College of Engineering
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Volume 14

Microrobots
Flying, walking, jumping

Q&A with Tsu-Jae King Liu
New dean of engineering

Berkeley ENGINEER

Fire & Water
Wiser wildfire management

Coming together as a community

At the beginning of this semester — my first as dean — I had the pleasure of welcoming more than a thousand new engineering undergraduates during student orientation. It was a wonderful opportunity to reflect upon the college's strong tradition of impact and look forward to a brighter future shaped by Berkeley engineers. Throughout the course of the semester, I have enjoyed meeting many other students, as well as alumni, parents and friends of Berkeley Engineering at various events. The enthusiasm and creative energy of students, impressive achievements and impactful contributions of alumni and strong support of parents and friends is truly inspirational — and they are in turn inspired by our outstanding faculty and dedicated staff, who are critical to the success of our mission.

Key to innovation with impact is the identification of important problems that are most worthwhile to solve. In consideration of global trends such as urbanization, increasing average life expectancy and the proliferation of information and communication technology, grand challenges for our society will respectively include environmental sustainability, human health and well-being and digitalization — all of which are intertwined with the issue of inequality. These are complex problems that transcend disciplinary, socioeconomic, cultural and political boundaries. To come up with effective solutions, we must bring together a diversity of perspectives, experiences and skills. In other words, Berkeley Engineering should be a place of convergence that results in new innovations, companies and industries, along with new knowledge and new graduates. You can read more about my goals with regard to diversity and inclusion in the Q&A in this issue of *Berkeley Engineer.*

To come up with effective solutions, we must bring together a diversity of perspectives, experiences and skills.

As the university's sesquicentennial celebration draws to a close, we should keep in mind that our ongoing success is tied to the well-being of our campus community as a whole. In my previous role as vice provost, I met people from across campus who were struggling with the effects of inadequate resources in the university, lack of affordable housing and food insecurity. We should be aware of and empathetic with the struggles of our fellow community members, and seek opportunities to help them much the same as we aim to help people in other parts of the world.

I look forward to working with you all to ensure that Berkeley Engineering will shine and continue to be a beacon of light for the world through the next 150 years!

—*Tsu-Jae King Liu*
DEAN AND ROY W. CARLSON PROFESSOR OF ENGINEERING

Dean Tsu-Jae King Liu welcomes a group of new students from the Management, Entrepreneurship, & Technology undergraduate program during student orientation. The engineering and business dual-degree program is now in its second year.

Noah Berger

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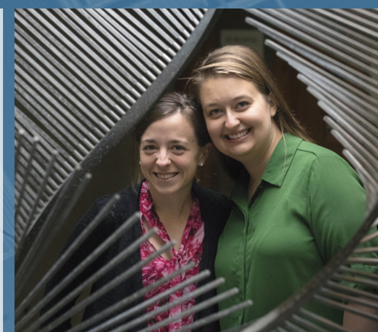

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PHOTO BY **ADAM LAU**

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LEADERSHIP

Expanding the pipeline

Noah Berger

To help strengthen the next generation of engineering leaders, Berkeley Engineering and Michigan Engineering co-hosted a three-day workshop in September to prepare diverse graduate students and recent doctoral graduates for a career in higher education.

Nearly 70 Ph.D. students and postdoctoral researchers from 30 institutions across the country convened at Berkeley for NextProf Nexus, designed to encourage more women and traditionally underrepresented groups to apply for engineering and science faculty positions.

Panelists and featured speakers at the workshop consisted of distinguished faculty, administrators and NextProf alumni from across the country, including **Michael Brown,** provost and executive vice president of the University of California, who spoke about diversity in the UC system in his keynote presentation.

"A growing body of research shows that the best solutions come from diverse teams. As engineers, we're called upon to solve some of the most important challenges society faces," said **Kara Nelson,** NextProf Nexus co-chair, associate dean of equity and inclusion at Berkeley Engineering, and a professor of civil and environmental engineering. "To develop the most creative and successful solutions, we need all the talent at the table."

Noah Berger

MACHINE LEARNING

Fighting fake news

With nearly every major news story comes a barrage of fake photos spread across the internet, often reaching viral status on social media. But it can be challenging and time-consuming to verify which images are authentic and which have been Photoshopped, preventing people from getting accurate news and skewing the online conversation.

Undergraduate students **Rohan Phadte,** an electrical engineering and computer sciences major, and **Ash Bhat,** an interdisciplinary studies major, figured there had to be an engineering solution for this problem. They've created a machine learning tool that helps people identify when an online photo has been doctored or is fake news. Called SurfSafe, their browser plug-in instantly checks online images against news sources and fact-checking sites, such as Snopes.com and Factcheck.org, then places warnings on falsified images. Just one month after its release, SurfSafe already had 4,000 users.

"In this day and age, we should all be reading fact-checking sites, but it's so unreasonable to expect each of us to spend 30 minutes online every day reading these things," said Bhat. "Instead, we've created an extension that you can download in 30 seconds and that will do all of the fact-checking work for you."

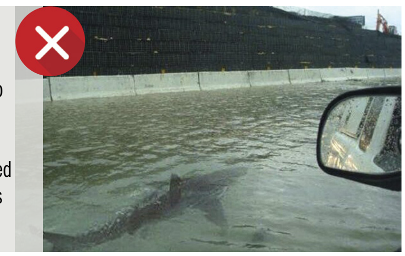
SurfSafe is just the latest offering from the duo's startup, RoBhat Labs, which they launched out of their apartment in 2017. Last fall, they released BotCheck.me, a browser extension that uses advanced machine learning to detect and tag posts from political propaganda bots. One year after its release, BotCheck.me has more than 62,000 users and boasts an accuracy rate of 97.5 percent.

So what's next? Phadte and Bhat — friends since middle school — have now brought five other Berkeley undergrads onto their team. Their plan is to make RoBhat Labs "the Norton AntiVirus of fake news," using machine learning techniques to fight online misinformation, in all its insidious forms.

Adam Lau

ASH BHAT
interdisciplinary studies

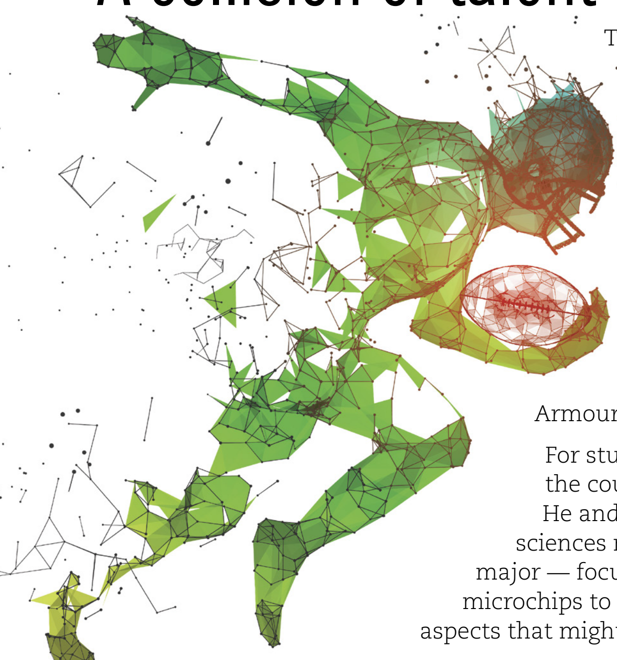
ROHAN PHADTE
electrical engineering and computer sciences



In 2017, following Hurricane Harvey, this doctored photo of a shark on a flooded highway in Houston was shared thousands of times on social media.

SPORTS TECH

A collision of talent



This spring, students from science, engineering, math and other technical majors came together with student-athletes as part of the introductory Sports Tech Collider Sprint course, offered by the Sutardja Center for Entrepreneurship and Technology (SCET). Divided into teams of 3–5 people, students were tasked with developing an idea that combined technology and innovation with a goal to create competitive advantages for athletes and sports teams.

"We're for the first time taking some of our best, brightest science, technology, engineering, math students on campus and putting them in a classroom with some of our best student-athletes," said **Stephen Torres,** a SCET industry fellow who came up with the idea.

The results were, to use Torres' word, amazing. Expecting maybe 15–20 students, more than 60 expressed interest and about 30 were eventually accepted. Under Armour even signed on as a sponsor.

For students like **Evan Rambo,** a legal studies major and safety for the Cal football team, the course was a way to explore his interests in injury prevention and player movement. He and his team — which included **Sahil Hasan,** an electrical engineering and computer sciences major, and **Tushar Mittal,** a chemical biology and materials science and engineering major — focused on developing wearable technology for football players. Gloves were fitted with microchips to aid with technique analysis, allowing players and coaches to evaluate performance aspects that might not be captured on video.

The team ended up taking first place in the course's final presentations, as well as SCET's prestigious Collider Cup. As for what's next, Rambo, Mittal and Hasan plan to keep working together to develop their model, with the hope of making it a fully marketable product someday.

And with an expanded version of the Sports Tech Collider being offered this fall, expect another good cross section of students to begin creating new and impactful sports-related technology, as well.

"It's not just athletics. It's not just academics," Torres said. "It's really [all of] us working in sync."

ADAPTED FROM AN ARTICLE BY HERB BENENSON, PUBLISHED IN THE SUMMER 2018 EDITION OF *CAL SPORTS QUARTERLY*

Q+A with Dean Tsu-Jae King Liu

Noah Berger

Tsu-Jae King Liu began her appointment as the 13th dean of Berkeley Engineering in July, becoming the first female dean in the college's 150-year history. She has been an international leader in the field of electrical engineering for more than 20 years, known for her pioneering research in semiconductor devices and technology, as well as her accomplishments as a teacher and administrator. She earned her B.S., M.S. and Ph.D. degrees in electrical engineering at Stanford University, then worked as a researcher at Xerox Palo Alto Research Center (PARC) before joining Berkeley's Department of Electrical Engineering and Computer Sciences (EECS) faculty in 1996. She has held several key administrative positions at Berkeley, including vice provost for academic and space planning from 2016–18 and EECS department chair from 2014–16.

Dean Liu recently sat down with *Berkeley Engineer* to talk about her vision and priorities for Berkeley Engineering. The following has been edited for length and clarity.

Let's start by talking about your background and how you first became interested in engineering.

My parents both came from Taiwan to the United States for graduate study. As graduate students at Cornell University, they met, got married and had me. My mother studied chemistry, while my father studied applied physics, although he had majored in electrical engineering at National Taiwan University. Growing up, I met many of my father's former college classmates at their annual reunions. Many had become engineers, so I got a sense back then that engineers were respectable and made a good living.

What brought you to California?

After earning his Ph.D. degree from Cornell, my father moved our family to California to pursue earthquake research. He did postdoctoral work at Caltech and UCLA before moving to the Bay Area to work at the USGS (United States Geological Survey) in Menlo Park. I grew up in Los Altos and consider it my hometown.

I applied to just a few universities during my junior year in high school, figuring that if none of them admitted me, I could always stay for my senior year and apply again the following year. I ended up getting into MIT, Caltech, UC Berkeley and Cornell; I chose Caltech because it was small and not too far from home.

In making this choice, I didn't realize that diversity — or, rather, the lack thereof — would be an issue for me. During my freshman year, the ratio of men to women was roughly 10 to 1. It wasn't that women were considered inferior intellectually. But when the ratio is so unbalanced, it doesn't make for a normal social climate. I was very shy back then and uncomfortable with the extra attention paid to me as a female student. That's why I ended up transferring the following year to Stanford.

How have things changed with regard to diversity since you were a student?

While diversity has improved in some sub-fields of engineering, it has declined in others. According to the National Center for Science and Engineering Statistics, diversity in engineering overall and in computer science has dropped in the past decade. Today, less than one in five bachelor's degrees in engineering or computer science in the United States is earned by a woman; the numbers are worse for underrepresented minority groups. This has resulted in low representation among engineering and high-tech industry professionals. The shortage of diverse role models in engineering perpetuates this issue.

This is an urgent matter because the pace of technological advancement is increasing. According to the Bureau of Labor Statistics, the United States faces a long-term deficit of workers skilled in computing and information technology. At the same time, women hold nearly 60 percent of jobs with a very high risk of computerization. Each of these issues can be addressed by closing the diversity gap and having engineers and computer scientists better represent the general population.

You've presented an interesting perspective of Berkeley Engineering's mission, one that considers diversity, equity and inclusion to be intrinsic values: Educating *Inclusive* Leaders, Creating Knowledge *Equitably* and Serving a *Diverse* Society. Can you explain why?

A key measure of the college's success is its impact. Today we live in a globally interconnected society comprising individuals of different racial, ethnic, cultural and socioeconomic backgrounds, who have a range of political and religious views, with differences in gender and sexuality, age and physical ability. To maximize the breadth of our discoveries, creativity of our innovations and reach of our educational programs, we must include the perspectives and value the contributions of people from every segment of our diverse society. Likewise, in order for our alumni to become more effective leaders, they must learn to be inclusive. I aim to elevate Berkeley Engineering to a higher level of excellence and impact by fostering an inclusive community so that all members can thrive and reach their full potential, with transformational impact in the fields of engineering and computer science.

There is a growing body of published research showing that diversity is advantageous for large organizations, as measured by financial performance and other metrics of success. A distinguished alumnus, Chancellor Gary May of UC Davis, gave a commencement speech at Berkeley in which he noted that air bag systems in cars were designed with the adult male body in mind. As a result, many smaller passengers were injured when these systems were first deployed. Gary also noted that sensors in automatic faucets still fail to detect the back of his hands because of his dark skin. These examples illustrate why diversity within engineering teams is important.

Some college-sponsored initiatives to foster inclusion include the Women in Technology Initiative at the University of California (WITI@UC), which I co-founded to address barriers for women in the tech industry. We also partnered with Michigan Engineering to host the NextProf Nexus workshop on the Berkeley campus earlier this year, as part of a nationwide effort to strengthen and diversify the next generation of academic leaders in engineering.

What are some of your near-term goals as dean?

UC Berkeley stands out for its breadth of excellence; we have the greatest number of graduate programs ranked in the top five by the National Research Council. By strategically leveraging this strength of the campus — as well as our proximity to Silicon Valley and San Francisco — we can gain an advantage over competing schools and colleges. Therefore, I aim to build or strengthen collaborative ties with other academic units on the Berkeley campus, with the Lawrence Berkeley National Lab and with industry. Collaboration with the social sciences and humanities becomes all the more important with the growing economic, social and political impacts of technological advances.

What opportunities and challenges are ahead in engineering education at Berkeley?

An ongoing challenge is accommodating burgeoning student demand for computer science courses, including at the upper-division level, with limited resources such as funding for teaching assistants, classrooms and lab space. I think there are exciting opportunities to leverage the tremendous advancement and proliferation of information and communication technology to effectively deliver educational content in new ways to enhance student learning and also to expand the reach of our programs, for example to students and working professionals around the world.

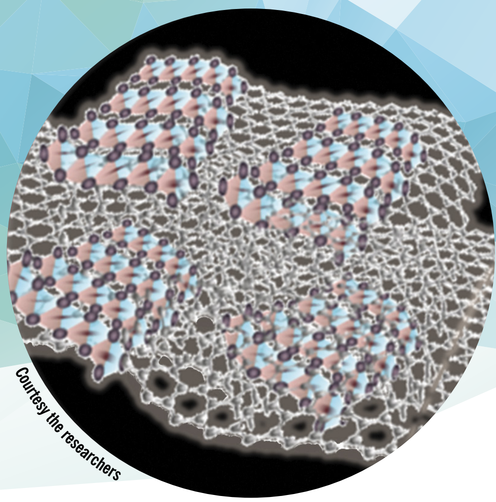
As the average life expectancy continues to increase, people will work for more years before retirement. Especially for those looking to re-enter the workforce or change careers, there is a growing need to update one's knowledge and skills — all the more so as digitalization transforms the nature of work, eliminating jobs that can be automated. We should aim to make our engineering programs as broadly accessible as possible.

What's your long-term vision for Berkeley Engineering? How do you see it looking in 10–15 years?

The culture within the college will be more inclusive, setting new standards for excellence and access in research, education and service to society. Since Berkeley Engineering is the largest supplier of technical talent in the Bay Area, it is my hope that our graduates will become ambassadors of equity and inclusion and transform the culture in the tech industry and in engineering. That is the level of impact that the leading college of engineering in the world should aspire to.

CIRCUITS

Origami electronics

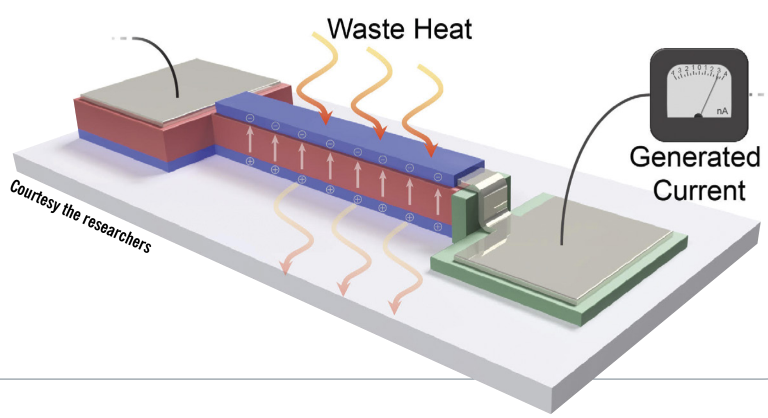


Research from the lab of **Liwei Lin,** professor of mechanical engineering, has given new meaning to the term "working paper." Using inexpensive materials, the scientists have fabricated electronic switches and sensors directly onto paper, where simply folding it could switch circuits on and off or otherwise change their activity — a kind of electronic origami. This new technology uses molybdenum carbide as the conducting metal. Molybdenum ions are added to gelatin in solution; the paper is then coated with the solution and dried. A laser beam precisely "writes" the desired circuitry patterns — about 100 microns wide — heating the molybdenum to about 1,000 degrees centigrade and forming conductors of durable molybdenum carbide. The unheated portions of the paper remain non-conductive, and the gelatin coating prevents the laser beam from burning the paper. Future research in this area will be focused on integrating components for energy generation, storage and functional use all on a single piece of paper.

MATERIALS

From waste heat to energy

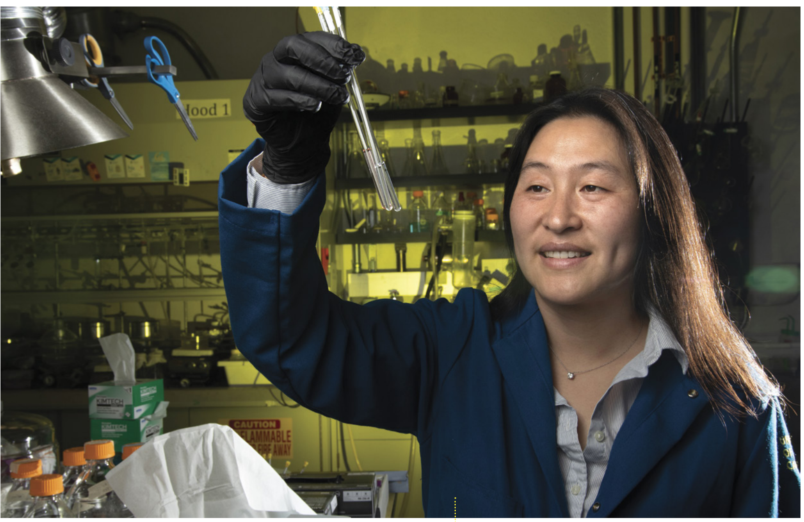
Nearly 70 percent of the energy produced in the United States each year is wasted as heat, much of it emanating from computers, cars or large industrial processes. But now, researchers led by **Lane Martin,** professor of materials science and engineering, have developed a thin-film device that converts waste heat from electronics into energy, using a process called pyroelectric energy conversion. The team synthesized thin-film versions of materials just 50 to 100 nanometers thick and then, together with the group of **Chris Dames,** associate professor of mechanical engineering, fabricated and tested the pyroelectric-device structures based on these films. Accurately measuring the properties of thin-film versions of pyroelectric systems had been a challenge, but these structures allowed the engineers to simultaneously measure temperature, electrical currents and source heat to test the device's power generation capabilities. The results suggest that, for fluctuating heat sources, the thin film can turn waste heat into useable energy with higher energy density, power density and efficiency levels than other forms of pyroelectric energy conversion, particularly from high-speed electronics.



ENVIRONMENT

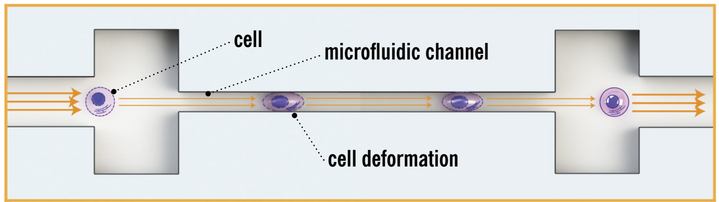
Cleaning up contamination

Like toddlers and orchids, proteins can be fussy. Remove proteins from the cell, and they will likely break down. But researchers led by **Ting Xu,** a professor with appointments in materials science and engineering and in chemistry, have figured out a way to keep certain proteins active outside of the cell, and have used this technology to create mats that soak up and trap chemical pollution. Previous efforts to stabilize proteins outside of the cell have yielded limited success, so the team developed a synthetic polymer — called RHP — that provides all the things a protein would need to keep its structure and function outside of its native environment. The RHPs were then mixed with a protein called organophosphorus hydrolase to make fiber mats that successfully soaked up a toxic insecticide. Xu said this approach should be applicable to other enzymes and materials, opening the door to larger mats that could be used in places such war zones or other contaminated sites.



Adam Lau

TING XU
materials science and engineering/chemistry



Courtesy the researchers

DIAGNOSTICS

Better breast cancer screening

Over the course of her lifetime, a woman in the United States has a one in eight chance of developing breast cancer. Key to the diagnosis is a biopsy, where cells are visually examined under a microscope by a pathologist. But microscopy inspection isn't totally quantitative, and cancer cells may be missed or normal cells mistaken for cancer cells. Now, technology developed by mechanical engineering professor **Lydia Sohn** and her research group could dramatically improve the accuracy of early breast cancer detection. Their technology, called mechano-node-pore sensing, or mechano-NPS, uses microfluidics — an inexpensive process in which small volumes of liquids flow under pressure through extremely small tubes, or micropores — to measure the relative softness or stiffness of isolated breast cells. Previously, the researchers had discovered that cancerous breast cells travel through the micropores more quickly than non-malignant cells because they are more pliable, or elastic. Using mechano-NPS, the researchers are now able to distinguish between two key subpopulations of breast cells that are central to breast cancer development. The researchers believe their technology should be applicable to samples from different biopsy procedures, and hope it can be expanded to test for other types of cancers.

HEALTH

Calorie burner

Brown fat, the fat cells that help mammals regulate their body temperature, could become a target for weight-loss drugs, thanks to a discovery by Berkeley researchers. The multidisciplinary team, including bioengineering professor **Sanjay Kumar** in collaboration with Andreas Stahl from nutritional sciences and toxicology, has identified the specific biochemical pathway that activates brown fat and causes the body to burn more calories. The researchers learned that when the brain releases norepinephrine, brown fat cells

stiffen, triggering a series of signals that end with these cells soaking up fat and sugars from the diet and burning them for heat. Furthermore, they determined the key role in this process played by myosin – a protein also found in muscle cells – which stiffens brown fat cells. As a test, the team used a drug to increase tension in brown fat cells and were able to show that this approach can lead to the burning of more calories. Future work will be focused on finding the right chemical compound to do this effectively.

ADAPTED FROM ARTICLES BY WALLACE RAVVEN, BERKELEY ENGINEERING, AND BRETT ISRAEL, UC BERKELEY OFFICE OF PUBLIC AFFAIRS

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Fire & Water

BY NATE SELTENRICH

Restoring natural fire regimes to California's mountains could be a win-win-win: more water, improved biodiversity and a reduced risk of catastrophic fires

The verdant meadows of Illilouette Creek drain directly into the southeastern corner of bustling Yosemite Valley via 370-foot Illilouette Falls. Springtime wildflower displays draw crowds from the popular lookout at Glacier Point, a short hike away.

The Illilouette Creek Basin also happens to be surrounded by a bowl of pure Yosemite granite, meaning its 40,000 acres are actually quite isolated in one important way: fire. When a blaze ignites by lightning, it's not likely to escape. Typically firefighters don't even bother.

In fact, despite its proximity to one of California's largest tourist draws, the Illilouette Basin is one of two wilderness areas in the state where fire officials allow lightning-sparked fires to burn by default with careful monitoring. That makes it an ideal living laboratory for scientists like Sally Thompson, professor of environmental engineering, who has used it to study how the frequency of fire affects the movement of water through the landscape.

Thompson's findings in the basin provide promising new evidence that the sort of natural fire regime seen in the Illilouette Basin since the current policy was enacted in 1972 can alter local hydrology in meaningful, largely beneficial ways — including sending more water downstream to end users.

Elsewhere in California, suppression is the name of the game: extinguish all flames at any cost. And while fire exclusion began to be widely practiced here in the late nineteenth century — with the overall goals of protecting lives and increasing timber output — it has of late been shown to have the opposite effect by building denser, duff-covered forests that eventually fuel massive, uncontrollable fires.

Frequent, moderate-intensity burns in California forests don't just reduce the risk of catastrophic fire. They also serve an ecological role by promoting biodiversity and the regeneration of fire-adapted native plants.

And, as Thompson's findings in the Illilouette Basin over the past five years have shown, fire can also be a boon to both local ecosystems and water users far downstream — including humans — largely because fire-thinned forests consume less water and offer more space for meadows and wetlands.

"If you take out deep-rooted trees and you replace them with more shallow-rooted plants like shrubs and grasses, those don't have access to as much water and they don't use as much," Thompson explains. "So in the absence of those trees, you're storing more water in the soils and groundwater, and that leaves the whole system more primed to start creating runoff and streamflow."

Snowpack is another important factor, although somewhat less intuitively: rather than cooling snow with shade, at the right elevation a dense forest can actually make it melt by trapping heat. Monitoring in the Illilouette Creek Basin over the past three winters has shown that snowpack is larger and persists for longer in burn gaps, Thompson says.

Put simply, more frequent, smaller fires mean more water. "Everything we see points to a wetter landscape: a watershed that has more water stored in its soils and in its groundwater, where the trees seem to get through the drought a bit better than trees in neighboring landscapes, and where we think there's an increase in the amount of stream flow that's coming from the basin."

Granted, the size of the streamflow effect is small: increased annual runoff from the basin today is estimated to be roughly seven million cubic meters — or about 1/60th of the capacity of the Hetch Hetchy reservoir — above what it was pre-1972. But replicate that at a few additional sites in a state that already needs more water and is staring down a drier, hotter climate, and the implications are positive.

"Given that we are facing a future where we're expecting everything to head in the other direction as far as water availability from these watersheds goes," Thompson says, "it seems like a management strategy that might start to give us more resilience for water resources."

"THE HYDROLOGY IS CHANGING HERE"

A native of Australia who holds a Ph.D. in environmental science from Duke University, Thompson first came to Berkeley in January 2012. Although her interest in how ecosystems and water cycles interact — a field known as ecohydrology — extends well beyond fire, it was during her very first weeks here that she became intrigued by the Illilouette Creek Basin.

The introduction came by way of esteemed Berkeley fire ecologist Scott Stephens, a professor in the College of Natural Resources' Department of Environmental Science, Policy and Management who has worked in the basin for the better part of two decades. His own research there began shortly after the Hoover Fire of 2001, which burned more than 7,000 acres and cleared large, dense stands of lodgepole pine in the southeastern portion of the watershed.

"After the Hoover Fire, we walked into a few of these places, and even in the middle of summer, you're walking in four inches of water," Stephens recalls. Where before had stood a forest now grew a wetland. "When I just pondered that, I said, 'My goodness, it looks like the hydrology is changing here.'"

LEFT: Katya Rakhmatulina (Photo by Adam Lau); **RIGHT:** burned tree in Illilouette Creek Basin, with Half Dome in background (Photo by Emily Gonthier); **OPPOSITE PAGE:** Illilouette Creek (Photo by Emily Gonthier)

Suspecting she might be able to help, Stephens shared this observation with Thompson during her third week on campus. He was right, and they've been working together ever since.

The modern history of the Illilouette Creek Basin, meanwhile, reaches back to the mid-1870s. That's when the National Park Service (NPS) officially adopted the policy of fire suppression that would be overturned a century later. During that period, Stephens says, the NPS extinguished about 80 fires in the basin, the largest of which grew to just a couple of acres. In other words, this 40,000-acre parcel experienced no significant fires for 100 years — an astonishing fact given that, as research out of Stephens' lab later demonstrated, in preceding centuries it had burned once every 8–15 years.

That all changed when the NPS, spurred by new research illustrating the importance of fire to Sierra Nevada forests, lifted the policy of suppression within the Illilouette Creek Basin in 1972. Instead, it adopted an approach known as "prescribed natural fire," which stipulates that unless the flames threaten to escape or to generate harmful levels of smoke, they're allowed to start and end on their own, with no human intervention at all.

That's exactly what has happened with the vast majority of fires to ignite there in the last 45 years, Thompson says, including the very first, which kicked off the post-suppression era with a bang in 1973. After the 2001 Hoover Fire, the basin burned again in 2004 in another area, then stayed quiet until last summer's Empire Fire, which gave Thompson and Stephens the chance to watch it transform in real time. Cumulatively, forest cover has been reduced by about 20 percent since the reintroduction of fire.

The Illilouette Creek Basin may be unique in Yosemite, but it's not entirely alone. About 80 miles south, in the heart of Sequoia-Kings Canyon National Park, lies the Sugarloaf Creek Basin, at a similar elevation and also about 40,000 acres in size. Although it's more remote and less studied, it has a very similar fire history to that of Illilouette Creek: fires began being suppressed in the 1870s — with great success — but were allowed to return starting in the 1970s. Together, these remain the only large parcels of public land in the state that are allowed to burn.

Sugarloaf doesn't burn as frequently and has been monitored less, Thompson says, but for research purposes it provides a counterpart to Illilouette where, going forward, similar questions can be asked and ideas tested about changes to the water cycle triggered by wildfire.

BOOTS ON THE GROUND

To better understand the fire-water connection within both basins, Thompson, Stephens and their collaborators — including Katya Rakhmatulina, a Ph.D. student in systems engineering from Thompson's

LEFT TO RIGHT: charred remnant in Illilouette Creek Basin; Katya Rakhmatulina and Emily Gonthier; fieldwork at shrub site in Illilouette Creek Basin; Emily Gonthier at creekside; Illilouette Creek (Photos by Adam Lau)

lab, who is the current student lead on the project — have employed a mix of historical data, remote sensing and fieldwork.

Historical sources include old aerial photographs, stream-flow measurements collected downstream on the Merced River since 1905, and precipitation data also extending back to the early 20th century. At both sites the team maintains three weather stations: one in a wetland, one among shrubs and one in a forest. These continuously gather data on climatic variables including temperature, precipitation, wind speed and soil moisture. They also record visual images that are helpful for monitoring snowpack.

But none of this would be possible without boots on the ground, and these days those boots most often belong to Rakhmatulina. Since teaming up with Thompson last summer — after taking over for Gabrielle Boisramé, who helped launch the project and earned a Ph.D. in environmental engineering in 2016 — Rakhmatulina has spent weeks in the mountains, manually sampling moisture levels in soils and woody debris or downloading data and replacing sensor batteries. The work involves skiing or hiking in and then camping out, often for days in a row, even in snow, she says.

Back at Berkeley, Rakhmatulina analyzes data and refines and tests the team's hydrologic model of the Illilouette Creek Basin. "Once you have set up the model, you can start playing with it," she says — to see what changes with things like snowpack and streamflow. "You can start with modeling historical fires, then increase their frequencies, and add the effects of future climate change."

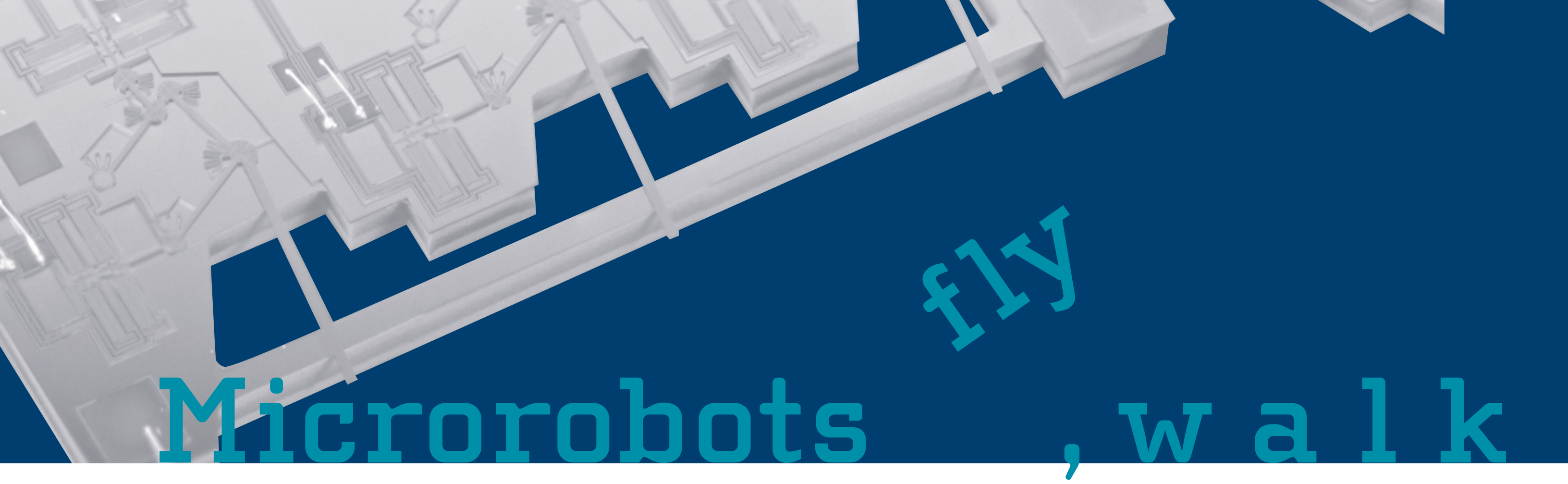
Along with this work factoring in the latest projections, Thompson says she'd like to investigate whether the altered water cycle in the Illilouette may be changing how the fire cycle works, with the wetter soils and fuels. She and Stephens have also discussed the possibility of studying water-cycle effects of mechanical forest thinning downslope in more populous areas.

Many of Thompson's future contributions will be remote, however, since she'll be taking an associate professor position the University of Western Australia. However, Thompson will remain an adjunct professor at Berkeley and continue to co-lead the project from afar.

The research's ultimate goal, she says, remains unchanged: to generate data for California forest managers that may aid in the weighing of different approaches. That could mean continued fire suppression; low- to moderate-intensity prescribed burns that reduce fuels on the forest floor but don't clear many trees; costly mechanical thinning; or, finally, expanding the practice of managed wildfire — which Thompson believes may be appropriate for nearly a fifth of the Sierra's total area.

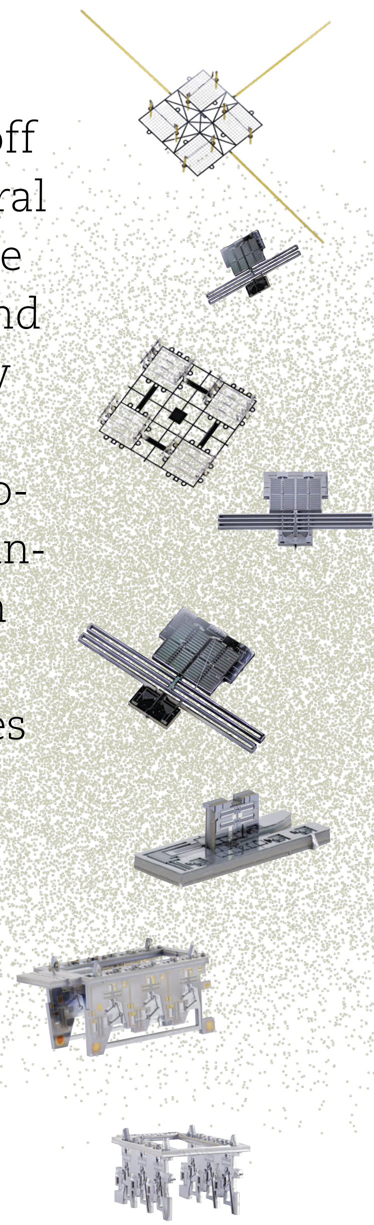
"I think there's momentum in that direction. The concept of managed wildfire has been around for a long time. This isn't a new idea, but it's a scary idea. It feels like relinquishing control," she says. But in many ways, the message is already clear: "We really need fire in these ecosystems."

See video and photo extras at **engineering.berkeley.edu/magazine.**



Microrobots fly, walk

STORY BY JENNIFER HUBER • PHOTOS BY ADAM LAU



A TINY ROBOT takes off and drunkenly flies several centimeters above a table in the Berkeley Sensor and Actuator Center. Roughly the size and weight of a postage stamp, the microrobot consists of a mechanical structure, propulsion system, motion-tracking sensor and multiple wires that supply power and communication signals.

This flying robot is the project of Daniel Drew, a graduate student who is working under the guidance of electrical engineering and computer sciences professor Kris Pister (M.S.'89, Ph.D.'92 EECS). The culmination of decades of research, these microrobots arose from Pister's invention of "smart dust," tiny chips roughly the size of rice grains packed with sensors, microprocessors, wireless radios and batteries. Pister likes to refer to his microrobots as "smart dust with legs."

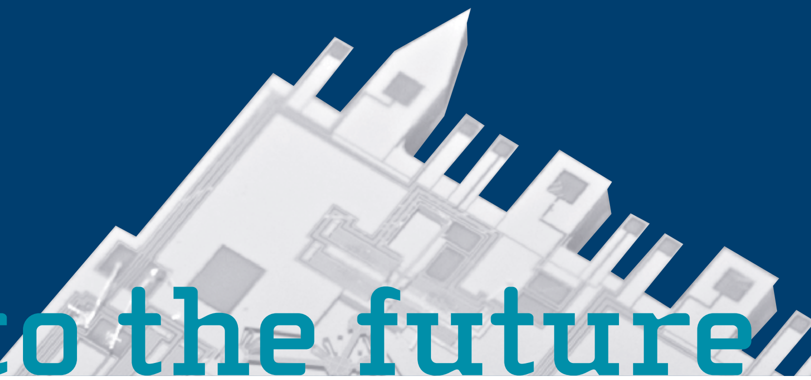
"We're pushing back the boundaries of knowledge in the field of miniaturization, robotic actuators, micro-motors, wireless communication and many other areas," says Pister. "Where these results will lead us is difficult to predict."

For now, Pister and his team are aiming to make microrobots that can self-deploy, in the hopes that they could be used by first responders to search for survivors after a disaster, by industrial plants to detect chemical leaks, or by farmers to monitor and tend their crops.

These insect-sized robots come with a unique advantage. For example, many farmers already use large drones to monitor and spray their plants to improve crop quality and yield. Microrobots could take this to a whole new level. "A standard quadcopter gives us a bird's-eye view of the field, but a microrobot would give us a bug's-eye view," Drew says. "We could program them to do important jobs like pollination, looking for the same visual cues on flowers as insects [see]."

But to apply this kind of technology on a mass scale, first the team has to overcome significant challenges in microtechnolgy. And as Pister says, "Making tiny robots that fly, walk or jump hasn't been easy. Every single piece of it has been hard."

and jump into the future



Flying silently with ion propulsion

Most flying microrobots have flapping wings that mimic real-life insects, like bees. But the Pister team's flying microrobot, called an ionocraft, uses a custom ion propulsion system unlike anything in nature. There are no moving parts, so it has the potential to be very durable. And it's completely silent when it flies, so it doesn't make an annoying buzz like a quadcopter rotor or mosquito.

The ionocraft's propulsion system is novel, not just a scaled-down version from NASA spacecraft. "We use a mechanism that's different than the one used in space, which ejects ions out the back to propel the spacecraft forward," Drew says. "A key difference is that we have air on Earth."

Instead, the ionocraft thruster consists of a thin emitter wire and a collector grid. When a voltage is applied between them, a positively-charged ion cloud is created around the wire. This ion cloud zips toward the negatively-charged collector grid, colliding with neutral air molecules along the way. The air molecules are knocked out of the way, creating a wind that moves the robot.

"If you put your hand under the collector grid of the ionocraft, you'll feel wind on your hand — that's the air stream that propels the microrobot upwards," explains Drew. "It's similar to the air-stream that you'd feel if you put your hand under the rotor blades of a helicopter."

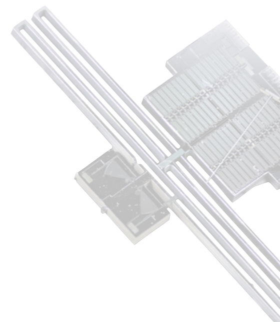
The collector grid also provides the ionocraft's mechanical structure. Having components play more than one role is critical for these tiny robots, which need to be compact and lightweight for the propulsion system to work.

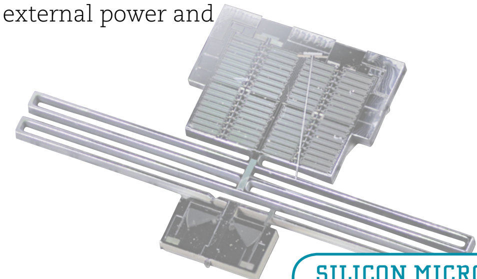
Each ionocraft has four ion thrusters that are independently controlled by adjusting their voltages. This allows the team to adjust the orientation of the microrobot much like a standard quadcopter drone, by controlling the craft's roll, pitch and yaw. What they can't do yet is make the microrobot hover. "So far, we can fly it bouncing around like a bug in a web, but the goal is to get it to hover steadily in the air," Pister says.

Taking first steps and jumps

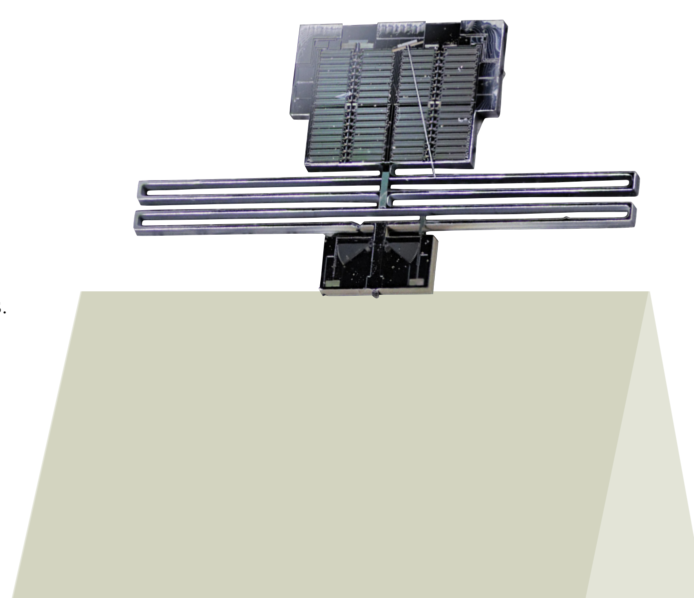
In parallel, the researchers are developing microrobots that can walk or jump. Their micro-walker is composed of three silicon chips: a body chip that plugs perpendicularly into two chips with three legs each. "The hexapod microrobot is about the size of a really big ant, but it's boxier," says Pister.

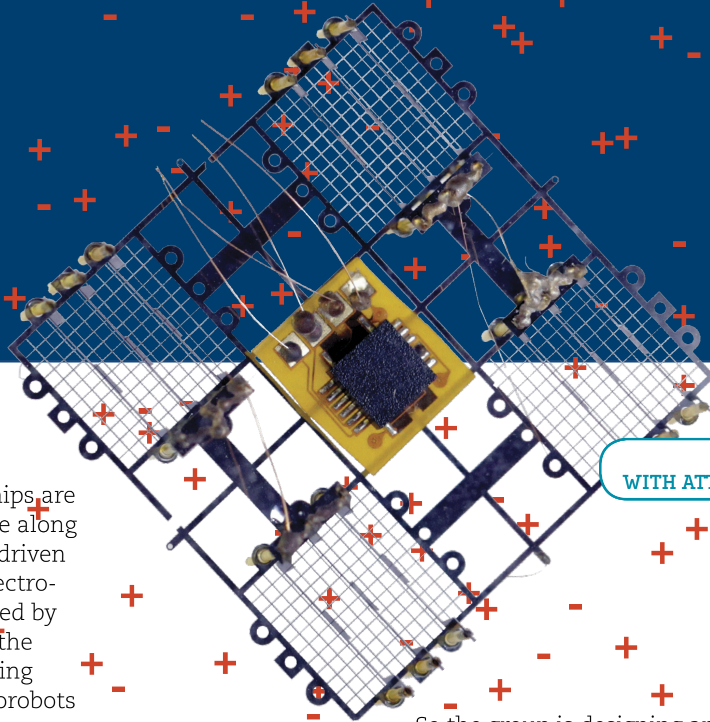
Not only does the body chip provide structural support, but it also routes the external power and





SILICON MICROROBOT DESIGNED FOR JUMPING





IONOCRAFT
WITH ATTACHED SENSOR BOARD

control signals to the leg chips. These leg chips are oriented vertically, allowing the legs to move along a surface in a sweeping motion. Each leg is driven by two tiny on-chip linear motors, called electrostatic inchworm motors, which were invented by Pister. One motor lifts the robot's body and the second pushes it forward. This unique walking mechanism allows three-dimensional microrobots to be fabricated more simply and cheaply.

Pister says the design should, in theory, allow the hexapod to run. So far it can only stand up and shuffle forward. However, he believes their recent fabrication and assembly improvements will have the microrobot walking more quickly and smoothly soon.

The jumping microrobot also uses on-chip inchworm motors. Its motor assembly compresses springs to store energy, which is then released when the microrobot jumps. Currently, it can only jump six millimeters in the air, but the team's goal is to have it to jump one meter from the floor to a table. To achieve this, they are developing more efficient springs and motors.

"Having robots that can shuffle, jump a little and fly is a major achievement," Pister says. "They are coming together. But they're all still tethered by wires for control, data and power signals. "

Working toward autonomy

Currently, high voltage control signals are passed over wires that connect the microrobot to a computer, complicating and restricting its movement. The team is developing better ways to control the microrobots, untethering them from the external computer. But transferring the controller onto the microrobot itself is challenging. "Small robots can't carry the same kind of increasingly powerful computer chips that a standard quadcopter drone can carry," Drew says. "We need to do more with less."

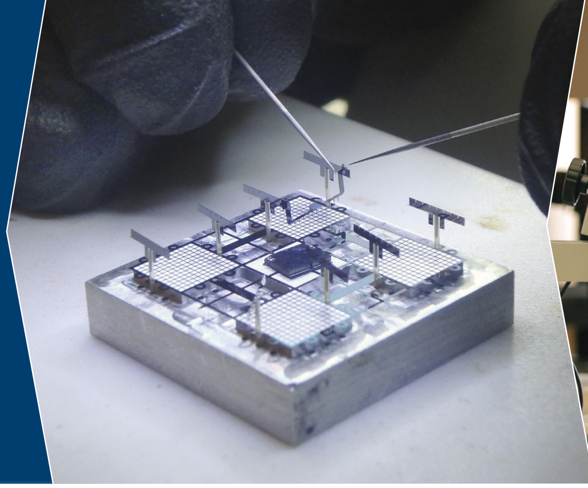
The team's flying microrobot uses a custom ion propulsion system unlike anything in nature. There are no moving parts, and it's completely silent when it flies.

So the group is designing and testing a single chip platform that will act as the robots' brains for communication and control. They plan to send control messages to this chip from a cell phone using wireless technology such as Bluetooth. Ultimately, they hope to use only high-level commands, like "go pollinate the pumpkin field," which the self-mobilizing microrobots can follow.

The team also plans to integrate on-board sensors, including a camera and microphone to act as the robot's eyes and ears. These sensors will be used for navigation, as well as any tasks they want the robot to perform. "As the microrobot moves around, we could use its camera and microphone to transmit live video to a cell phone," says Pister. "This could be used for many applications, including search and rescue."

Using the brain chip interfaced with on-board sensors will allow the team to eliminate most of the troublesome wires. The next step is to eliminate the power wires so the robots can move freely. Pister's students showed early on that solar cells are strong enough to power microrobots. In fact, a microrobot prototype that has been sitting on his office shelf for about 15 years still moves using solar power.

Now, his team is developing a power chip with solar cells in collaboration with Jason Stauth (M.S.'06, Ph.D.'08 EECS), who is an associate professor of engineering at Dartmouth. They're also working with electrical engineering and computer sciences professor Ana Arias to investigate using batteries.



Daniel Drew assembles a new ionocraft.

Finally, the researchers are developing clever machine learning algorithms that guide a microrobot's motion, making it as smooth as possible.

In Drew's case, the initial algorithms are based on data from flying a small quadcopter drone. "We're first developing the machine learning platform with a centimeter-scale, off-the-shelf quadcopter," says Drew. "Since the control system for an ionocraft is similar to a quadcopter, we'll be able to adapt and apply the algorithms to our ionocraft. Hopefully, we'll be able to make it hover."

Putting it all together

Soon, the team hopes to have autonomous microrobots wandering around the lab directed by cell phone messages. But their ambitions don't stop there. "I think it's beneficial to have flying robots and walking robots cooperating together," Drew says. "Flying robots will always consume more energy than walking robots, but they can overcome obstacles and sense the world from a higher vantage point. There is promise to having both, or even a mixed-mobility microrobot, like a beetle that can fly or walk."

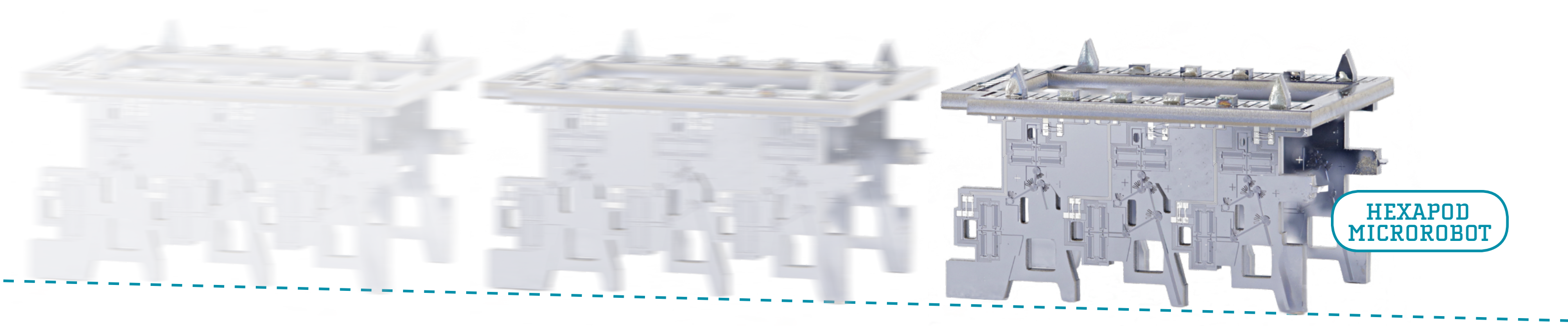
Mixed-mobility microrobots could do things like monitor bridges, railways and airplanes. Currently, static sensors are used to monitor infrastructure, but they are difficult and time-consuming to deploy and maintain — picture changing the batteries of 100,000 sensors across a bridge. Mixed-mobility microrobots could also search for survivors after a disaster by flying, crawling and jumping through the debris.

"I think it's beneficial to have flying robots and walking robots cooperating together....There is promise to having both or even a mixed-mobility microrobot, like a beetle that can fly or walk."

"Imagine you're a first responder who comes to the base of a collapsed building. Working by flashlight, it's hard to see much but the dust hanging in the air," says Drew. "Now, imagine pulling out a hundred insect-sized robots from your pack, tossing them into the air and having them disperse in all directions. Infrared cameras on each robot look for signs of life. When one spots a survivor, it sends a message back to you over a wireless network. Then a swarm of robots glowing like fireflies leads you to the victim's location, while a group ahead clears out the debris in your path."

The applications seem almost endless given the microrobots' potential versatility and affordability. Pister estimates they might cost as little as one dollar someday, using batch manufacturing techniques. The technology is also likely to reach beyond microrobots.

For Pister's team, the path forward is clear; the open question is when. "All the pieces are on the table now," Pister says, "and it's 'just' a matter of integration. But system integration is a challenge in its own right, especially with packaging. We may get results in the next six months — or it may take another five years." BE



Bill Bowman

Andrew Alleyne (M.S.'92, Ph.D.'94 ME) received the prestigious American Automatic Control Council's Engineering Practice Award for his "pioneering contributions to modeling, simulation and control of dynamic thermal systems and their applications in aerospace, automotive and building control industries." He is a professor of mechanical science and engineering at the University of Illinois at Urbana-Champaign.

Lisa Alvarez-Cohen, professor of environmental engineering, has been appointed vice provost for academic planning at UC Berkeley. She currently serves as chair of the Academic Senate and co-chair of Berkeley's strategic planning steering committee.

Nancy Amato (M.S.'88 CS) has been named head of the computer science department at the University of Illinois at Urbana-Champaign — the first woman to lead the department. She will be coming to the university from Texas A&M University, where she has taught since 1995, with a research focus on robotics, parallel algorithms and bioinformatics.

James Ang (M.S.'84, Ph.D.'86 ME) has joined the Department of Energy's Pacific Northwest National Laboratory as chief scientist for computing. He will also be the lab's contact for the Advanced Scientific Computing Research mission.

Sanjeev Arora (Ph.D.'04 EECS) and **Umesh Vazirani** (Ph.D.'86 CS) were elected as members of the National Academy of Sciences. Arora is a professor of computer science at Princeton University. Vazirani, an electrical engineering and computer sciences professor at Berkeley and director of the Berkeley Quantum Computation Center, is one of the founders of the field of quantum computing.

Robert Bachman (B.S.'67, M.S.'68 CE) and **Edward Kavazanjian Jr.** (D.Eng.'78 CE) were named as Distinguished Members of the American Society of Civil Engineers, the organization's highest honor. Bachman, who has his own structural engineering practice, has played a leading role in the development of landmark seismic provisions in California. Kavazanjian is professor of geotechnical engineering at Arizona State University and director of the Engineering Research Center for Bio-Mediated and Bio-Inspired Geotechnics.

John Bischof (B.S.'87, M.S.'89 BioE, Ph.D.'92 ME) has been appointed director of the University of Minnesota Institute for Engineering in Medicine. He has been a member of the university's mechanical engineering faculty since 1993, conducting research on thermal bioengineering and nanomedicine.

Eric Brewer (B.S.'89 EECS) and **James Demmel** (Ph.D.'83 CS) of the Department of Electrical Engineering and Computer Sciences have been elected to the American Academy of Arts and Sciences. Brewer, professor emeritus of computer sciences and vice president of infrastructure at Google, is considered one of the most influential architects of the internet. Demmel, who currently chairs the department, is known for his research in adaptive, high-performance linear algorithm software.

Bioengineering doctoral student **Thomas Carey** was named winner of the Diagnostics World Early Innovator Award for his project on late-stage cancer diagnosis. He and his colleagues are developing a low-cost microfluidic-based platform to detect the presence of biomarkers present in virtually every fluid.

Soumen Chakrabarti (M.S.'92, Ph.D.'96 CS) and **Sunita Sarawagi** (Ph.D.'96 CS) have been named to *Analytics India Magazine's* list of top 10 machine learning researchers in India. Both are currently computer science professors at Indian Institute of Technology Bombay.

Environmental engineering doctoral student **Joseph Charbonnet** won first place in the UC system's "Slammys," a competition where graduate students explain their research in less than three minutes. His winning presentation described using manganese-coated sand to capture, clean and re-use stormwater, with the aim of diminishing storm damage and replenishing depleted aquifers.

Four engineering professors have been selected for the Bakar Fellows Program, which supports faculty working to apply scientific discoveries to real-world issues: **Steven Conolly,** professor of bioengineering and of electrical engineering and computer sciences; **David Schaffer,** professor of bioengineering, of molecular and cell biology and of chemical and biomolecular

Three named as top young innovators

A Berkeley professor, graduate student and recent alumnus — all affiliated with the Department of Electrical Engineering and Computer Sciences — have been named to *MIT Technology Review's* 2018 list of "35 Innovators Under 35."

Assistant professor **Alessandro Chiesa** is the co-founder of Zcash, a cryptocurrency that ensures complete privacy in online transactions. Using zero-knowledge cryptography, Zcash guarantees the validity of transactions while enabling users to shield sensitive data and protect themselves from identity theft.

Graduate student **Chelsea Finn** is working out of the Berkeley Artificial Intelligence Research Lab, creating algorithms that enable robots to learn as children do — by building on previous play and observations. Robots in her lab are tackling such challenges as using a wooden shape-sorting toy, in hopes of having robots master tasks by exploring instead of programming.

A research scientist at OpenAI, **John Schulman** (Ph.D.'16 EECS) is developing novel algorithms for reinforcement learning applications, which reward machines for a correct response. Schulman hopes these machine-learning algorithms can eventually be used in areas such as robot locomotion.

TOP PHOTO COURTESY ALESSANDRO CHIESA, MIDDLE PHOTO BY KOJO ACQUAH, BOTTOM PHOTO BY ERIC LOUIS HAINES

New STEM podcast

When bioengineering Ph.D. students **Sally Winkler** and **Kayla Wolf** first launched the Double Shelix podcast in 2016, they hoped to start a public conversation about the challenges women face in pursuing STEM careers. Now, just two years later, they've aired 19 episodes, building an audience of over 1,000 listeners from 40 countries.

The podcast has covered topics that range from cultivating mentorships and battling imposter syndrome to navigating the ins and outs of grad school. Earlier this year, they also released a series of episodes called "You Do Belong in Science," featuring science and education experts discussing the creation of supportive STEM communities.

"Facing hardship in a STEM career can feel really awful, but it happens to everyone," they said. "In giving our listeners tools to address challenges they face — like poor mentorship or burnout — and introducing them to leaders who have faced similar struggles, we hope to help our listeners thrive."

Going forward, Winkler and Wolf plan to host their first live show, and in 2019, produce episodes that highlight the unexpected career paths of successful scientists. The Double Shelix podcast is currently available on iTunes and Google Play.

PHOTO BY ADAM LAU

engineering; **Ming Wu** (M.S.'86, Ph.D.'88 EECS), professor of electrical engineering and computer sciences; and **Ting Xu,** professor of materials science and engineering and of chemistry.

Anca Dragan and **Raluca Ada Popa,** assistant professors in the Department of Electrical Engineering and Computer Sciences, have been named 2018 Sloan Research Fellows, an honor for "early-career scholars whose achievements mark them as among the very best scientific minds working today." Dragan runs the InterACT lab and researches artificial intelligence and robot-human interactions; Popa is co-founder of the RISELab, where she researches computer security, systems and applied cryptography.

Susan Eggers (Ph.D.'89 CS) has received the 2018 ACM-IEEE CS Eckert-Mauchly Award, the first woman so honored in the award's 39-year history. A professor at the University of Washington, she was cited for "outstanding contributions to simultaneous multithreaded processor architectures and multiprocessor sharing and coherency."

Nicolas Fawzi (Ph.D.'07 BioE), assistant professor at Brown University, and **Sapun Parekh** (Ph.D.'08 BioE), group leader at the Max Planck Institute for Polymer Research in Mainz, Germany, are collaborating on a project to study membraneless organelles, thanks to a grant from the Human Frontier Science Program. "We never would have done this if we hadn't met as Ph.D. students in the same entering class together at Berkeley and in the Berkeley-UCSF program," said Fawzi.

Ken Goldberg, professor of industrial engineering and operations research and of electrical engineering and computer sciences, has received the Chancellor's Award for Faculty Research in the Public Interest for his work with a team of postdoctoral, graduate and undergraduate students that has spent the past four years developing the Collaborative Assessment and Feedback Engine (CAFE).

Andrea Goldsmith (B.S.'86 EMS, M.S.'91, Ph.D.'94 EECS) has won the IEEE Eric E. Sumner Award "for contributions to the fundamental understanding and innovation in adaptive and multiple antenna techniques for wireless communication networks." She is a professor of electrical engineering at Stanford University.

Elizabeth Hausler (M.S.'98, Ph.D.'02 CEE) received the Campanile Excellence in Achievement Award from the UC Berkeley Foundation and the Cal Alumni Association, in recognition of her work as the founder and CEO of Build Change.

Christopher Hegarty (M.S.'90, Ph.D.'91 EECS) has been named chief executive officer of ANCA Group, a leading manufacturer of CNC grinding machines.

Mechanical engineering professor and department chair **Roberto Horowitz** (B.S.'77, Ph.D.'83 ME) has been honored with the ASME Rufus Oldenburger Medal, in recognition of his significant contributions to control applications in mechatronics, magnetic data storage and traffic systems.

Philip Lee (Ph.D.'06 BioE) is the co-founder and chief operating officer of Senti Bio, which is developing a design platform for synthetic gene circuits that can rapidly design, build and test various therapeutic circuits.

Jitrenda Malik, professor of electrical engineering and computer sciences, has won the International Joint Conference on Artificial Intelligence's 2018 Award for Research Excellence. The award honors the high quality research he has consistently produced over the course of his career.

Mechanical engineering graduate student **Jonathan McKinley** won the 2018 USA Triathlon Collegiate Club National Championships, besting 800 competitors for the honor.

Larry Nagel (B.S.'69, M.S.'70, Ph.D.'75 EECS) has won the IEEE Donald O. Pederson Award in Solid State Circuits. He was cited for "the development and demonstration of SPICE as a tool to design and optimize electronic circuits."

Brittany Nelson-Cheeseman (M.S.'07, Ph.D.'09 MSE) was awarded the 2018 Undergraduate Research Award at the University of St. Thomas, where she is an assistant professor, for demonstrating impactful faculty-student collaboration in undergraduate research. "I personally see [undergraduate research] as really mentoring and making sure that your students do research that's meaningful to them, that's meaningful to the greater world," she said.

Edward Rice (B.S.'49, M.S.'51 CE) has received the American Concrete Institute's highest honor — ACI Honorary Membership — for his extraordinary contributions to the concrete field and service to the institute. He has been a member of the institute for more than 65 years and became a fellow in 1997.

Clyde Rodriguez (B.S.'95 EECS) returned to his alma mater, Madera High School, to deliver the keynote speech at the graduation ceremony in June. In it, he recounted his own journey from immigrant farmworker to tech executive, and encouraged graduates to "be bold, be fearless, fight comfort, write your next chapter."

Alice Agogino honored with presidential award

Mechanical engineering professor **Alice Agogino** has been named winner of the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring (PAESMEM), the government's highest honor for mentors who have worked to expand talent in science, technology, engineering and mathematics (STEM). Since joining the Berkeley faculty, Agogino has mentored hundreds of students as well as numerous junior faculty. Nearly half of her graduate student mentees are from groups underrepresented in STEM. To further support engineering students at Berkeley, Agogino has also created a tiered mentoring network, in which senior doctoral students advise masters and undergraduate students. In addition to her efforts on campus, Agogino has worked with local schools, museums and organizations to engage K-12 students in STEM topics.

PHOTO BY NOAH BERGER

Aviad Rubinstein (Ph.D.'17 CS) received the Association for Computing Machinery's 2017 Doctoral Dissertation Award. In his thesis, he established the intractability of the approximate Nash equilibrium problem, an enduring problem in theoretical computer science. He recently became an assistant professor at Stanford University.

S. Shankar Sastry (M.S.'79, Ph.D.'81 EECS) was awarded the Berkeley Citation, one of the university's highest honors, during Berkeley Engineering's 2018 graduate commencement ceremony. The award was in recognition of his leadership and numerous contributions to the college and campus community.

Scott Shenker, professor of electrical engineering and computer sciences, has been named recipient of the ACM Paris Kanellakis Theory and Practice Award, in honor of his pioneering contributions to fair queueing in packet-switching networks, which have had a major impact on modern computer communication and have been fundamental to the growth of the internet.

Ikhlaq Sidhu, professor of industrial engineering and operations research and faculty director and chief scientist at the Sutardja Center for Entrepreneurship and Technology, has been awarded the 2018 Major Education Innovation Award by the IEEE Educational Activities Board for his contributions in entrepreneurship pedagogy and innovative teaching methods.

Mark Stacey became the new chair of the Department of Civil and Environmental Engineering, replacing outgoing chair **Robert Harley.** A member of the faculty since 1996, he currently heads a National Science Foundation project to examine infrastructure resiliency in California.

Kristin Stephens-Martinez (M.S.'13, Ph.D.'17 CS) is a new assistant professor of computer science at Duke University. Her research is focused on the intersection of education and computer science, using data available in large classrooms, both local and MOOCs.

John DeNero named top teacher

John DeNero, the Giancarlo Teaching Fellow in the Department of Electrical Engineering and Computer Sciences, has been selected for the Distinguished Teaching Award, one of Berkeley's highest honors. As the instructor for two of the largest courses on campus — introductory computer science for majors and introductory data science — DeNero is known as an engaging teacher who makes big classes feel personal. He has also developed an innovative approach, including automated technologies and a cadre of student instructors and mentors, to keep the material accessible and the courses running smoothly.

PHOTO BY DOUG BIRNBAUM

Peg Skorpinski

Masayoshi Tomizuka, professor of mechanical engineering, received the American Automatic Control Council's Bellman Heritage Award for his seminal and pioneering contributions to the theory and practice of mechatronic systems control. The award is the highest lifetime achievement honor for a control system engineer or scientist.

Ram Vasudevan (B.S.'06, M.S.'09, Ph.D.'12 EECS) has received the 2018 Young Investigator Award from the Office of Naval Research. He is an assistant professor of mechanical engineering at the University of Michigan.

Andrew Whittaker (M.S.'85, Ph.D.'88 CE) has been honored as a SUNY Distinguished Professor, the highest faculty achievement in the State University of New York system. He joined the faculty at the University at Buffalo in 2001, and his research focuses on earthquake and blast engineering of buildings, bridges, nuclear facilities and other critical infrastructure.

Paul Wing (M.S.'66, Ph.D.'71 IEOR) supports STEAM programs in New York's Bethlehem School District, providing grants to fund technology upgrades in classrooms, robotics programs, 3-D printers and an aerial photography program. He also created a district-wide STEAM committee and volunteers at an after-school program at an elementary school.

Margaret Yau (B.S.'04 EECS) has been named professor of the year by Crafton Hills College, a community college in Yucaipa, California. She has taught computer science and computer information systems at the college since 2011, after earning an M.S. in computer science from the University of California, San Diego.

Bin Yu, professor of electrical engineering and computer sciences and of statistics, has won the Committee of Presidents of Statistical Societies' Elizabeth L. Scott Award, which is given to an individual who has fostered opportunities for women in statistics.

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James Anderson, professor emeritus of civil and environmental engineering, died in August at the age of 92. He received his bachelor's degree from the University of Pittsburgh and his master's and Ph.D. degrees from Cornell University. In 1966, he joined the Berkeley faculty, where he worked as a professor until his retirement in 1991. A well-respected teacher, he authored or co-authored three books on surveying methods, among numerous other publications.

William R. "Bill" Baker died in May at the age of 103. In 1938, Baker, still an engineering student at UC Berkeley, was hired by Ernest Orlando Lawrence for his Radiation Laboratory, the predecessor to Lawrence Berkeley National Laboratory (LBNL), as the lab's first electrical engineer. For the next 42 years, he worked on technologies for the lab's large particle accelerators, or cyclotrons, and was deeply involved in fusion energy research. A prolific researcher, he held approximately 50 patents related to his work.

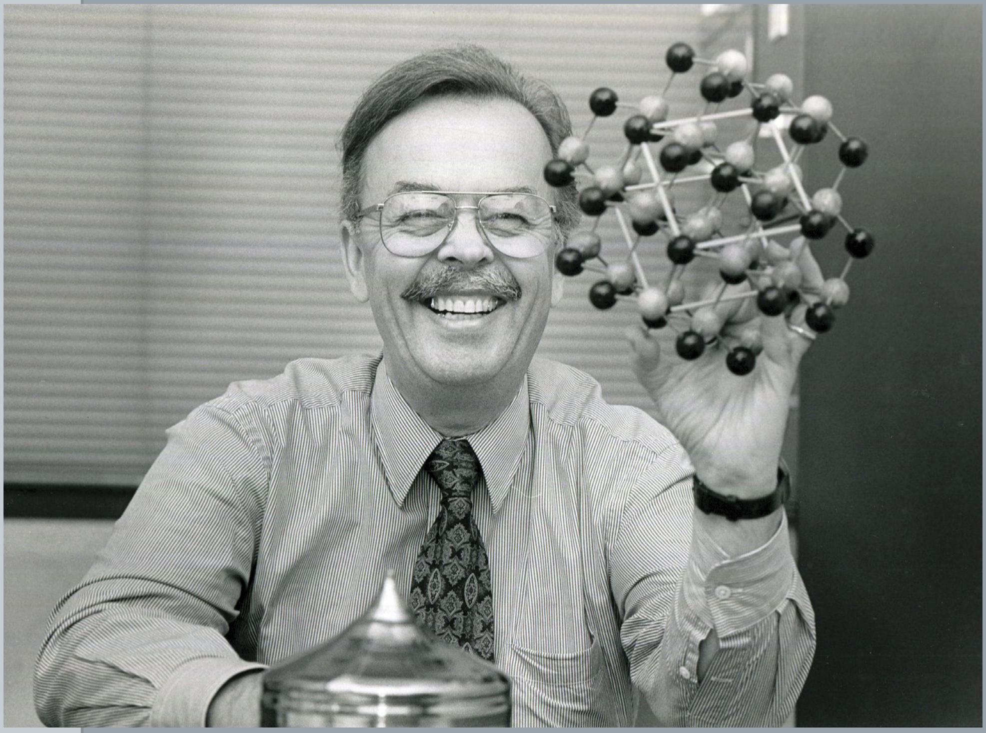
Bradley Card (M.Eng.'52 CE) died in June at the age of 92. After graduation, he worked at General Electric's Hanford Works, then taught engineering at Yakima Valley Community College. He later became a partner in PLSA Engineering, where he worked until he was 88 years old.

Ray Lundgren (B.S.'50, M.S.'54 CE) died in June at the age of 93. He worked at Woodward Clyde Consultants, which later became Woodward-Lundgren and Associates, eventually acting as chairman of the board. He also served as president and board member of the Engineering Alumni Society, president of the Cal Alumni Association and member of the Lafayette planning commission and city council. He was honored with the Berkeley Foundation's Trustees Citation in 1980.

Slobodan Mitric (M.S.'68, Ph.D.'72 CE) died in May. From 1973–78, he was an assistant professor of civil engineering at Ohio State University. He then joined the World Bank, where he worked as an urban transportation expert for the next 25 years.

Krishna Seshan (Ph.D.'75 MSE) died in October 2017 at the age of 71. After graduating from Berkeley, he worked at LBNL, Intel and IBM, and was also an assistant professor of materials science at the University of Arizona. During his retirement, he created Project Enable at San Jose State University, a program that connects engineering students with clients to make adaptive aids for elderly and disabled people.

Justin Yeo Jun Xi, a mechanical engineering student, died in December 2017 at the age of 22. A sophomore, he had worked with other students to develop Dingo, an app that enables users to send automatic notifications to friends upon reaching a destination.



Eugene Haller, professor emeritus of materials science and engineering, died in June at the age of 75. A highly-regarded leader, teacher and mentor, he helped to redefine the field of materials science and engineering to include semiconductors, ultimately co-authoring a textbook on the subject. He made significant research contributions in the area of growth and applications of ultrapure — both chemically and isotopically — and doped semiconductors, and his ultrapure germanium lies at the heart of the Multiband Imaging Photometer in NASA's Spitzer Space Telescope. A native of Switzerland, he joined Lawrence Berkeley National Laboratory (LBNL) as a staff scientist in 1973 and the Berkeley Engineering faculty in 1980; he later founded the Electronic Materials Program at LBNL, which continues to this day. The author or co-author of more than 1,000 papers, he was honored with many prestigious awards during his career, including election to the National Academy of Engineering in 2010.

PHOTO BY BRUCE COOK

Keegan Houser

Renee and Thomas Warnock next to their listing on the Builders of Berkeley wall in front of the University Library on October 9, 2018.

A lasting legacy

For Thomas Warnock (M.S.'86 CEE), the highlights of his Berkeley experience included engaging academics, impactful research projects and lifelong friends. And of course, there were also the legendary Point Reyes hikes and oyster-eating adventures, organized by his mentor, engineering professor David Jenkins.

Last year, Thomas and his wife, Renee, decided to establish a charitable gift annuity as a meaningful way to honor his experience at Berkeley and leave a legacy that will transform lives.

"Knowing that many others have spent a large portion of their lives and good fortune forging the science and engineering that benefits society has inspired us to give," says Thomas.

For Thomas and Renee, a charitable gift annuity was the best planned gift choice, as it provides many benefits such as the diversification of their portfolio. It will ultimately fund the Thomas W. Warnock Fellowship, supporting civil and environmental engineering master's students studying water and wastewater engineering.

"With a charitable gift annuity, you can diversify your portfolio with tax advantages now and later," says Thomas, "with the knowledge that your gift will enrich opportunities for students into the future."

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