UC San Diego
Jacobs School of Engineering

Pulse

Summer 2014

UC San Diego Center for **Wearable Sensors**

Wearable Sensors: **First in Series of New Centers at the Jacobs School**

I am pleased to announce that we have launched the Center for Wearable Sensors here at the UC San Diego Jacobs School of Engineering. In this issue of *Pulse*, you'll find plenty of information about our new center, which is designed to accelerate wearable-sensor research in order to improve human health and address a range of security and fitness issues. This is the first in a series of new "agile" research centers at the Jacobs School. Each will apply emerging and converging technologies to address big challenges facing society. Our second new center—the Center for Extreme Events Research—is well under way. You'll be hearing more soon.

Since I began as Dean in September 2013, I have consistently said that the Jacobs School is a great place; and my goal is to build on excellence and make it even better. The agile centers are a powerful tool to do just this. We will further enrich the intellectual environment for our students, expand and deepen collaborations with industry partners, and strengthen our research profile—all while leveraging engineering as a force for the public good.

I describe the new centers as "agile" because they can be set up quickly and are nimble enough to change course as research challenges and opportunities shift. Our plan is to launch three new centers per year for the next three to four years. Each center will be built around a coordinated research vision created by a group of faculty. Centers will engage with the larger engineering community through regular workshops, which will connect faculty, students, industry partners, research funders and other constituents. I hope to see many of you—the Jacobs School's alumni and friends—at these workshops in the coming years.

Soon after my call went out across the Jacobs School for ideas for new centers, more than 10 groups of professors volunteered for further discussion and exploration. I view the strong interest as a testament to both the strength of our faculty and a deeply held desire at the Jacobs School to ensure that our work has the greatest impact possible.

One high-impact path forward is entrepreneurship. The agile centers will create environments where coordinated groups of world-class researchers from different disciplines work together. These teams, in turn, will be well positioned to benefit from the Jacobs School's programs focused on developing, training and supporting entrepreneurs.

Just this spring, we announced the latest resource for our entrepreneurs: the Triton Technology Fund (see pg. 10). It is a venture capital fund created by a group of our alumni that invests in innovations from UC San Diego alumni, students, faculty and staff.

These are exciting times at the Jacobs School, and I welcome your ideas on how we can work together to fulfill our mission to educate tomorrow's technology leaders; conduct leading-edge research and drive innovation; and transfer discoveries for the benefit of society. I can be reached at: DeanPisano@eng.ucsd.edu

Albert P. Pisano, Dean

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Center for Wearable Sensors: On the cover: Jared Tangney (B.S. '09, M.S. '12, Ph.D. '14) runs through the corridor under Atkinson Hall while wearing his company's sensors. Tangney is a co-founder of Electrozyme, a UC San Diego startup focused on analyzing the chemical constituents of sweat in real time for fitness and health applications (pg. 4).

Wearable Sensors will Transform Healthcare, Security and More

Amay Bandodkar


Jayoung Kim

At the new Center for Wearable Sensors, researchers develop systems to enable a wide range of preventive-health, security and fitness applications. Top UC San Diego faculty, students and researchers work together to accelerate the pace of innovation by tackling tough research challenges and technical bottlenecks in key areas such as sensors, low-power circuits, materials, electrochemistry, bioengineering, wireless network technologies, preventive medicine, the life sciences and more.

http://WearableSensors.ucsd.edu

Twenty years ago, you took your car in for repairs when it started making funny noises; that is, if you didn't find yourself stranded on the side of the road first. Today, your car is loaded with sensors that constantly monitor its "health."

Wearable sensors have the potential to do for human health what automobile sensors have done for car owners: to make unobtrusive health monitoring the norm.

Through the new Center for Wearable Sensors, the Jacobs School of Engineering is leading the charge to develop wearable sensing technologies to improve human health through better preventive-health monitoring. And unlike an engine light that tells you to go see your mechanic, your doctor could be alerted in real time if there is a problem.

Most of today's wearable health sensing technology is invasive, time consuming to use, and captures data from a single moment in time, such as when someone with diabetes pricks their finger to draw blood for a glucose test. Pregnant moms often find themselves in the hospital wired up to hulking machines to monitor fetal heart rate or contractions.

What if people in these kinds of situations could simply wear a small, unobtrusive sensor that monitors their important health data continuously, and wirelessly transmits it to the cloud for analysis and review by their physician on a computer or smartphone? The continuous monitoring would provide a much richer data set from which their physician could assess their health, and the ability to move about freely would improve the patient's quality of life.

Through the Center for Wearable Sensors, Jacobs School professors are collaborating to address these challenges and many others. The researchers are harnessing a growing body of expertise in biological and electrochemical sensing, flexible electronics, wireless technology and medical devices at UC San Diego and among its many industry and institutional partners in the region.

A simple fabric is printed with an electrochemical sensor using a stamp and a propriety ink blend developed in the laboratory of Joseph Wang.

Wearable electronics are a hot topic in industry and research, with potential applications in healthcare, security and forensics, fitness and entertainment. The market is expected to grow from $14 billion in 2014 to more than $70 billion in 2024, according to technology consulting firm IDTechEx.

"We are bringing together the top-notch nanoengineering, bioengineering, electrical engineering and computing expertise here at UC San Diego; and we have an excellent medical school to guide us on clinical needs," said Joseph Wang, director of the Center for Wearable Sensors. "The campus is surrounded by leaders in the wireless and biotech industries, and we have close research partnerships with many institutions in the area. UC San Diego is uniquely positioned to play a major role in the digital health revolution."

The coming flood of health-monitoring data could also be a boon to researchers studying health, the origins of disease and how disease progresses in the body. Over the long term, such monitoring could serve as an alert system for impending illness for an individual, or be used to identify public health issues and epidemics by mapping indicators of infectious disease collected from individual wearable sensors.

Engineering faculty affiliated with the Center already have close working partnerships with the UC San Diego School of Medicine in order to focus on these kinds of questions. There are approximately a half dozen clinical trials and studies under way at UC San Diego looking at mobile devices, said Dr. Kevin Patrick, a professor of family and preventive medicine and a member of the new Center.

Turn the page for research updates from Center faculty ▶

PARTNER WITH US

Joining the Center for Wearable Sensors provides access to UC San Diego faculty, researchers, and graduate students who are transforming the field of wearable technologies.

http://WearableSensors.ucsd.edu

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Self-Powered Sensor Systems

Electrical engineering professor Patrick Mercier is working to drastically reduce the power requirements of future wearable sensor systems. At the same time, his lab is developing technologies to collect—from the environment—the small amounts of energy that would be required to power these ultra-efficient systems. His lab, for example, is developing better ways to scavenge energy from sweat from the skin or from electromagnetic radiation such as WiFi signals.

Mercier plans to embed these tiny self-powered sensor systems into clothing, where they will never need recharging. Such systems could monitor your heart rate, hydration levels and blood sugar while sending the information wirelessly to your phone. Patients at risk could be warned of an oncoming heart attack. The system might even automatically call an ambulance.

"My research group is called the Energy Efficient Microsystems Group. The key is the word 'systems.' We're working on biosensors, we're working on the electronics that interface with the sensors, we're working on the analog-to-digital converters for the biological data we collect, we're working on the wireless radios that communicate the information to your smartphone or smartwatch, and we're working on the energy management and energy harvesting side of things," said Mercier, who is the associate director of the Center for Wearable Sensors. His high-level goal for the research: to help people and to improve health care.

Forensic Finger

Jacobs School engineers have developed a wearable sensor that can quickly detect gunpowder and explosives at a crime scene.

Researchers from Joseph Wang's lab in the NanoEngineering Department tested the device at a local firing range where it was accurate 75 percent of the time and delivered results in about four minutes. This "forensic finger" project is still at the proof-of-concept stage.

Doctoral student Amay Bandodkar and postdoctoral fellow Aoife O'Mahony are leading the effort to create forensic-finger sensors on the fingertips of latex gloves using proprietary screen-printing technology.

The glove's index finger, which investigators would use to swab for samples, is equipped with a screen-printed sensor made of silver chloride and carbon electrodes. The thumb is equipped with a solid-state ionogel, an ion-conducting liquid set inside a polymer matrix. Bring the thumb and index finger together and the two sensors combine to become an electrochemical cell. The powder in the collected sample reacts on the carbon electrode to reveal the electrochemical signatures characteristic of heavy metals found in gunpowder and signatures of electroactive components found in explosives. The sensor transmits the information to a portable electrochemical analyzer that displays the results. The device would be useful for a wide range of on-site crime scene investigations in various forensic and combat situations.

Solar Tarps

If semiconductor materials were flexible and stretchable without sacrificing electronic function, what could you do with the technology? A "solar tarp" capable of providing low-cost electricity is one exciting possibility. You could fold them up, pack them away and then stretch them back out when you need power. Rural villages, disaster-relief operations and many remote humanitarian, conservation or military operations could benefit from solar tarps.

Writing in the journal *Chemistry of Materials*, nanoengineering professor Darren Lipomi reports on several new discoveries he and his team have made that could lead to the kinds of "molecularly stretchable" electronics that would be required for solar tarps and a range of new self-powered wearable sensor technologies.

Flexible electronics do exist today, and they are enabling a new generation of wearable sensors and other mobile electronic devices. There is, however, a big difference between "flexible" and "stretchable" electronics. Flexible electronics are akin to wrapping a basketball with a sheet of paper that would wrinkle. Stretchable electronics, which Lipomi is pursuing, are closer to the idea of wrapping that same ball with a thin sheet of surface-conforming rubber.

NanoEngineering professor Darren Lipomi with a stretchable semiconductor prototype.

Lipomi's team, for example, recently discovered that polymers with strings of seven carbon atoms attached produce the balance of stretchability and functionality that would be needed for electronics and medical devices that are flexible, stretchable, collapsible and fracture proof.

Understanding the Brain-Body Connection

Tim Mullen and Yu Mike Chi

A wireless, dry EEG headset from Cognionics enables researchers to track brain signals in real time as the wearer performs common tasks outside the laboratory.

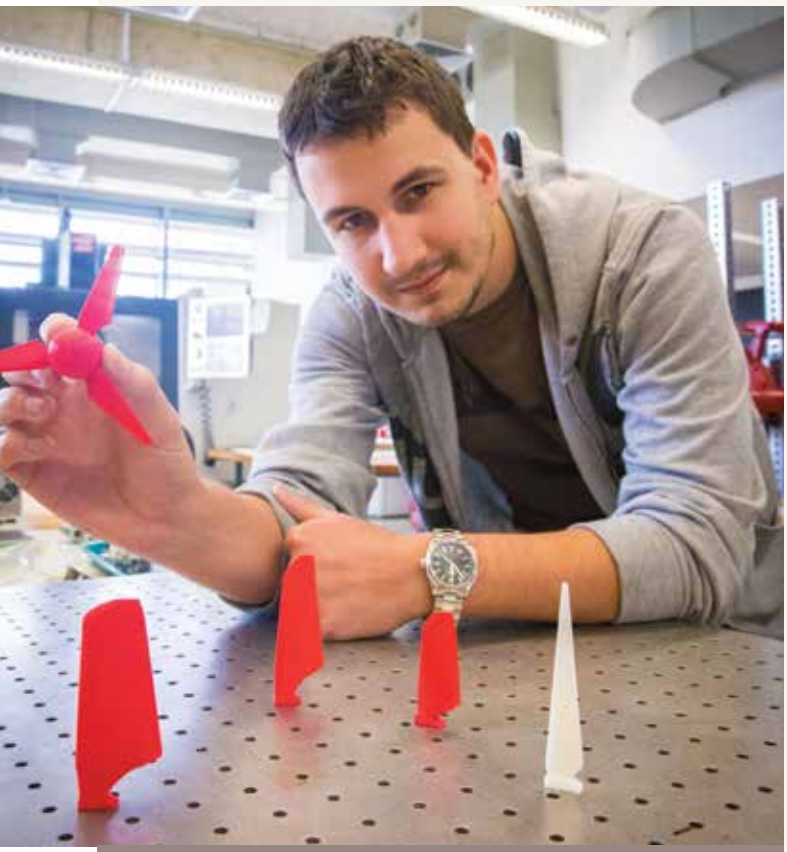
Moments after an earthquake, seismologists track seismic waves captured on ground-based sensors to pinpoint the quake's epicenter. Could the same concept be applied to identify where a neurological signal originates within the brain? A $1.8 million National Science Foundation project led by bioengineering professor Gert Cauwenberghs could answer this question. The work is focused on improving our understanding of how the brain controls the body—from the firing of a single neuron, to multiple neurons acting collectively, to the whole body's response. Understanding this sequence of events is key to identifying the origins of neurological diseases such as Parkinson's and developing new therapies. Cauwenberghs is working with Cognionics, a startup co-founded by alumnus Yu Mike Chi (Ph.D. '11), which has developed a wireless, dry EEG headset that tracks brainwaves in real time as the wearer performs common tasks such as walking or sleeping in a realistic setting outside the lab. The team is using a statistical analysis method developed by Tim Mullen and Christian Kothe at the UC San Diego Swartz Center for Computational Neuroscience to take those EEG data and make inferences about network activity inside the brain. Their combined brain imaging system was recently highlighted by National Institutes of Health Director Francis Collins in congressional testimony about the potential impact of neurotechnology research on health and economic development.

Design, Build, Test. Repeat.

Sometimes new designs backfire. That's part of the design process.

Jacobs School undergraduates learn this fact of engineering life while designing wind turbine blades in Structural Engineering 120. This undergraduate class gives students the chance to iterate on the design-build-test process thanks to 3D printers that enable rapid prototyping.

Students who take SE 120 with professor Falko Kuester get to design, model, simulate, analyze, print and then test their turbine blades. One team built and tested more than 16 blade designs over the course of several weeks. Structural engineering major Sean Kuehn was part of that team. You can calculate all day long, Kuehn explained. But your prototypes don't always do what you want them to do because in the real world, no assumptions are made.



Senior Sean Kuehn displays several of his team's wind turbine blade designs. Rapid prototyping has revolutionized SE 120, an undergraduate computer-aided design class in structural engineering. Students now design, build and test multiple iterations of their designs.

Many of the student teams started with long slender blade designs that resemble the wings of an airplane. Testing their blades revealed that this design produces too much lift and not enough forward propulsion, which is what the blades need to generate energy. Kuehn's team tweaked their designs in many different ways, including making changes in the twist angle on the blade.

"I'm very excited to see the innovation, the spark that takes over when students get involved in a design project that includes rapid prototyping," said Kuester, who also holds a faculty appointment in Computer Science & Engineering. "Normally, there is a disconnect between the CAD world, the digital world and the physical world. In this course, we model a structure using CAD techniques and run simulations to determine how that structural specimen performs under certain conditions."

That's often where instruction stops. Kuester's students, however, go on to print and test physical prototypes of the models they have designed—and then incorporate what they learn into the next design iteration.

Mimi Ngo is a structural engineering undergraduate who took the class last year and went on to work as a lab assistant in subsequent quarters. "We learned how our structures failed. We had the opportunity to see if our predictions were accurate," she said.

"We always try to provide as much hands-on experience as possible in our lab classes," said Steve Porter, a senior development engineer who helped design the course and works closely with students. The project gives students a window into the economics of design, construction and engineering by tracking materials and building costs as well as energy production.

As part of the final exam, the undergraduate teams measured wattage generated by their turbine blades in the teaching lab's wind tunnel. A leaf blower mounted horizontally on a work bench generates the wind for the tunnel.

The students also test their blades—mounted to aluminum turbine towers they also design and construct—on a miniature shake table. The table simulates actual earthquakes that have occurred in California, Chile and Japan.

"You learn more in rapid prototyping classes," Kuehn said. "You screw up, you learn from it. You do better, you learn from it. In the end, you end up with the best design."

Outstanding SENIORS

POOJA MAKHIJANI

When Pooja Makhijani first visited the Jacobs School, she didn't know if she wanted to be an engineer. "I went on lab tours during my visit and was amazed that professors were willing to mentor me that fall," she recalled. Makhijani signed up for bioengineering. A Jacobs Scholar, she took an unpaid research position her first year and worked on an independent project, which became the seed for her senior thesis. She served as Triton Engineering Student Council (TESC) president in her junior and senior years. She created a peer mentorship program and spearheaded the creation of a scholarship fund to help students attend conferences and present their work. She plans to attend medical school at Stanford.

ZACH JOHNSON

When he graduated in June, Zach Johnson joined four other Jacobs School computer science alumni on the Glass team in Google[x], Google's moonshot group. Johnson is better known to his classmates and the teachers here as zachoverflow, his Twitter handle and Internet pseudonym. Johnson interned at Microsoft and Facebook before landing an internship on the Glass team last summer. "I had a few assigned projects but I got them done early and decided to squash other people's bugs—it's a good way to make friends," he said. When he's not programming or thinking about philosophy, Johnson enjoys playing the hammered dulcimer, a string instrument generally found in folk music pieces.

CELINE LIONG

In the past four years at the Jacobs School, Celine Liong has done research in four different labs, including work on drug delivery and solar cells. She also was the president of the UC San Diego chapter of the Society of Women Engineers. She plays badminton and likes to cook. Liong, who is the first in her family to go to college, said she was drawn to nanoengineering because of the field's potential. "You can do so much," she said. This fall, Liong will explore more of this potential at Stanford, where she will work toward a Ph.D. in translational medicine.

Sam Avery, front left.

SAM AVERY

Sam Avery was standing on the ceiling. But to him, it seemed like everyone else was upside down. "You think the ceiling is the floor," he said. "Your mind completely agrees it's the floor. It's one of the craziest things I've ever experienced." Avery was on his second flight on a special NASA plane with UC San Diego's zero-gravity team. They were investigating how biofuels burn in space, at the suggestion of mechanical engineering professor Forman Williams. It was Avery's second stint on the team, this time as captain. Avery is headed for graduate school at Stanford. He'd like to start his own company some day.

Victor Lee, fourth from left.

Photo credit: Tony Wong

VICTOR LEE

Under Victor Lee's leadership, the UC San Diego chapter of IEEE (the Institute of Electrical and Electronics Engineers) grew from about 400 members to 630, becoming the second largest in the nation. Lee said he's just giving back. "I'm pretty sure I owe my success to IEEE," he said. He is graduating with a bachelor's in electrical engineering this year, but he's not quite done with UC San Diego. Next year, he will be a master's student here. "This is what I like," he said. "This is what I'm good at." In his spare time, Lee is transforming his parents' home into a smart house. His latest project is an automatic watering system for his mother's plants.

New Venture Capital Fund to Commercialize Innovations from UC San Diego Community

A group of UC San Diego alumni have created a venture capital fund—the Triton Technology Fund—that is specifically focused on commercializing innovations by UC San Diego faculty, students and alumni. The Triton Technology Fund invests in companies in the software, communications, electronics, materials, medical devices and instruments sectors.

"The Triton Technology Fund is going to accelerate the success of our innovators by injecting crucial resources into our entrepreneurism and commercialization initiatives," said Albert P. Pisano, dean of the UC San Diego Jacobs School of Engineering.

Alumnus David Schwab (B.A. '79, applied sciences), a seasoned venture capitalist, is leading the alumni-driven effort to create the externally owned and managed Triton Technology Fund.

"UC San Diego ranks fifth among the top U.S. universities in federal research and development dollars, with over $1 billion in expenditures for fiscal year 2012," said Schwab. "I am excited about the prospect of working to match UC San Diego-related technologies with specific needs in targeted vertical markets."

The Jacobs School's von Liebig Entrepreneurism Center will help identify and mentor teams interested in working with the Triton Technology Fund.

"We believe that the Triton Technology Fund will have a positive impact on the entrepreneurial culture at UC San Diego and in the local innovation ecosystem," said Rosibel Ochoa, Senior Executive Director of Entrepreneurism and Leadership Programs.

The Triton Technology Fund is part of a larger venture capital fund—Vertical Venture Partners—also created by Schwab. Approximately 20 percent of the Vertical Venture Partners fund will be allocated to Triton Technology projects involving UC San Diego faculty, students or alumni.

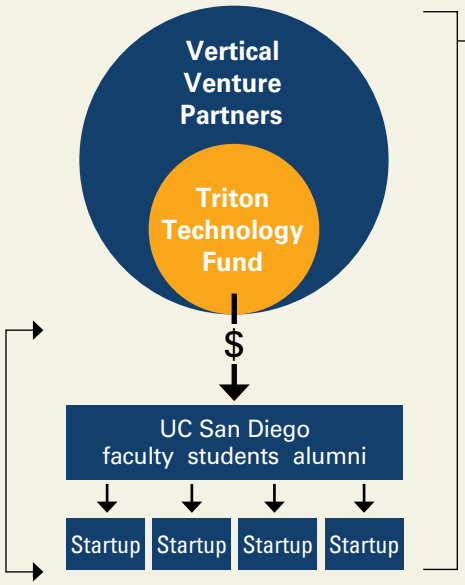
The Triton investment committee, a group of volunteers that advises Schwab, includes UC San Diego alumni Steve Hart (M.S. '80, mathematics), CTO and co-founder of San Diego-based ViaSat; and Paul Conley (M.S. '96, bioengineering; Ph.D. '99, mechanical engineering), a managing partner at Paladin Capital.

According to Sujit Dey, an electrical and computer engineering professor and experienced entrepreneur, the new fund will help unlock the tremendous potential for UC San Diego innovations to be successfully commercialized by faculty, students and alumni.

CONNECT WITH THE TRITON TECHNOLOGY FUND

Are you a UC San Diego alumna or alumnus, student, professor, researcher or staff member who is interested in learning more about the Triton Technology Fund? Get started at: www.ttf.ucsd.edu.

Triton Technology Fund at UC San Diego



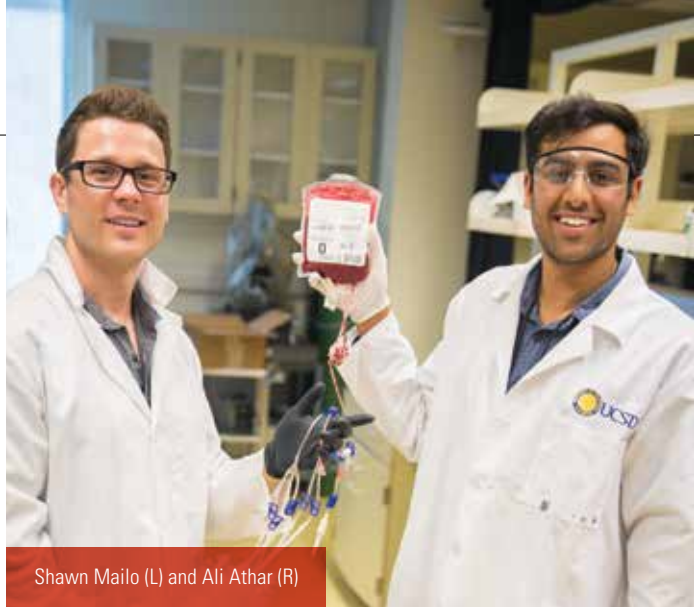
UC San Diego
von Liebig Entrepreneurism Center

- business mentoring
- commercialization advising

Commercialization Focus
Business-to-business enterprises in software, communications, electronics, materials, medical devices and instruments industries.

UC San Diego alumnus David Schwab (B.A. '79, applied sciences)

Determining Blood's Expiration Date


Shawn Mailo (L) and Ali Athar (R)

Hospitals and blood banks routinely discard blood donations after 42 days. But this expiration date, first proposed in the 1950s, is only a rough estimate of how long blood can be stored. Does all blood really go bad in that time?

Ali Athar, a UC San Diego graduate in chemical engineering, and Shawn Mailo, a master's student in bioengineering, are working on a prototype called the Stored Blood Quality Diagnostic Device that may offer a better way of testing the shelf life of blood. Within five minutes, the device would sample a drop of stored blood to measure how much oxygen it can hold and how fast and easily it can transport oxygen. It will also look at whether the red blood cells are still in shape to squeeze through the tiniest veins, said Mailo, who also earned a bachelor's in mechanical engineering from UC San Diego. "We believe that based on these measurements, we can tell how well the blood will function in the body."

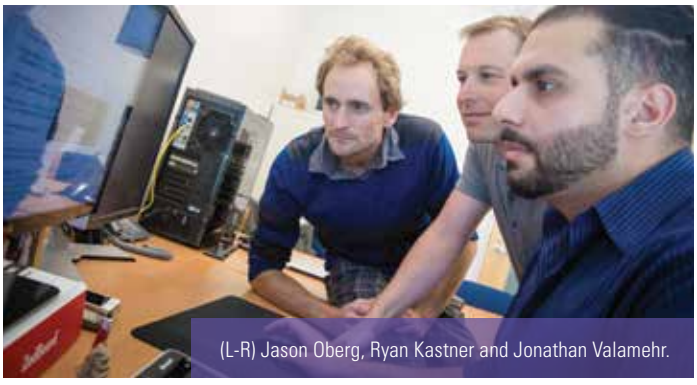
Every unit of blood used in a hospital costs roughly $1000, including operational and administrative costs, so their device could be a money saver as well, Athar explained.

By judging the quality of blood ahead of time, hospitals could prevent the need for repeat transfusions. The device might also alleviate blood bank shortages by keeping the banks from prematurely discarding good blood.

The two have found an essential group of mentors through the Jacobs School's von Liebig Entrepreneurism Center NSF Innovation Corps (I-Corps) program, which helps UC San Diego researchers commercialize their discoveries. As part of the program, they have received funding for lab equipment and advice as well as introductions from a venture capital expert and a regulatory consultant. "It's really been critical for us," Athar said. "Without them, we probably would be lost in a sea of paperwork and have no idea how to get started."

The researchers hope to finish their prototype by September 2014, with an eye to releasing a commercial device in two to three years.

A Safer Internet of Things


(L-R) Jason Oberg, Ryan Kastner and Jonathan Valamehr.

Computer scientists at UC San Diego have developed a tool that allows hardware designers and system builders to test hardware security—a first for the field. One of the tool's potential uses is described in the May-June issue of *IEEE Micro* magazine.

"The stakes in hardware security are high," said Ryan Kastner, a professor of computer science at the Jacobs School of Engineering. There is a big push to create the so-called Internet of Things, where all devices are connected and communicate with one another. As a result, embedded systems—small computer systems built around microcontrollers—are becoming more common. But they remain vulnerable to security breaches. Some examples of devices that may be hackable include medical devices, cars, phones and smart grid technology.

The tool, based on the team's research on Gate-level Information Flow Tracking, or GLIFT, tags critical pieces in hardware security systems and tracks them. The tool leverages this technology to detect security-specific properties within a hardware system. For example, the tool can make sure that a cryptographic key does not leak outside a chip's cryptographic core.

Kastner, postdoctoral researcher Jonathan Valamehr and Ph.D. candidate Jason Oberg started a company named Tortuga Logic to commercialize this technology. The company is currently working with two of the top semiconductor companies in the world.

Engineering Graduates Aim for Game-Changing Green Chemistry

Christophe Schilling, Genomatica CEO and UC San Diego bioengineering alumnus.

Pull on a wetsuit, and you're wearing an engineered marvel created mostly from petroleum-based chemicals. But San Diego-based company Genomatica—co-founded by UC San Diego bioengineering alumnus Christophe Schilling—sees a different future. At Genomatica, the snap of your surfing spandex and a host of other products start with chemicals that have been produced more sustainably, by bacteria that consume something other than crude oil.

In late 2012, Genomatica produced five million pounds of BDO (1,4-butanediol), a chemical essential in the manufacture of thousands of products from fabrics to plastics. They used in-house computational modeling and genetic engineering to design *E. coli* bacteria that produce BDO out of renewable feedstocks such as sugar.

Now licensed to chemical giant BASF and bioplastics leader Novamont, the product is cleaner, more cost-effective to manufacture and performs exactly the same as BDO made from fossil fuels, said Schilling (Ph.D., '00, bioengineering).

"The big companies in the mainstream chemical industry know the end applications of these products and they know the market," he said. "Being able to offer them the ability to sell their customers a renewable version of the same chemical, that's very attractive to them."

Genomatica's success earned it the 2013 Kirkpatrick Chemical Engineering Achievement Award, which recognizes the most noteworthy chemical engineering technology commercialized globally in the prior two years. In 2011, the company won the EPA Presidential Green Chemistry Challenge Award. The two prizes underscore the broad ambitions of Schilling and his team.

"Our model is to be the biotechnology partner to the chemical industry," he explained. "We're an enabler of change, to empower chemical companies with new technology and to make the same exact products they make today, but with better economics and greater sustainability."

Schilling launched Genomatica in 1998 with bioengineering professor Bernhard Palsson, and the company's platform technology stems from research Schilling did in Palsson's lab. Their original focus was a company that would pioneer the use of computational modeling for single-cell organisms in life science applications. But in 2007 the company saw how their technology could "unlock a very large opportunity in the chemical industry," Schilling said, "and that was compelling for us to pursue."

Harish Nagarajan (Ph.D., '12, bioinformatics and systems biology), who graduated from Palsson's lab, said this shift toward sustainable chemicals was part of what drew him to the company. Nagarajan is one of 18 UC San Diego graduates, including six from the Jacobs School, who have joined the company.

Genomatica won *The Scientist's* "Best Place to Work in Industry" award in 2012 and 2013, and Nagarajan and others say the company's collaborative and innovative atmosphere is one of the best they've experienced. Ishmael Sonico (B.S. '91, chemical engineering) especially admires the company's core values, including his two favorites: "We are relentless" and "We are united." From his first days on the job, he said, "I noticed that when someone had an issue, everyone attacked it, as a group... and within hours, not days or weeks, the problem was solved."

The next challenge for Genomatica is to develop a commercially viable production process for butadiene, a key component of tires and latex. But Schilling is looking beyond specific products to having a lasting impact on the industry. "We want to say we helped plant the seeds of change," he said, "so in 10 or 15 years we'll see an already-innovative industry deliver products made in a better way, helping make the products all around us be more sustainable."

Mechanical engineering professor Thomas Bewley, director of the Coordinated Robotics Lab at the Jacobs School of Engineering

Real-Life Toy Story

Jacobs School alums, take note: you can now buy a toy at your local Best Buy that engineering graduate students here at UC San Diego helped design. The toy, named MiP—short for Mobile Inverted Pendulum—is the result of an intense collaboration between the UCSD Coordinated Robotics Lab and toymaker WowWee.

MiP can balance itself and drive around on two wheels. "Its organic nature is particularly engaging: when it stands, it gently sways back and forth; when pushed, it takes a step back to regain its balance. In a very real way, the dynamics of MiP mimic life," said mechanical engineering professor Thomas Bewley, director of the Coordinated Robotics Lab at the Jacobs School of Engineering.

Users can connect with MiP right out of the box in several different modes of play. You can interact with the toy robot immediately using intuitive hand gestures. Install the tray that MiP can carry and test your skill at stacking games. Or put a full soda can on MiP's tray, and drive it to a friend across the room via Bluetooth and a free smartphone app. And, of course, MiP can dance—either to the beat of its own built-in tunes, or to any tunes on the user's phone or tablet.

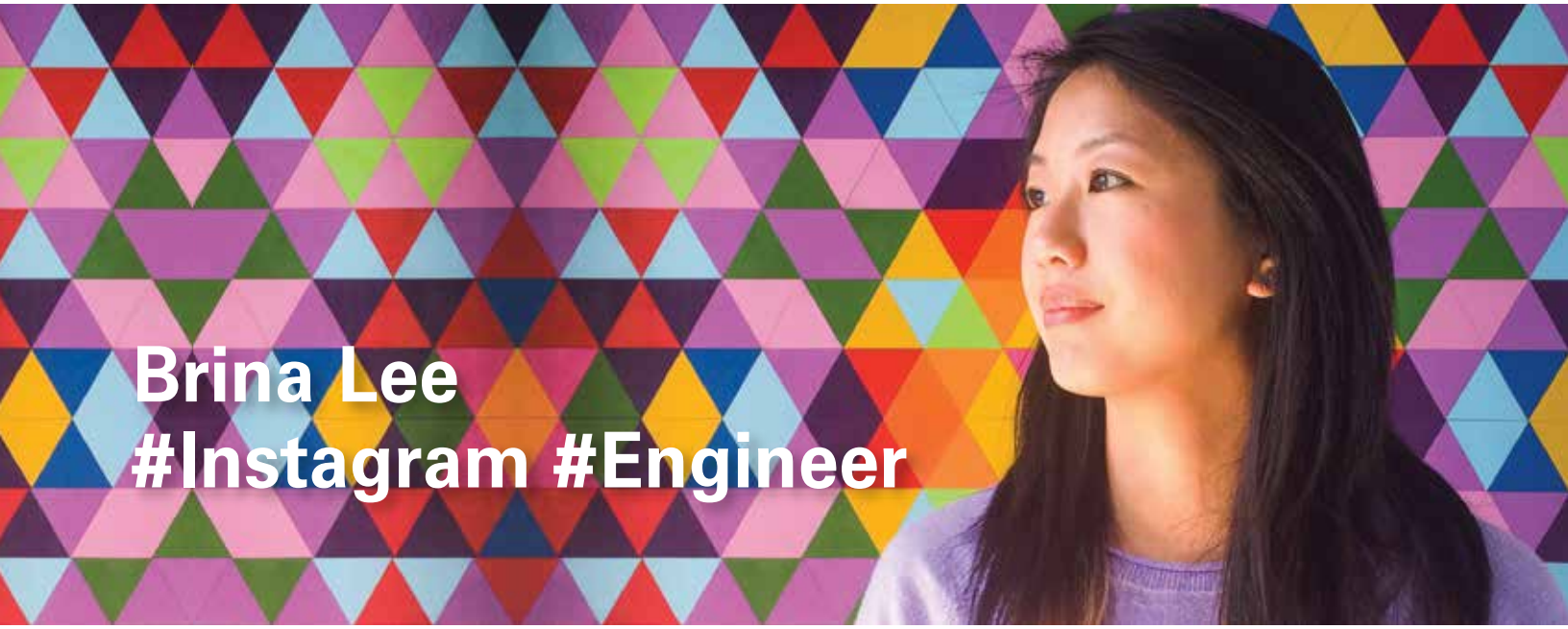
Want one? MiP is available for $100, currently at Best Buy and later more broadly. Convince a buddy to get one too, and they can box, Rock 'Em Sock 'Em–style, via the robot's boxing app.

Researchers in the UCSD Coordinated Robotics Lab designed the algorithms that balance MiP, and helped to select and calibrate the various phone-grade and toy-grade components that make it all work. WowWee designed the robot's body and its user interface, including the smartphone app, and endowed MiP with its unique personality, which it expresses through sound and bright LED eyes.

"The partnership between WowWee and UC San Diego is going to yield some amazing and dynamic products in the years to come," said WowWee USA president Peter Yanofsky. "We are very excited to be on the cutting edge of this ideation and execution, beginning with the amazing MiP."

Ph.D. student Saam Ostovari led the efforts in Bewley's lab to reduce their small two-wheel designs in scale and cost using strict "design for manufacturing" ideas. He helped transfer the lab's experience in solving balancing problems using toy-grade components to WowWee. Ostovari also spent countless hours Skyping and emailing with WowWee's engineers in Montreal and Hong Kong, addressing questions regarding how to bring manufacturing costs down to a bare minimum, while maximizing the toy's fun factor. Ostovari labored in secret over several iterations of the design until January 2014 when he helped WowWee unveil MiP at the Consumer Electronics Show in Las Vegas. Named a Product of the Future by *Popular Science* at the show, MiP was a highly popular finalist in the Last Gadget Standing competition at CES and received critical acclaim from many in the industry.

"That's when it hit me," Ostovari said. "This thing is actually going to be a toy that people can buy."



Brina Lee #Instagram #Engineer

When she first applied for computer science internships as a student here at the Jacobs School, Brina Lee felt like she'd hit a wall of rejection. Lee, who had a bachelor's in communications from UC San Diego and a background in marketing, was turned down across the board. Now fast-forward just two years, and she is the first female engineer to have been hired at Instagram, the popular image sharing app, after it was purchased by Facebook.

How did she do it? Lee became one of the star tutors for computer science teaching professor Rick Ord and worked her way up to a teaching assistant job. She finished her master's degree in computer science in just four quarters and interned at Google and Facebook. The latter hired her in April 2013. After completing the company's boot camp, she chose to work at Instagram, which Facebook had acquired in spring 2012.

The company was a good fit for Lee, a photo enthusiast, who likes to go on photo walks on her days off. Since she started working there, she has been making a special effort to compose her shots. "There is so much creativity and attention to visual details here. I love it being a part of my daily life," she said.

As the only female engineer on the team, Lee believes she brought a different perspective. She was working on the team that builds the tools to show ads on Instagram. Four more women have joined the team in the past year, not including female interns, Lee explained.

Asked what she learned here at the Jacobs School, Lee's first answer is persistence. "Rick told me to keep trying" after she didn't land an interview for an internship, she said. Ord remembers things a little differently. Lee was already quite persistent before becoming his student, he said. "In one word: attitude," Ord said. "Brina had the right attitude."

Lee successfully took all prerequisite undergraduate computer classes while tutoring Introduction to Java and Discrete Mathematics as a volunteer. She then officially became a computer science master's student and became Ord's teaching assistant for the same Intro to Java class where she had been a tutor. This was her favorite experience at UC San Diego, she said. She learned how to better communicate, explain the issues, teach and mentor. "It's exciting to see a group of young minds learn something new and discover their passion for technology," she said. "I'm a huge advocate for everyone to learn how to code, no matter what industry they are in or will be in the future."

During her time at the Jacobs School, Lee also worked on a master's project with computer science professor Ryan Kastner. She built a wearable device called Droop, which helped identify bad posture. "It was 100 percent Brina's idea, and it spanned several CS topics, including embedded systems, human-computer interaction and mobile computing," said Kastner. "It also showed how computing can make an impact in everyday life."

Camaraderie was another thing Lee gained from the Department of Computer Science and Engineering. Many of her former fellow undergraduate and graduate students now work at Facebook and keep in touch. "The great thing about the Jacobs School is that we graduate as a team and we still work as a team," she said. "We try to understand tech problems together."

The camaraderie goes beyond one company and extends to Silicon Valley as a whole. Alums see each other at birthday parties and weddings. "One team, one dream," she said.

UCSD Pascal Still Resonates

Bruce Sherman, a UCSD Pascal Pioneer, honors Ken Bowles through a computer science scholarship

Bruce Sherman was all business almost from the moment he arrived at UC San Diego in 1977. Intrigued by an introductory programming class required for his economics degree, he joined the team of student researchers working on the UCSD Pascal Project. UCSD Pascal, a modification of the programming language Pascal, was created by computer science professor Kenneth Bowles as a way to teach programming on the microcomputers that were beginning to replace mainframes on campus. UCSD Pascal was on the verge of wider public release, and Sherman worked as one of the project's first technical support team members.

Sherman followed UCSD Pascal and Bowles through the historic first decades of the software industry. With other project veterans, he worked at SofTech Microsystems as the company commercialized UCSD Pascal. And when Bowles launched his own company TeleSoft in 1981, he brought Sherman on board to handle sales and marketing. TeleSoft's success helped Sherman retire when the company was sold 10 years later.

"My early undergraduate research experience launched me into an amazing career," Sherman said. "I can't emphasize enough how important an experience that was, and I'd like to support other students in having a similar experience."

To that end, Sherman has established a living trust to contribute to the Kenneth Bowles Endowed Scholarship for Computer Science. It's a deeply personal gift for him, one that reflects the pride he feels in being part of the UCSD Pascal Project and in working with Bowles.

Bowles' caring management style and visionary mindset were critical to the Project's success, Sherman recalled. "While it was happening, we knew we were doing something interesting, but I don't know if we knew how iconic and important it would be."

Sherman's research background made him valuable at TeleSoft, but the personal contacts he made at UC San Diego were also important. Undergraduates may think of campus research as a chance to hone their technical skills, he said, but they shouldn't overlook the community and networking opportunities that linger long after graduation.

Today, Sherman works as a Registered Investment Adviser for a select group of clients—some of them old friends from TeleSoft —and as a senior vice president of portfolio management at Telos Capital Management, Inc. His gift to the Bowles Scholarship is one that resonates with his passion for helping people grow and create with their wealth. "It feels right to give back to that, to give opportunities to others, especially in view of my career where I'm helping other people plan their legacies," he said.

The Kenneth Bowles Undergraduate Scholarship

Established in 2005, the Kenneth Bowles Scholarship Endowment Fund provides, in perpetuity, scholarship funds to support one CSE undergraduate student for four consecutive years. Gifts to support this scholarship and many other Jacobs School initiatives are needed and greatly appreciated.

If you would like to make an outright gift (of cash or appreciated securities) to the Kenneth Bowles Scholarship Endowment Fund and help students today, visit: http://bit.ly/1I7A2mB and enter the Bowles Scholarship Fund #2303

Contact **Jan Dehesh**:
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Making a planned gift.

For more information on how to join Bruce Sherman and include the Jacobs School in your estate plans, please go to:
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Contact **Danielle R. Dawson**, JD, director of development at the UC San Diego Foundation's Office of Gift Planning for a free, no-obligation consultation:
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