California Institute for Telecommunications and Information Technology

High-Touch Healthcare

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On the cover: The "music glove" prototype, which uses familiar tunes to help stroke patients recover fine motor skills, is just one of the new technologies under development in Calit2's recently opened eHealth Collaboratory.

Healt

wenty-one-year-old Haley McDermott lives in Bakersfield, Calif., about 2¹/₂ hours north of Los Angeles. She has cerebral palsy, severe developmental delays and

a seizure disorder. For the past six years, her mother, Debbie, has taken her every four to six months to Bakersfield's Kern Regional Center to consult with Dr. Ira Lott, a UC Irvine pediatric neurologist.

> The McDermott family, (above) Robert, Debbie, Shelby and Haley (seated) – lauds its telemedicine experience with Dr. Ira Lott. "I wish more people had this opportunity," Debbie says.

Lott does not see Haley in Bakersfield, however; he is 115 miles away at the UCI Medical Center. The physician and head of UCI's telemedicine program consults with Haley and her mother using high-speed, two-way, interactive audio-video conferencing equipment.

Haley, who lacks head and trunk control, spent much of her time slumped down in her wheelchair, Debbie says. One of her leqs was contorted, making it several inches shorter than the other and causing painful pressure wounds on her tailbone.

Last year, during a routine neurological visit, Debbie mentioned the pressure wounds to Lott. He referred Haley to Dr. Sam Rosenfeld at Children's Hospital of Orange County, who performed life-altering spinal fusion surgery. Her pressure wounds healed, she has better head and trunk control, and instead of crying, she smiles all the time, her mother says. "Now she's happy. She can sit and be part of the family instead

by Anna Lynn Spitzei



Dr. Patrick Chen: Telemedicine benefits his patients at SOS who need specialized care. of lying in her bed on her stomach staring at the mattress."

Advances in information technology are creating revolutionary healthcaredelivery mechanisms like telemedicine that can improve quality, reduce cost and quite possibly save an overburdened system from imploding. The wide assortment of eHealth applications includes smart phones, iPads and mobile operating systems, which offer inexpensive monitoring and increased access; online and wireless solutions, which provide independence for seniors and comfort for sick children; and electronic medical records, which smooth information exchange and afford an extra layer of security.

Technology Reaches Out

Telemedicine actually debuted in 1906, when the first EKG was transmitted over telephone lines. In 1967, two years before the first message arrived on the Internet, Massachusetts General Hospital and Logan International Airport established a link to allow specialists to provide immediate care for seriously ill travelers. Today, ongoing improvement in the technology has broadened telemedicine's reach to include those in rural or underserved areas who otherwise might not have easy access to quality medical care. Haley is just one of many patients Lott treats via telemedicine. In addition to those at the Kern Regional Center in Bakersfield, he consults with a host of other California clinics participating in a statewide project called the Specialty Care Safety Net Initiative (SCSNI). The two-year pilot, administered by the California Center for Connected Health Policy, is identifying ways to establish permanent telemedicine relationships between medical centers and underserved areas, and to better understand the barriers that slow this effort.

All five University of California medical schools participate in SCSNI, which currently links 40 clinics statewide with specialists at the UC medical centers. Eventually, the program will use the California Telehealth Network (CTN), a state- and nationwide broadband network that will connect more than 850 healthcare organizations.

"When resources are scarce for specialists, telemedicine can really help to fill these gaps."

Lott, the veteran of 1,200-plus telemedicine consults, first explored telemedicine 10 years ago when he recognized the extent of the disparity in rural areas for specialty medical care.

"Before [telemedicine] we had to drive out to these areas and hold clinics. That just was not cost-effective and it didn't result in good continuity," he says.

After conducting dozens of telemedicine consultations and completing a reliability study, Lott was sold. "I became convinced that it was a reliable vehicle for delivering neurology care."

Debbie McDermott couldn't agree more. "I wish more people had this opportunity. I advocate for kids with disabilities and I always tell them about telemedicine," she says.

"And Dr. Lott, even though he is a neurologist, was looking at the whole

child, not just the seizures. A lot of physicians would have looked at Haley and thought, 'why bother doing a surgery that costly and that massive.'"

UCI's telemed specialists also include a pediatric endocrinologist, a pediatric psychiatrist and an adult neurologist who conduct live, real-time consultations with patients in the SCSNI clinics. These clinics include the Share Our Selves (SOS) community clinic in Costa Mesa, Calif., which uses the telemedicine consultations for some of the 1,000-plus patients who visit the clinic each month.

SOS Medical Director Dr. Patrick Chen joined the clinic in 2006. In the last five years, he says, there has been nearly a 100 percent increase in those without insurance seeking a primarycare provider. Many of these patients have chronic diseases that require specialty care. "Telemedicine is opening up healthcare to people who otherwise wouldn't have access to it. When resources are scarce for specialists, telemedicine can really help to fill these gaps," he says.

SOS is also testing e-consult in a program funded by Access OC, a nonprofit program that addresses specialty care for the county's uninsured population. E-consult can fill the bill for the type of referrals that don't require real-time patient-to-doctor contact, such as neurology, dermatology and cardiology. Currently, 12 specialists participate in the program, assessing cases and returning their recommendations to the SOS doctors within 48 hours.

Chen recently did a neurology e-consult for a 38-year-old pregnant patient with a history of seizures. She was taking two anti-seizure medications, and Chen wanted to be sure they would not adversely affect the pregnancy. He documented her case, sent it via e-consult to a neurologist, and learned that both medications were safe to use during pregnancy. Engineering professor Pai Chou is designing compact sensor platforms that can wirelessly monitor babies and children for a variety of conditions. Originally developed to monitor movement in preterm infants, the Eco-node device contains an expansion interface that permits attachment of other types of sensing devices. One application involves interfacing with multiple sensors that measure the carbon dioxide concentration in an infant's breathing zone, and vital signs, such as temperature, heartbeat and breathing patterns in an attempt to provide an early warning system for Sudden Infant Death Syndrome.



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In the iMove Center, oversized versions of several games – including Pong, Reveal, baseball and football – are projected onto the floor. Children with disabilities learn to steer their wheelchairs by maneuvering them as game controllers, and their movements can be tracked and compiled for later review. Engineering professor David Reinkensmeyer hopes to install a version of the game in a center for children with cerebral palsy. "We want to put this in a clinic that has lots of kids coming in, to learn how we can refine the system to make it really engaging."

Testing the system (from left): engineering doctoral candidate Danny Zondervan, postdoctoral researcher Riccardo Secoli, Luke Reinkensmeyer and his dad, David.

"Live telemedicine is great but it requires a lot of coordination," he says. "E-consult is a cost-effective way to access specialty care without requiring the patient to attend another appointment."

For Dr. Laura Mosqueda, head of UCI's geriatrics program, telemedicine is a win-win for the elderly. "An office visit can mean four to six hours of upset for them," she says. "If I can have [virtual] office hours in assisted-care living facilities and nursing homes, it's good for everybody. The facilities don't have to transport folks, patients don't have the upset and I can be more efficient. They can get quicker, better care."

Telemedicine also facilitates home monitoring, which is especially helpful in the first few days after a hospital stay. "You could send them home with telemedicine equipment and they could have a daily visit with their doctor," she says, adding, "There aren't enough geriatricians to take care of all the older adults. This is a better way to utilize resources."

A Balancing Act

Nurses are in short supply, too, according to Ellen Olshansky, director of UCI's Program in Nursing Science. eHealth technologies and telemedicine can extend the reach of nursing care, especially when it comes to monitoring those with chronic illness and keeping patient/provider communication channels open. Olshansky cautions, however, that the human connection – the importance of which is emphasized in nursing education – must be maintained in the process.

"The trend towards eHealth is good in many ways; it's using technology in a positive manner," she says, citing the trend toward early hospital discharge and home health monitoring. "We just have to balance it with human interactions and making sure we are there for our patients."

If telemedicine's next stop is the home, then Calit2's Telepresence Interactive Operating System, Telios, could be there too. The software, built on a Web 2.0 platform, allows two-way communication via webcam between medical specialists and individuals in the privacy of their homes. Peripherals – monitors for heart rate, blood pressure or glucose, for example, and devices like stethoscopes, otoscopes, dermascopes and more – can be connected to the system to aid in diagnosis and monitoring.

"The [teleconferencing] systems can't be beat at what they do, but they're very, very expensive," says Hector Parra, who coordinated UCI's participation in the SCSNI and helped develop a Telios prototype that is being used at the SOS clinic. "Telios is completely softwarebased so it's free and offers a very low barrier to entry. With a Web browser and a webcam you can get some of the same features."

Additionally, most teleconferencing systems are cumbersome and difficult to integrate into other products. One of Telios' strengths, Parra says, "is it's very modular, so if you need to add different components or integrate something, you can."

Adds Lott: "Telios is a very promising application because home care is going to become increasingly important in all aspects of medicine in the next decade."

"Our approach is not to create universal solutions but to use technology to lower the barriers to individual support."

Telios meshes with current consumer electronics trends too. "Almost every new television will have a Web browser built into it, and since we designed the system around Web 2.0 it will work in every TV," says co-developer Mark Bachman, assistant professor of electrical engineering and computer science.

Web TV is just one in a long list of wireless devices and online applications transforming healthcare research, development and deployment. *(continued, page 6)*

Hector Parra, at Calit2, uses Telios to confer with Dr. Ira Lott in his UCI Medical Center office.



Finger sensors built into a glove generate musical notes, encouraging stroke patients and those with serious hand injuries to exercise the limb by creating music. The exercises translate into practical skills, like using a key or writing with a pencil. "Music is an under-used path for rehabilitation," says graduate student Nizan Friedman, who is collaborating on the device with engineering professors Reinkensmeyer and Bachman. "There's been a lot of promise in using music for enticing motor activity in the brain."



New technologies are melding with the latest advances in medicine, computer sciences, engineering, biology, chemistry and gaming.

Nowhere will these disciplines merge more seamlessly than in Calit2's new eHealth Collaboratory, where researchers pool their multidisciplinary expertise to create what Irvine division director G.P. Li calls a "high-touch" approach.

"High-touch goes beyond developing the next new gadget," Li says. Technology users have different needs and the eHealth Collaboratory seeks to bridge these gaps.

"We want to personalize the individual user experience for patients, but also for physicians, nurses and other healthcare providers. We want to offer enough information to the users but not so much that they have information overload. Our approach is not to create universal solutions but to use technology to lower the barriers to individual support."

Located on the building's third floor, the Collaboratory advances all facets of eHealth, giving researchers a venue to display their breakthroughs and attract additional funding. Telemedicine, mobile operating systems, wireless solutions and even micro- and nano-fluidics are all on the agenda but are just one step on the road to the ultimate destination: user empowerment.

Enabling Empowerment

"We're trying to figure out how to use technology to empower people to take care of their health," says Bachman, who manages the recently opened space. "The fact that telecommunications is such a big part of our lives and consumer electronics are now so cheap opens the door to a great opportunity."

True to its name, the eHealth Collaboratory is truly collaborative, he says. "We have an opportunity to learn to build things that really work but we've got to collaborate with people who are in the trenches, who know exactly what healthcare consumers really want."

One such collaboration includes a mechanical and aerospace engineer, a

neurologist, an electrical engineer and a computer science gaming expert. The four professors joined forces to create "iMove," a grant-funded endeavor that combines information technology, robotics and neuro-regenerative therapies to improve human mobility.

David Reinkensmeyer, professor of mechanical and biomedical engineering, and anatomy and neurobiology, is a principal investigator. "We are particularly interested in whether training in robotic environments can improve motor skill performance outside of the training environment," he says. "We are trying to understand the computational mechanisms of human motor learning."

Mobile Solutions

In another Collaboratory project, pediatric anesthesiologist Dr. Zeev Kain and engineer Bachman are teaming with psychologist Michelle Fortier to develop a mobile application for children undergoing cancer treatment. "Pain Buddy," which is funded by a \$450,000 grant from the Hoag Foundation, will prompt kids to report their pain level at regular intervals on a handheld electronic device - a kind of mobile pain diary. The data will be downloaded on a server and made available to the child's oncology treatment team, which can respond with instructions and recommendations.

The current iteration features a customizable avatar that can walk children through the process; future versions may include a social networking component so kids can communicate with peers experiencing the same conditions. "The literature shows us that children age 8 and up can really use these electronic devices to monitor their health information," says Fortier. "I thought this would be a great way to provide them with improved pain management, but also with a tool that could be their buddy during the cancer treatment."

Fortier, who is using \$50,000 of her grant money to support the Collaboratory, plans a Spanish-language version of the Pain Buddy, as well as an adaptation for other types of acute and chronic pain.

Online Support

Computer scientist Walt Scacchi collaborates with healthcare professionals to develop online games and virtual world applications that can address a host of chronic health issues like obesity, asthma and diabetes.

"These ailments are growing very fast and there are not enough healthcare providers to deal with that," he says. Low-cost game technology or virtual worlds can provide sustained reinforcement and help those with illnesses interact with others who have similar conditions. "With social networks, people start to know how to help themselves and help each other. And they may find that less intimidating than a face-to-face encounter with a doctor or nurse in a medical setting."

Computer science professor Magda el Zarki is working with a physician on two proposals to develop virtual worlds for children with autism and their caregivers. By incorporating autistic behavioral traits and characteristics

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"We have an opportunity to learn to build things that really work but we've got to collaborate with people who are in the trenches."



A balance-monitoring insole that fits into any shoe uses pressure sensors and an accelerometer to provide quantitative, real-time information on the wearer's gait. The insole measures center of gravity and the amount of force generated by each part of the foot, and sends the data directly to the physician or therapist. A secondgeneration prototype will include a data-logging chip that can save gait information, allowing doctors or therapists to examine it during future appointments. "That would allow us to decrease power and make the insole less obtrusive and more mobile," says Peyton Paulick, a biomedical engineering graduate student who works on the project with engineer Mark Bachman and Dr. Hamid Djalilian. "We want to make it really simple." demonstrated by the children, el Zarki hopes to create realistic venues in which they can hone their social skills and caregivers can learn strategic behavioral strategies.

She believes more health-related functions will begin to evolve online. "The interfaces are getting easier to use and I think people are going to move much more into immersive worlds," she says. "There is a tremendous amount of possibility in this area."

Online platforms can offer individualized help for relief of other medical conditions. Dr. Hamid Djalilian, a UCI Medical Center otolaryngologist, created an online treatment program for tinnitus, a ringing, humming or buzzing in the ears that affects approximately 30 million people in the U.S.

A state-of-the art treatment device costs about \$6,000, but Djalilian created an inexpensive substitute: *beyondtinnitus.com*, a subscription Web site that uses algorithms to produce sounds that relieve those heard by the patient.

Djalilian says a pitch that is close to the sound of the ringing will help a large majority of patients, but can be annoying to listen to. So the site utilizes a soundmixing algorithm that creates a variety of more pleasant sounds. When the user has identified the correct tinnitus pitch and loudness, the program delivers a customized sound file that can be downloaded onto an iPod or other device.

The sound file also can be mixed with the user's own MP3 music, working in the background to stimulate the parts of the brain that can reduce the ringing. Djalilian says about 95 percent of the Web site users have found relief.

Pain relief also is the focus of an online tool developed by pediatric anesthesiologist Kain. He used the Web to create a personalized application that helps children prepare for surgery and their parents manage postsurgical pain.

The Web-based Tailored Intervention Preparation for Surgery (WebTIPS), a colorful and compelling site designed by DMA Animation, allows parents to log on prior to the surgery to enter information specific to themselves and their children. They answer questions about anxiety level, temperament, coping style, belief in pain medication and more.

Data are processed and the site delivers a personalized program that includes information about the surgery, postoperative pain management and tips for coping. "Everything is individualized," Kain says. "When they go home, if it's 3 a.m. and the child is crying, parents can go to the site and see what to do."

Making Paper Passé

The trend toward digital solutions doesn't stop with innovative products. Digitizing medical records has become a priority for healthcare providers. Not only can electronic medical records raise quality of care while lowering cost, but the federal government is offering incentives – close to \$22 billion in American Recovery and Reinvestment Act funds – as well as penalties, which begin in 2015, for failing to adopt the technologies.

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WebTIPS provides children and their parents with individualized pain management advice.

Active Space rehabilitation employs a video-tracking system and computer analysis to encourage improved movement in stroke or Parkinson's patients. Patients attempt to imitate movement they see projected on a screen – movement that takes into account their physical limitations and challenges them to move beyond – and receive positive feedback as they improve. "We're trying to move this out of the realm of being perceived as rehabilitation and really trying to make it more entertaining," says iMove collaborator John Crawford, associate professor of arts-dance.



UCI Medical Center began transitioning to electronic medical records in 2009, implementing phase two last year. "We have taken all of this information that people are used to putting in a paper chart and we've moved that into an electronic format. The EMR runs seven days a week, 24 hours a day," says Adam Gold, director of emerging technologies at UCIMC.

The system is available even during maintenance and updates, as users are taken to a read-only system. This seamless process takes place across all 3,000 hospital workstations.

Portability, manageability, oversight and data are improved. "That information is always available now, whereas before, we really only had the chart and what the doctor or nurse had in their head at the time," Gold says.

EMRs also ensure safety in drug dispensing. Electronic medication management requires healthcare providers to interact with the system at the dispensary and again before they medicate the patients. The system can also sound an alarm to prevent negative drug interactions and alert providers to serious side effects.

Dr. Mosqueda says the EMR improves efficiency and quality of care in her geriatric practice by making it easier to track secondary conditions associated with illness or disease. "If someone has diabetes, it's easier to track things like blood sugar, and we can use electronic means to remind us to check renal function, foot care and eye care, and all the other things that go around it."

The Next Steps

Coming up on the agenda at UCI Medical Center is connecting clinicians to the EMR through their iPhones and iPads, which entails encrypting, password-securing and managing approximately 400 devices.

Patient and physician portals will also debut later this year, allowing both groups outside access to pertinent medical records. The patient portal will allow patients to link their medical records to online health resources like Microsoft Health Vault and to decide which parts of the record they want to share with other providers or family members.

Technology in healthcare management will continue to evolve. In five years, Gold says, he wouldn't be surprised to see iPads mounted in every patient room for interacting with the EMR, Bluetooth barcode scanners for patient identification and medication information, and device-to-device communication that would allow realtime updates to be sent to doctors.

"We don't want to turn people into laboratory animals. If we do that, we have completely failed."

Developing systems to support these devices is critical to achieving total integration. "You can buy every gadget in the world and give it to the clinicians but if we don't implement it right from a technology and usability perspective, they are not going to use it," says Gold.

Calit2's new eHealth Collaboratory strives to deliver healthcare solutions that meet these same criteria. "Our high-touch approach includes involving patients, physicians, nurses and other healthcare providers as we develop new technologies," says Calit2 director Li. "In this way, we hope to create technology that can be personalized to a wide range of users and will be valuable to those delivering the healthcare as well as those receiving it."

In all cases, the focus is on empowerment and personal dignity, says Bachman. "Everybody is doing eHealth right now but they're all doing the same things. They all want to strap things to you and take data from you. But we don't want to turn people into laboratory animals. If we do that, we have completely failed," he insists.

"It's not enough to improve people's health if we do it the wrong way. We want to promote better health through empowerment, with dignity and respect."



Healthcare delivery driven by smart phones or other mobile devices is proliferating. Experts predict that by next year, the number of available mHealth applications will triple from 200 million to 600 million. By 2015, more than 500 million of the nation's 1.4 billion smart phone users will run some type of phone-based medical app, creating a \$60 billion market.

About a year ago, after delivering a guest lecture to a biomedical engineering class, Dr. Hamid Djalilian and the class professor, Dr. Brian J.F. Wong, both UCI otolaryngologists, chatted about the possibility of using an iPhone to create less expensive hearing aids. After further discussion, the two decided to move forward. Medical student Alan Foulard contributed his programming skills to the project and six months later, EarTrumpet was introduced.

The app, which can be downloaded on an iPhone, iPod or iPad, features a self-administered hearing test that identifies user-specific frequencies in need of amplification. The app imports that data and automatically delivers a customized hearing aid program.

"Based on the data from the hearing test, we give them the right shape for the hearing amplification," says Djalilian, who guided the design. "If they have high-pitch hearing loss, they only get amplification of high pitches." Users can "tweak" the results to improve them.

Jack Kelly Clark vouches for the product. The retired photographer read about the app in a UC publication and thought it might be the answer for his 90-year-old father-in-law. Bob Wise, Sr. (pictured) had recently spent nearly \$5,000 on a hearing aid but even after several trips back to the store for adjustments, it "simply made everything too loud." Finally, Wise stopped using it altogether.

Clark enlisted the help of his sister-in-law, who downloaded EarTrumpet onto her iPad. Together they approached Wise, who consented to the preliminary hearing test. "I could have told you that!" he bellowed to family members upon seeing the test results.

But after trying the customized program, Wise changed his tune. "I can really hear you now," he said. A few adjustments later, he announced that it worked "way better" than his expensive hearing aid.

Son-in-law Clark subsequently bought an iPod Touch, downloaded the EarTrumpet app and gave it to Wise to experiment with. Now they're awaiting the availability of Bluetooth since Wise doesn't like being tethered to earphones. In the meantime, Clark, who has mild hearing loss himself, tried the EarTrumpet too. "It really does work," he says. "The thing is so simple to use."

Paying the Price

Americans spend more on healthcare than citizens in any developed country. Just three years ago, healthcare expenditures accounted for 16.2 percent of our gross domestic product. That number is expected to increase to 30 percent by 2040 and to 97 percent by the end of the century. Billionaire investor Warren Buffet refers to this steady rise as "a tapeworm eating at our economic body."

While many believe eHealth can provide solutions, the resulting financial model still needs work. In the current fee-for-service paradigm, medical professionals receive payment for each service they provide, but the structure of eHealth presents remuneration challenges for insurers, policymakers and providers.

"The fear is that under fee-for-service payment, eHealth will be just another way of increasing utilization – that it will be an add-on and not a substitute," says Paul Feldstein, UCI professor of economics and public policy, and a nationally recognized authority on the economics of healthcare.

Telemedicine today is funded mainly by grants and mandated contracts, and most doctors agree that modifying the payment paradigm is essential if it is going to establish a foothold.

"There is a big need to come up with an economically sustainable model for telemedicine given budget constraints and people having to earn

a living when they provide services," says Dr. Ira Lott, a UC Irvine pediatric neurologist and director of telemedicine.

Capitation might be an answer, according to Feldstein. The system, traditionally used by large health maintenance organizations, pays healthcare providers a predetermined amount for each person assigned to them, whether or not that person seeks care. Providers who work within this structure often focus on preventing illness, a less expensive approach than treating it.

A "bundled" pricing model is also an option. One fee covers all the components of given procedures: anesthesia, supplies, hospital costs, doctor fees, etc. This allows patients to shop around for the best price. "It encourages competition and creates an easier

business model," Feldstein says. "And it encourages the hospitals and physicians to get together to try to reduce costs and

integrate care. That would be very conducive to eHealth methods." Change is slow to take root and difficult to establish. Federal and state policies play a role too. When Medicare changed its policy in the early 1980s from costbased reimbursement to fixed prices, it led hospitals to discharge patients sooner. And Medicare physician fee-for-service payment caused a flood of additional tests, treatments and services, because physicians could make more money that way.

What Feldstein believes could jumpstart the necessary change is either capitation payments to large integrated healthcare organizations or forcing consumers to shoulder more of the burden of their healthcare costs. That would require health plans to compete more, giving them the incentive to introduce technology-driven alternatives.

"I think eHealth has tremendous potential but it won't be realized unless there is a financial incentive to lower cost and increase quality," he says. "Unless you can start showing physicians that it can give them some advantage, they are not likely to adopt it." *(CP)*

"There is a big need to come up with an economically sustainable model for telemedicine." **The Stability Sole**, featured on page 8, is just one of the many innovative technologies being developed in Calit2's new eHealth Collaboratory. Advances in information technology are creating revolutionary healthcare-delivery options that can improve quality, reduce cost and provide patient empowerment.

Join us June 2 to learn about the Collaboratory, where researchers from different disciplines share ideas, learn from each other and demonstrate working prototypes. See how the Collaboratory's high-touch approach advances all facets of eHealth, including telemedicine, mobile operating systems, wireless solutions and even micro- and nano-fluidics.

Registration is required; visit www.calit2.uci.edu for complete details.

Igniting Technology is a semiannual event sponsored by Knobbe Martens Olson & Bear LLP in partnership with the University of California, Irvine division of the California Institute for Telecommunications and Information Technology.



In conjunction with Igniting Technology, join us for ACE2011: Electromotive



An interactive exhibition in the Calit2 Building atrium featuring the works of two UCI Arts Computation Engineering graduate students - *Ferreflection*, by Eric Mesple and *Pulse*, by David Resnick

Opening reception: 7 pm, Thursday, June 2, 2011



Ferreflection combines real-time video interpolation, microprocessors and electromagnets to create fluid silhouettes of the viewer. When the electromagnets are triggered by the viewer's interaction, the ferrofluid magnetically pulls upward onto the face of a metal wall, recreating the viewer's image on the surface of the piece. The wall is covered by 300 electromagnets and is situated in a reservoir filled with the ferrofluid. *Ferreflection* delves into the possibilities for interactivity between humans and electro-mechanical objects.

Pulse is an experiment in the health effects of expanded consciousness. Solenoids (linear pulsing electromagnets) are placed on the participant's body, acting as automated acupressure fingers preset to basic acupuncture points and music-therapy theory. As the artist moves his hands in the space around the participant's body, custom software tracks the movements and actuates pulsing patterns and frequencies, as well as audio oscillators that transmit sound through headphones to the participant. Because s/he is connected to an EKG machine that displays heart rate variability (HRV), the artist can see in real time how the experience affects the participant's sympathetic and parasympathetic nervous systems – key parts of the human immune system. HRV data will be combined with survey data to determine if *Pulse* achieves its goals.

Exhibit will remain on display 8 am - 7 pm in the Calit2 Building, June 3 – 12, 2011. It is free and open to the public.



by Lori Brandt

Top: Russell observes dancer Kumiyo Kai, a first-year graduate student and Fulbright scholar, and undergraduate violinist Manisha Vasishta as they perform with strategically placed sensors on their bodies.

"This information will help us with dancers, but we may also be able to transfer it to other populations such as the elderly, who have a high risk of falling." f feet could talk, those belonging to a dancer would probably have much to say. And Jeff Russell, assistant professor of dance science, is listening.

Russell uses innovative technology in Calit2's eHealth Collaboratory to study the demands of dance on the musculoskeletal system. Russell and his team intend to learn from the feet of tap dancers by developing a custom insole for tap shoes. A thin layer of laminate is embedded with sensors and accelerometers to measure pressure and acceleration of the feet, and a data-logging chip collects the numerical values of force that a dancer's feet undergo while tapping.

Russell oversees 18 students from various disciplines conducting dance science research at the forefront of the field. Alison Ozaki, a biological sciences student and former tap dancer, remembers her own shin pain. "The rapid percussive footwork performed in tap suggests that the foot and ankle sustain stresses that could lead to injuries," explains Ozaki, who collaborates with biomedical engineering graduate student Peyton Paulick to design the insole.

The partnership is producing more than a shoe insert.

"With people who excel in different subjects working together, discussions about possibilities are more open," Ozaki says. "It's rewarding to see there's something we all have in common and that is the desire to learn more."

Russell's applied research projects, which run the gamut from detecting bacteria on the barres in dance studios to studying joint flexibility and range of motion in dancers' ankles, all bridge the arts and sciences.

"Everything I'm working on has to do with understanding the demands put on the body from dance or performing," says Russell, a certified athletic trainer, who has 30 years of experience in sports medicine, orthopaedics and dance medicine. "Once we grasp that, we can determine how to make it less demanding and how to physically condition in specific areas.

"Most people don't think of dance as athletics," he adds. "But in many ways, it is just as rigorous as sports, especially in terms of the hours of practice, repetitive motion and physical demands on the body."

Two of his students are comparing balance in dancers and non-dancers. Laura Obler, majoring in dance and chemistry, and Tiffany Yu, a biological sciences major, seek to understand how dance training affects balance and what patterns people demonstrate as they try to maintain postural stability. They are using a balance





platform equipped with sensors to measure and compare the degree of sway exhibited while standing on two feet and on one foot.

"This information will help us with dancers, but we may also be able to transfer it to other populations such as the elderly, who have a high risk of falling," Russell explains.

The balance platform is just one of the high-tech tools in Russell's arsenal that has applications across disciplines. He also works with a motion capture system to collect biomechanical data. Typically used to create realistic animations in film and video games, motion capture technology has also been applied to artistic endeavors and movement analysis in orthopaedics, rehabilitation and sports.

But Russell also sees the technology's potential for scientific research in performing arts. He employs six high-speed cameras with visible red and infrared light sources that track the movement of reflective markers taped strategically to a dancer's or musician's body. Special computer software combines the information from the cameras into a graphic representation, or stick figure, on a computer screen.

Russell recently tracked the movement patterns, joint angles and speed of a professional wheelchair dancer to establish a baseline for training (see page 26). And he's just begun a motion capture study to look at the upper body of violinists, who often experience neck and back pain from the strenuous position required to hold their instrument.

"If we can map a performer's motions in a way that allows us to see what kinds of movement patterns are leading to painful overuse syndromes, then we can determine how to change the way we teach techniques to reduce injuries," Russell says.

David Reinkensmeyer, professor of mechanical and biomedical engineering, and anatomy and neurobiology, also is interested in studying human mobility. He designs technology that helps people recover from neurological trauma, such as stroke and spinal cord injury, and he committed funds to buy two of the cameras for Russell's system.

"There are about 30 faculty on campus with the goal of improving movement training, rehabilitation and exercise through new technologies," Reinkensmeyer says. "Russell's work and the motion capture system could be a helpful resource for us all."

Russell and eight of his students will be presenting their projects at the International Association for Dance Medicine and Science's Annual Meeting this fall in Washington, D.C. Russell, who says dance science and medicine lags about 20 years behind sports medicine, couldn't be prouder. "If I can graduate students who know what I know, do what I do and expand our exploration, we've got multiplication, and we'll see a real advancement of the field. Then we will have accomplished something." «





Top: Tiffany Yu and Russell discuss Kai's balance testing.

Center: Vasishta watches as sensors are attached to her hand and arm.

Bottom: (Clockwise, from left) Student researcher Alison Ozaki, tap dancer and M.F.A. candidate Reneé Fox-Moore, and engineering undergraduate Ryan Garcia join Russell as they make adjustments to the custom insole for Fox-Moore's tap shoe.

BLAZING The Path Forward



n Dec. 7, 2000, then-California Gov. Gray Davis and University of California President Richard Atkinson announced the creation of four Institutes for Science & Innovation, including a joint award to UC Irvine and UC San Diego for the formation of Calit2. Exactly 10 years later, on Dec. 7, 2010, Davis and Atkinson are joined by a host of past and present leaders paying tribute to the institute's accomplishments and supporting its path-forward plans.





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The Path Forward

articipants at UCI and UCSD are united by a high-speed, real-time HD Internet connection, making it a virtual two-campus, oneinstitute anniversary celebration. The ceremony serves as a backdrop for the campuses to jointly unveil the official plaques renaming the institutes as the Governor Gray Davis Institutes for Science and Innovation, in honor of Davis' instrumental contribution.





he 10th anniversary celebration continues later in the day with local activities at the respective campuses. UCI opens its building for guests to tour labs and experience research projects. Entering its second decade, the institute's path forward focuses on the digital transformation of healthcare, energy, the environment and culture.

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Endless Possibilities

erving as the gateway to commercial viability, Calit2's TechPortal is now incubating innovation for four startups. The companies produce vastly different products but share the attribute of being based on UC-licensed technology.

BiMaple Inc., the first to move into the building's second-floor incubator when it opened last June, is developing instant interactive search technology based on the work of UCI computer scientist Chen Li.

Two more recent tenants – ZeroWatt Technologies and Tear Diagno – were consecutive winners of the Paul Merage School of Business' annual business competition plan for UCI students, staff and researchers. ZeroWatt is developing proprietary technology, based on professor Payam Heydari's engineering research, to vastly improve power consumption in a critical component of many electronic systems. Tear Diagno's mission is to develop and market innovative ophthalmic diagnostics and cataract surgical devices to improve eye care worldwide. UCI alumnus Kaveh Azartash co-invented some of the technology as part of his biomedical engineering graduate dissertation and now serves as the company's CTO.

The most seasoned company in TechPortal, Shrink Nanotechnologies Inc., moved into the incubator last fall to take advantage of its ties to UCI-sponsored research and the campus's recharge R&D facilities. Entering its third year of business, Shrink, which also has offices in Carlsbad, Calif., is poised to break into the marketplace with several viable products, according to Mark L. Baum, the company's co-founder. Baum took the time to answer a few questions.

> "UCI and the TechPortal have a lot to offer, and the campus administration, in particular, is fairly progressive in understanding the needs of small companies."

Mark Baum
Shrink co-founder

Calit2 UC Irvine

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Shrink Nanotechnologies engineer Scott Strayer, a UCI alumnus, conducts most of his work in the TechPortal.

In brief, what does Shrink Nanotechnologies do?

Shrink's mission is to develop leadingedge "commercializable" technologies, primarily from university engineering, biology and chemistry labs, but also orphaned technologies within larger industry businesses, and ultimately build companies around those technologies by bringing our unique FIGA business model to bear. FIGA is an acronym that stands for Finance, Industry, Government and Academia. We believe that in order for any small technology-oriented business to be sustainable and ultimately successful, influence and contribution from one or more (if not all) of the FIGA elements will be required.

When/how was the company started? How many employees now?

The company is the brainchild of Michelle Khine, UCI assistant professor in biomedical engineering, as well as my partner, James B. Panther, II, and me. James and I manage a hedge fund called Noctua Fund. I have known Michelle since she was a teenager, and have always admired her brilliance. We decided to back her ideas and form a company based on work she had done in her lab while at UC Merced, which she continues to develop at UCI. Shrink was started in 2008, and we now have eight employees and eight consultants working on our behalf.

Acquiring initial and sustainable funding can be a challenge for a startup company. Who are Shrink's investors?

Shrink was initially funded by Noctua Fund LP; however Shrink has also received investments from high-networth individuals and hundreds, if not thousands, of retail shareholders (we are publicly traded under the stock symbol INKN). Because Noctua has resources and history with small public companies like ours, the process has been fairly friction-free.

What are some of the applications/ markets Shrink is penetrating?

Shrink's initial products are cellculturing devices, as well as a software suite to assist in bioanalysis. We have a product called StemDisc that we are launching this year. And we have another product called Cell Align that we also expect to launch this year. We are also working to commercialize a suite of shrink film products called NanoShrink which is based on Michelle's work. But Shrink is also using its public company equity to look at making additional accretive acquisitions, and this is part of our strategy as well, in terms of creating shareholder value.

(continued, page 22)

Does Shrink have customers purchasing product at this point?

We have not sold our products yet. We do expect that there will be customers in the United States and abroad for what we are selling. We are going to market in the next few months.

Who are Shrink's competitors and what sets you apart from them?

We have numerous competitors in the cell-culturing space. Suffice it to say that our product relative to our leading competitor produces more results, in a better material, quicker and with fewer steps – and our product will be 20 percent less expensive. These are the kinds of metrics that we address in all of the products we are going to market with.

Why was Shrink interested in becoming a TechPortal tenant?

Access to our science founder, Michelle Khine, was important for us. But access to the broader university community of people who can give us feedback on our product, help with product surveys and even administration (like Goran Matijasevic and the Technology Transfer office at UCI) and university organizations (like MF3) – all of whom have helped us since we have been associated with UCI.

Now that you have been in TechPortal for half a year, what has the experience been like and what benefits have you reaped from being there?

It has been terrific so far. UCI and the TechPortal have a lot to offer, and the campus administration, in particular, is fairly progressive in terms of understanding the needs of small companies. Without these sorts of resources, small companies really are further behind the proverbial 8-Ball of larger established businesses.

Without giving away any company secrets, what are you working on in the incubator space? We are 100 percent, laser-beam focused on commercialization of our technologies and devices – and that starts at proof-of-concept prototyping and goes all the way to packaging and conducting market surveys. We have done all of this and more at the TechPortal.

Finally, what are the short-term and long-term goals for the company?

Short term – we are going to market with our initial products. University technology and academic papers don't mean much if the science cannot be translated to a product that users can buy and experience value from. Longer term – we are in technologyand company-acquisition mode - looking for bright and committed people and businesses that need capital and resources that we have access to. There are a lot of great companies who need these kinds of resources, and we want to have a few of them join our team as we grow and create value for our shareholders.

he TechPortal Entrepreneur Series

debuted in October with a few dozen aspiring faculty and student entrepreneurs gathered in the building's seminar room, eager to better understand the process of launching a successful startup. As the series progressed, so too did the number of interested attendees. By the end, the program filled the Calit2 auditorium. **FOR UNIVERSITY RESEARCHERS TO BEGIN** the commercialization process, the first stop should be the UCI Office of Technology Alliances, according to patent attorney Steven Nataupsky and senior licensing officer Megha Patel, who opened the series with a presentation on protecting intellectual property. They urged the audience to file a Record-of-Invention form as soon as practical in order to establish a relative timeline for the invention and begin the patent process. "One of the things you have to do to get a patent is show your invention is not obvious to someone of ordinary skill in your field," Nataupsky said. "Even if you think your invention is not special, even if it's something you came up with overnight, turn that into an ROI because oftentimes it may be patentable."

RAISING THE NECESSARY SEED FUNDS to turn an idea into a thriving company is a crucial next step for the budding startup. In the November session, two successful entrepreneurs shared their fundraising advice. Winston Ho (pictured), founder and president of two companies, Maxwell Sensors and Applied BioCode, was joined by Fan-Gang Zeng, a UCI professor who has helped launch three startup companies. Both men have used a variety of methods to raise the necessary capital for their endeavors, ranging from small business grants to private funders. Ho believes angel funding is the easiest to obtain but it comes with inherent risk. "While you can make a friend rich, you can also lose that friend," he said. "That's tremendous pressure." Explain the technology carefully and be honest about the risk, Ho advised.

FREQUENT INTERACTIONS WITH POTENTIAL CUSTOMERS is one of the best ways for a startup to build and refine its product. That was the message when the TechPortal series continued in February. Brant Cooper (pictured) and Patrick Vlaskovits, authors of "The Entrepreneur's Guide to Customer Development," explained how the lean startup philosophy is a good way to assess the market. The approach focuses on developing product and customers simultaneously, enabling the startup to maximize the number of changes required to its device or service with the smallest investment possible. "Your business model will change and you have a limited amount of money. You have to find out what works before you run out of money," Cooper counseled.

FIRST IMPRESSIONS MATTER. They can either make or break a deal, and according to the March presenter, Chris Van Dusen, that is why it is critical for entrepreneurs to be able to succinctly "wow" potential financial backers and customers with a compelling message about their startup. "It's how you're perceived. It's everything you figure out later, minus the later," he said. "Your elevator pitch closes deals before they ever get started – good or bad." Van Dusen, who has several startups of his own in the works, emphasized the importance of articulating your company's "special sauce" in order to differentiate yourself from competitors.

TAKING A "WHAT NOT TO DO" APPROACH was the final lesson in April. Bart Greenberg, a corporate lawyer who represents entrepreneurs, startups and emerging technology companies, shared with attendees the more common mistakes made by companies in their business plans and explained how to avoid them. Greenberg outlined the 11 critical components of a plan starting with a needle-sharp focused executive summary and ending with a sensible exit strategy. "You can't plan on the future looking like the past and you have to plan for contingencies," Greenberg said. He advised the group not to spend too much time drafting their business plans and making them "look pretty." "Don't get too involved in the details of the product or service and how it works," he explained. "That's not what investors care about – they care about the market opportunity and how you're going to make them money."

Benefits of submitting a complete ROI

- Provides official record of invention
- Basis for patentability review by OTA staff and patent attorney
- Basis for Non-Confidential Disclosure of invention can be marketed to potential licensees









by Stuart Ross

Fiscal Therapy These nutritious supplements can improve your financial health

NOTES

Telemedicine and Advanced Health Technology

United States Army Medical Research and Materiel Command BAA 11-1 Proposals will be accepted any time until Sept. 30, 2011. This program seeks to explore medical science and engineering technologies to maximize benefits for military medicine. Research is focused on: medical robotics, health information technologies, medical imaging, advanced prosthetics, human performance, computational biology, biomonitoring, neuroscience, nanomedicine, biomaterials, medical logistics and telemedicine. Applicants should determine the agency's interest by submitting a pre-proposal rather than writing a full proposal or attempting a discussion by phone. Pre-proposals may be submitted at any time, on any of the research areas of interest outlined in the BAA. Projects may be as long as 5 years.

Nanoscience and Nanotechnology in Biology and Medicine

National Institutes of Health PA-11-148 Due dates are June 5 and Oct. 5, 2011, and Feb. 5, 2012. This program provides support for cutting-edge nanoscience and nanotechnology research that can lead to biomedical breakthroughs and new investigations into the diagnosis, treatment and management of diseases and traumatic injuries. Because advances in nanoscience and nanotechnology will enable the engineering of bioactive nanoscale structures, processes and

systems, this program will also support projects that develop new or improved nanotechnology and nanosciencebased tools, concepts and devices. This solicitation offers standard project grants; a companion solicitation offers smaller exploratory grants on the same themes (PA-11-149).

Microsystems Technology

Defense Advanced Research Projects Agency (DARPA) BAA 10-35 Proposals may be submitted any time until Sept. 1, 2011 (extended from March 1). The Microsystems Technology Office's mission is to exploit breakthroughs in materials, devices, circuits and mathematics to develop microsystems components with revolutionary performance and functionality. The program supports research in electronics, photonics, MEMS, algorithms and combined microsystems technology to deliver new capabilities for sensing, communicating, energizing, actuating and processing information. Many advanced topics are listed in the RFP including non-silicon electronics, novel photonic devices, quantum devices, advanced imaging, chip-scale sensors, RF/ optical transceivers and microsystems for navigation. This solicitation is primarily intended for early-stage research, defined as efforts of less than 12 months, costing less than \$1 million. Proposers are strongly encouraged to submit a proposal abstract in advance of a full proposal.

For more

funding

opportunities,

visit the research

section of the Calit2

Web site: www.calit2.uci.edu

Research Coordination Networks (RCN)

National Science Foundation 11-531 Deadlines in 2011 and 2012 vary by subprogram; consult the solicitation. RCN provides opportunities for new collaborations, including international partnerships, in single disciplines or for interdisciplinary work. Grants support groups of investigators for communicating and coordinating their research and educational activities across organizational, geographic and disciplinary boundaries. The goal is to use collaborations and networks to advance a field or create new directions in research or education. Priority also will be given to innovative collaboration strategies or technologies and to the development of shared standards for data and metadata. Proposals should focus on a topical theme: a broad research question, a special technology or an innovative approach. Funding requests should be directed more to the networking activities than to lab or field research. Several NSF directorates are participating in this program, some with separate interests and submission requirements; applicants should consult with program officers in the areas of interest before submitting a proposal.

Cyberlearning: Transforming Education

National Science Foundation 10-620 Full proposals are due July 14, 2011. Through the Cyberlearning program, NSF pursues three related goals. One is to understand how technology can be used to help people learn, either through individual use or through collaborations mediated by technology. Another goal is to use technology for collecting, analyzing and sharing data to understand learning, while a third is to design new technologies for these purposes. Of particular interest are technological advances that allow more personalized learning experiences, help populations not well served by current educational practices, allow access to learning resources anytime and anywhere, or provide new ways to assess capabilities.



Education and Entrepreneurship

Ewing Marion Kauffman Foundation (Kansas City) Letters of inquiry accepted at any time. The national programs of the Kauffman Foundation relate to entrepreneurship with grants that are "limited to programs and/or initiatives that have significant potential to demonstrate innovative service delivery, in support of education and entrepreneurship." Past grants have been awarded for research and conferences on such topics as the patent

system, business ownership data, women-owned firms, venture capital networks, self-employment, enterprise zones and business plan competitions. The foundation does not provide funding for startup companies. The foundation wants *only* a letter of inquiry to begin the review process. Interested faculty must check with UCI's Foundation Relations office (949-824-7455) before contacting the Kauffman Foundation, in order to coordinate with other UCI applications.



"I was close to a breakthrough when the grant money ran out,"

> **Computing Research Infrastructure** National Science Foundation 08-570 Proposals are due August 3, 2011. This opportunity supports the creation, enhancement and operation of world-class computing research infrastructure in two categories. Institutional Infrastructure awards support the creation of new computing infrastructure or the enhancement of existing infrastructure to enable topnotch research and education at the





Debut Demonstration

What do a cinematic opera performance and the scientific visualization of a Midwest tornado have in common? The answer: a super high-definition (SHD) 4K digital video projector. Attendees of the 2011 CENIC (Corporation for Education Network Initiatives in California) conference, held at UCI in March, saw a variety of 4K content when they visited the Calit2 Building auditorium. The first 4K technology demonstration at the Irvine campus was driven by collaboration with Calit2 at UC San Diego. The real-time transmission utilized CENIC's gigabit Internet Protocol (IP) optical-fiber network to link the two divisions, with the 4K content sent from San Diego to viewers in Irvine. 4K images have roughly 4,000 horizontal pixels – offering approximately four times the resolution of the most widely-used HD television format, and 24 times that of a standard broadcast TV signal.

I Will Follow You

Using the same technique employed by the creators of the hit movie "Avatar," Department of Dance graduate student Mark Tomasic and Calit2 faculty affiliate Jeff Russell used light-reflecting markers to learn more about dancers' movement patterns, joint angles and movement speed. Wheelchair dance pioneer Mary Verdi-Fletcher, founder and artistic director of the Dancing Wheels Dance Company and School in Cleveland, Ohio, and her wheelchair were outfitted with 22 reflective markers in Calit2's SHAPe lab. As she performed dance moves, six cameras with red and infrared capabilities followed her, tracking the reflections and building a computer-generated stick figure from the composite set of points. The research will be used to study and codify creative movement and artistic technique in dancers with and without disabilities (see page 14).



LEBITS and Bytes by Shellie Nazarenus

[Bits and Bytes]

Lessons on Licensing Technology

October marked the fifth consecutive year that Calit2 offered a seminar series for members of the Osher Lifelong Learning Institute (OLLI). Attendees learned about the institute's new technology business incubator, TechPortal, and during the course of the three-part series heard firsthand accounts from a few of the startup companies that Calit2 has enabled. In the first class, Alvin Viray (pictured) from UCI's Office of Technology Alliances explained the process of working with researchers to protect their intellectual property and, subsequently, how the university licenses the technology for commercial use.





The Innovative University

What's the "secret sauce" for making Calit2's multidisciplinary and private sector collaborations work? Nearly 30 faculty members from the Harvard Business School delved into a better understanding of the institute's key ingredients as part of a new HBS faculty immersion program to build the innovative university. Calit2 at UC San Diego was selected as the first host site for the program; researchers and staff from both divisions spent two days with the Harvard faculty in a series of interactive discussion groups and presentations. After following up with leadership at both campuses, HBS is producing a formal case study that documents the institute's novel approaches for creating transformative relationships.

Healthcare Optimization

The digital road to optimum health is being paved by a "harmonic convergence" of advances in biology, information sciences and communications, according to Dr. Drew Senyei, a Calit2 advisory board member and managing director of Enterprise Partners Venture Capital. Senyei shared his insights as a physician and highly successful medical entrepreneur with a Calit2 audience in February. "What we will need for the future of medicine is what Calit2 has - a multidisciplinary team. We need to focus that on the hard problems that are in healthcare today," he said. Achieving optimal health individually, and collectively, will require the implementation of emerging technologies. Senyei emphasized that the healthcare system must undergo a paradigm shift, moving from a reactive to proactive model. "I believe information technology is the underlying pillar by which we can get to this new system of P4 medicine," he said, referring to healthcare that is preventive, predictive, personalized and participatory.





Energy Empowerment

Nearly 200 people wanted to get smart about energy efficiency so they attended the semiannual Igniting Technology program in November at Calit2. Based on audience feedback, the program didn't disappoint, with six knowledgeable presenters approaching the topic of energy distribution and consumption from diverse fields of expertise. From the developing



nationwide smart grid down to technology tools for changing individual behavior, attendees learned about the latest in energy efficiency research, policy, building codes, incentives and feedback mechanisms.

In the Spirit of Collaboration

It turns out that Calit2's approach to multidisciplinary research collaborations is one shared by the U.S. Air Force's Office of Scientific Research. Thomas P. Russell, director of the office, spoke to an audience at Calit2 in February about its ambitious agenda to anticipate, plan and develop technologies that will be used 20 years or so from now. To succeed, he explained, the Air Force is seeking cross-disciplinary collaborative ideas. Three areas of basic research – aerospace, chemical and material sciences; physics and electronics; and mathematics, information and life sciences - have been identified as critical to the success of the Air Force of the future. "We're very disciplineoriented," he said. "We need researchers who will reach out to others in different disciplines." The Department of Defense had a research budget last year of just under \$2 billion, a figure that has increased by 40 percent over the past several years.





Multidisciplinary By Design

A new program for UCI undergraduates was launched this spring by Calit2 and the Undergraduate Research Opportunities Program. The Multidisciplinary Design Program (MDP) brings together students from various disciplines into design teams; the teams are co-mentored by at least two professors from different schools. The inaugural program consists of 17 design projects with 83 undergraduate participants who will have access to a specially designed MDP project lab on the second floor of the Calit2 Building. In March, back-to-back workshops were held for faculty mentors to meet and discuss program logistics, while the students' session included team-building and leadership exercises (pictured). The program is designed to help students develop the multidisciplinary skills and knowledge that will propel them into graduate studies or careers in fields that explore the connections between different concentrations.

[Bits and Bytes]



A Fitting Occasion

No tricks, just treats for Calit2 Building occupants who attended a morning mixer last Halloween. Faculty, researchers and students alike enjoyed getting to know their neighbors a little better over a light breakfast in the festively decorated seminar room. In addition to good conversation and food, everyone received an addition to his/her work wardrobe. The institute's staff used the occasion to distribute the newest Calit2 logo-embroidered shirts for researchers to wear when doing lab demonstrations for the building's frequent visitors.

A Research Showcase

All the time, and everywhere, there has been an explosion in real-time communication capabilities. For a decade, the Calit2-affiliated Center for Pervasive Communications and Computing (CPCC) has been researching emerging communication technologies that dramatically change the way people access and use information. In March, the center's faculty and students shared what they have been developing as part of a research showcase for Southern California companies. The audience learned many of the challenges and opportunities in the areas of circuit and hardware design, communications systems and networks. "CPCC conducts fundamental research in these areas with the goal of pushing the technological limits as far as possible," explained Hamid Jafarkhani, the center's director. The presentations were followed by a poster session and lab demonstrations.



Leadership Exploration

People, places and trends in Orange County was the theme for the Southern California Leadership Network's annual excursion in February. The network, which is a partnership with the Los Angeles Area Chamber of Commerce, picked three places to visit. Among the stops was Calit2, where this year's group of leadership fellows explored the trend towards heightened public university and industry partnerships.



Stuart Ross (pictured), the institute's research development assistant director, discussed the institute's efforts to foster commercialization and incubate startups. The presentation was augmented by a stop in the building's visualization lab to see several examples of industry partnerships. Calit2@UCI is a multidisciplinary research institute that develops information technologybased innovations. By integrating academic research with industry experience, the institute seeks to benefit society, incubate new technology companies and ignite economic development. Calit2 focuses on the digital transformation of healthcare, energy, the environment and culture. University of California, Irvine California Institute for Telecommunications and Information Technology 4100 Calit2 Building Irvine, CA 92697-2800 NONPROFIT ORG. U.S. POSTAGE PAID Santa Ana, CA Permit No. 1106

Calit2

Telematic

University of California faculty are at the cutting edge of "telematic" performance, a term used to describe real-time, collaborative, networked concerts taking place in multiple locations. Michael Dessen, UCI assistant professor and slide trombonist, and UCSD professor Mark Dresser, a bassist, have produced several concerts using software that can transmit CD-quality sound with extremely low latency, allowing them to perform rhythmically complex and sonically rich music in tight synchrony. The duo's telematic performance during Calit2's 10th anniversary celebration, which took place via the institute's high-bandwidth OptIPuter network, drew on their shared history of exploration in jazz and contemporary music.

For more anniversary photos, see pages 16 – 19.