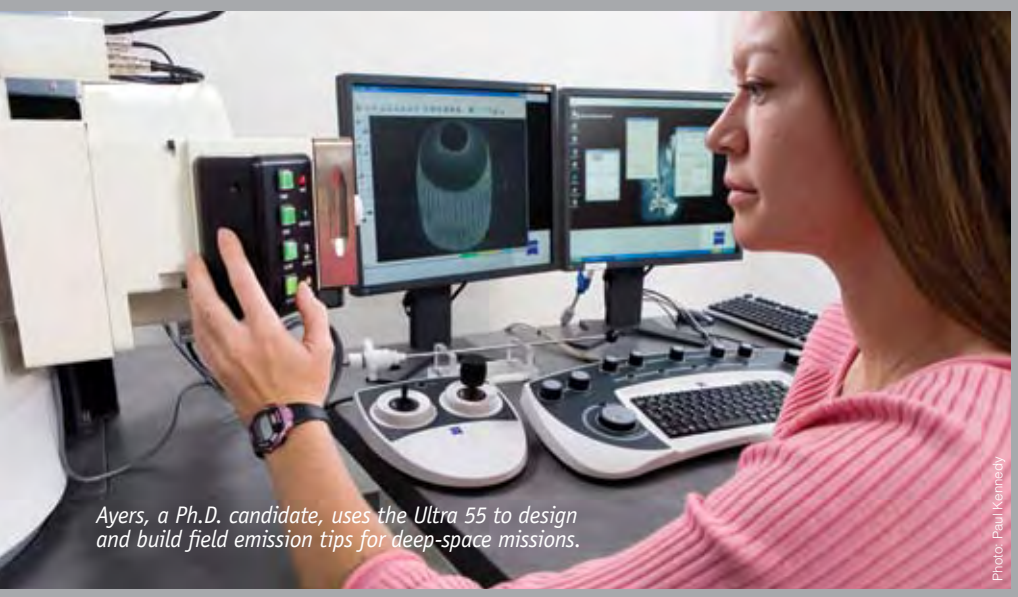
The equipment will be shared by Calit2's researchers, its industry partners and Carl Zeiss SMT's application development team.

The SEM microscopes will be a boon to all three. The high-level microscopy will be particularly useful to Orange County and Los Angeles-based aerospace, biomedical, semiconductor and energy systems industries, which will have the opportunity to use these

Reaching for the Stars

One of many researchers benefiting from the cutting-edge equipment in the Zeiss Center of Excellence is Jessica Ayers. Ayers, a biomedical engineering graduate student, is working with fellow BME graduate student John Lin to build a microscopic field-effect propulsion system for deep space missions.

Conventional rocket propulsion uses ejected combustion products comprised of lightweight elements like hydrogen and oxygen to produce thrust. Ayers' ionic propulsion system will use much smaller quantities of heavier elements that are ejected at extremely high velocities to produce the long-term thrust required for deep space missions.



Ayers, a Ph.D. candidate, uses the Ultra 55 to design and build field emission tips for deep-space missions.

Photo: Paul Kennedy

She designs and builds the complex field emission tips – which enable the fuel to migrate to the emitting portion during operation – using MEMS (micro-electro-mechanical-systems) techniques.

The scanning electron microscope in the Zeiss lab at Calit2 allows Ayers to image the fabricated tips. In the next stage of her research, she'll use it to analyze the necessary surface coatings to ensure coverage integrity and thickness. She will also use the EVO to view the wetting characteristics of the molten indium (fuel compound) on the coated tip.

"One of the major challenges of my project is a very precisely shaped tip, so confirming that is my first priority," says Ayers. "The SEM in the Zeiss lab is user-friendly, with more automation and graphical user interface windows than the other scanning electron microscopes on campus."

instruments on a recharge basis. Zeiss will use the lab to demonstrate the instruments' capabilities and application ranges for its customers. And UCI faculty and students will use it to conduct their research.

"There are other electron microscopes on campus, but they can't do the job as well."

According to Peter Clark, president and general manager of Carl Zeiss SMT Inc., Calit2 was a perfect choice for the Center of Excellence. "We wanted an environment that makes a strong and genuine statement of innovation, technology and excellence. Calit2 exactly matches this requirement. It was also clear that UCI has a strong desire to grow and a vision to position itself as one of the leading universities in North America."

Productive Partnership

Current and potential users are enthused with the technology and its capabilities, says Joe Hovendon, Zeiss district sales manager. He's brought in aerospace, semiconductor, forensics, materials research and nanotechnology companies for demonstrations, with positive results. "They're all excited about having the facility here in Southern California, and they're all looking forward to using it."

Industry partners will use the equipment as the lab becomes fully staffed. "The biggest hurdle right now is getting everyone here fully trained and qualified to use the microscopes," says Hovendon. "The demand for this technology is very high."

Dan Mumm, assistant professor of chemical engineering and materials science, and project scientist John Porter are training student users. At present, 37 UCI students, whose fields range from materials science to chemistry, biology and MEMs, are training on the equipment. Instruction

(continued, page 6)

Open House Celebrates Center's Debut

Micrograph contest winner Thomas Pine, Stenkamp, second-place winner Grace Qin and Adam Schofield, who placed third.

Calit2 marked the opening of the Carl Zeiss Center of Excellence with a two-day open house, April 27-28. The event included tours of the new microscopy lab, specimen sampling and display of the student micrograph entries. Contest winners were announced in welcoming remarks by Calit2 Irvine Division Director Albert Yee. UCI Assistant Professor Dan Mumm and Dirk Stenkamp, managing director of Process Control Solutions at Carl Zeiss SMT AG, Germany, gave brief presentations about the partnership.

The micrograph entries are pictured on page 10-11.

Zeiss Center of Excellence Recharge Rates

	Hours of Use	Rates per Hour	
Equipment/Supply or Service	Peak: 6 a.m.- 11:59 p.m. Off-Peak: Midnight-5:59 a.m.	UCI Users	Industry Users
EVO	Peak	$45	$120
EVO	Off-Peak	$22.50	$120
Ultra 55	Peak	$45	$120
Ultra 55	Off-Peak	$22.50	$120
Crossbeam	Peak	$75	$120
Crossbeam	Off-Peak	$37.50	$120
Technical Training		N/A	$30

Rates subject to change without notice

includes a one-hour group orientation and one-on-one training with Mumm or Porter, as well as successful completion of a comprehensive test.

"This partnership will keep us on the forefront of research activity and infrastructure."

Calit2 is in the final stages of evaluating applicants for a permanent lab manager to oversee training and day-to-day operations. The center will eventually operate 16-24 hours each day.

A Bright Future for Research

The Zeiss Center has the potential to change the Southern California research landscape in important ways. "Southern California is a hotbed of biotech activity," says Mumm, who was integral in getting the Zeiss partnership established. "In addition to the cluster of small industrial organizations located here, we have a large aerospace and defense industry that continually requires access to high-resolution microscopy. Furthermore, the lab offers easy access, being five minutes from the Orange County airport."

Zeiss's president agrees. "Our long-term success will be based on our ability to be present and intimate with the growing nanotechnology communities in the U.S.," says Clark. "Southern California is a fast-growing and exciting arena for nanotechnology, thanks especially to its strong local defense companies."

The microscopy center offers another benefit to UCI and Calit2. As one of only a couple in the country that exists in partnership with an instrument manufacturer, "when Carl Zeiss develops a product innovation, they'll exchange the existing instruments for those incorporating the latest technologies," Mumm says. "This partnership will keep us on the forefront of research activity and infrastructure."

High-Tech Tools

SBT Donation Facilitates Specimen Preparation

Researchers using Calit2's Carl Zeiss Center of Excellence recently got some state-of-the-art assistance.

Six specimen-preparation tools were donated to the lab by South Bay Technology, Inc., a Southern California materials-preparation manufacturing company. The equipment will be used to prepare SEM cross sections, deposit high-resolution films onto samples, and clean samples and/or microscope parts. It is valued at more than $125,000.

The IBS/e Ion Beam Sputter Deposition and Etching System helps researchers prepare specimens for SEM imaging.

"These instruments represent the latest in materials processing equipment and will provide the users with a broad range of technologies," says South Bay Technology President David Henriks. "The idea here is not to limit the researchers to tools that may have been acquired years ago for a different purpose."

"Our goal with the Calit2 partnership is to always have the proper equipment available for the job."

The donated equipment includes a lapping and polishing system, a lapping fixture, a tripod polisher, a low-speed diamond-wheel saw, an ion-beam sputter-deposition and etching system, and a plasma cleaner.

"If you're trying to drive a nail into a piece of wood and all you have is a screwdriver, you won't be very effective," says Henriks. "We have the tools to allow researchers to be effective in processing their samples for analysis. Our goal with the Calit2 partnership is to always have the proper equipment available for the job."

In addition to assisting Calit2 researchers with their specimen preparation, the SBT/Calit2@UCI partnership provides other opportunities. The company's headquarters and manufacturing facility are located in San Clemente, and the lab's proximity allows SBT to respond quickly to new materials preparation challenges as well as demonstrate the efficiency of their equipment to new customers.

"Zeiss manufactures outstanding instruments and their performance is limited only by the quality of the specimen being imaged. South Bay Technology provides a means to improve sample quality, which then allows customers to exploit the technology in the Zeiss tools," says Henriks.

He adds: "We're very excited about the possibilities this partnership presents. It is a win-win-win situation for South Bay Technology, UCI and Zeiss. I am looking forward to a mutually beneficial partnership and I foresee more rapid development of materials processing tools that could change the face of materials research."

FUNDING NOTES

by Stuart Ross

Government funding agencies and the University of California itself encourage research interactions with industry. Because Calit2's charter emphasizes close working relationships with industry, it is important to be aware of these possible sources of support. Some of the more important funding sources that match industrial funding of university research include:

Discovery Grants

www.ucdiscoverygrant.org

The University of California offers grants in the fields of digital media, networking, biotechnology, electronics manufacturing and IT for the life sciences. A pilot program also provides funding related to nanotechnology, health and wellness, and energy and the environment. One of the advantages of the Discovery Grant program is the wide range of funding levels – from $50,000 to well over $1 million, depending on the project needs and quality. The industrial firm must have a research base in California and must match the UC funding; there are specific guidelines for the funding provided by industry. The application process is completed online. The next deadline is in October 2006.

Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR) programs

www.sba.gov/sbir/indexsbir-sttr.html

As the names imply, these programs seek to help small businesses advance their research, typically through cooperation with university researchers. The programs are offered by several federal agencies, including the Department of Defense, the National Science Foundation and the National Institutes of Health. The grants are awarded in three phases – proof of concept, development, and commercialization, with successively greater levels of funding. Typically the Phase I funding is limited to $75,000, but Phase II can provide up to $750,000. In these programs, the small business must be the prime contractor to the government and the university can be a subcontractor; the university's share of the funding is set by the guidelines. Research topics and deadlines vary from one federal agency to the next, but the overall procedures and guidelines are common to all the programs.

The Industry-University Cooperative Research Centers Program

www.nsf.gov/eng/iucrc

This National Science Foundation program promotes longer-term, more formal arrangements with industry, focused on a general research topic. Typically a center has a formal membership list of companies, with differing levels of membership fees, a formal evaluation procedure, arrangements for sharing intellectual property among the members, and an agreement signed by all the members. Awards are usually made for five years; the level of funding provided by NSF is scaled according to the size of the center and the amount of funding received in membership fees. The host university (or universities) must provide cost sharing as well.

Grant Opportunities for Academic Liaison with Industry

www.nsf.gov/pubs/1998/nsf98142/nsf98142.htm

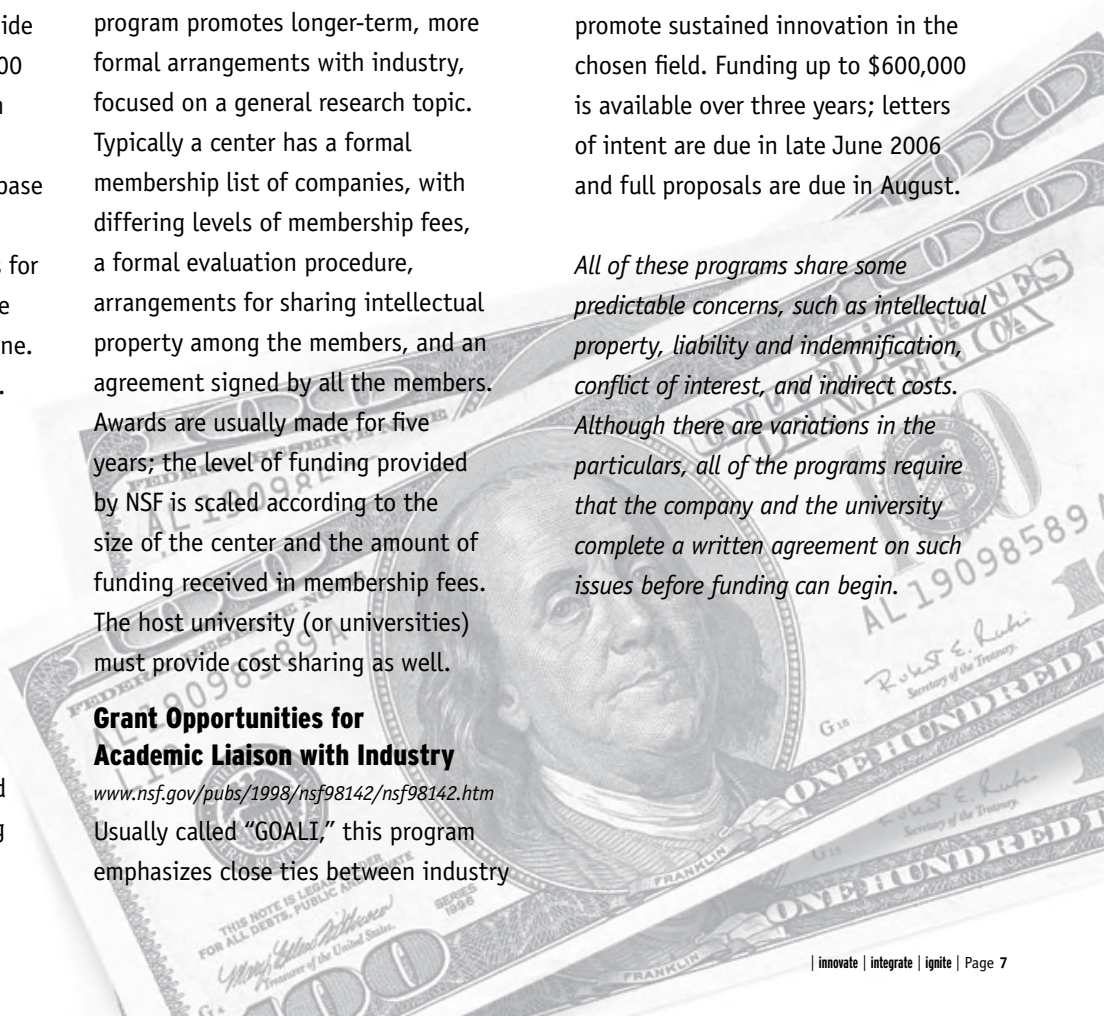
Usually called "GOALI," this program emphasizes close ties between industry and university at the project level, typically through short-term personnel assignments. For example, GOALI supports faculty visits to industry for a few months at a time, industry visits to the university for teaching or research, support for a postdoctoral fellow working in industry, or support for industry mentorship of graduate students, to name some examples. GOALI is also an NSF program; deadlines vary by topic area.

Partnerships for Innovation

www.nsf.gov/pubs/2006/nsf06550/nsf06550.htm

This program for medium-scale efforts may also involve governmental partners or international partners, in addition to the university lead organization and the industrial partner. Through research and/or education, the projects should promote sustained innovation in the chosen field. Funding up to $600,000 is available over three years; letters of intent are due in late June 2006 and full proposals are due in August.

All of these programs share some predictable concerns, such as intellectual property, liability and indemnification, conflict of interest, and indirect costs. Although there are variations in the particulars, all of the programs require that the company and the university complete a written agreement on such issues before funding can begin.



Submerged/ Ascension

Submersion: Dancers Marc Sicignano, Rachel Lopez and Jae Cho interpret underwater life in "A Fish Impression."

Photo: Gregory Gallardo

Graduate Students' Collaboration Stars Calit2 Building

Most research buildings have one purpose. They house research. Deidre Cavazzi and Kara Miller had other ideas. They decided the Calit2 Building should star in their master's thesis dance performance.

by Anna Lynn Spitzer

Cavazzi and Miller are UC Irvine MFA candidates, charged with conceiving and producing a performance piece to satisfy degree requirements. Both are interested in exploring dance beyond the boundaries of the traditional stage and both are fascinated by technology.

On the recommendation of dance professor Lisa Naugle, the two decided to collaborate.

Thus began a partnership that resulted in a unique two-night multi-media dance performance and video installation held in February and staged in – and starring – the Calit2 Building.

The dances were choreographed to emphasize the structure's atrium and flowing spaces, as well as its New Media Arts lab. Dancers incorporated the building's staircase, windows, concrete floor and four separate stories into their work. The New Media Arts lab served as a sort of theater-in-the-round – in

"I was absolutely fascinated by the expansiveness of the space."

reverse – as audience members moved themselves around the room in wheeled chairs for improved vantage points.

Submerged/Ascension consisted of five dances that exemplified ascension – choreographed and, in one case, videotaped, by Cavazzi, and performed in the building's soaring atrium and surrounding areas – and five dance/audio-visual pieces representing submersion, that were choreographed, directed and/or filmed by Miller and presented in the second floor black-box theater-style lab.

Merging Themes

Cavazzi and Miller approached the project differently.

Miller was interested in juxtaposing the ocean and dance as a way to increase cross-cultural understanding. Cavazzi wanted her performance to honor her late mother.

Cavazzi envisioned flying high; Miller was feeling inundated.

"I was absolutely fascinated by the expansiveness of the space and those windows," says Cavazzi, who adds that she was struck by the ascendant quality of the atrium's architecture.

Ascension: Dancers unfurl gauzy banners from the atrium's upper levels

Photo: Bentley Cavazzi

"I was submerged in the experience of technology..."

"I felt submerged," says Miller, who was already considering the ocean she had come to love as a backdrop for her dances. "I was submerged in the experience of technology and the idea that this gigantic ocean is a place where dance and technology could meet and grow together. At the time, I couldn't begin to 'ascend' because there was so much to comprehend."

Once the two started working together, they discovered their respective approaches actually complemented each other.

"When we began to work, we realized that our themes overlapped so much. Deidre has submersion in her work and I have ascension in mine," Miller states.

Cooperation and Connection

Cavazzi's theme of ascension – brought to life by dancers dressed in white, ethereal music, filmy strips of fabric descending from upper floors, and the use of lanterns and soft lighting – was inspired by her mother, who passed away last summer. "My mom was extremely instrumental in supporting me and encouraging me to dance," she says. "It was really important to me as a dancer and an artist to share my love and my feelings for my mom through my work."

Miller, who has traveled extensively, presented dance video installations

Photo: Bentley Cavazzi

Ascension: Lanterns contribute to the ambience.

filmed in Mexico and Sri Lanka as part of her performance. She views the ocean as a metaphor for connecting diverse cultures through dance. "Because some of what I presented involved people from different countries, it was really the ocean that connected all of those pieces," she explains.

Cavazzi is deeply connected to the ocean as well. She is a certified marine naturalist who wrote the curriculum for the Dana Point Ocean Institute when it opened its ocean education center. She still works at the institute part-time.

Miller, who directed a New York City dance company for seven years, is currently interning at DreamWorks SKG, and hopes to use her experience to produce and direct independent dance films. "Video dance is a tool of cross-cultural understanding," she says. "Dance can cross borders and transcend language, and film reaches more people than dance in a theater can."

Triumph

Cavazzi, Miller and their mentor, Naugle, were all delighted with the outcome.

"This was the first project I've set within an interior space and it all really exceeded my expectations," says Cavazzi.

"It was just really incredible," Miller agrees.

Says Naugle, a member of both students' thesis committees: "Deidre and Kara did an exceptional job of conveying their themes and presenting intriguing, moving performances. They clearly demonstrated that dance does not have to be confined to a theater stage."

What Lies Beneath

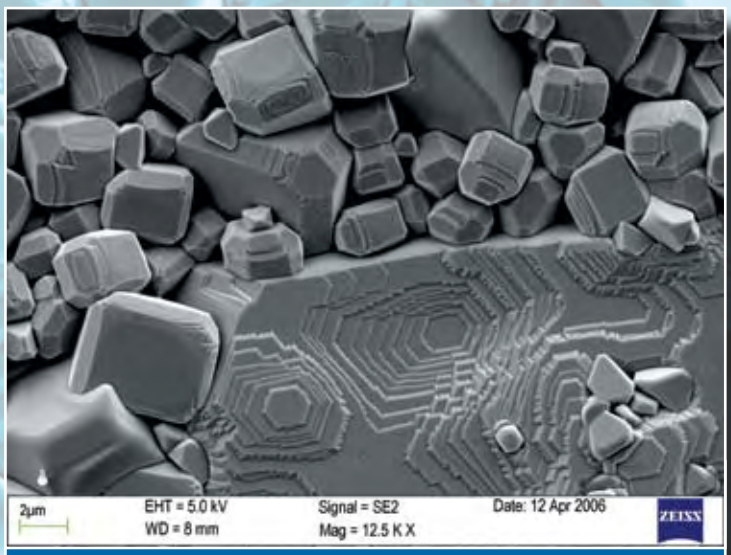
Calit2 sponsored a student micrograph competition in conjunction with the opening of the Carl Zeiss Center of Excellence. Micrographs – photographs captured with the center's scanning electron microscopes – were judged on image quality and the science behind the research. Judges included: Dave Howard, Jazz Semiconductor; Ali Yousefiani, Boeing; Mike Lowery, AMO, Inc.; and Phil Collins, UCI assistant professor of physics and astronomy.

First-place winner Thomas Pine, whose micrograph "Thermal Facets on the Free Surface of Annealed Yttrium-Doped Strontium Titanate (SYT) Ceramic Pellet" appears on the cover and at top left, is a graduate student in mechanical and aerospace engineering.

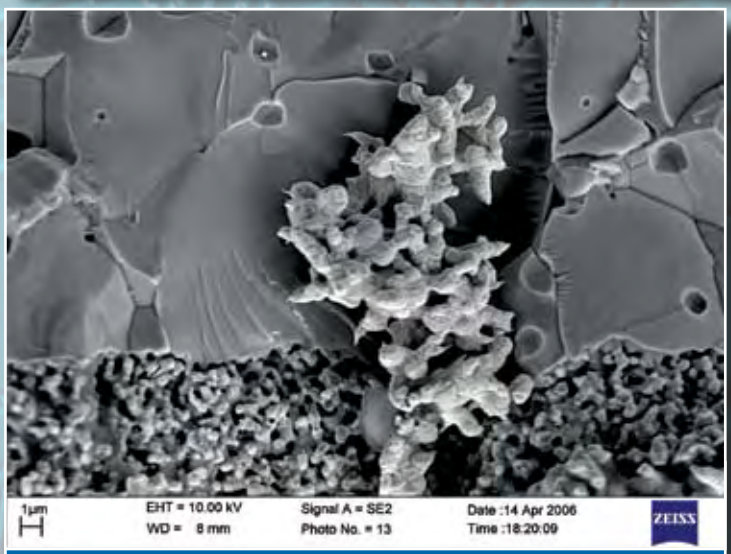
He explains that the conductivity of strontium titanate, a superconductive ceramic material, can be enhanced by introducing (doping) the element yttrium. This doping can increase its potential for use as an anode component with higher purity and better electrochemical properties in high-temperature solid oxide fuel cells.

Grace Qin's second-place "Crystal Tree of Perovskites" and Adam Schofield's third-place "Seventy Microns Beneath the Surface" also appear at left.

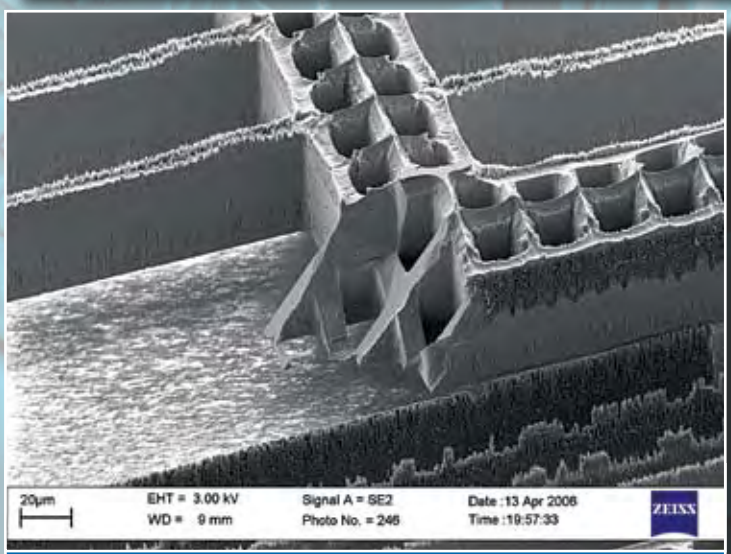
At right are the contest's eight semi-finalists.



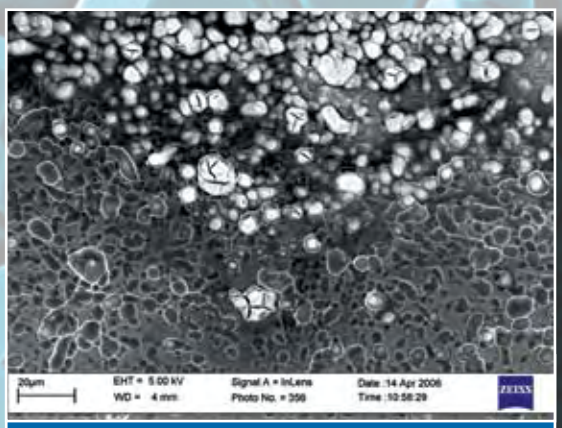
Thermal Facets on the Free Surface of Annealed Yttrium-Doped Strontium Titanate (SYT) Ceramic Pellet
Thomas Pine • Faculty sponsor: Daniel Mumm



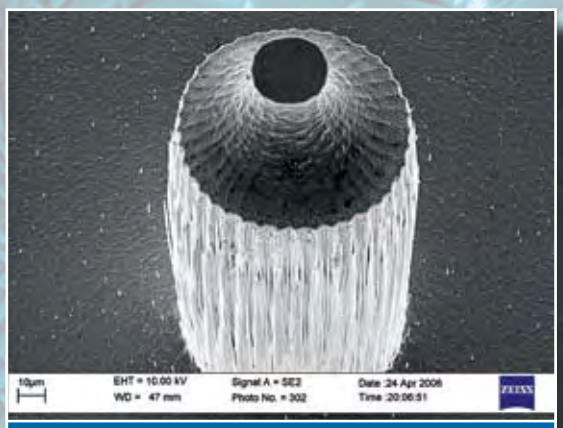
Crystal Tree of Perovskites
Ya Grace Qin • Faculty sponsor: Daniel Mumm



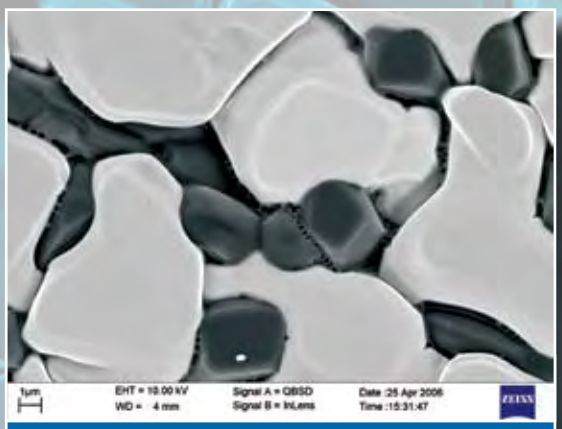
Seventy Microns Beneath the Surface
Adam Schofield • Faculty sponsor: Andrei Shkel



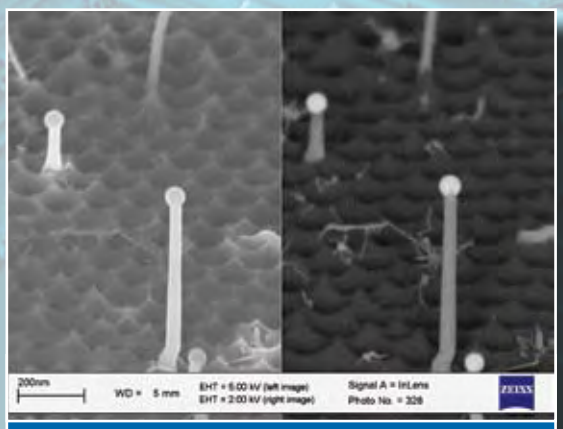
LSM Deposit on AAO Template
Anh Duong • Faculty sponsor: Daniel Mumm



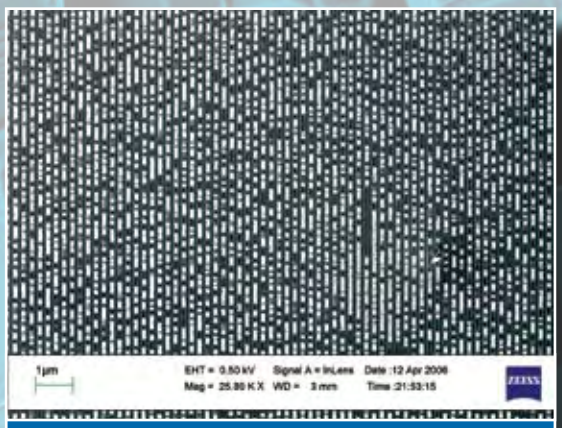
MEMS FEEP Thruster Tips
Jessica Ayers • Faculty sponsor: William Tang



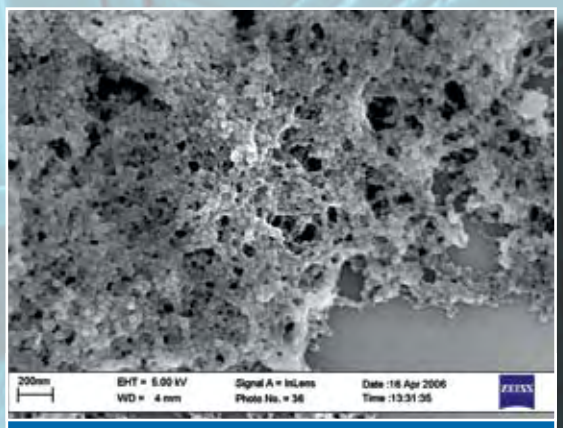
A Web of Decomposition: Zircon's Loss is Mullite's Gain
R. Peter Dillon • Faculty sponsor: Martha Mecartney



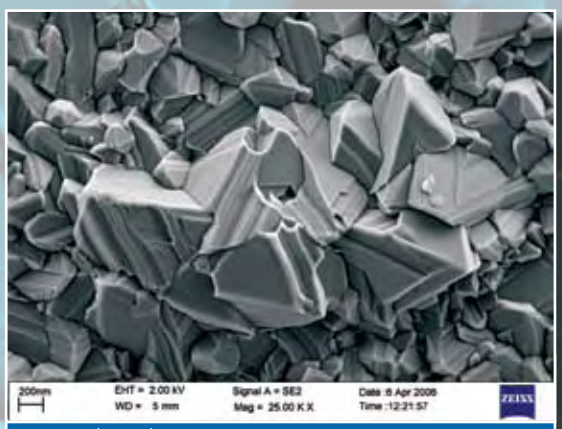
Zinc Oxide Nanowire Capped with Spherical Tin Catalyst
Zhiyong Fan • Faculty sponsor: Jia G. Lu



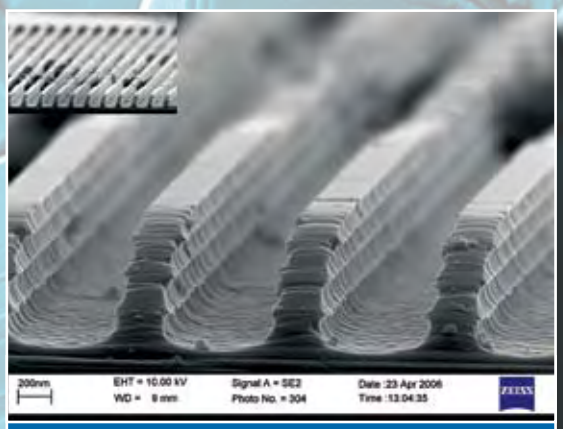
Do You See the Matrix?
Yen Peng Kong • Faculty sponsor: Albert Yee



Polysilsesquioxane Nanoparticles
Mariya Khiterer • Faculty sponsor: Kenneth Shea



$(Mn, Cr)_3O_4$ Spinel Phase Formed on Solid Oxide Fuel Cell Interconnect (Crofer APU22) Surface
Sungbo Shim • Faculty sponsor: Daniel Mumm



473nm-Grating Silicon Mold Cross-Section for Nanoimprinting
Wei Zhou • Faculty sponsor: Albert Yee

Calling all Commuters

Photo: Paul Kennedy

by Anna Lynn Spitzer

Postdoctoral researchers James Marca and Craig Rindt are developing travel behavior models for the travel assistant. The device will predict its owner's destination and recommend alternatives.

It's 8 a.m. Monday. Does your cell phone know where you are going?

It will soon. UC Irvine's Institute of Transportation Studies, in conjunction with UC San Diego researchers, is developing a platform that will transform cell phones into Personal Travel Assistants.

Not only will your phone advise you about freeway conditions, it will "know" your destination and when necessary, supply you with a revised route and/or timetable.

By incorporating human social dynamics and behavior modeling, the PTAs will predict your travel plans and suggest alternatives in the event of traffic tie-ups.

Using live information supplied by cell phones' global positioning systems, the platform will extrapolate relevant data from the user's daily travels. A complex series of algorithms and statistical modeling will shape the data into a probabilistic model of the driver's daily travel habits.

Will Recker, professor of civil and environmental engineering, and postdoctoral researchers James Marca and Craig Rindt are overseeing the travel behavior modeling research in Irvine, while the San Diego contingent, led by Ingolf Krueger, assistant professor of computer science and engineering, is designing the PTA's software.

The Personal Travel Assistant will be highlighted at the next Igniting Technology presentation on June 8. To register: *www.calit2.net/events/ignitingtechnology*

Developers are designing the new system to work with existing technology. "Cell phone technology with GPS and fancy graphics is already available, so it makes sense to utilize that," Marca explains.

The behavior modeling is computationally intensive. It will require three or four days to crunch several months of travel data into a probabilistic model. The behavior model will run on a dedicated server that will be connected wirelessly to drivers' cell phones.

A continuous data stream constantly allows the system to build and update models when the driver is not traveling. "If you drive somewhere new one day, the system will learn it by the next," Rindt says.

The initial user interface is a cell phone, but future platforms can include automotive navigation systems, PDAs or even wristwatches. Developers expect the prototype to be complete by this summer.

VoIP Phones

Garrett Hildebrand, network planner, and John Schaefer, communications analyst, work in UCI's Network and Academic Computing Services department, where they provide information technology leadership, expertise, infrastructure and service to support the university.

What are VoIP phones?

A Voice over Internet Protocol (VoIP) phone is a device that acts like a telephone but passes digitized voice traffic across local-area or campus networks, or the Internet, using Internet Protocols. IP telephones encapsulate digitized voice data into data packets, which are then routed to a server.

What equipment is required?

You will need a data network that supports the Internet Protocol and provides connectivity to other IP phones. Because other IP phones are typically on the Internet, you need an Internet connection, like DSL or a cable-modem line at home, or the campus network. If you're calling standard phones, you'll also need a gateway to that system.

Are there differences in VoIP phones?

There are three types of VoIP phones. One is the type used at Calit2: it is self-contained, and only requires a capability to find the VoIP server so it can access its pre-programmed features. It also requires a network connection with power over Ethernet (PoE).

The second type is a "soft phone." Skype software, which runs on your computer, is an example; it uses speaker and microphone jacks to support a headset that handles calls.

Lastly, the VoIP phone can be a standard phone set that is plugged into a VoIP adapter. That system converts the analog signal to digital, encapsulates it in TCP/IP packets, and interfaces it to the network.

For Skype and other similar services, there is a monthly service fee for using the servers and gateways.

What are the benefits to phone customers?

VoIP benefits anyone who makes frequent long-distance calls. The packets of digitized voice data can be forwarded over the Internet or other IP networks at no cost. As the call nears its destination, it is connected into the network, reducing or eliminating toll fees.

How does one switch to VoIP service?

From home, you can download software from Skype, SipPhone or other VoIP developers, and start making calls immediately over your DSL or cable modem connection. These companies have various monthly rates that include certain features like voicemail, caller ID and others.

Alternately, you can pick up an IP phone adapter at an electronics store and plug it into your network. You add your standard phone, sign up for their service and you are ready to go. The phone adapter is about $60.

Because the VoIP uses the Internet, are long-distance and international calls free, after you pay your ISP?

This is true if you are using VoIP at home or you have subscribed to a VoIP provider independent of the campus telephone service. Not all international calls are free, but they can be if you are calling someone who uses the same VoIP service provider. There isn't one VoIP provider that covers every continent; those countries that are not covered are still less expensive than regular telephone services.

Are companies like Skype safe for computer users? What are the risks?

There are more than 500 million Skype users. The computer is safe as long as you keep current with the latest anti-virus and operating software and/or have a firewall.

VoIP is vulnerable to the same issues that affect the data network, like viruses and spam. It is much easier to "tap" into the network and capture data than it is to tap into your phone line. This will become less of an issue as encryption and other security measures continue to develop.

The UCI IP phones, such as the Cisco IP phones deployed at Calit2, are secure. The network they connect to can tell the difference between an IP phone and other types of network devices. The IP phones are put into their own private VLAN (Virtual Local Area Network) that other devices – such as computers – cannot "see."

Are there any other disadvantages to the consumer?

Your IP phone is only as reliable as the network(s) it connects to. If you experience ISP outages with your computer, so will your phone.

One of the biggest disadvantages is power. Your regular phone service line is always powered, even in a major power outage. The same is true with the campus telephone system. There are battery and generator backup systems that keep the phone services running during a power outage of any kind.

With home VoIP, you will lose your phone service if your computer, VoIP converter, DSL box and/or cable modem are not connected to an uninterruptible power supply (UPS) system. Even then, it will only work for as long as the UPS can maintain power via batteries.

What are some other companies that offer these VoIP services?

There are a myriad of companies that offer VoIP services: Vonage, SunRocket, VoiceElipse, SipPhone, Speakeasy, Covad, Google and more. They are not all the same. Each one offers different international calling countries and prices. There is even a company known as Onvine which markets a VoIP phone and videoconferencing service known as "Tomato Vine."

Is Calit2 still the only building on campus using this technology?

Not anymore. Natural Sciences II is using Cisco IP phones. Information and Computer Sciences announced that it plans to use them in its newest building, Bren Hall (ICS3). About half of NACS is using IP phones at this time. The determining factor is the network, which needs an upgrade in certain areas.

More:

www.nacs.uci.edu/telephone/voip.html

EcoRaft
Seeds of Restoration

Carpenter, an evolutionary biologist, and Tomlinson, who has art and computing backgrounds, each brought unique skills to the project.

Photo: Paul Kennedy

More than 80 percent of lush Costa Rican rainforests have been chain-sawed and bulldozed for pasture and farmland. Exposed to rain, the rich topsoil eroded, vast areas lie abandoned and useless to farmers – yet they're far from useless to Calit2 affiliates Bill Tomlinson and F. Lynn Carpenter.

by Fran Tardiff

They've employed the tropical environment in their EcoRaft project to model a lesson in restoration ecology. Incorporating new technology developed at Calit2, the engaging, interactive game focuses on kids 8 to 12 years old.

"While having fun playing the game, they're learning basic rules of an ecosystem; namely, that destroying a habitat is easy. Restoring it, while an uphill battle, is still possible," says Tomlinson, assistant professor of informatics and drama.

Collaboration Breeds Education

His collaboration with Carpenter, professor of ecology and evolutionary biology, has created a way of transferring computer-generated plants and animals from one virtual habitat to another. In EcoRaft, three desktop computers are virtual islands. A mobile tablet PC is the "raft" on which plant and animal species "float." With raft in hand, the child picks up a hummingbird, a coral tree seed or other plant from a healthy, diverse environment and carries it to an island where habitat has been destroyed. A program, written in Java and C++, works with infrared sensors to enable the animated object to "jump" from healthy island to raft to barren land. Youngsters working together can repopulate the devastated island and help it blossom into a thriving rainforest.

The unique, multi-device game lets kids break the plane of the computer screen to interact with the environment and other people in ways both exciting and loaded with potential.

About 2,500 people have seen EcoRaft so far. Responses have ranged from "Wow, that's cool," by kids who tried it in the Calit2 lab and at Santa Ana, Calif.'s Discovery Science Center, to nods of approval from grownups at the Siggraph 2005 exhibit in Los Angeles. The next step is to install permanent exhibits at the Discovery Science Center and similar sites around the country. Tomlinson sees EcoRaft as a powerful educational tool, part of a comprehensive lesson plan teachers can build around a museum field trip.

It also could be used to teach about other ecosystems on a more sophisticated level. Tomlinson and his team of graduate and undergraduate students are working on an infrastructure that accommodates new content for this kind of platform. And a downloadable version of the game will soon be available for play on home computers.

Repairing the Damage

"Most people don't know about restoration. Yet they have the feeling that something's not quite right with the natural world," says Carpenter, an expert in hummingbirds. Her research in Costa Rica restoring tropical forests and soils led to her role as ecological consultant for EcoRaft. She has lived with the vibrant hues and sounds of the tropical forest. She knows how hummingbirds fly, and which plants must grow first to support other species, all nuances of the interactive EcoRaft game that make it come alive.

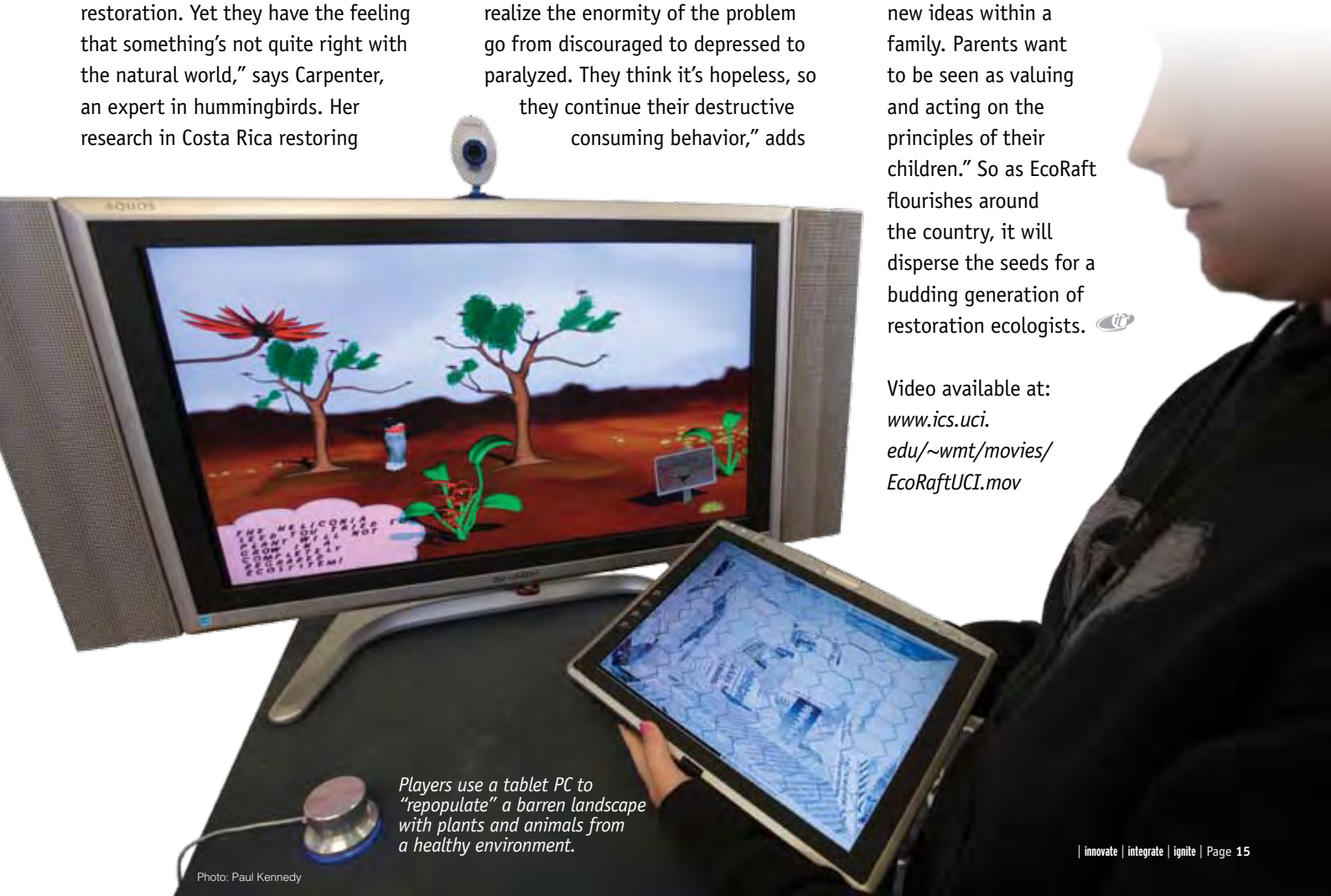
Restoration ecology grew out of the need to repair the heavy metal slag heaps left after mining. Now it's the study of how a destroyed habitat returns to biodiversity and how human intervention can help by jumpstarting the succession process. Restoration is most necessary where human activity – farming, fishing, mining, road building – has changed the whole ecological function of an area, Carpenter explains. Costa Rica is only one trouble spot. "The Amazon has the largest tract of uncut rainforest, but it's going fast. Great Britain has only 1 percent of its forests left, and the U.S. is down to about 10 percent of its original forests. Many people are in denial. Others who realize the enormity of the problem go from discouraged to depressed to paralyzed. They think it's hopeless, so they continue their destructive consuming behavior," adds Carpenter, who believes EcoRaft can be a positive way of cultivating hope and cooperation, of getting young people to skip the paralysis stage and go directly to activism.

A Project Blossoms

The researchers' common hope of repairing damaged environments through education is one reason EcoRaft sprouted at UCI. Calit2 is another. "They provided the lab space. And by its nature Calit2 encourages cross-disciplinary collaboration; it gave me a reason to call Lynn to see if we could combine our interests," says Tomlinson. For similar reasons, EcoRaft has attracted funding from a host of sources: an $80,000 Calit2 Nicholas Foundation Prize for Cross-Disciplinary Research, the Emulex Corp., the Donald Bren School of Information and Computer Sciences, and Claire Trevor School of the Arts.

With a reminder that "it all starts with the kids," Tomlinson opens an online video of youngsters enjoying the game. "Children are a pathway to new ideas within a family. Parents want to be seen as valuing and acting on the principles of their children." So as EcoRaft flourishes around the country, it will disperse the seeds for a budding generation of restoration ecologists.

Video available at: *www.ics.uci.edu/~wmt/movies/EcoRaftUCI.mov*



Players use a tablet PC to "repopulate" a barren landscape with plants and animals from a healthy environment.

Photo: Paul Kennedy

Young Entrepreneurs Learn from Experts

In January, Calit2 partnered with the UCI Center for Entrepreneurship and Innovation to offer a semi-monthly series of workshops for students. The Student to Start-Up Entrepreneurial Skills Workshop Series is designed to give young business minds the skills necessary to navigate the complexity of the business-formation process. It is geared to those interested in starting closely held/family-owned businesses as well as those more interested in technology-based investment-grade ventures. Each class is taught by a team comprised of a member from the Senior Core of Retired Executives (SCORE) and recent UCI graduates with successful experience in the subject area. The program is supported by Web-based distance learning materials for students who want to pursue the subject in more detail. The series will continue next academic year in the Calit2 Irvine Building.

Governor's Office Pays a Visit

Representatives from the Office of the Governor visited UCI's Calit2 Building in early February. David Crane, special advisor on jobs and economic growth, and Mindy Fletcher, deputy chief of staff for external affairs, spent the day touring the facility and learning more about the impact the institute is having on California's technology research sector. The meeting, which was facilitated by Duane Roth, Calit2 advisory board member and CEO of CONNECT, included project demonstrations. Crane and Fletcher were also briefed on research investments made by private and public funding sources, including corporate partnerships and federal grants.

Gaming Goes MASSIVE

More than 100 invited academic and industry participants joined in a dialogue about the future design, and technical and cultural challenges presented by massively multiplayer games. Presented by UCI's Game Culture and Technology Lab, Institute for Software Research (ISR) and Calit2, the MASSIVE research summit in April included case studies and models for collaboration. Jack Emmert, creative director of Cryptic Studios, gave the keynote address. Massively multiplayer online games are those in which thousands, or in some cases, millions of people, inhabit a virtual world via the Internet. MMOGs are the fastest-growing sector of the PC game market and are placing new demands on the Internet. The two-day summit included an evening reception with gaming demonstrations and industry recruitment tables.

From Soup to Nuts, Consumers Scan Smartly

Shoppers deciding what to buy at the supermarket now have a new tool to learn more about products ranging from cans of peas to bars of soap. GreenScanner, developed by UCI Calit2 researcher Bill Tomlinson, is a public database of product information and opinions that can be accessed from home or by using mobile devices with Internet capabilities, such as cell phones and PDAs. Consumers can freely access GreenScanner by visiting *www.greenscanner.net* to find out which company makes the product and other items produced by that manufacturer. It also provides the framework for consumers to evaluate and share their own information about products. Tomlinson's vision is that GreenScanner will become a forum for shoppers to read comments on whether products are environmentally friendly, as well as how they taste, whether they work well and if they are a good value.

Getting the Big Picture

The high-definition plasma display screens installed in the Irvine Calit2 Building's atrium might be superb for viewing the big game, but instead, they will be used to broadcast a variety of Calit2 presentations, performances and research demonstrations. Two 61-inch screens and a cluster of four 42-inch screens were installed in the four-story atrium. The six screens can simultaneously broadcast different images, or, in the case of the four-screen cluster, can air a larger view of a single image. The plasma screens connect to the Internet and to labs operating in the building. They also will be used for webcasting lectures, playing DVDs and transmitting new media arts performances. In addition, they can be integrated into specific research projects: for instance, to post announcements in a simulated ResCUE disaster drill.

Water Experts Talk Technology

A group of water research scientists came together in March to discuss technological challenges and opportunities in hydrology and near-coastal oceanography. The attendees included not only experts from the UCI and UCSD divisions, but also an expanded group of potential collaborators from coast to coast. The two-day workshop incorporated focus group discussions on environmental sensors, data information systems and scientific visualization, and environmental modeling. Participants prioritized research opportunities with plans to have Calit2 formally support project areas that will advance technologies and applications in hydrometeorology, the environment and water resources.

Computational Biology Ignites Panel Series

In April, G. Wesley Hatfield and Rick Lathrop shared their CODA Genomics Inc. success story with Orange County entrepreneurs and investors at the first "Igniting Technology" panel presentation. Co-sponsored by Calit2 and intellectual property law firm Knobbe Martens Olson & Bear LLP, Igniting Technology is a four-part series that examines UCI research and showcases the ways it can have broader applications in the business community. The event included an overview of the research that uses the power of computation to build synthetic genes for pharmaceutical and biomedical research. Other panelists included Bob Molinari, CODA Genomics' CEO; and V. J. "Raj" Rajadhyaksha, senior director for business development at Paramount Biosciences LLC, who until recently was the associate director of UCI's Office of Technology Alliances. The next Igniting Technology presentation, scheduled for June 8, features transportation experts who are prototyping a device for personalized travel assistance (see page 12).

The California Institute for Telecommunications and Information Technology is a two-campus multidisciplinary research institute. In collaboration with UCSD, Calit2@ UCI integrates academic research with industry experience to seek innovative IT approaches that will benefit society and ignite economic development. More than 150 UCI faculty, 250 students and 100 industry partners are actively engaged in Calit2 research areas that include the environment, transportation, emergency management, health care, education and entertainment. The four-story Calit2 building on the UCI campus includes state-of-the-art labs, meeting rooms and open research spaces.

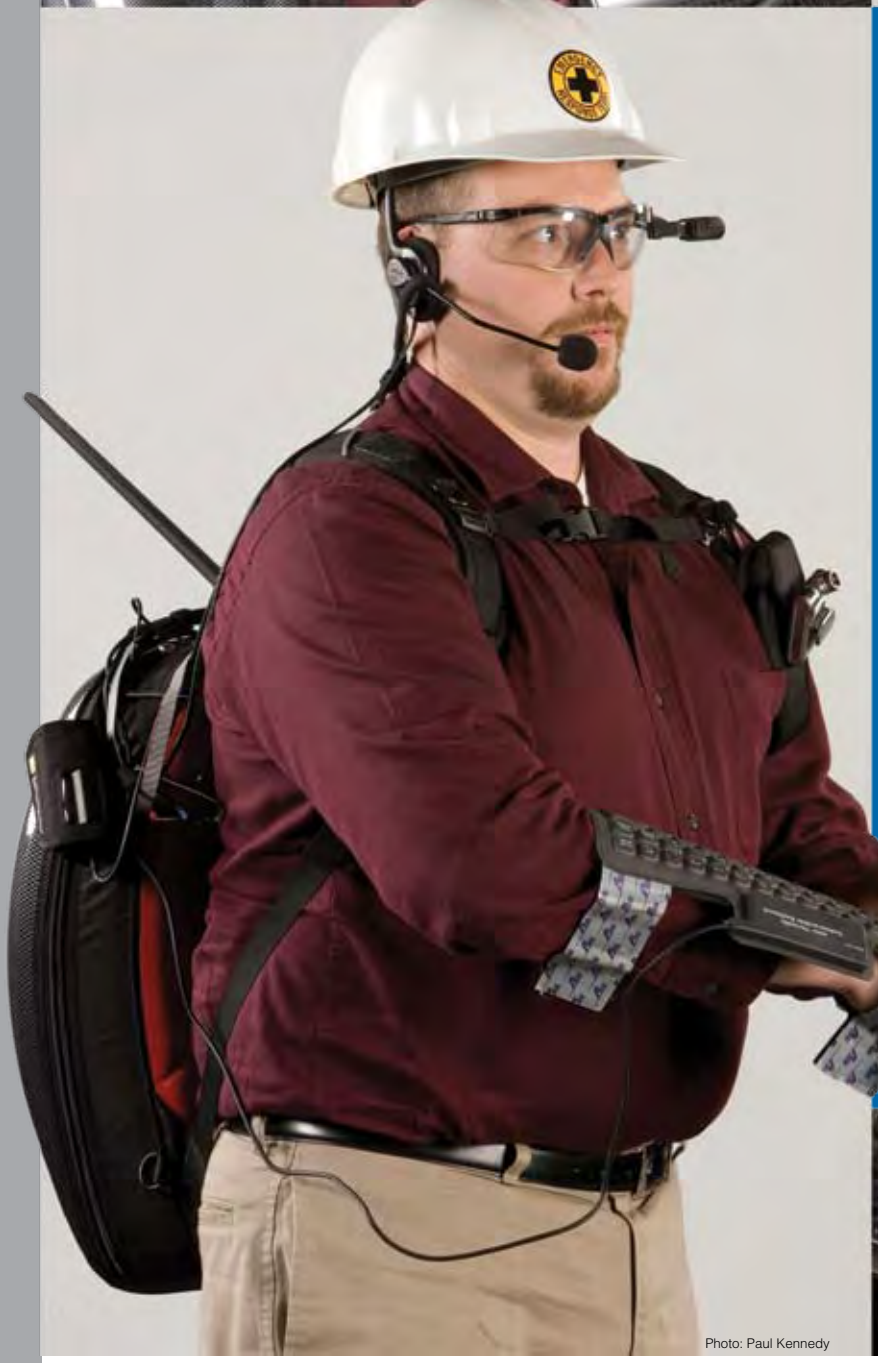


Photo: Paul Kennedy

Chris Davison's Evac-Pack looks like a futuristic backpacking kit. Instead, it will save lives in the urban jungle.

The Calit2 Responsphere team designed and constructed the apparatus to aid first-responders in crisis situations; it allows constant communication with an emergency operations center during search-and-rescue procedures. In buildings equipped with multi-modal sensors and Wi-Fi, it can also tell rescuers which rooms are occupied.

Read more about Evac-Pack's high-tech lifesaving capabilities in the next issue of *Interface*.

Calit2

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

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