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California Institute
for Telecommunications
and Information Technology
CALIT2

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University of California, Irvine

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CALIT2 Celebrates

YEARS

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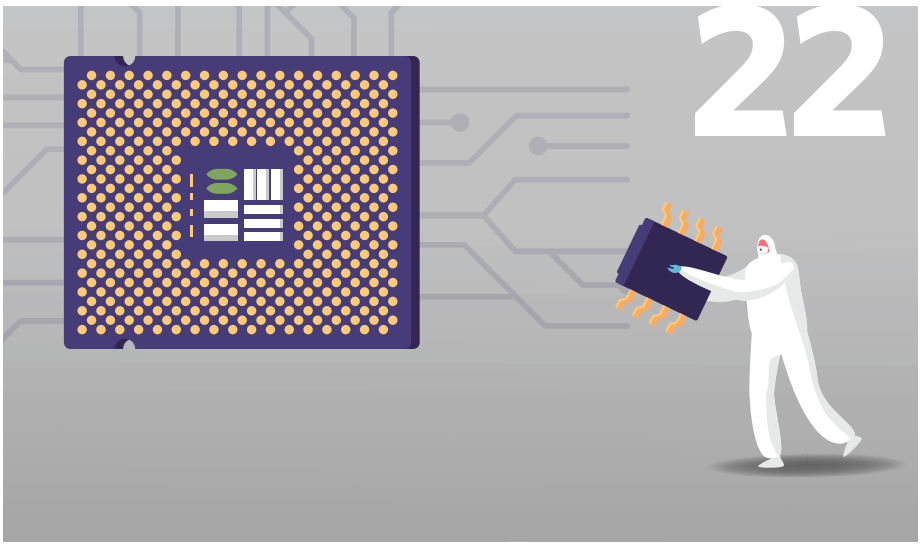

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TWENTY YEARS OF MULTIDISCIPLINARY ACHIEVEMENT

Shelly Nazarenus

INSTITUTE REFLECTS ON ITS PAST AND PREPARES FOR THE FUTURE

Created in 2000, the California Institute for Telecommunications and Information Technology – known as CALIT2 – has pursued world-class multidisciplinary research to promote discovery and innovation. Its initial mission was to harness the ubiquity and scale of the internet and wireless technologies to accelerate growth in multiple scientific areas and industries that were undergoing a massive transformation. Over two decades, CALIT2 has focused on transdisciplinary collaborations of significant scale and complexity, while creating advanced scientific facilities and living laboratories to support the nearly 250 UC Irvine faculty who have affiliated with the institute in pursuit of this goal.

ON A MISSION

Four key words define CALIT2's mission: innovate, integrate, incubate, ignite. Under the direction of Professor G.P. Li, the institute innovates novel solutions in a multidisciplinary research environment, integrates a wide range of academic expertise with industry experience, incubates technology startups and ignites economic development.

In 2010, at the end of CALIT2's first 10 years, the institute embarked on a quest to identify focus areas on which to base future investments. Four application areas emerged: health, culture, energy and the environment. The institute set to work on the digital transformation of these areas by developing technological and institutional innovations using its unique laboratories, technical staff and research spaces. These capabilities facilitate the formation of cross-disciplinary teams of internal and external partners who successfully compete for funding and produce impactful accomplishments that have broad societal applications.

"CALIT2 takes ideas beyond theory into practice, accelerating innovation by lowering the barriers to it," explains Li, who became the institute's director in 2007. "While the university traditionally has focused on education and research, CALIT2 extends that focus to include development and deployment of a proof-of-concept and prototype infrastructure for testing new solutions in a real-world context."

The institute represents an experiment in inventing the university research environment of the future by:

- Building horizontal links among departments to foster multidisciplinary collaboration
- Creating research themes that align faculty interests with challenges of interest to society
- Supporting faculty, students, industry, government and community partners
- Enabling prototyping in CALIT2 advanced scientific facilities
- Serving as a living laboratory for innovative solutions
- Providing a bridge between academia and industry via its technology incubator, TechPortal

CALIT2's research topics and projects reflect the evolution of technology. From Internet of People to today's Internet of Things and tomorrow's Internet of Service and Value (which will provide users with actionable intelligence via data analytics), CALIT2 – along with the emerging technologies

"CALIT2 takes ideas beyond theory into practice, accelerating innovation by lowering the barriers to it."

that support this disruption – has been at the forefront. As an institute specializing in telecommunications, CALIT2 began using social communications platforms to research and improve the relay of information from person to person. Soon after, sensors and actuators became increasingly important in the establishment of the cyberphysical systems that led to today's IoT. And the institute is working to optimize the explosive growth of data from people and things for tomorrow's Internet of Service and Value. This creates the Internet of Everything, where data and processes generated from people, things and the environment create improved outcomes for society.

IN THE FUTURE

The future is closer than we think, and CALIT2 is leading the way through convergence of research into human health, sustainable energy, environmental sciences and the cultural systems that bind us together. Two drivers unite these four research pillars: the high-performance computing/intelligent sensing nexus that is at the heart of the data revolution and increased understanding of complex system dynamics, providing the context through which accurate data models can be engineered and deployed.

Statistical learning methods once confined to the quiet corners of academia and national research labs have now burst more widely onto the scene. Deep learning, machine learning, artificial intelligence, Bayesian belief nets and support vector machines now support applications ranging from robotic surgery to autonomous mobility to personalized music streaming – all of it built on a foundation of data.

CALIT2 is well positioned to lead the campus into this data-rich future – from the building's ground floor lab, which is developing new materials for personal energy harvesting, to the fourth-floor Data Engineering ThinkTank, where UCI and industry collaborate on state-of-the-art machine-learning technology to create edge-computing methods for optimizing advanced manufacturing. Future projects include multiple collaborations: with banks, to utilize machine learning that can efficiently assess portfolio risks; with manufacturing industries, to create systems that adaptively learn emerging constraints to process human workflows; with global supply chain managers, to optimize the transport of perishable goods; and with Earth scientists, to better model the complex dynamics of the threatened ecosystems upon which we depend.

To implement its next ten-year vision, CALIT2 is working closely with UCI's Research Cyberinfrastructure Center and leveraging NSF resources from the Qualcomm Institute at UC San Diego. The Data Engineering ThinkTank, which provides an interactive window into state-of-the-art computing and storage resources, will offer a new shared facility for faculty and students to conduct digitally enabled scientific research. CALIT2 believes this effort will transform UCI into a leader in cyber-engineering and the development of edge-computed Internet of Everything technology for data refinement.

"For 20 years, CALIT2 has successfully demonstrated its ability to establish and manage shared-use facilities and scientific instrumentation for UCI researchers," Li says. "In the years to come, CALIT2 will build a next-generation, shared cyberinfrastructure, enabling comprehensive research in the Age of Data."

MILESTONES

December 2000

California governor's office launches four visionary Institutes for Science and Innovation, including CALIT2. The institutes share a vital mission: to address large-scale societal problems through interdisciplinary research and new market applications.

October 2003

CALIT2 researchers receive a five-year, $12.5 million National Science Foundation-funded project called ResCUE – Responding to Crises and Unexpected Events. The project encompasses five university partners as well as ImageCat, a Southern California disaster management company.

November 2004

UCI celebrates the opening of the CALIT2 Building with a ribbon-cutting ceremony and distinguished roster of speakers, including UC President Robert Dynes and retired Rockwell CEO Donald Beall.

June 2005

CALIT2 begins its annual Summer Undergraduate Research Fellowship in Information Technology (SURF-IT) program, with funding support from Emulex. Thirteen UCI students participate.

November 2005

One year after the building opens, the inaugural issue of CALIT2's award-winning Interface magazine debuts.

April 2006

Igniting Technology premieres, showcasing CALIT2's novel multidisciplinary research and technology-transfer efforts. The panel presentation becomes the institute's signature semiannual event with ongoing support from intellectual property law firm Knobbe Martens, LLP.

July 2007

The Bio-Organic Nanotechnology clean room facility at CALIT2 opens adjacent to the INRF clean rooms. BiON is dedicated to research and development of micro-nano devices using biological and organic materials.

August 2007

CALIT2's research efforts grab national media attention. CNN's "American Morning" features reporter Christopher Lawrence in a live news feed from HIPerWall, at the time one of the world's highest-resolution display walls.

April 2008

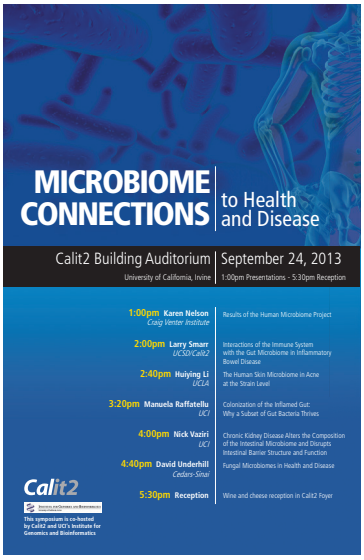
Work begins on a number of eHealth projects, including telemedicine, mobile operating systems and wireless solutions such as wearable devices. During an annual institute visit, Chancellor Michael Drake is particularly interested in the XSense technology embedded into a baseball cap.

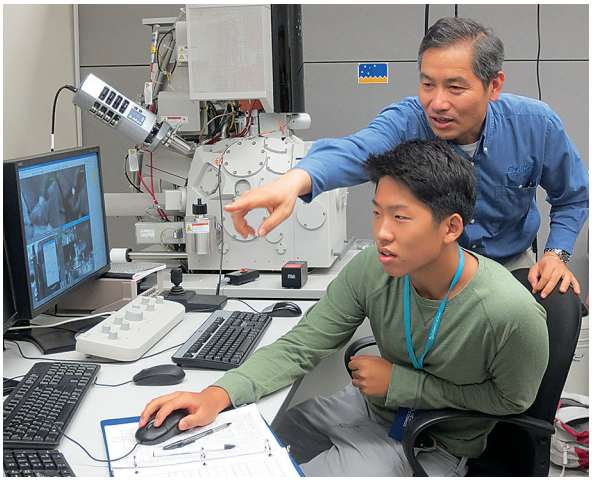
June 2010

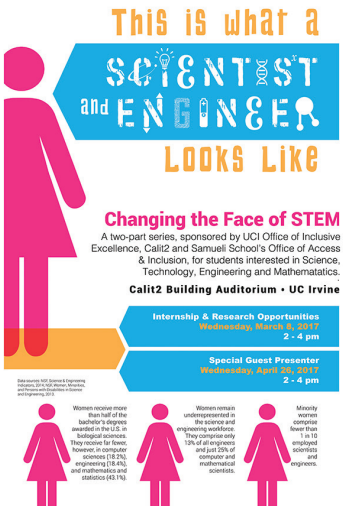
Bi-Maple becomes the first tenant in the newly launched TechPortal, a pre-incubator space in the CALIT2 Building for fledgling businesses to translate their research and development success into commercially viable products.

December 2010

CALIT2 celebrates its 10th anniversary with participants







at UCI and UCSD united by a real-time, high-definition internet connection, making it a virtual two-campus, one-institute celebration. The institute's Path Forward research plan for the next decade is unveiled.

September 2011

The California Plug Load Research Center (CalPlug) is established at CALIT2. The California Energy Commission awards the center a $1 million research grant to support development of energy-efficient solutions for pluggable devices.

April 2012

The Laboratory for Electron and X-ray Instrumentation is established as the campuswide materials characterization user facility. In 2019, LEXI becomes one of the facilities that comprises the Irvine Materials Research Institute.

September 2013

CALIT2 hosts the first annual Microbiome Connections symposium, featuring various perspectives of research in a relatively new field of study. Over time, the symposium grows into a UCI-led national microbiome initiative.

November 2014

The outreach program "This Is What a Scientist and Engineer Looks Like" debuts for women and underrepresented minority students interested in STEM careers.

January 2015

CALIT2's innovative Multidisciplinary Design Program (MDP) kicks off, engaging UCI students from a wide range of

disciplines in project design teams co-mentored by at least two faculty from different schools.

February 2015

Thanks to a gift from the Kay Family Foundation, FABWorks, a student maker space, opens for business on the second floor of the CALIT2 Building.

November 2015

Backed by a generous donation from an Orange County technology leader, the Microsemi Innovation Lab, known as the smart-technology maker space, is established at CALIT2.

June 2016

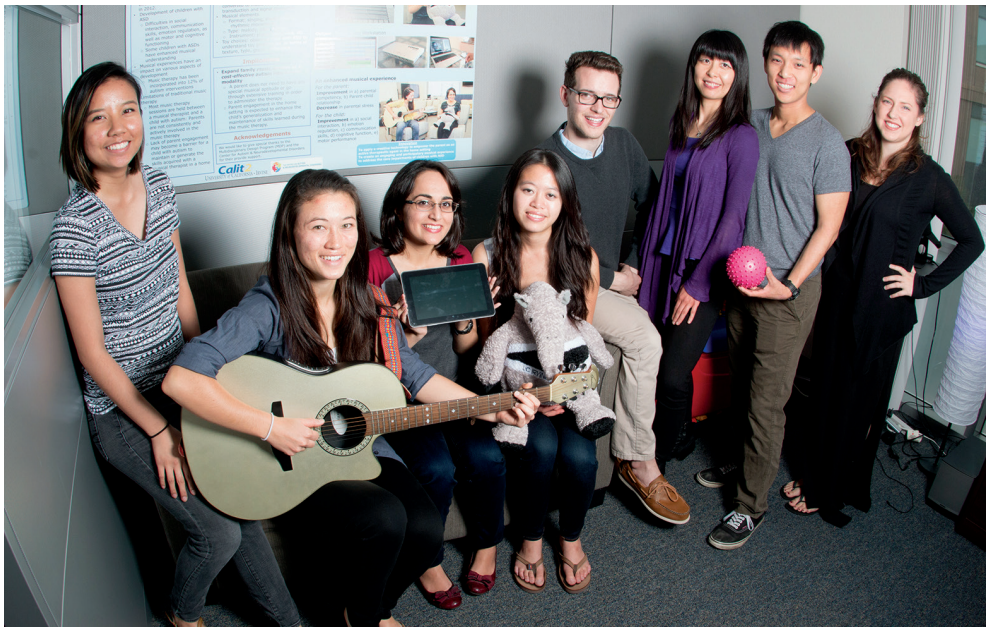
The U.S. Department of Energy establishes the Clean Energy Smart Manufacturing Innovation Institute, and CALIT2 becomes the CESMII Southern California Regional Demonstration Center, with a focus on the Smart Connected Worker project.

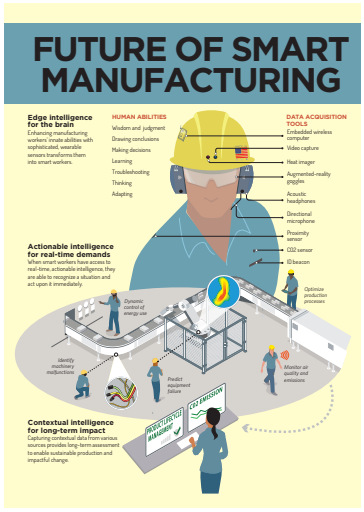
August 2016

The inaugural CALIT2@UCI Engineering Graduate Fellowship Program, sponsored by Broadcom Foundation, accepts research proposals for fellowship consideration. In the spring of 2017, the first-year fellows present their work with awards going to the best projects.

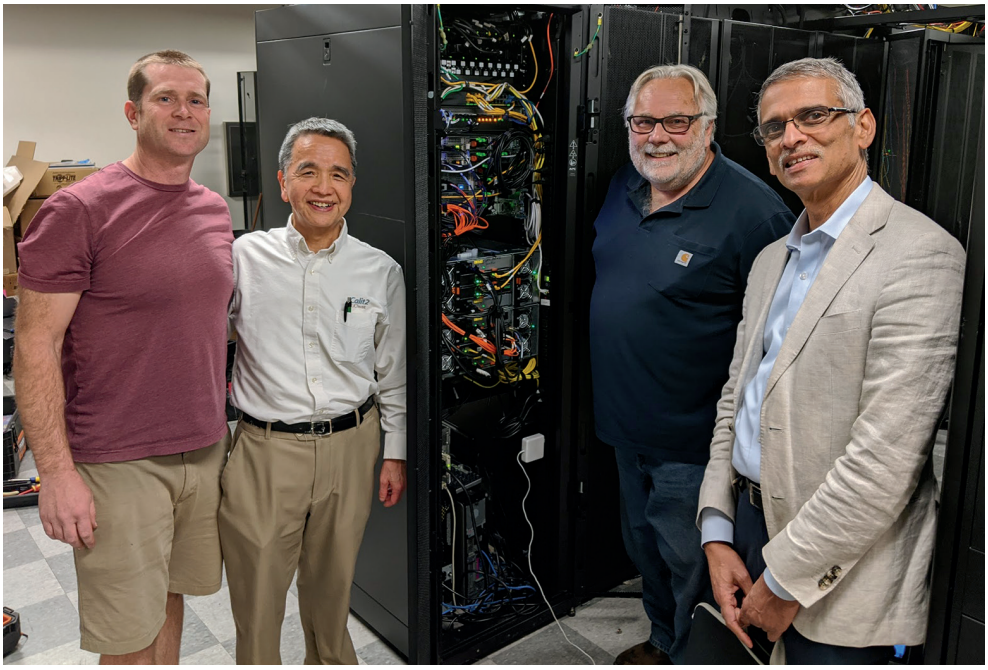
October 2016

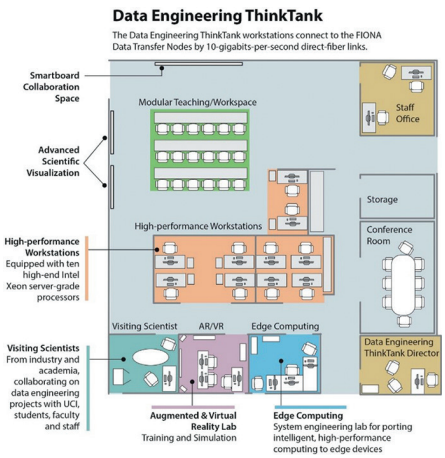
CALIT2 partners with the Irvine Health Foundation to provide an online healthy aging resource, Iris O.C., focused on empowering seniors through beneficial aging





Iris O.C.
Locally Growing Healthy Lives





activities.

September 2017

The Ninth International Conference on Energy Efficiency in Domestic Appliances and Lighting, EEDAL17, is hosted by CALIT2 at UCI. It is the first time the conference was held in the United States.

August 2018

After years of planning, an HPWREN router is installed in the CALIT2 Building. HPWREN is a high-bandwidth, wireless, internet-connected sensor and communication network that supports applications in research, education and public safety. In 2019, it is upgraded with a new server and storage complex, making CALIT2 a repository for all of the county's HPWREN sensor and image data – and a rich resource for UCI researchers.

June 2019

On the building's fourth floor, CALIT2 opens the Data Engineering ThinkTank, which serves as a portal to the NSF-funded Pacific Research Platform.

November 2020

CALIT2, as a managing partner, joins the national Cybersecurity Manufacturing Innovation Institute (CyManII) effort to improve cybersecurity and energy efficiency for American manufacturing.

Reflections from the Founding Director

Larry Smarr
Distinguished Professor Emeritus, Department of Computer Science and Engineering, UC San Diego

Photo: Erik Jepsen, UCSD

For 20 years, CALIT2 has been part of a historic experiment within the University of California on re-envisioning the land grant university for the 21st century. Under the leadership of then-UC President Dick Atkinson and California Governor Gray Davis, CALIT2 was chosen as one of the California Institutes for Science and Innovation on Dec. 7, 2000. The chancellors of UCSD (Bob Dynes) and UCI (Ralph Cicerone) were the principal investigators on the CALIT2 proposal to search out expanded collaborations across the two UC campuses, and explore how these innovations could involve and benefit the private sector and communities that support the universities. The state funds allowed for the design and construction of award-winning buildings on both campuses, creating unprecedented university hubs for multidepartmental collaboration and shared state-of-the-art research facilities for photonic systems, nanoengineering, microscopy, robotics, visualization/virtual reality and prototyping.

It has been my honor to work closely with the two CALIT2 division directors, Professors Ramesh Rao (UCSD) and G.P. Li (UCI), since the beginning. Our notion of administration was local campus autonomy, while seeking collaborative opportunities between the two campuses. This decentralized approach has been quite productive, enabling CALIT2 to interact with hundreds of faculty and thousands of students from almost all the UCSD and UCI schools and departments. As a result, CALIT2 has helped win hundreds of millions of dollars in federal and foundation grants, most with multidepartmental or multi-institutional PIs and co-PIs. Most rewarding to me has been seeing projects arise that integrate talented investigators from the arts, humanities and social sciences with those from the physical and biomedical sciences and engineering.

Since its formation, CALIT2 has had a focus on systems integration of the deep specialties of individual faculty to create transdisciplinary collaborations of significant scale and complexity. Our goal was to create living laboratories of the future, to envision the early transformational impacts of advances in information technology and telecommunications on real-world problems ranging from intelligent transportation, environmental monitoring, sustainable energy, disaster response, personalized medicine and healthcare to cultural systems. In many cases, we created digital twins of aspects of our world, so as to optimize the explosive growth of data from people and objects. In a way, one can think of CALIT2 acting as an academic amoeba, reaching out its pseudopods to pull together a wide diversity of researchers into an everchanging pattern of growth.

This approach created research themes that aligned faculty interests with challenges of interest to society. To better transfer these innovations to real life, CALIT2 sought to deeply involve a broad range of private sector companies on campus, so that the university innovations could be scaled to the needs of society. This has involved collaborations with hundreds of companies, as well as incubating dozens of startups in our two buildings. In addition, CALIT2 has reached out into the Southern California communities to partner with first responders, healthcare providers, educational institutions and environmental groups. These two decades of engagement with such a diverse set of academic, student, industry, government and community partners have laid a strong foundation for CALIT2 to be an ongoing critical catalytic caldron for inventing novel disruptive solutions to the increasing challenges of the coming decades.

An early industry funder of the institute, Broadcom Co-Founder and Chairman Henry Samueli reflects on the role of CALIT2:

"The California Institute for Telecommunications and Information Technology plays a very important role in the state's innovation economy. Companies like Broadcom depend on that innovation to produce the new technologies and the talent pipeline that we need in the future. As industry has become increasingly competitive on a global scale, companies tend to focus their R&D resources on near-term product development that can be brought to market within a few years. We have come to rely on universities for the longer-term, five- to ten-year horizon research projects, and that is exactly where the sweet spot is for CALIT2. The institute's collaborative, multidisciplinary nature is so important for addressing the engineering grand challenges that we face. In particular, the information technology sector has become deeply embedded in virtually everything we do in our hyperconnected world. This confluence of IT with nearly every sector of society makes having CALIT2 right here at UC Irvine that much more vital to boosting our local economy by stimulating startups and creating the highly skilled talent pool to fill these exciting and well-paying jobs."

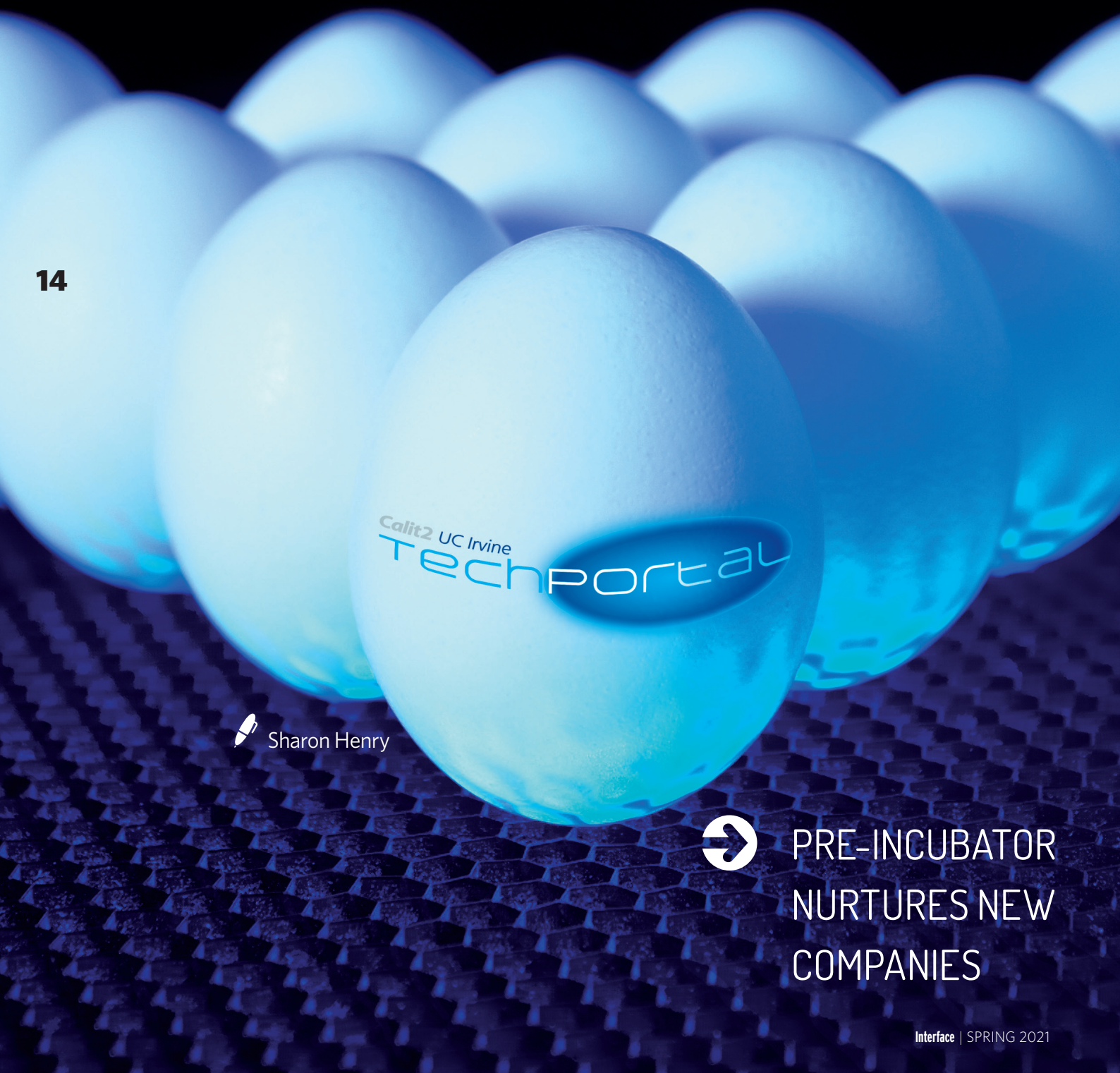
Former UCI Samueli School of Engineering Dean Nicolaos Alexopoulos played a significant role in the creation of CALIT2 and has been a long-time champion of the institute:

"There are four California Institutes for Science and Innovation and in my opinion, the most successful one is CALIT2. There is a fundamental reason – the leadership is great, yes – but the more fundamental reason is because it is based on engineering science, which helps us form all of that knowledge to develop useful products and things that make the economy run and improve the quality of human life. From the simplest, most trivial thing you use every day to the most complex, it is engineering science. That is what has made CALIT2 so successful with a clear focus on producing outcomes that help the marketplace and society. CALIT2 believes it has a responsibility to give back and wants its research to impact and empower California communities."

Retired Microsemi CEO and UCI advocate Jimmy Peterson has been a strong supporter of CALIT2, providing the funding and equipment for the building's Microsemi Innovation Lab:

"Building successful industry and community partnerships, such as OCTANe, is a testament to the tenacity of CALIT2. UCI wants to honor and thank industry leaders, but the fact is, industry should be thanking UCI and what they've done for us. What we've been working on together and talking about, is how we can innovate and move forward together. UCI has the ideas to solve problems. The hands-on project experiences that students get at CALIT2 are producing the next generation of talent who are going to look at challenges a little differently, and break the mold. By working together, we can take an already successful institution to the next level to impact more lives around the world."

STARTUP SUCCESS



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Sharon Henry

PRE-INCUBATOR NURTURES NEW COMPANIES

The four California Institutes for Science and Innovation – spread across the University of California campuses – were created in 2000 by then-Governor Gray Davis, specifically to spur innovation in the Golden State and accelerate technology transfer. In 2010, CALIT2 at UC Irvine launched TechPortal to fulfill the CISI mission by accelerating the transfer of academic research and ideas into the marketplace and stimulating the California economy.

Considered a pre-incubator, TechPortal houses and assists young startups still in the process of formulating business plans, developing prototypes, establishing an entrepreneurial team, soliciting investments and preparing for market readiness. TechPortal has been home to 20 startups, many of which have gained strong footholds in their respective markets. Here's a brief look at five former incubator tenants that have made the transition from startup to thriving company.

Hiperwall, Inc.

Founded 2008

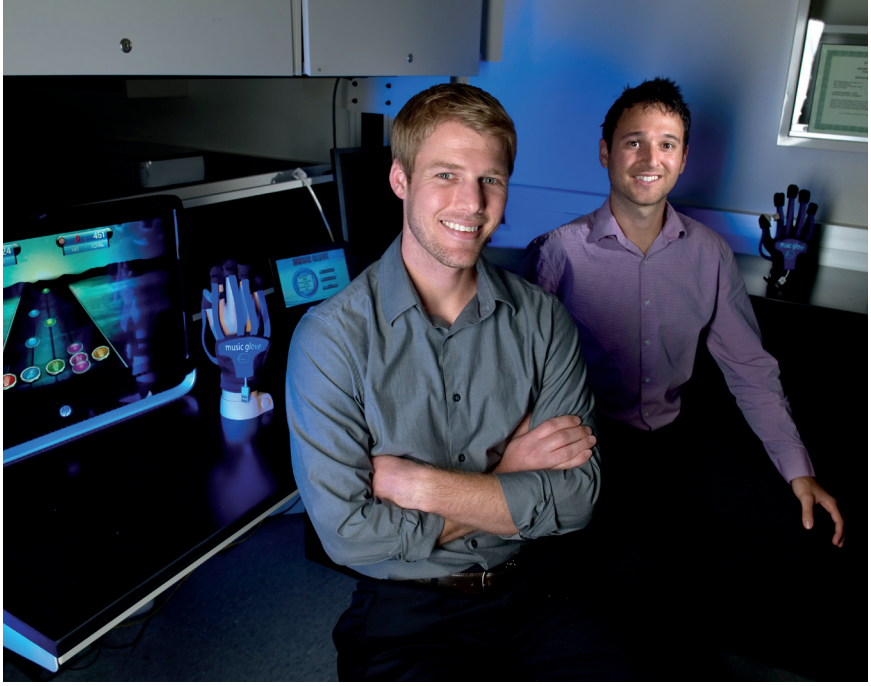
Hiperwall, Inc. produces a software system that converts standard computer monitors into ultrahigh-resolution video display walls with nothing more than commonly available PCs, monitors and network equipment.

Hiperwall began as a research project funded by the National Science Foundation at UCI in 2004. The goal was to build the world's highest resolution tiled video display wall. It was designed to enable scientific visualization on an unprecedented scale and showed imagery and data sets that measured hundreds of millions of pixels and gigabytes of data.

The company's co-founder and chief technology officer, Sung-Jin Kim, developed early versions of software for Hiperwall (originally named HIPerWall for Highly Interactive Parallelized display Wall) as part of his graduate work at UCI. Upon completing his doctorate, he joined CALIT2 as a postdoctoral researcher and continued his research on distributed visualization and improved the software.

Stephen Jenks, a UCI professor at the time, and Kim launched the startup in CALIT2's Visualization Lab. The researchers co-founded Hiperwall, Inc. to commercialize the tiled display technology into a cost-effective software solution that uses commodity computing and display components.

With more than 3,000 installations in 71 countries, Hiperwall, Inc. has grown into a leading company in video wall software and distributed visualization technology.



Flint Rehab

Founded 2011

UCI engineering alumni Nizan Friedman and Danny Zondervan founded Flint Rehab. They were doctoral students when they designed, created and tested their first product, the MusicGlove, in CALIT2's eHealth Collaboratory.

The MusicGlove infuses hand therapy with the engaging element of music. A next-generation rehab device, it helps stroke patients with hand paralysis regain function and can be used at home or in a clinic to augment traditional physical therapy. Its commercial success inspired Friedman and Zondervan to develop new products based on the MusicGlove model. They wanted to take "the essence of why people enjoy the MusicGlove – the connection between music, the brain and the addictive qualities of game playing – and distill that, then convert it into a way that can be used on other parts of the body," Friedman said.

That determination led to their next offerings and their growth. Flint hired fellow UCI biomedical engineering alumnus Justin Rowe to serve as lead engineer on new products. In 2018, Flint Rehab received $1.72 million in grants for further development of its stroke rehab technology, and in 2019, they began selling their CT Speech and Cognitive Therapy App. The app contains more than 100,000 exercises to help improve speech, language and critical thinking skills to help retrain the brain.

Today, Flint Rehab has more than $8 million in funds, employs 15 people and has sold more than 10,000 rehabilitation devices.

Biopico Systems

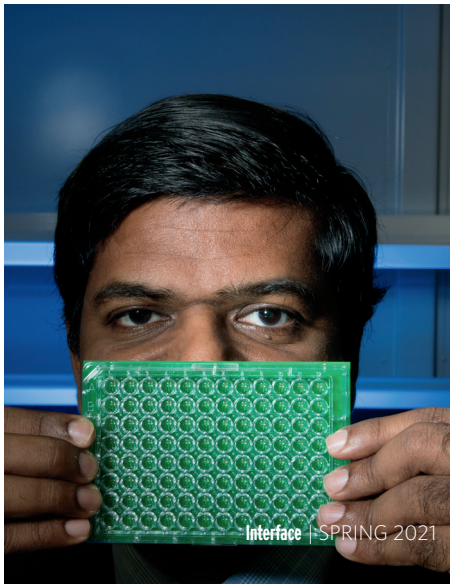
Founded 2011

Biopico Systems is based on technology conceived in the early 2000s when company founder John Collins was a UCI postdoctoral researcher. Collins and his staff tapped the pumping and mixing capabilities of biofluidics to engineer a tiny chip that can process millions of separate biochemical reactions simultaneously.

The company moved into TechPortal in 2013 and began developing therapeutics and diagnostics tools for cells, organoids and organs. Using Biopico's "closed" cell culture, therapeutic scientists can improve their process efficiency for long-term multistep tissue culture under current good manufacturing practice regulations enforced by the FDA. Biopico is also developing organ-on-a-chip technologies with electrophysiological monitoring for multiple applications.

In October 2020, Biopico Systems received a two-year, Phase II Small Business Innovation Research grant for $800,000 from the National Institutes of General Medicine Sciences for development of their closed automated system for stem cell culture. Biopico's fluidic system automates the cell culture process for cellular therapies, like stem cell, and develops a protocol for therapeutic cellular manufacturing.

Since its inception, Biopico Systems has been awarded $3.3 million in federal grants and $296,500 in federal contracts.



Xidas

Founded 2015

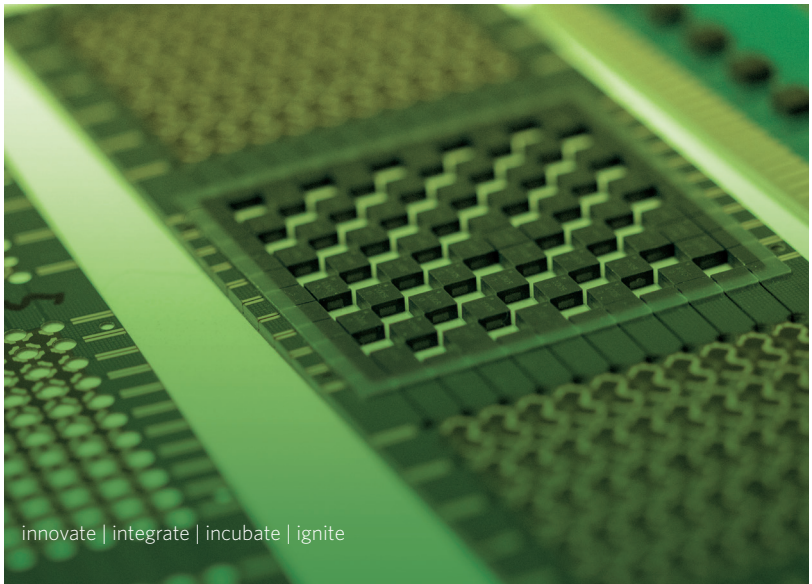
Xidas (formerly Integra Devices Inc.) is a technology company that produces the next-generation of micro-scale solutions. Through a powerful miniaturization platform, called AmalgaTM, Xidas has surpassed the limitations of current micro-engineering and manufacturing, allowing the production of microdevices for industrial, IoT and medical applications that were once impossible.

Leveraging more than $20 million of funding from government and commercial grants, co-founder Mark Bachman, a former UCI engineering assistant professor, led the research effort to develop a new form of micro-manufacturing. With the Amalga technique, the company can demonstrate dozens of different types of highly functional, complex, 3D microdevices that cannot be produced by semiconductor-style processing, or precision manufacturing alone.

In 2015, the company became a CALIT2 TechPortal tenant and began to commercialize the technology.

Products range from vibration-based perpetual batteries, in-canal hearing devices, in-body medical sensors and microfluidic sensors. Their flagship product is the world's first miniaturized microwave micro-relay that can hot-switch power.

In May 2019, Xidas completed a $6 million series-A syndicated investment round led by Los Angeles-based venture capital firm Kairos Ventures. The company was also awarded a National Science Foundation Small Business Innovation Research Phase II grant for $750,000 to develop and commercialize miniature energy harvesting systems.



Summit Technology Laboratory

Founded 2016

Two UCI computer science professors, Aditi Majumder and Gopi Meenakshisundaram, started Summit Technology Laboratory. The company offers software to create engaging environments by delivering interactive, multiuser experiences on surfaces of any size, shape and scale.

In 2017, Majumder received a $225,000 National Science Foundation Phase I Small Business Innovation Research (SBIR) grant, which served as the company's main funding source. Summit's current technical team includes UCI alumni Duy-Quoc Lai and Alexander Sidenko.

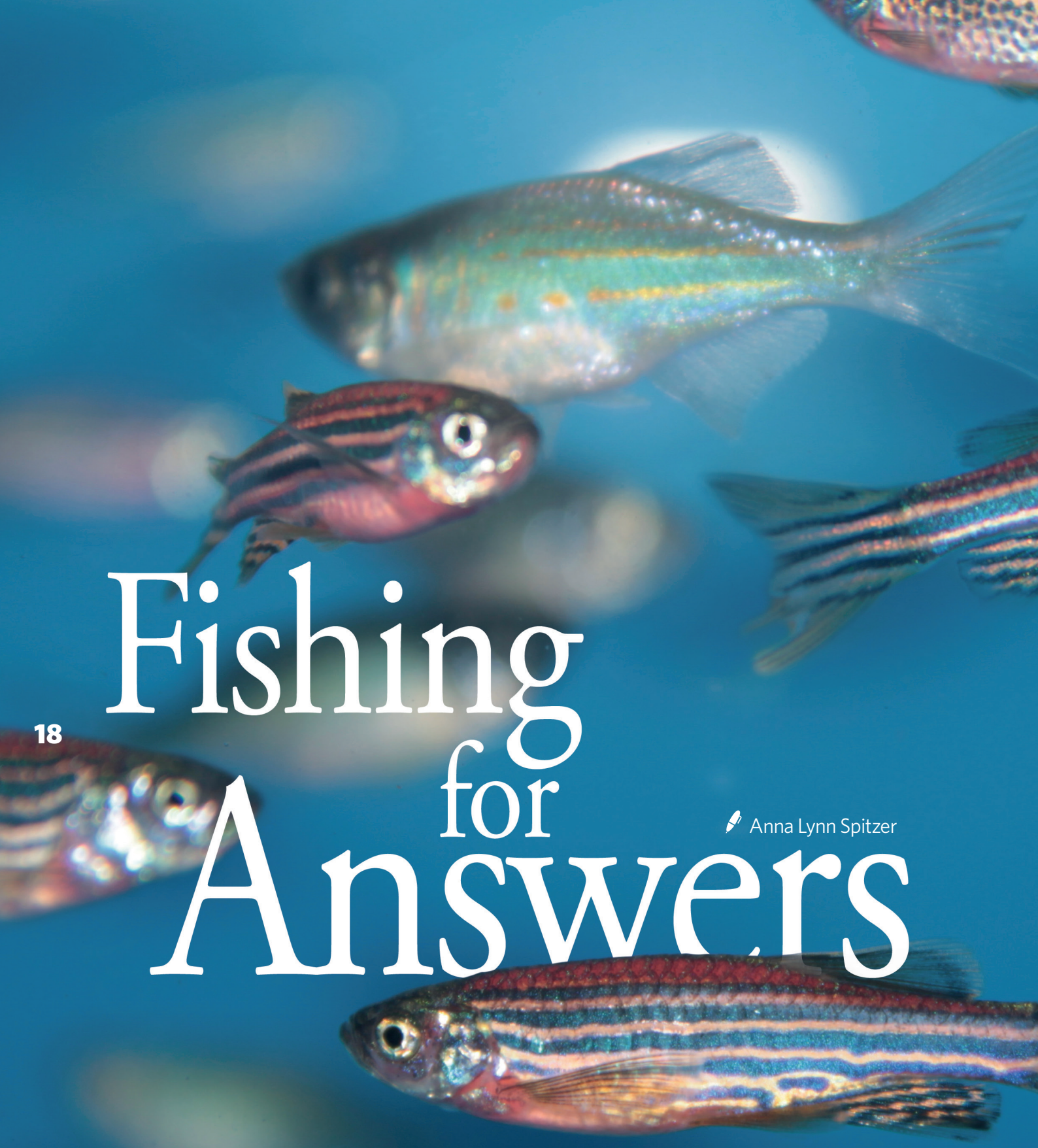
Majumder's visualization lab at CALIT2 is a state-of-the-art research facility focused on novel display technologies, computational cameras and projectors, and projection-based augmented reality. Her lab's researchers patented the projection aggregation and integration software (PRAIS) that provides seamless imagery that can cover any complex surface, creating a unique visual experience for the user. The technology transforms 3D objects or spaces of any shape and size, from cups and vases to cylinders, domes and rooms, into magical aesthetic spaces for shareable and immersive experiences for multiple users. When combined with projectors, the technology turns any 3D shape into a display.

Summit's offerings have been successfully deployed commercially. More than 50,000 customers have experienced Summit's interactive display capabilities in large-room, interactive, multiuser environments.

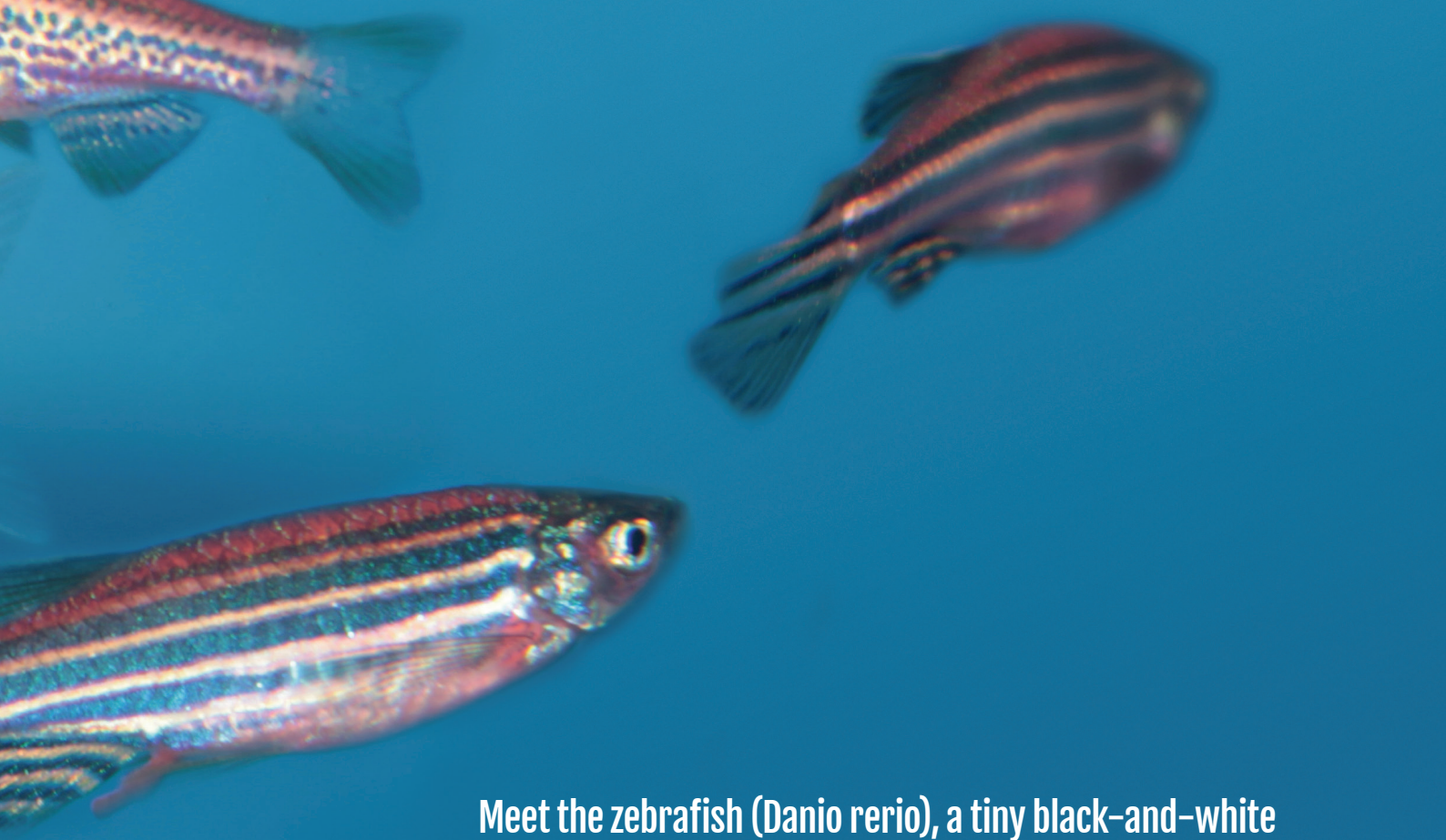
In June 2020, Summit Technology Laboratory was awarded $1.875 million in Phase II SBIR funding.

Fishing for Answers

Anna Lynn Spitzer



STARTUP COMPANY STUDIES A MEMBER OF THE MINNOW FAMILY TO FIND HEALTHCARE SOLUTIONS



Meet the zebrafish (Danio rerio), a tiny black-and-white striped member of the minnow family. Typically less than 2 inches long, zebrafish produce hundreds of offspring that completely mature from embryo to adult in less than three months. They're inexpensive and optically transparent during development, meaning researchers can see through the embryos to study organ formation.

Zebrafish also bear a striking genetic resemblance to humans, sharing more than 70% of our genetic code. These traits have elevated the status of the teeny swimmers in biological and physiological research over the last decade or so, and they are currently playing a key role at startup Sensoriis, Inc., CALIT2 TechPortal's newest tenant. The company, which seeks to create and market digital health and telehealth products for clinical and personal use, is conducting electrophysiological assessments of zebrafish to help it develop sensor-based solutions for humans. Its intricate sensing system allows Sensoriis to monitor the fishes' physiological signals to gain a better understanding of human cardiac and neurological disease, assist in drug development and screening, and develop a host of consumer products.

Sensoriis' chief technology officer is Hung Cao, UC Irvine assistant professor of electrical engineering and computer science, who co-founded the company with Dr. Michael Lau, a board-certified OB-GYN who serves as CEO. Cao and Lau, both of whom have sensor expertise, met at the University of Washington several years ago, when Cao was on the faculty there and Lau, who was running a medical device company called Mirabilis, served on the school's STEM advisory board.

At the time, Cao was working on a fetal electrocardiogram measurement sensor, which attracted Lau's attention. "We decided to form a company and immediately came up with several patentable ideas, one of which recently was granted a U.S. patent," says Lau, who also has an MBA.

Sensoriis, whose name is from the Latin for sensors, incorporated in 2016. It employs four full-time staff, including an engineering director, an electrical engineer and a senior scientist, as well as several part-time lab and business employees. The company, which moved into TechPortal earlier this year, is in the process of additional hiring.

Above: The company is leveraging powerful zebrafish genetics to develop new healthcare products and drug-screening protocols

Opposite page: Sensoriis' system can record electrophysiological signals from four zebrafish simultaneously for over an hour.

Among its ongoing projects are the fetal electrocardiogram patch, which will connect to a smartwatch or mobile phone and uses patented technology to help pregnant women monitor their babies' heartbeats, and a closed-loop pH measurement sensor for laboratory applications. But the fledgling company's primary focus is its zebrafish research, along with a wireless cloud-based technology it developed to analyze the massive amounts of resulting data.

The work is revolutionary. Although zebrafish have served as stand-ins for human physiological systems for years, previous zebrafish screening was limited to one fish taken out of water and deeply anesthetized – resulting in possible variations in functionality – before sensors were attached. The fish died quickly, and it was impossible to monitor several fish simultaneously, let alone in their natural habitat.

Additionally, all data processing and analysis had to be conducted manually, precluding large-scale studies. But Sensoriis, funded by Phase I and II Small Business Innovation Research grants from the National Institutes of Health, is developing two important technologies: a new way to obtain electrocardiogram (ECG) and electroencephalogram (EEG) data from multiple fish and larvae in water, and a cloud-based system that can process, interpret and study the resulting large-scale data.

Sensoriis utilizes a perfusion system that provides low concentrations of anesthesia to the fish as they swim. Because the fish are only mildly sedated, measurements can continue for over an hour. Currently, four fish can be monitored simultaneously, and Cao hopes to increase that number to eight or even 16. "We want more fish to be tested, but we also want reliable data," he says. "We haven't found our sweet spot yet."

The company's cloud-based analytics platform, dubbed the Sensoriis Mobile Data Management System, sends signals from the sensors through cellphones to the cloud, where advanced analysis occurs. "We like cellphones because everybody has them," Lau says. "We don't have to go through a fancy computer."

Data analysis includes machine learning and transfer learning, a process that enables the data to be translated to understand other organisms. "We can transfer our findings between species to analyze things we didn't know before. It is a powerful tool, marrying

sensors that are very, very sensitive with a telemedicine system and cloud analytics," says Lau.

The company uses the data to design cardiologic and neurological studies, as well as new drug screening protocols. "Drug development is so expensive, even in small animals like mice or rabbits," Lau says. In fact, the average cost to develop a new drug is currently $1.3 billion, according to the Journal of the American Medical Association.

It is easy and comparatively inexpensive to study the effects of drugs, not only on the development of zebrafish embryos but on future generations as well. "With humans, you have to wait 20 years to examine future generations, but with zebrafish, you can see it in three months," says Lau.

Specifically, Sensoriis is investigating the effects of drugs on cardiomyopathy – heart muscle degeneration – and arrhythmia. "Heart disease plagues the world as the leading cause of mortality," Cao says. "Cardiac arrhythmia alone contributes about 350,000 deaths annually in the U.S."

Because the sensors are also capable of measuring zebrafish brain signals though EEG, the company plans in the future to investigate the long-term effects of drugs on neurological conditions like epilepsy. "We can detect a really minute ECG or EEG signal from a fish," Lau says. "And our mobile data management system allows us to do all kinds of analytics."

Most of Sensoriis' fish come from collaborator and customer Xiaolei Xu, who directs the Zebrafish Genetics Laboratory at the Mayo Clinic. Xu is generating embryonic and adult zebrafish models with modified genomes to study human cardiovascular diseases, including heart failure, cardiomyopathy and arrhythmia.

He and his researchers need reliable technologies that can measure phenotypes in these tiny, genetically modified fish. So Xu tests new products developed by Sensoriis, and provides feedback and suggestions. "Our collaboration is a perfect combination of two labs with complementary expertise," says Xu, who is pursuing joint funding with Cao's lab. "One of us has expertise in genetics and disease modeling, and the other in bioengineering and machine learning."

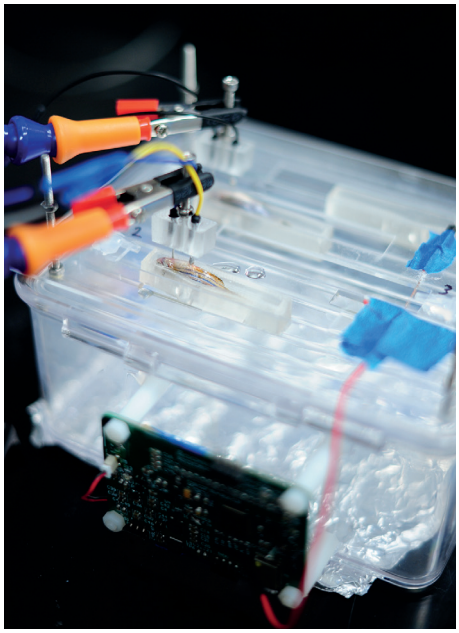
He adds that the collaboration is "a perfect example of current biomedical research – teamwork is critical for making new discoveries. Our goal is to develop new methods that enable us to fully leverage powerful zebrafish genetics to discover novel mechanisms and therapies for human cardiovascular diseases."

Sensoriis has an ambitious timeline: over the next five years, it hopes to have a wide range of products ready to market to a long list of customers, including laboratories, drug companies, consumers, physicians and large telehealth and wearables companies.

The fetal heart rate monitor that Cao began developing in Washington recently won an $80,000 POP (Proof of Product) grant from UCI's Beall Applied Innovation funding program, which will allow the company to link maternal and fetal ECG data with that from embryonic zebrafish in the hopes of detecting congenital heart disease in unborn babies. "I have been pursing this for several years," Cao says. "The POP grant validates our fetal/maternal ECG patches, and we have had good results with embryonic ECG in fish."

In addition, the company plans to be well on its way to developing a medical-grade fetal well-being monitor that uses telemedicine to allow clinicians to screen patients from afar, as well as its wireless pH measurement sensor for labs. An STD (sexually transmitted disease) point-of-care test for consumers is also in the works.

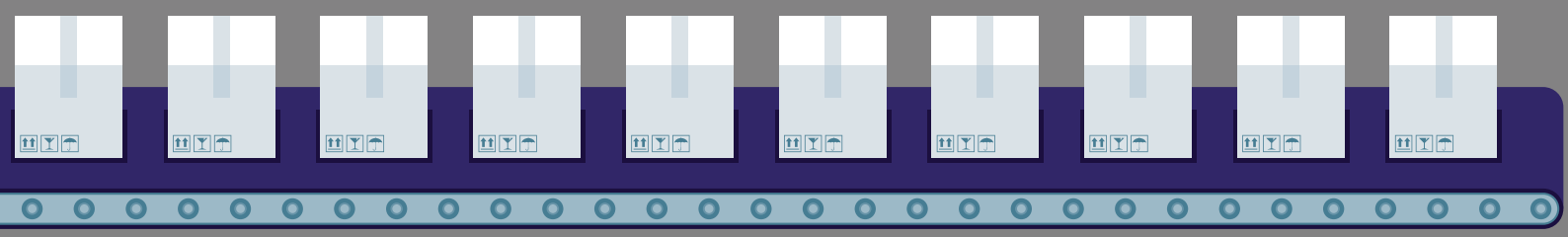
"All the big data we are collecting from the zebrafish will help us develop much better analytics that we can use in the future," says Lau. "It is all applicable to products in many fields, including cardiology and neurological science. Our goal is to use it to develop cutting-edge digital health and telehealth applications for affordable healthcare."



MANUFACTURING SECURITY

Sharon Henry

RESEARCHERS AIM TO HELP PROTECT



When cybersecurity researchers anticipate how cybercriminals might undermine U.S. manufacturing, they imagine scores of doomsday scenarios.

Consider the advanced integrated circuit (IC), known as a semiconductor chip. The IC forms the brains of computing devices in everything from cellphones to space stations. Without the IC, we'd live in an altogether different world – no internet, no Google, no Silicon Valley.

The magic comes from a small wafer, usually made of silicon and imprinted with layers of microscopic masks to produce a pattern of electronic components. The wafer is diced into many pieces, each containing one copy of the circuit, called a die.

Manufacturing an IC may involve more than 1,000 precisely controlled steps. Procuring intellectual property, blueprint design, fabrication, testing, assembly and packaging are largely outsourced to third-party vendors. There are multiple points along this supply chain where things can go wrong.

Imagine a rogue worker sabotaging an otherwise sound chip design by modifying a few masks on it to redirect energy. Once the malicious IC is embedded into a device, energy is redirected to burn out the circuitry, leaving the device (phone, computer, missiles with built-in satellite navigation) incapacitated, leading to potentially disastrous consequences.

If something like this happens, could the culprit be captured, and perhaps more importantly, could the criminal act have been prevented?

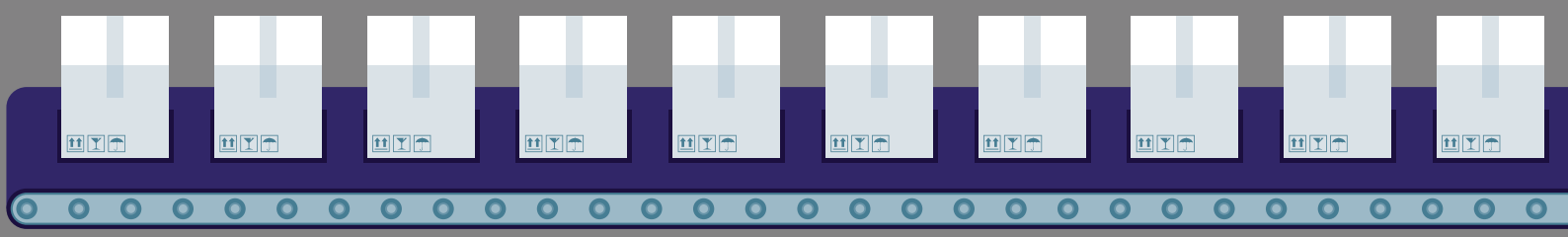
Last November, in an endeavor to answer this question and others about vulnerabilities in American manufacturing, the University of Texas at San Antonio launched the national Cybersecurity Manufacturing Innovation Institute (CyManII). The $111 million public-private partnership funded by the U.S. Department of Energy engages in collaborative research and development to help the nation's manufacturers become more resilient against cyberattacks and ensure U.S. competitiveness in advanced manufacturing.

CALIT2, a CyManII managing partner, will collaborate with 24 other universities to develop tools, technologies and guidance for securing manufacturing supply chains, factory automation and information, and workforce development.

"Our target group is small- and medium-size manufacturing companies. Upgrading their efficiency by leveraging data will allow for a surge of demand from internal markets," says G.P. Li, UC Irvine CALIT2 director. "At the same time, we want to ensure cybersecurity and provide energy efficiencies that support the nation's goal to combat climate change and its impact."

According to Li, UCI has a deep commitment to advanced

U.S. SUPPLY CHAINS AND IMPROVE ENERGY EFFICIENCY



manufacturing as evidenced by the establishment of advanced manufacturing programs at CALIT2. These include:

- EVOKE Lab and Connected Learning Lab
- Data Engineering ThinkTank
- The Smart Connected Worker program
- California Plug Load Research Center
- Integrated Nanosystems Research Facility (INRF), Bio-organic Nanofabrication Facility (BiON) and MEMS fabrication facility
- IoT Cyber Test Range

"These labs and facilities will play key roles as test beds and development sites for securing clean-energy advanced manufacturing," Li says.

The Smart Connected Worker program is leading the way by developing a platform that leverages artificial intelligence to transform collected data into metrics, insights and predictions.

This platform creates digital twins of human workflows in advanced manufacturing contexts. Digital twins are virtual representations of the real world that incorporate physical objects, processes, relationships and behaviors via augmented and virtual reality. Captured information will help produce solutions to reduce energy consumption and environmental impacts, and produce a more equitable workplace.

UCI's Cybersecurity Policy & Research Institute (CPRI) also is contributing to the effort. The institute is generating comprehensive technical

and policy-driven strategies to address cybersecurity's technical, legal, policy and human challenges, and building consensus around cybersecurity solutions at the intersection of technology, law and policy.

A key CPRI initiative is the establishment of the IoT Cyber Test Range, which develops protocols for testing IoT systems. With funding from the Taubman Foundation, the IoT Cyber Test Range in the CALIT2 Building seeks to detect security vulnerabilities in order to evaluate the robustness of different security approaches implemented in IoT systems and devices.

Then there is the V-GER (Virtual/Augmented, Gamified Experiential Reality) Cyber Test Range, a collaboration of the Smart Connected Worker program, CPRI/IoT Cyber Test Range and INRF. V-GER is contributing to CyManII's goals for workforce development and supply chain security tools by producing VR/AR content for gamification of cybersecurity education, exploration and simulation.

Its platform will incorporate real-time operational features through which participants (game designers, engineers and players) encounter real-world, real-time security challenges for Internet of Things technologies inherent to advanced smart manufacturing.

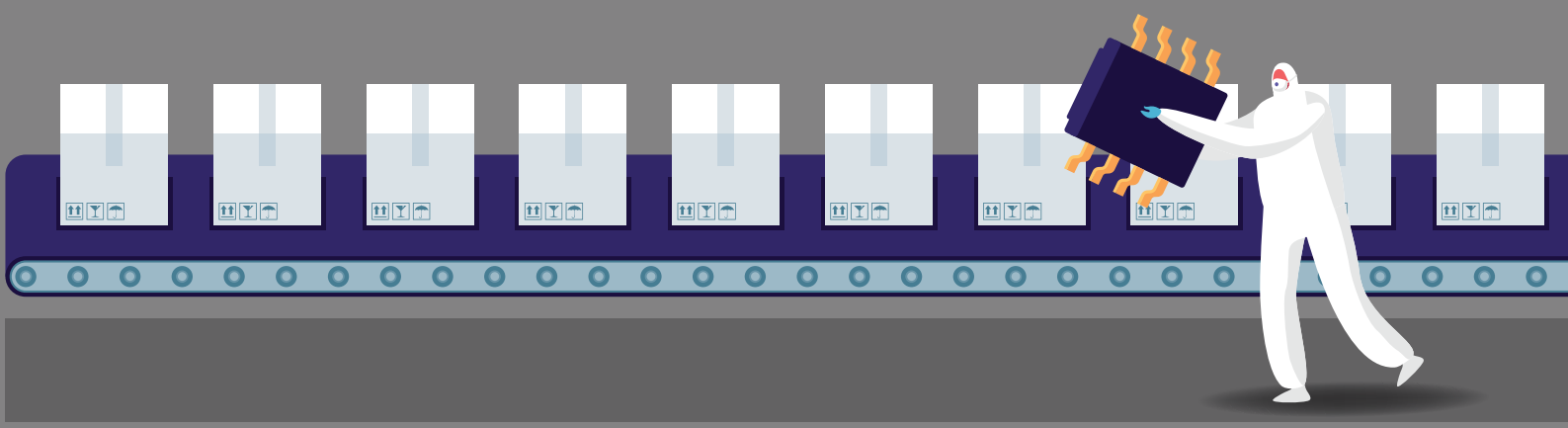
"Users can think like an attacker and map out where cyber risk exists," says Richard Donovan, CALIT2 assistant director of research development for sustainable smart manufacturing. Researchers expect to develop prototype applications that demonstrate workflows associated with semiconductor fabrication. When it comes to preventing intrusions, such as sabotaging IC circuits, a multiscale operations model could be designed that spans tooling design and manufacturing, device making and supply chain operations, Donovan explains.

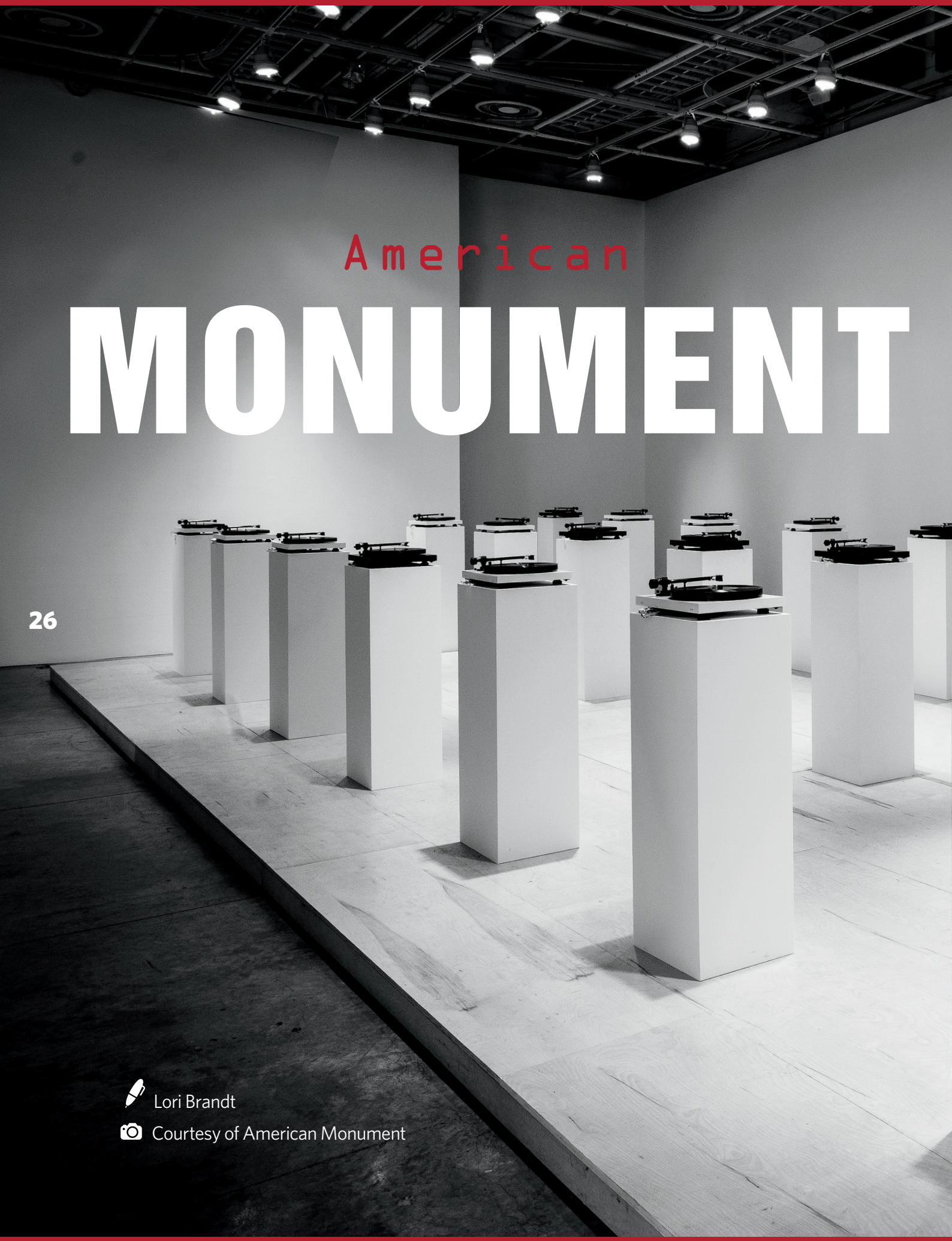
"These models could connect individual dies with individual masks and mask locations, and further down the road with individual mask suppliers and factories," he says.

Scanners could be equipped to notice when one die looks different from others. Anomalies would be flagged if the mask-writing instructions don't match the blueprint design. These solutions could detect deviations before their consequences end up on the final device.

While this generation of research is squarely aimed at cyberphysical systems, using data to analyze the implications of machines communicating with each other must encompass human and environmental systems as well, Li says. In addition to the four elements – cyber, physical, human and environmental – it is the effects of human interactions on cybersystems and the environment that will be critical to achieving effective, secure and energy-efficient advanced manufacturing. And data will remain every bit as critical to the effort.

"Scientists will need to aggregate data from all four elements and take a holistic approach to find tools and solutions to produce safer, more equitable workplaces and reduce environmental impacts," Li says. "To do that, data is everything."



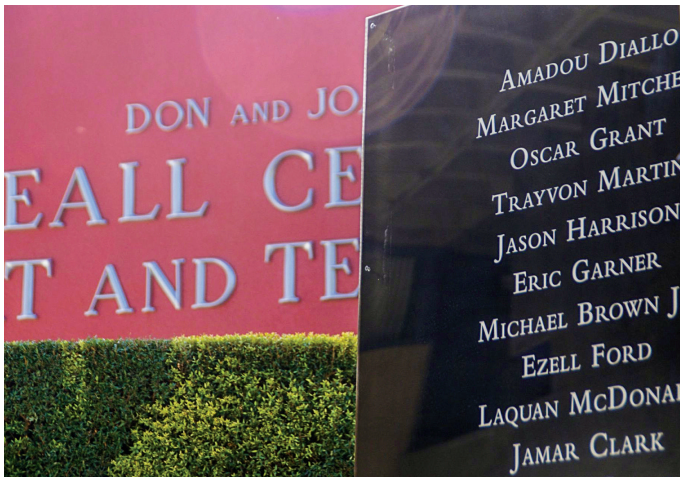


American MONUMENT

Lori Brandt
Courtesy of American Monument

COLLABORATIVE PROJECT EXPLORES COMPELLING ACCOUNTS OF RACE AND VIOLENCE

American Monument (AM) was the last exhibit at the UC Irvine Beall Center for Art + Technology before the world shut down due to the COVID-19 pandemic.



Visitors to the Beall Center's American Monument exhibit listen to audio recordings of police confrontations with Black civilians.

Created by conceptual artist lauren woods and curator Kimberli Meyer, AM examines the cultural conditions under which African Americans lose their lives at the hands of police officers. Through audio recordings and case documents, the inter-media artwork gives visitors an intimate look into the disturbing encounters.

The show drew hundreds of visitors from Oct. 2, 2019, until it closed March 16, 2020. A mere two months later, George Floyd was killed and the country erupted in social protests supporting the Black Lives Matter movement. The subject matter addressed in AM was being discussed by people of all races across the country and in other parts of the world. Still today, people are engaging in conversations, examinations and increased understanding of systemic racism and violence against Black people.

woods and Meyer intended AM to serve as a vehicle for students, scholars and the public to analyze the complex relationships that exist among race, material violence, structural power and monumentality itself. The exhibit was conceived to travel and continually expand,

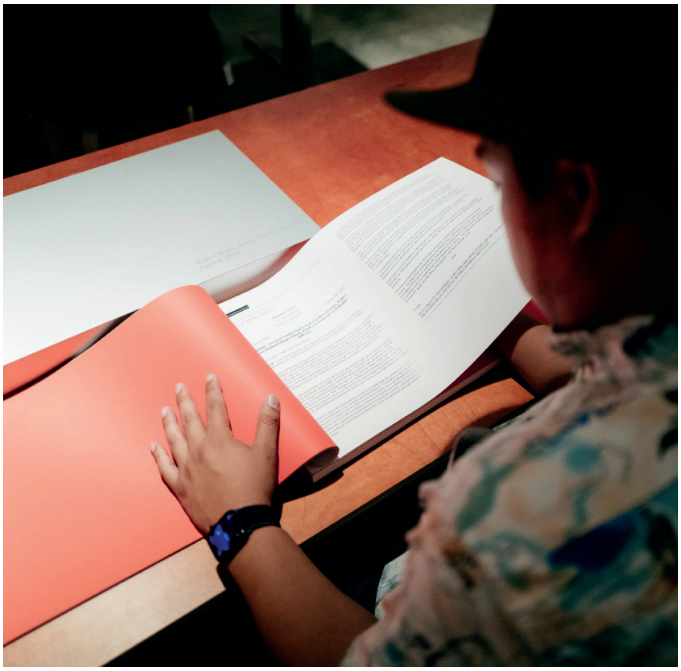
moving across the country year to year, "unveiled" at universities, museums, storefronts, community centers and churches. With future iterations on hold, it is fortunate that AM will be resurrected in a living digital representation, with help from a four-person team at CALIT2.

Although they are located on opposite sides of the campus, the Beall Center and CALIT2 were both founded in 2000 with a common interest in technology and its multidisciplinary intersections. They are collaborating on this project as part of the Beall's Blackbox Projects residency program. Beall Center Artistic Director David Familian and Sergio Gago-Masague, director of CALIT2's Engaging Technology and Application Design Lab and assistant professor of teaching in information and computer science, serve as project coordinators.

AM was initially funded by the Mike Kelley Foundation, and then additional support came from the Beall Family Foundation and Andy Warhol

The exhibit includes use-of-force reports, prosecutor and autopsy reports, witness testimonies and 911-call transcripts, all documents gathered through Freedom of Information Act requests.

Visitors are able to read through all documents associated with each of the 22 cases.



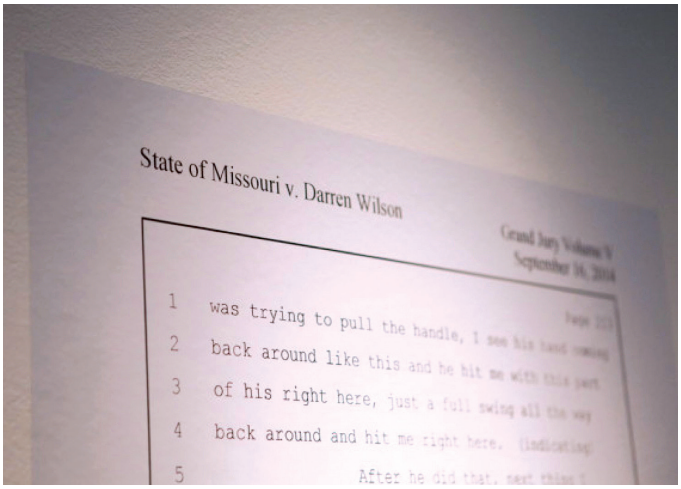
Foundation for the Visual Arts. At the outset, Familian realized a catalog would be inadequate for documenting AM. He, along with woods and Meyer, pulled together a team to conceptualize and implement an interactive website and smart archive of the work. In addition to Gago-Masague, the group includes representatives from the schools of arts, humanities, information and computer sciences, and law.

THE PHYSICAL EXHIBIT

AM featured 22 cases of police- or law enforcement-sanctioned violence against Black people. The center of the exhibit was a sound installation with turntables sitting on a grid of white pedestals. Visitors could play the records themselves to hear the audio recordings of police confrontation with Black civilians right before the use of lethal force. Eric Garner, Philando Castile and Freddie Gray were just a few of the distressed voices heard. In the next room sat a conference table and stools, where visitors could sort through one of 22 metal boxes and read documents associated with each case. The documents were assembled through Freedom of Information Act (FOIA) requests and include use-of-force reports, prosecutor reports, autopsy reports, witness testimonies and transcripts of 911 calls.

THE DIGITAL ITERATION

Hosted by the Beall Center, the interactive web system will include all of the case documents, offering worldwide access



to AM. Data files will be meta-tagged with keyword descriptions embedded in the code so they are easily searchable. The smart archive includes features for both adding updates to cases and allowing approved scholars to annotate documents. Future plans include incorporating artificial intelligence methods, such as natural language processing, to automatically analyze and extract relevant information based on users' needs, enabling scholars to data mine the case files.

woods and Meyer view the web system as an online gathering for people to contribute cases for investigation and provide further documentation for analysis and future exhibitions. "The digital platform aspires to be not only a public learning and information-sharing portal but also, eventually, a collaborative knowledge-production platform," says woods. "We are collaboratively building this with the idea of its full emergence serving as a tool for the public."

The web system also will contain the recorded sessions of the March 2020 Think Tank Marathon held at the Beall Center. The two-day event brought together scholars, lawyers, community activists, students and artists who gathered to process and incubate issues and ideas raised by the artwork.

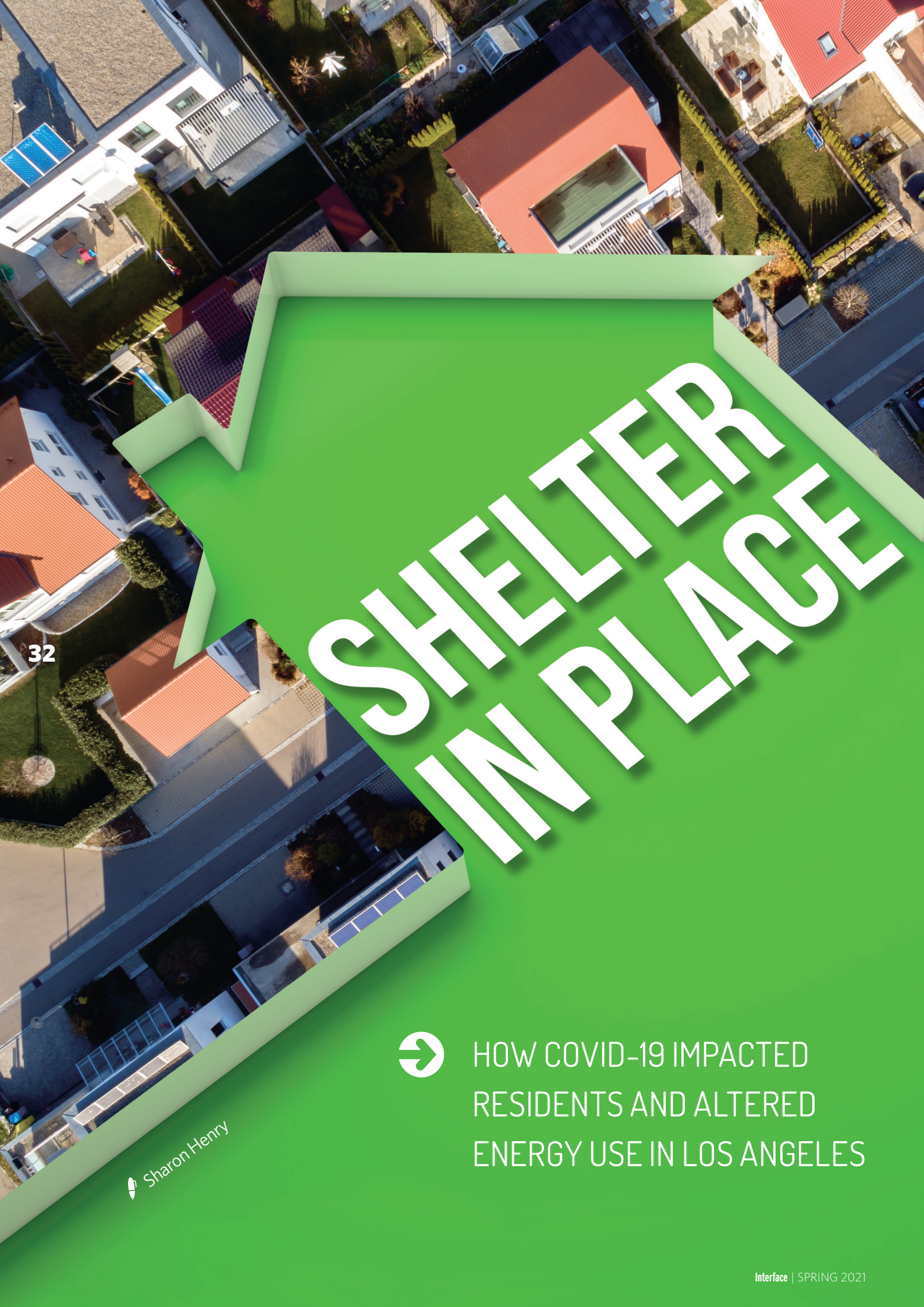
"The website will eventually be an active element of the work – providing the mechanisms for people to make FOIA requests, annotate documents, share information, and in this way support others who are pursuing the larger project of ending white supremacy, police brutality and state violence. In this sense, it is an active piece of the work, not a passive record of its existence," said Meyer.

Familian believes the project offers a unique model for scholarship and research into the issue of police treatment of Black people. "We are creating an evidence-based dataset where scholars can start to look at language and behavior and how they have changed or stayed the same over time," he said. "If you look at the Sandra Bland case, you can determine when the situation intensified. You can hear it in the recording."

The digital representation of the exhibit will include recorded sessions of the two-day Think Tank Marathon at which scholars, lawyers, community activists, artists and students gathered to discuss issues and ideas raised by the artwork.

Gago-Masague hopes the first phase of the web system will be open to the public by summer 2021. A native of Spain, he has worked on art-related projects before in his homeland. "I'm happy to be involved and collaborate with artists again. As an engineer and scientist, I really enjoy learning from other disciplines, in particular learning how technology can contribute to other domains."

As the country recovers from the pandemic, AM will be able to open in other locations. But it is thanks to technology that the web system will keep the important concepts raised by the artwork accessible for visitors from around the world to critically reflect upon and inspire change.



SHELTER IN PLACE

HOW COVID-19 IMPACTED RESIDENTS AND ALTERED ENERGY USE IN LOS ANGELES

Sharon Henry

In the early afternoon of March 19, 2020, as the threat of COVID-19 was rapidly spreading throughout California, Governor Gavin Newsom issued a mandatory and immediate stay-at-home order for everyone except essential workers.

Millions of Californians left their workplaces and classrooms, shuttered their businesses and went home.

At Los Angeles Department of Water and Power (LADWP), the largest municipal utility in the United States, the unprecedented shift in potential energy needs raised immediate questions. What impact would COVID-19 have on energy usage, and how would the pandemic affect their four million customers?

The California Plug Load Research Center (CalPlug) has collaborated with LADWP on energy issues since 2012.

When COVID-19 hit, CalPlug joined forces with LADWP's Efficiency Solutions Engineering group and its La Kretz Labs to analyze how energy use had been affected by the changes in life and work styles brought on by this once-in-a-lifetime event.

The research team used 2020 energy data from LADWP during the pandemic and compared it to data from previous years to evaluate the impact of the pandemic on the utility company's service territory. Multiple L.A. neighborhoods, each representing about 2,000 customers, were analyzed.

"We had to explore our options to find out what are the impacts of the COVID-19 pandemic on our infrastructure – such as transmission lines and transformers – as well as the billing impacts on our customers while they are using more energy during the day," says Amir Tabakh, chief of Energy Solutions Engineering at LADWP. "As a result, we decided to use our valuable partnership with CalPlug and reached out to Dr. G.P. Li and his team for their research into potential solutions and directions for educating our staff, customers and utilities throughout the country."

The analysis began by understanding changes in behaviors during this period. In mid-March through April, as shelter-in-place orders were issued, about 25 percent more Los Angeles residents stayed at home compared to pre-pandemic numbers.

By early April, visits to L.A. grocery stores and pharmacies had dropped substantially, but trips to retail stores, parks, recreation areas and transit stations dropped even more.

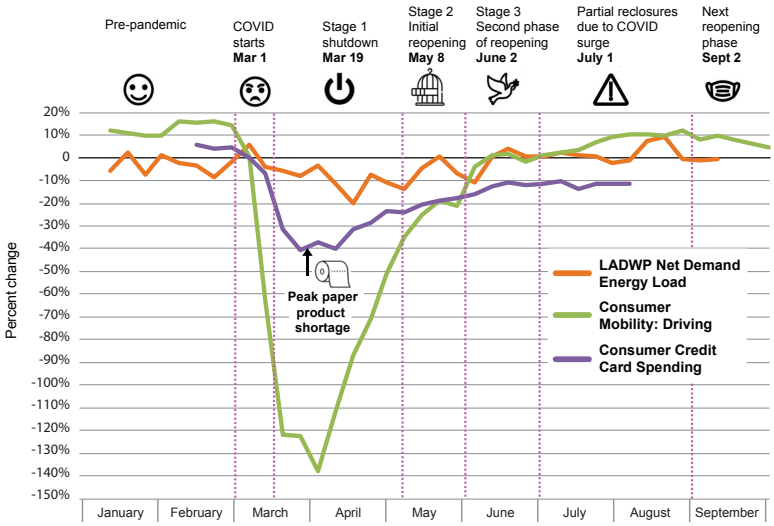
These changes were the most extreme in March and April. By June, visits to groceries and pharmacies had rebounded significantly, but time spent at workplaces, stores and parks remained 30 to 40 percent lower than average.

"Behavior data showed massive shifts in how many people were unemployed or working at home, especially in March and April," says CalPlug's Research Director Joy Pixley. "More time at home means more use of computers, TVs, appliances and lighting, as well as heating and cooling."

"Occupancy is a major driver of energy use" says CalPlug's Technical Director Michael Klopfer. "Energy information provides an interesting snapshot into how the schedules of people changed."

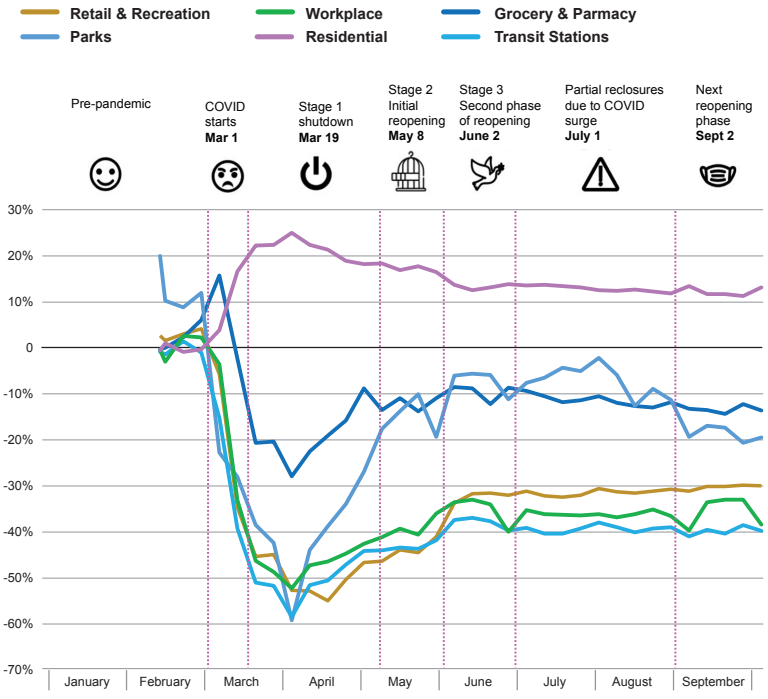
Results showed that residential energy usage noticeably shifted, especially during the early part of the pandemic. Decreased energy use in the morning reflects people starting their day more slowly on weekdays. Similarly,

Changes during COVID stages



Sources: LADWP Feeder Data: Net Demand, Apple Mobility Reports, J.P. Morgan Chase Consumer Credit Card Spending: cnbc.com

Changes in where people went (2020/2019)



Source: Google COVID-19 Community Mobility Reports

> “These are essential steps on the technical journey for achieving zero greehouse gas emissions.”

mid-afternoon shows increased energy consumption corresponding to more use of appliances and air conditioning or heating when many people would normally be at work or school. Remote work continuing past the COVID-19 pandemic will likely have a similar effect, if for a smaller group.

The difference was lower for weekends during the daytime. However, weekend averages showed higher late night and early morning energy usage. This suggests a shift to late night leisure activities for people no longer constrained by standard daytime work hours. It may also reflect people who would normally be working late nights in entertainment venues who were instead at home.

By September and October, the impact due to more people being at home during the day had lessened but had not been eliminated.

The heat events during early fall 2020 had an exceptionally high impact because more people were home and required air conditioning, adding to the energy burden.

“The good news is that average energy increases for most neighborhoods were small,” says Pixley. “But we know those averages include some households that were harder hit. So we looked at what other studies told us about who was most affected in terms of increased energy bills.”

The results showed that compared to higher-income Angelenos, those with lower incomes were more likely to lose their jobs during the pandemic and less likely to be able to work from home. This unequal impact is especially problematic because disadvantaged households already pay a higher proportion of their income on energy.

To help support these households, LADWP is not charging late fees or shutting off water or power for nonpayment during the crisis, and it offers financing and discounts for qualifying customers.

COVID-19 also allowed researchers to gain insights into how buildings can be idled more effectively. "One set of commercial buildings investigated did not show a substantial decrease in after-hours energy use even when the majority of building tenants were not allowed inside," says Klopfer. "Commercial buildings act almost like sensors to let us get a better understanding of space usage and change because of the pandemic."

Pixley adds, "The patterns suggest that computers and other devices were left on even with low or no occupancy. This is a wake-up call for improving energy efficiency in commercial buildings."

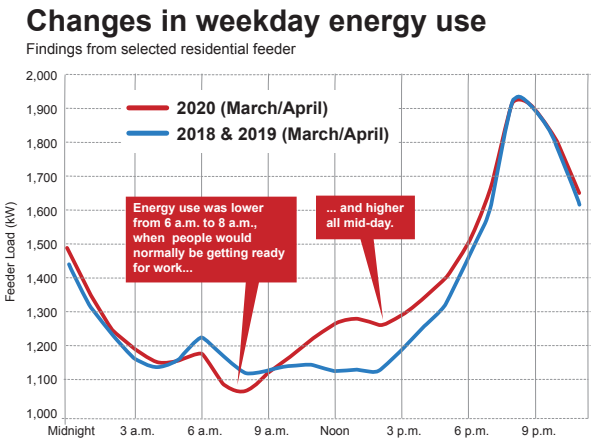
"The data-driven results of this CalPlug research not only shed light on customer behavioral changes in energy usage consumption patterns, but also helped identify otherwise unexpected hardship situations where the needs of some of our customers were addressed more equitably," says David Jacot, director of Efficiency Solutions at LADWP. "As this partnership with CalPlug continues to advance, we look forward to developing further opportunities for additional, more specific, project-based collaborations like our current work on COVID-19 and energy use in disadvantaged communities."

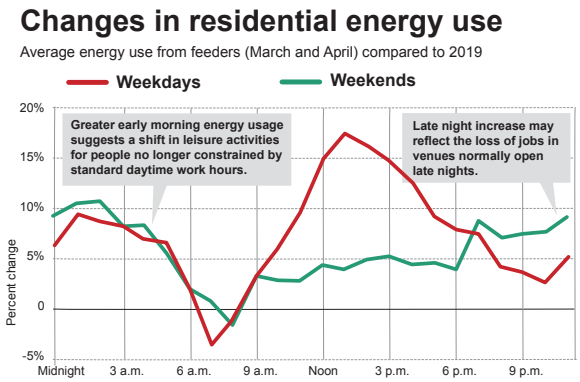
During 2020, there was a boom in clean-energy production and use, as renewables covered for fossil fuel energy sources. But there is a dark side as well to these shifts in usage, explains Klopfer.

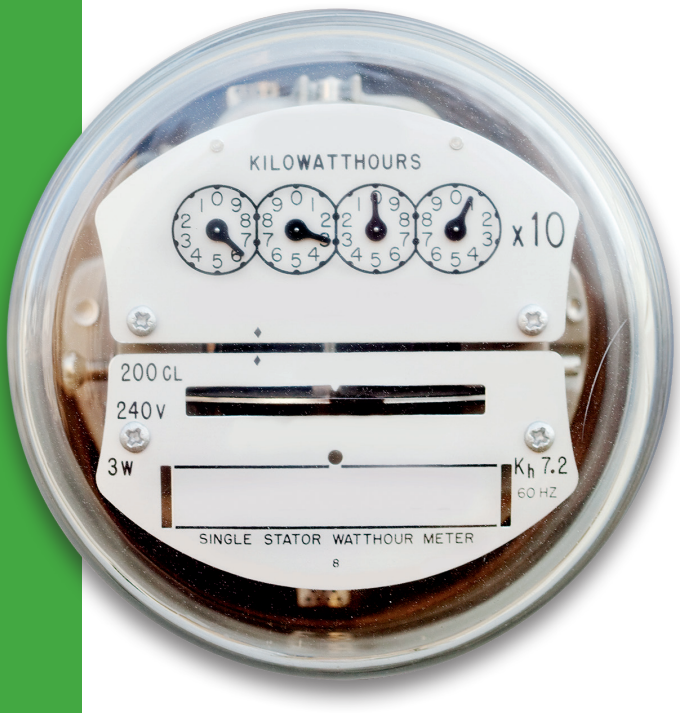
"California's energy grid is very lean and relies on a careful balance of expected supply and expected demand: when forecasts are off, widespread energy supply problems can result. The impact of the COVID-19 pandemic on normal energy use combined with extreme weather conditions were a major contributing factor to the fall 2020 California rolling blackouts."

The lessons from the COVID-19 pandemic on energy use can help improve the resiliency of our grid and energy security for our societies most vulnerable, as well as reduce the carbon footprint of the energy that powers our lives.

The future collaboration in emerging technologies between CalPlug and LADWP is aimed toward improving how energy loads can be better scheduled to align with clean energy availability. This work requires integrating three key elements: developing technology solutions, evaluating effective utility program design, and researching human behavior and how it can adapt to new circumstances, particularly the challenges of climate change, Pixley says. "These are essential steps on the technical journey for achieving zero greenhouse gas emissions."





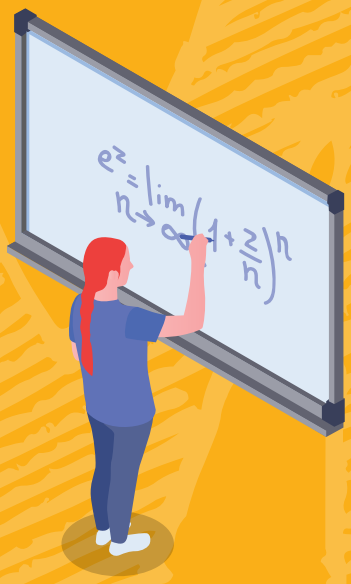


Connected

Shani Murray

RESEARCHERS EXPLORE PIVOTAL TRANSITIONS IN STEM LEARNING AND CAREER DEVELOPMENT

Learning

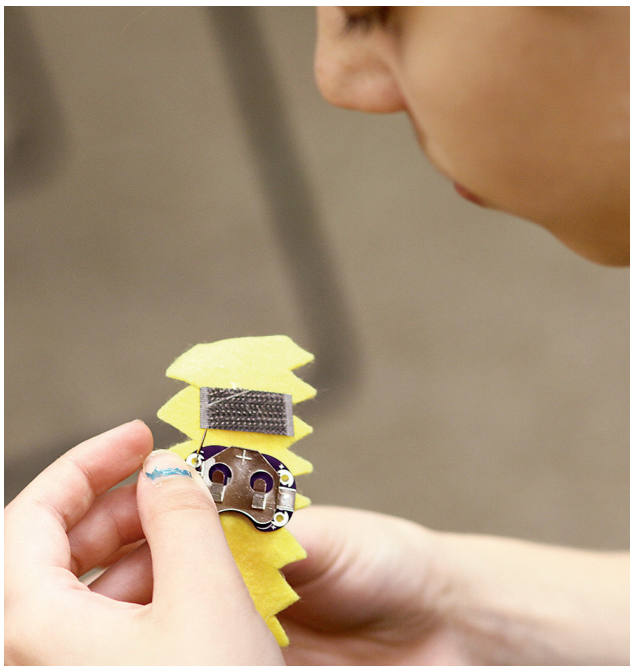


During a February panel discussion in honor of Black History Month, UCI alumnus Anthony Mays talked about his journey from Compton to Google and how, back in high school, it was a computer lab instructor who suggested he turn his passion for technology into a career.

Such moments can be pivotal, especially in the lives of underrepresented youth, but is there a way to capture these encounters and scale them for greater impact?

Two new projects in UCI's Connected Learning Lab, located in the CALIT2 Building, are exploring this and other questions, such as how does playing a board game lead a young girl to consider an engineering degree, or how are online learning programs exposing students to a more diverse set of career options?

The Connected Learning Lab supports programs that help youth transition from young person to adulthood.



STEM LEARNING FOR MIDDLE SCHOOL GIRLS

CLL Director Mimi Ito, CLL Associate Director Vera Michalchik and Informatics Professor Kylie Peppler have received a STEM Next Opportunity Fund grant for $250,000 through the Gordon & Betty Moore Foundation for their project, "Connecting Middle School Girls' STEM Learning Across Settings."

The program is associated with another STEM Next project, the Million Girl Moonshot, which aims to engage one million girls in STEM learning over the next five years through afterschool and summer programs. STEM Next "turned to the Connected Learning Lab as a research partner on that project to better understand the brokering of connections between those programs and career development," says Peppler. "What is

super critical is the adults helping to make those connections for the kids – they're the 'brokers.'"

Peppler goes on to explain how she has played that role in her own family. "I remember watching my niece play a board game, and I could tell she was a really great computational thinker, even at a young age," she says. "So I wanted to introduce her to Scratch and other programming platforms, and then she started enrolling in computer science courses." Peppler and her CLL colleagues are now exploring how STEM Next programs act as brokers, helping expose kids to various opportunities. "You might want to call them learning transitions," she says.

Through the end of 2022, this CLL project will examine those transitions and the role that adults play. "We're hoping to uncover things that are more scalable – ways that organizations are working systematically to introduce careers or to line up internships or externships in the local community – so we can identify practices that other organizations could adopt."

Working with participants already within the STEM Next network, the CLL team will analyze how current practices translate into next steps for girls. "A lot of connected learning is about taking all of these siloed educational opportunities and creating a coherent ecosystem for the girls, but the adults in that ecosystem play a large role in setting up the linkages," says Peppler. "It really boils down to three spheres of thought – interests, relationships and opportunities – and at the intersection of those three things is where care and learning occur."

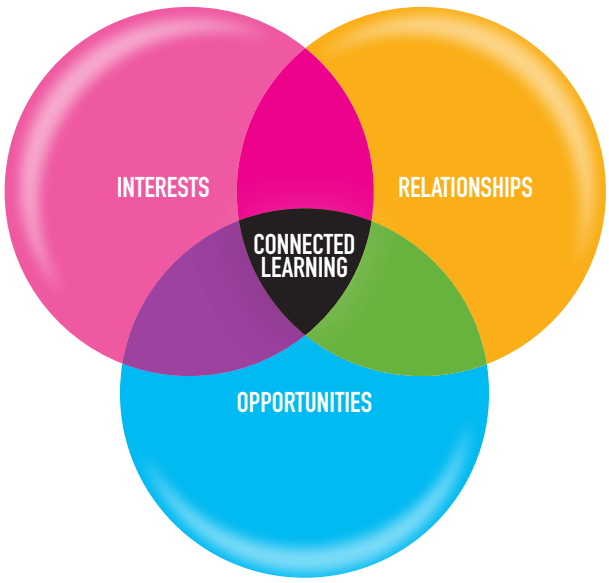
EVALUATING YOUTH CAREER DEVELOPMENT

The second CLL project is the result of a $100,000 gift awarded to Ito and Michalchik from Roadtrip Nation (which produces content, products and experiences to help individuals pursue fulfilling careers) and the Strada Education Network (which aims to provide more purposeful pathways between education and employment). Ito and Michalchik, along with CLL Senior Research Manager Amanda Wortman, will be evaluating the new Roadtrip Nation Experience online career-exploration program.

This work builds on current CLL work, funded by the Gates Foundation under the Equitable Futures initiative, which is looking at community-based nonprofits that support kids' career development. "These community-based organizations have strategies that really help young people develop identity and develop connections," says Michalchik. "And the leading organization that's been working in this space for a very long time – they're like the inventors of career identity and social connections – is Roadtrip Nation."

The Roadtrip Nation Experience is a simple, self-contained curriculum designed to help young people better identify their interests, learn about possible careers related to those interests and find mentors.

"We'll be looking at their curriculum and how it's being used in supporting young people to develop their capacity to move into gainful employment, and to understand their place in the world and how they wish to function as an adult," says Michalchik. "Our evaluation is part of this much larger area that we're working in, which is helping to support the transition from young person to adulthood by thinking not only about education but about meaningful engagement in the world."



> "It really boils down to three spheres of thought – interests, relationships and opportunities – and at the intersection of those three things is where care and learning occur."

A Parting Shot

CALIT2 embodies the importance of collaboration.

That's the foundation upon which both the institute and the building itself were built. The four-story, 120,000-square-foot structure at UC Irvine opened in November 2004 and includes state-of-the-art labs and two floors of open space. The space is assigned by project, not department, which encourages cross-disciplinary ideas and relationships, and it is easily configurable, lending itself to new partnerships.

UCI broke ground for its CALIT2 building in summer 2002, a year and a half after Governor Gray Davis announced the creation of the California Institutes for Science and Innovation. This photo, taken July 14, 2003, captures construction progress on the main entrance side of the building. The CALIT2 Irvine division building was the first of all newly constructed CISI facilities to open across the UC campuses.

Today, more than 200 faculty members are actively engaged in CALIT2 activities. Some reside in the building, conducting research and working with students, while others maintain home department locations but collaborate on institute projects with peers from various disciplines. The affiliated researchers take advantage of the shared-use facilities, administrative support and student fellowships – all value-added services that CALIT2 brings to the campus and its partners.

Under the direction of Professor G.P. Li, CALIT2@UCI develops IoT technology-based innovations in a multidisciplinary research environment. By integrating academic research with industry experience, the institute seeks to benefit society, incubate new technology companies and ignite economic development. CALIT2 focuses on the digital transformation of healthcare, energy, the environment and culture.

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The soaring, four-story glass entrance is a signature hallmark of the CALIT2 Building. The space, known as the CALIT2 Atrium, is adjacent to the building's auditorium, making it a popular location for coffee breaks, receptions, poster sessions and exhibits. Through the years, it has also served as a unique backdrop and stage for several UCI dance department performances.

Photo: Gregory Gallardo, retired CALIT2 facilities manager