CASE SCHOOL OF ENGINEERING

2018-2019

MOMENTS THAT MATTER

CASE WESTERN RESERVE UNIVERSITY

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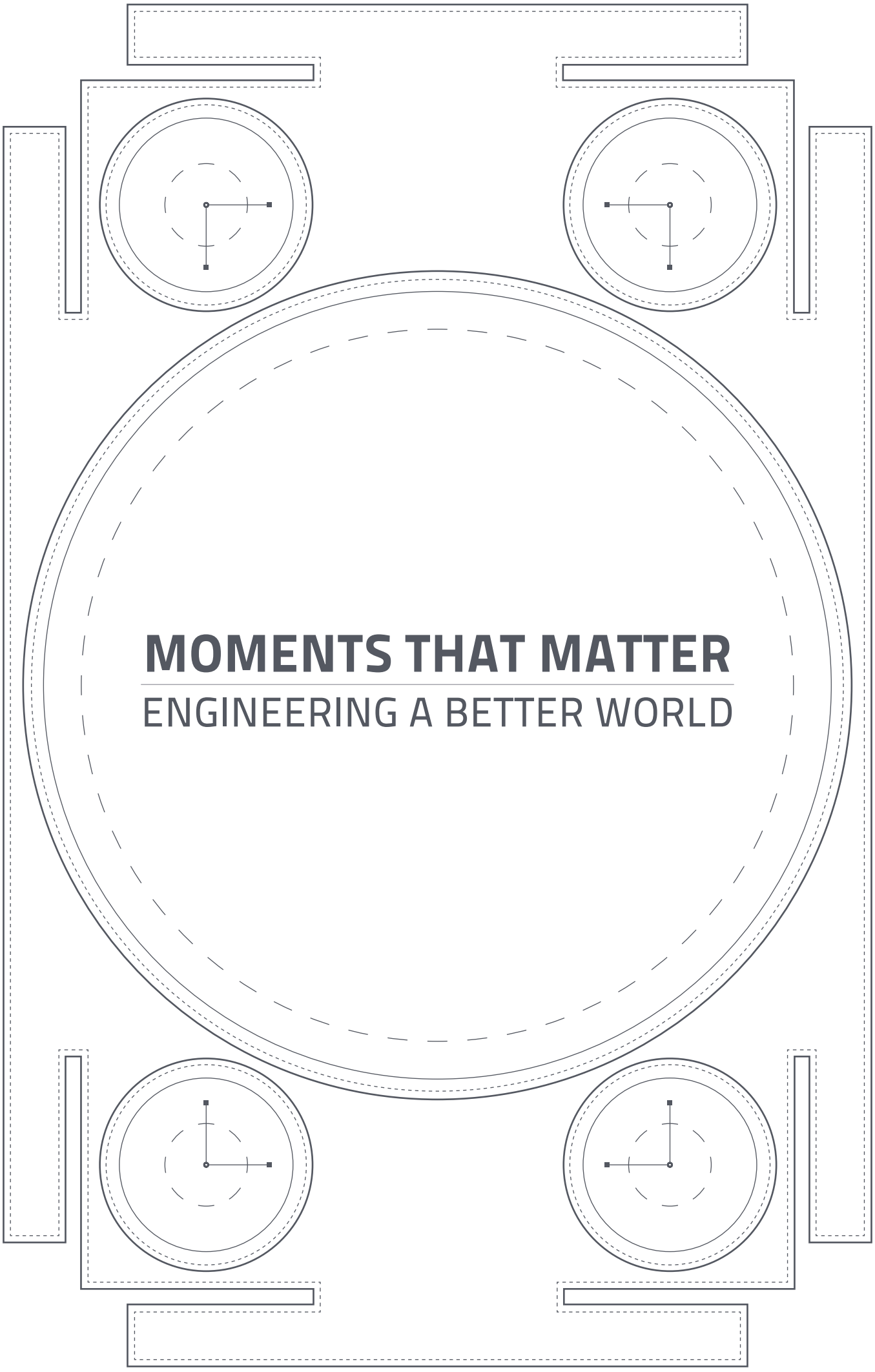


MOMENTS THAT MATTER

ENGINEERING A BETTER WORLD

ENGINEERING A BETTER WORLD, MOMENT BY MOMENT

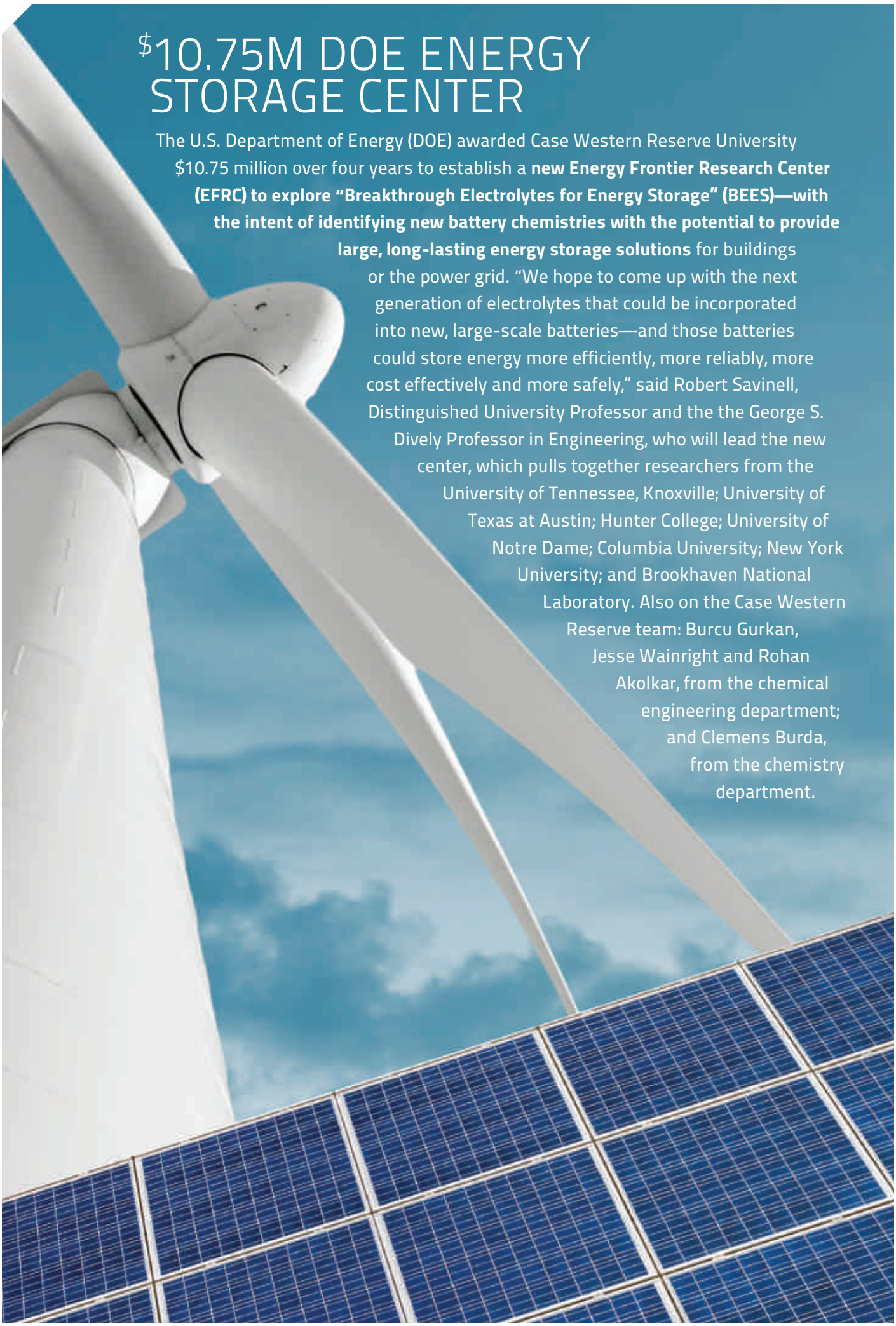
The process of discovery is built on a foundation of smaller steps—moments that move us closer to solutions. This year, we celebrate those pivotal milestones: the moments that matter.

From a $10 million Department of Energy research center and an innovative biomedical engineering alliance to improving water treatment and power grids, a high-tech take on smoking cessation and a new initiative for women in technology, we're translating a series of small moments into giant advancements.

As I finish my first full year as dean of the Case School of Engineering, I am amazed at the tenacious spirit of our students, faculty, staff and community in developing engineering solutions that make a difference.

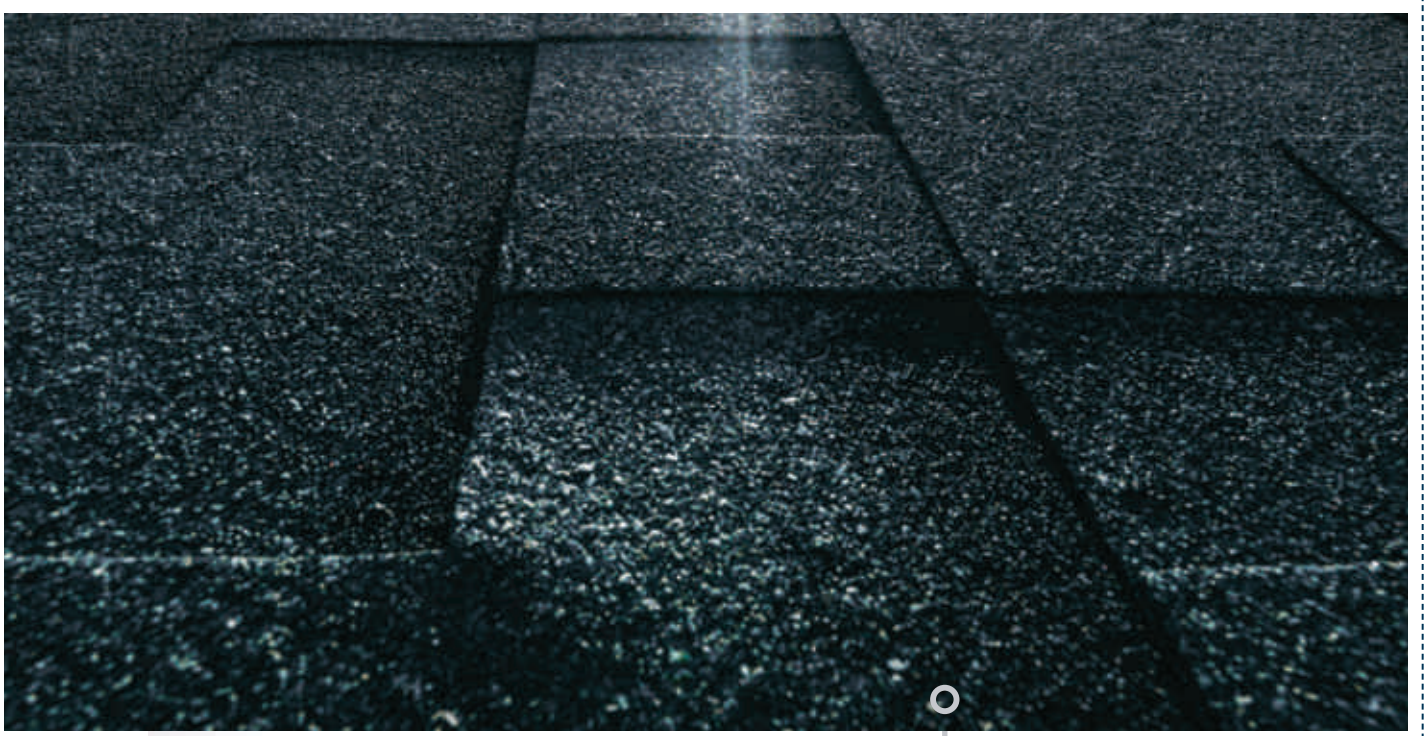
I hope you'll join me in celebrating these moments—and many more.

Venkataramanan "Ragu" Balakrishnan
Charles H. Phipps Dean, Case School of Engineering
Case Western Reserve University



$10.75M DOE ENERGY STORAGE CENTER

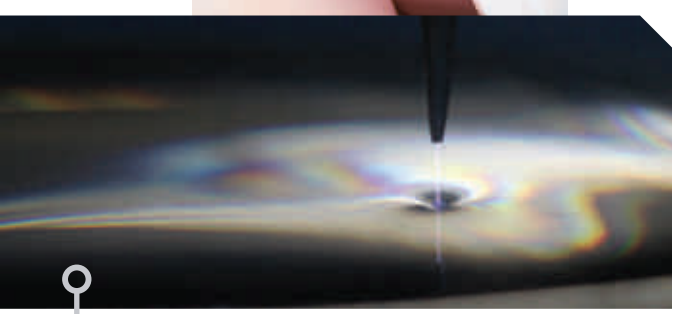
The U.S. Department of Energy (DOE) awarded Case Western Reserve University $10.75 million over four years to establish a **new Energy Frontier Research Center (EFRC) to explore "Breakthrough Electrolytes for Energy Storage" (BEES)—with the intent of identifying new battery chemistries with the potential to provide large, long-lasting energy storage solutions** for buildings or the power grid. "We hope to come up with the next generation of electrolytes that could be incorporated into new, large-scale batteries—and those batteries could store energy more efficiently, more reliably, more cost effectively and more safely," said Robert Savinell, Distinguished University Professor and the the George S. Dively Professor in Engineering, who will lead the new center, which pulls together researchers from the University of Tennessee, Knoxville; University of Texas at Austin; Hunter College; University of Notre Dame; Columbia University; New York University; and Brookhaven National Laboratory. Also on the Case Western Reserve team: Burcu Gurkan, Jesse Wainright and Rohan Akolkar, from the chemical engineering department; and Clemens Burda, from the chemistry department.



CHAMELEON ROOFS

Imagine the roof of your house shifting colors from dark blue to light blue when the sun comes out—saving money and energy. Such "chameleon roofs" were developed by civil engineering professor Xiong "Bill" Yu. They're constructed from asphalt shingles coated with plastic film or spray paint that changes color depending on the amount of natural light. A darker roof will absorb more heat from the sun and help to heat a house in winter; a lighter-colored roof will reflect the light and help keep a home cooler in the summer.

Case Western Reserve researchers are partnering with American Manganese Inc. on a DOE project for recycling lithium-ion batteries.



MAKING AMMONIA GREENER

Ammonia has dozens of modern uses, and is essential in making the fertilizer that sustains most of our global food production. But its synthesis in large plants—requiring vast amounts of hydrogen gas from fossil fuels—makes ammonia among the most energy-intensive and greenhouse gas emitting chemicals. Case Western Reserve chemical engineering faculty members Julie Renner and Mohan Sankaran have come up with a **new electrolytic process utilizing a plasma electrode to create ammonia from nitrogen and water at low temperature and low pressure,** and without using hydrogen or the solid metal catalyst necessary in traditional processes. This method could one day be optimized to lead to smaller, more localized ammonia plants that use green energy.

50-YEAR SOLAR PANELS

Case Western Reserve's SDLE Center researchers were awarded a **$1.35 million Department of Energy Solar Energy Technologies Office grant to continue their work toward increasing the efficiency and lifetime of photovoltaic modules**—specifically aimed at pushing their lifespan to 50 years. The project, led by Roger French, the Kyocera Professor of Ceramics, seeks to double the current lifetime of solar panels.

NASA EARLY CAREER AWARD FOR CO2 CAPTURE SYSTEM

Manned trips to Mars would require the ability to generate oxygen en route, but before that might be possible, scientists first have to improve how carbon dioxide (CO2) is filtered and reused in spacecrafts. Burcu Gurkan, an assistant professor of chemical engineering, received a NASA early career award to develop an approach that uses an ionic liquid membrane to capture CO2 in microgravity.

ENVIRONMENTAL BENEFITS OF EVS MAY VARY BY LOCATION

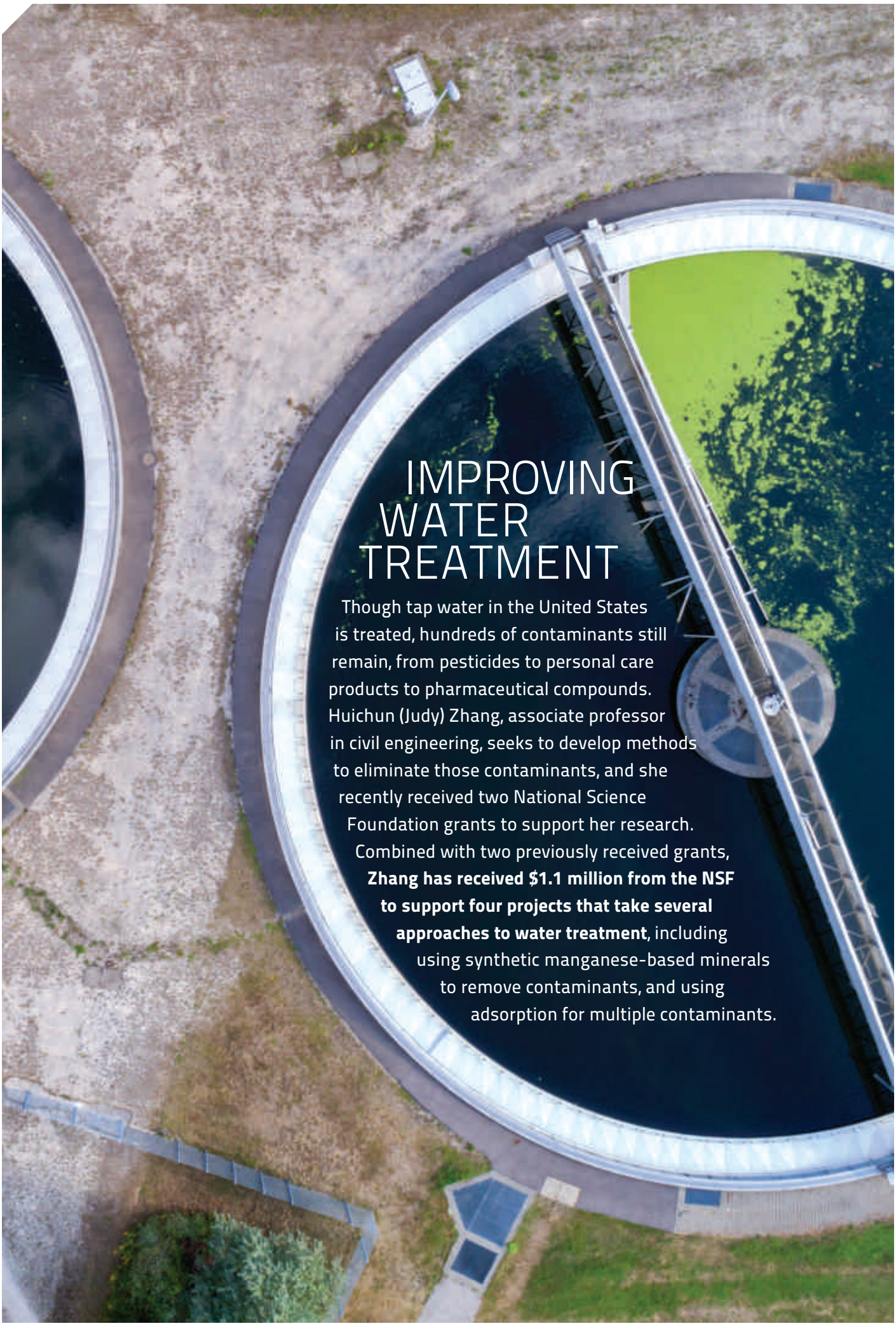
Case Western Reserve researchers found that exactly *how* friendly electric vehicles (EVs) are as an alternative to fuel-burning vehicles may actually depend on where you live. The "green" value of EVs can vary dramatically across the United States due to climate differences, whether producing the electricity to recharge them relies on fossil fuels, and how far the vehicles are driven each day, according to lead researcher Chris Yuan, professor of mechanical and aerospace engineering. The study found that electric vehicles can sometimes contribute as much in greenhouse gas emissions as their conventional counterparts—even if indirectly from the electricity consumed by the battery in powering the vehicle.

NEW MATERIAL FOR ENERGY STORAGE

The development of cost-efficient, scalable and reliable catalysts is critical for sustainable energy generation. A study conducted by Case Western Reserve macromolecular science and engineering researchers—recently published in *Advanced Materials*—explores the use of carbon-based, heteroatom-doped, three-dimensional, mesoporous electrodes as a promising catalyst for electrochemical energy conversion and storage. The material has a large surface area, maximized exposure to active sites, three-dimensional conductive pathways for efficient electron transport, and porous channels to facilitate electrolyte diffusion. Plus, it can be mass produced in a cost-effective way.

FIRST-FLIGHT SUCCESS

The goal: fully electric passenger jets. The milestone moment in getting us there: the first successful in-air test of the battery technology needed to make it possible. In a first flight test, a single-propeller fiberglass airplane stayed airborne for 171 minutes—almost twice as long as previous tests—before the batteries died. **The flight-time boost came from the placement of "structural battery" components that were built into the wings of the unmanned aerial vehicle**. The innovation, developed by Vikas Prakash, professor of mechanical and aerospace engineering, turns the wings themselves into an extension of the batteries powering the plane. The technology not only extends flight time and distance, but allows more room in the fuselage for critical payload. This development is part of a funded research and commercialization project from the Partnership for Research in Energy Storage and Integration for Defense and Space Exploration (PRESIDES) Energy Storage program, a partnership sponsored by the Ohio Federal Research Network (OFRN) and managed by the Great Lakes Energy Institute, received in 2016.



IMPROVING WATER TREATMENT

Though tap water in the United States is treated, hundreds of contaminants still remain, from pesticides to personal care products to pharmaceutical compounds. Huichun (Judy) Zhang, associate professor in civil engineering, seeks to develop methods to eliminate those contaminants, and she recently received two National Science Foundation grants to support her research. Combined with two previously received grants, **Zhang has received $1.1 million from the NSF to support four projects that take several approaches to water treatment**, including using synthetic manganese-based minerals to remove contaminants, and using adsorption for multiple contaminants.

GREENER FIRE PROTECTION

Because most synthetic polymers are highly flammable, it's necessary to flame retard them for use in electronics, transportation, appliances and construction applications. Current methods of flame retardation pose concerns for their toxicities. Researchers in the Department of Macromolecular Science and Engineering, led by faculty members David Schiraldi and Gary Wnek, are developing low-toxicity additives to replace current flame retardants. Using materials from nature, they've seen promising results with polyethylene, polypropylene and polystyrene, as well as developed coatings for building applications that can resist major fires for as long as 20 minutes.

DENDRITE GROWTH IN LITHIUM METAL BATTERIES

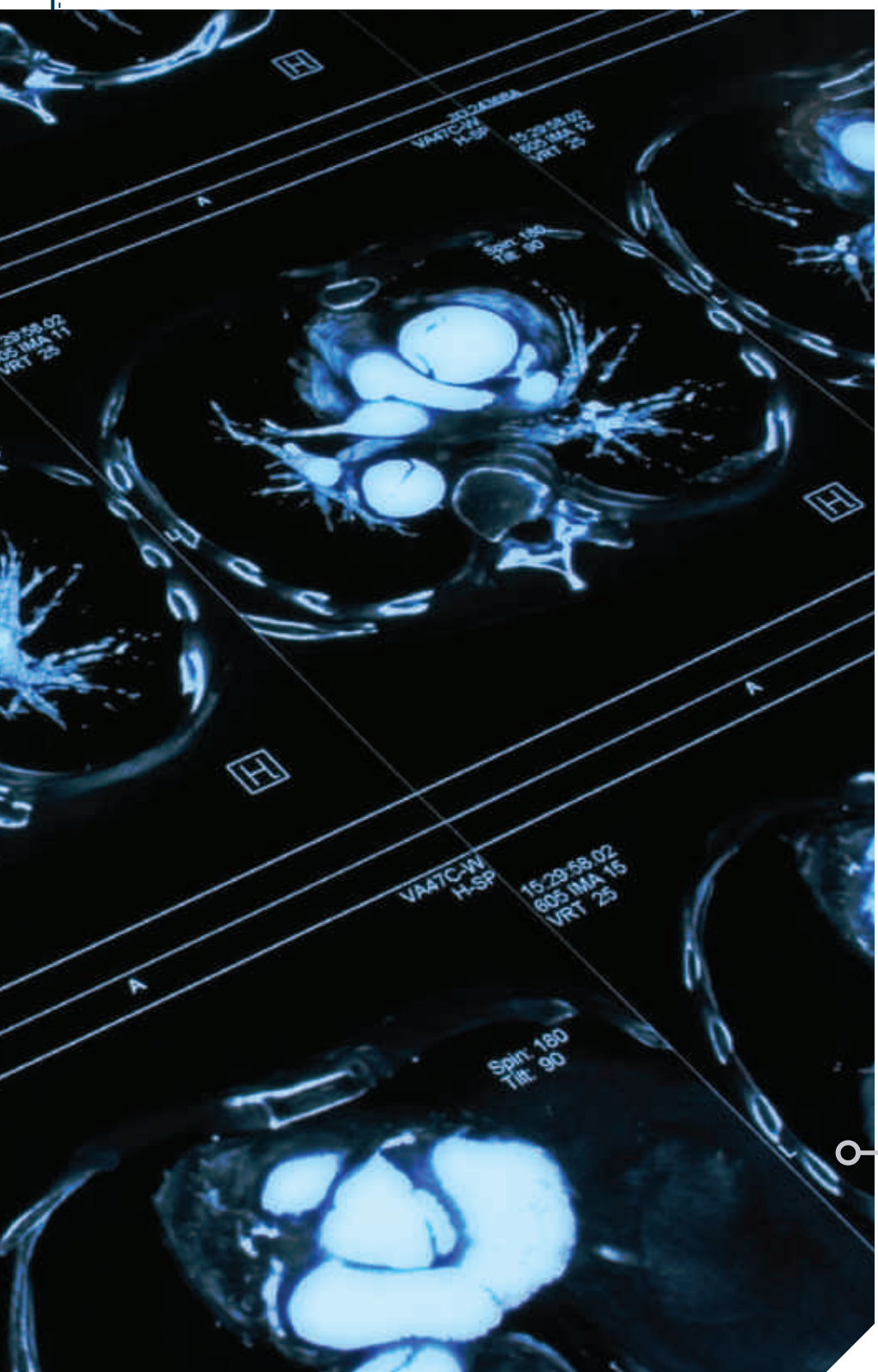
Researchers in chemical engineering discovered that transport limitations within a surface film called the solid electrolyte interphase are responsible for the formation of lithium dendrites in lithium-metal batteries—one of the barriers to the commercial implementation of safe, energy-dense batteries.

CWRU AND CSU PROPOSE DOWNTOWN CLEVELAND MICROGRID

Downtown Cleveland could greatly benefit by building a secure microgrid that delivers secure power to businesses that don't want to risk power failures and who want a power supply safe from cyber attacks.

That's the summary of a report prepared by the Great Lakes Energy Institute at Case Western Reserve University and the Energy Policy Center at Cleveland State University. The report, which was prepared with the support of a Cleveland Foundation grant, recommends that Cleveland and Cuyahoga County build a microgrid centered around a proposed co-generation facility at Cleveland Thermal.

According to the report, the estimated $100 million project would supply commercial customers with highly efficient power delivered in a secure system that would be operational 99.999 percent of the time. The proposal projects annual earnings of almost $162 million, and could result in as many as 2,264 new jobs in the city by 2026.



HIDDEN CLUES: BIOMEDICAL ENGINEERING RESEARCHERS LOOK OUTSIDE TUMORS TO DIAGNOSE AND ADVANCE CARE

Researchers at Case Western Reserve University's Center for Computational Imaging and Personalized Diagnostics (CCIPD) identified new targets for their machine-learning algorithms—they're looking outside tumors at surrounding tissues for clues to make more accurate diagnoses and predict outcomes for cancer patients.

They discovered they can quickly and accurately predict which lung cancer patients will benefit from chemotherapy by analyzing how immune cells around the tumor itself are arranged. And they found that examining the shape of the blood vessels feeding nodules found on lung CAT scans can indicate whether the nodule is cancerous or benign.

Center director Anant Madabhushi, F. Alex Nason Professor II of Biomedical Engineering, and his team also found markers on tissue outside breast tumors that indicate whether a patient will respond to chemo.

These discoveries were heralded as a top-10 medical breakthrough by *Prevention Magazine*, and Nature named Madabhushi among the field's most creative thinkers when it comes to innovative approaches for beating cancer.

CCIPD researchers also turned their attention to assisting digital pathologists by developing a new quality control tool to help standardize and improve the digitization of medical images.

Learn more at engineering.case.edu/ccipd

ENGINEERING RESEARCHERS RECEIVE FUNDING TO MOVE HEALTH CARE INNOVATIONS TO MARKET

Four Case School of Engineering researchers received funding from the Ohio Third Frontier Commission via the CWRU Technology Validation and Startup Fund Program to help them commercialize their discoveries.

The fund focuses on driving development in biomedical sciences, advanced materials, sensors, energy, advanced manufacturing and software/information technology.

Recipients include:

- Kiju Lee, assistant professor of mechanical and aerospace engineering, for interactive block games for routine cognitive assessment of older adults at high risk of Alzheimer's disease
- Mei Zhang, assistant professor of biomedical engineering, for a potent immunotherapeutic for melanoma, osteosarcoma and other solid tumor cancers
- James Basilion, professor of biomedical engineering and professor of radiology at the Case Western Reserve School of Medicine, for targeted microtubule disruption agents for prostate cancer
- Ronald Triolo, professor of biomedical engineering, for clinical evaluation of a self-leveling walker

BIOMEDICAL ENGINEERING ALLIANCE

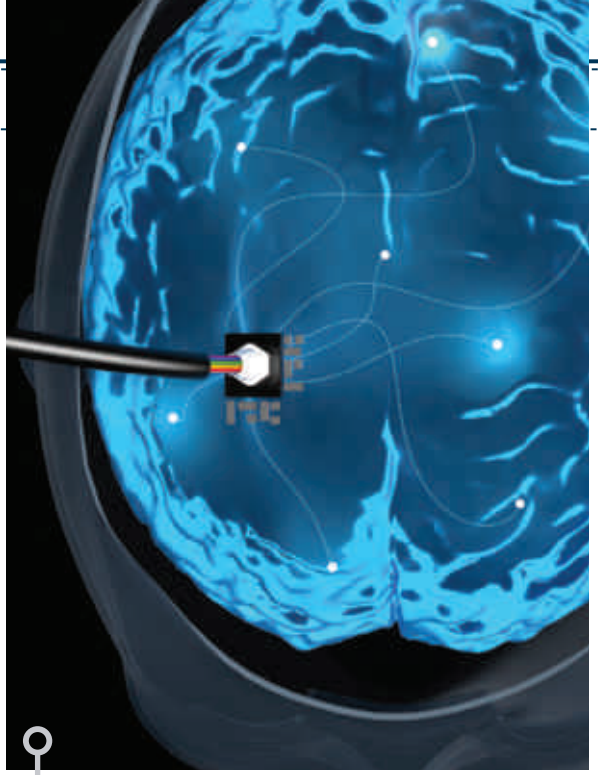
Case Western Reserve University and Cleveland Clinic have launched a new partnership to advance research and education in biomedical engineering across greater Cleveland's growing health innovation ecosystem. The alliance capitalizes on the synergistic strengths of both institutions' nationally renowned biomedical engineering departments to create a unique program with an extensive portfolio of laboratory breakthroughs that led to life-changing treatments for patients.

Additionally, the alliance increases opportunities for trainees at all levels—from high school to postdoctoral education—to study with renowned scientists, physicians and engineers whose expertise ranges from nanotechnology and neural engineering to imaging and regenerative medicine.

EXPLORING UNCHARTED TERRITORY IN THE HUMAN BRAIN

The human brain is a complex symphony of electrical communication—a collection of more than 100 billion neurons transmitting, receiving and unconsciously processing roughly 11 million pieces of information per second. When a neurological disorder like epilepsy disrupts this mass communication system, the results can be devastating. Dominique Durand, the Elmer Lincoln Lindseth Professor of Biomedical Engineering, and PhD student Nick Couturier discovered a new technique to stop seizures before they start—by directing a low-frequency stimulus to nerve fibers. They demonstrated a success rate of more than 90 percent in biologic models using this axon-exciting technique.

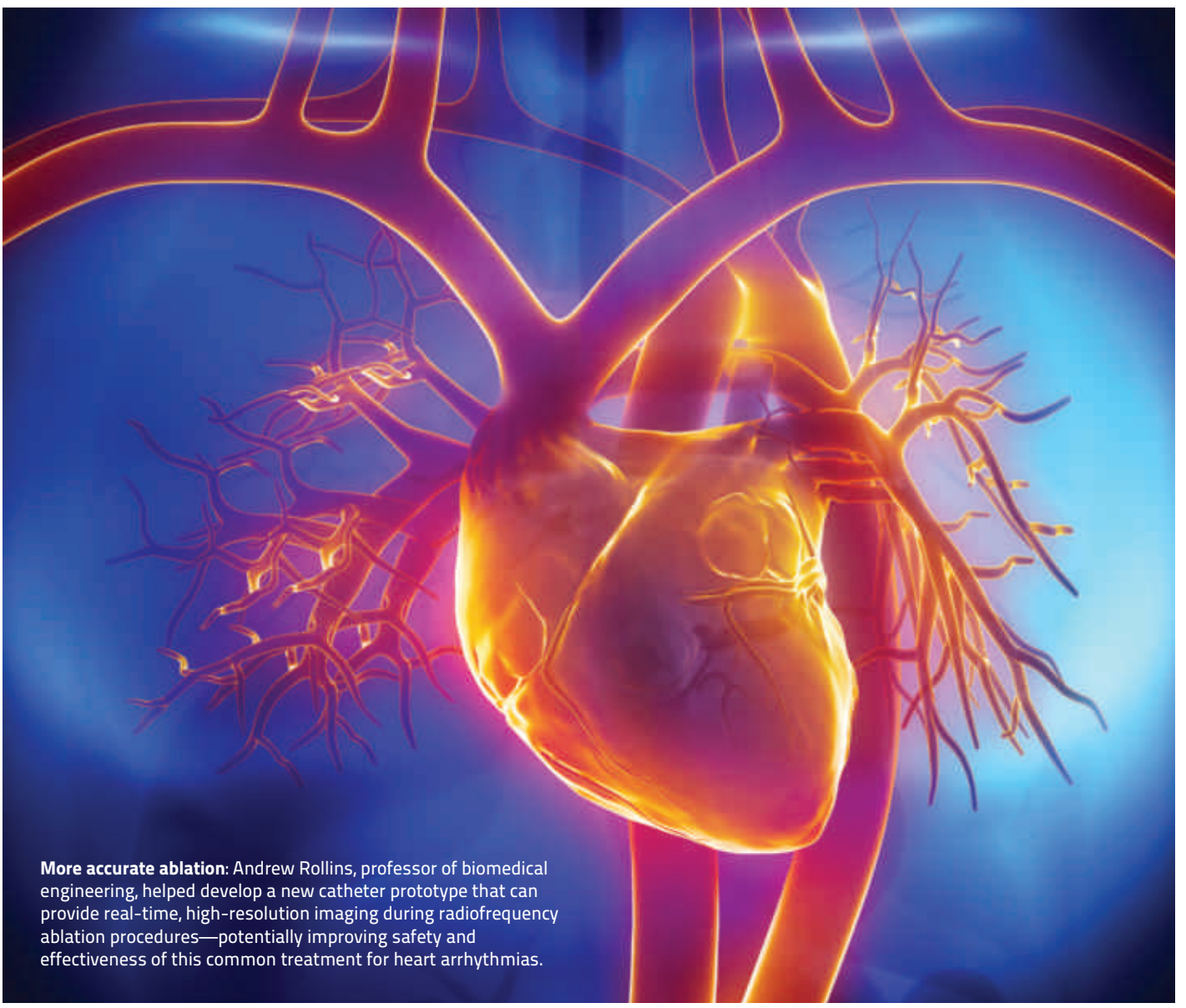
Understanding how the brain communicates is critical to making advancements in the treatment of neurological disorders like epilepsy. Earlier this year, Durand also discovered a new form of neural communication when he and his team observed a wave of neural activity generated by low-level electric fields leap across a cut made in brain tissue.



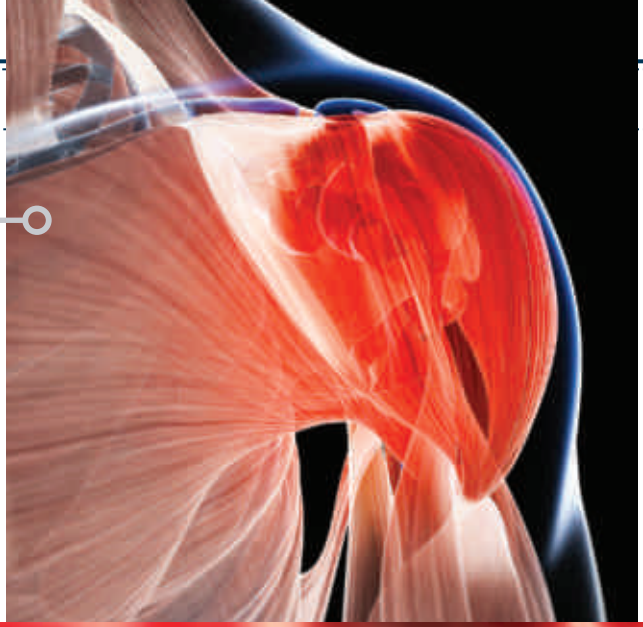
Jeffrey Capadona, professor of biomedical engineering, received more than $5 million in combined funding from the National Institutes of Health and Veterans Affairs Rehabilitation Research and Development to develop and evaluate antioxidant coating strategies for microelectrodes implanted in the brain that could decrease tissue inflammation and improve their performance.

Six near-market-ready innovations from engineering researchers received funding from the Case-Coulter Translational Research Partnership to help them on the path to commercialization:

- Sickle cell disease biochip blood-cell adhesion test for emerging anti-adhesive therapies (Umut Gurkan, the Warren E. Rupp Associate Professor of Mechanical and Aerospace Engineering, and Jane Little, professor of medicine at the Case Western Reserve School of Medicine)
- 3-D ultrasound imaging for ophthalmology (David Wilson, professor of biomedical engineering, and Faruk Orge, professor of ophthalmology and visual sciences at the School of Medicine)
- LunIOTx: decision-support technology for predicting response to immunotherapy in lung cancer (Anant Madabhushi, the F. Alex Nason Professor II of Biomedical Engineering)
- Magneto-optical diagnosis of Lyme disease in blood samples (Umut Gurkan and Brian Grimberg, assistant professor of international health at the School of Medicine)
- Magnetic resonance fingerprinting for target identification in deep brain stimulation (Cameron McIntyre, the Tilles-Weidenthal Professor of biomedical engineering; and Mark Griswold, professor of radiology at the School of Medicine)
- Novel positron emission tomography imaging agent for tumor detection and treatment (James Basilion, professor of biomedical engineering, and Susann Brady-Kalnay, professor of biomedical engineering at the School of Medicine)



More accurate ablation: Andrew Rollins, professor of biomedical engineering, helped develop a new catheter prototype that can provide real-time, high-resolution imaging during radiofrequency ablation procedures—potentially improving safety and effectiveness of this common treatment for heart arrhythmias.



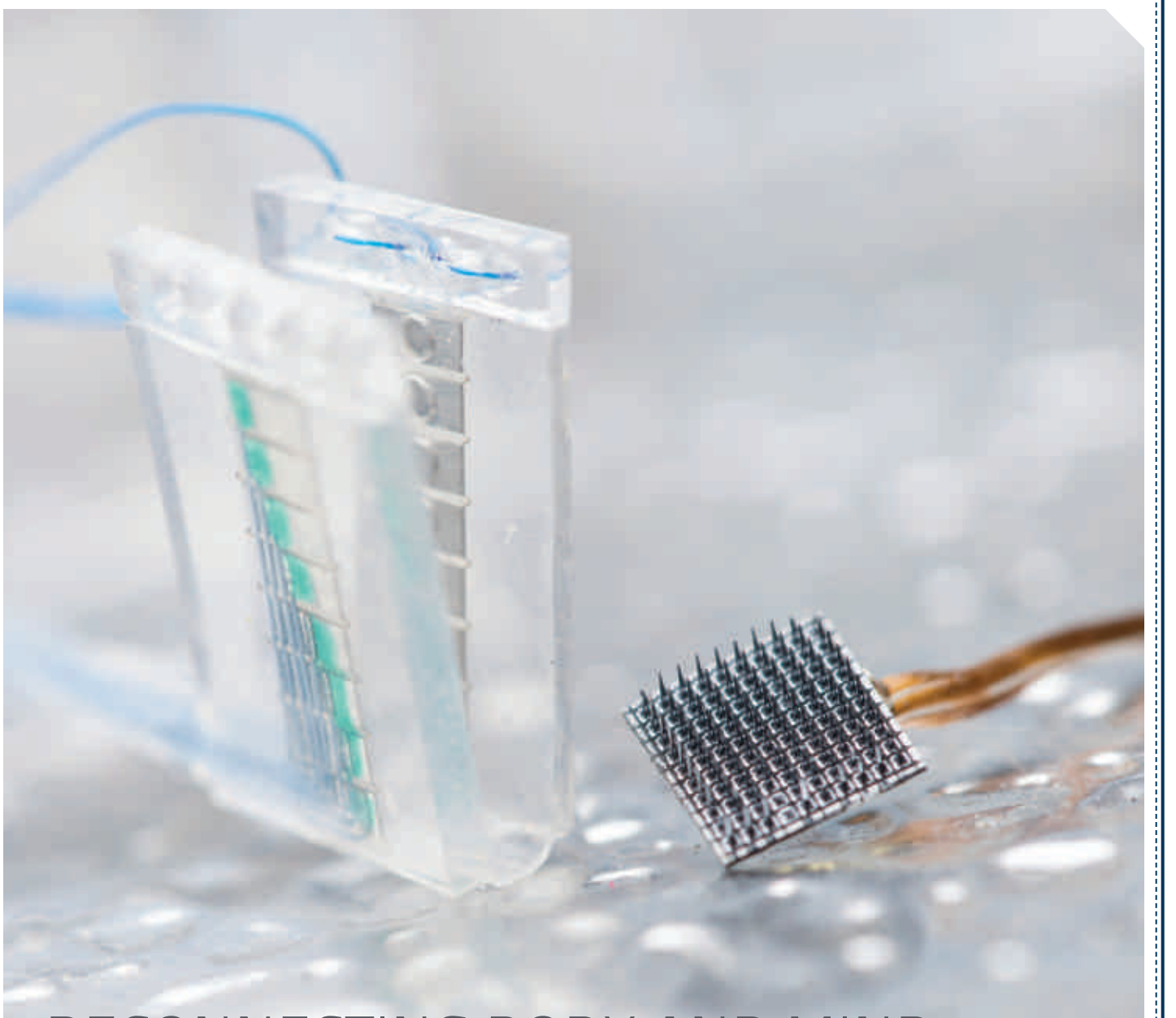
Ozan Akkus, the Leonard Case Jr. Professor in the Department of Mechanical and Aerospace Engineering, was awarded three new U.S. patents for inventions in electrochemical processing of materials and advanced Raman spectroscopy for materials imaging, all for use in health care applications.

XaTek Inc. raised $9.1 million to advance and test ClotChip—a handheld device that quickly gauges blood's clotting ability developed by Pedram Mohseni, professor of electrical, computer and systems engineering. The company aims to have the device cleared by the FDA for use in hemophilia and anticoagulation therapy markets by mid-2021.

Case Western Reserve University spinoff company Haima Therapeutics received $150,000 in funding from the U.S. Department of Defense to study the feasibility of freeze-drying synthetic platelet technologies for on-field deployment. They also received a grant from the NIH's Small Business Innovation Research program to advance the development of synthetic platelets to treat thrombocytopenia.

Anirban Sen Gupta, professor of biomedical engineering, co-founded Haima Therapeutics. Last year, the company and Case Western Reserve signed an option to license and develop Sen Gupta's artificial platelet technology, SynthoPlate.

A team of Case Western Reserve researchers developed a new method for single-use biosensor fabrication that significantly boosts efficiency and sensitivity. In a paper published in *Scientific Reports*, they demonstrated the ability of the sensor to detect Glypican-1—a biomarker of pancreatic cancer.

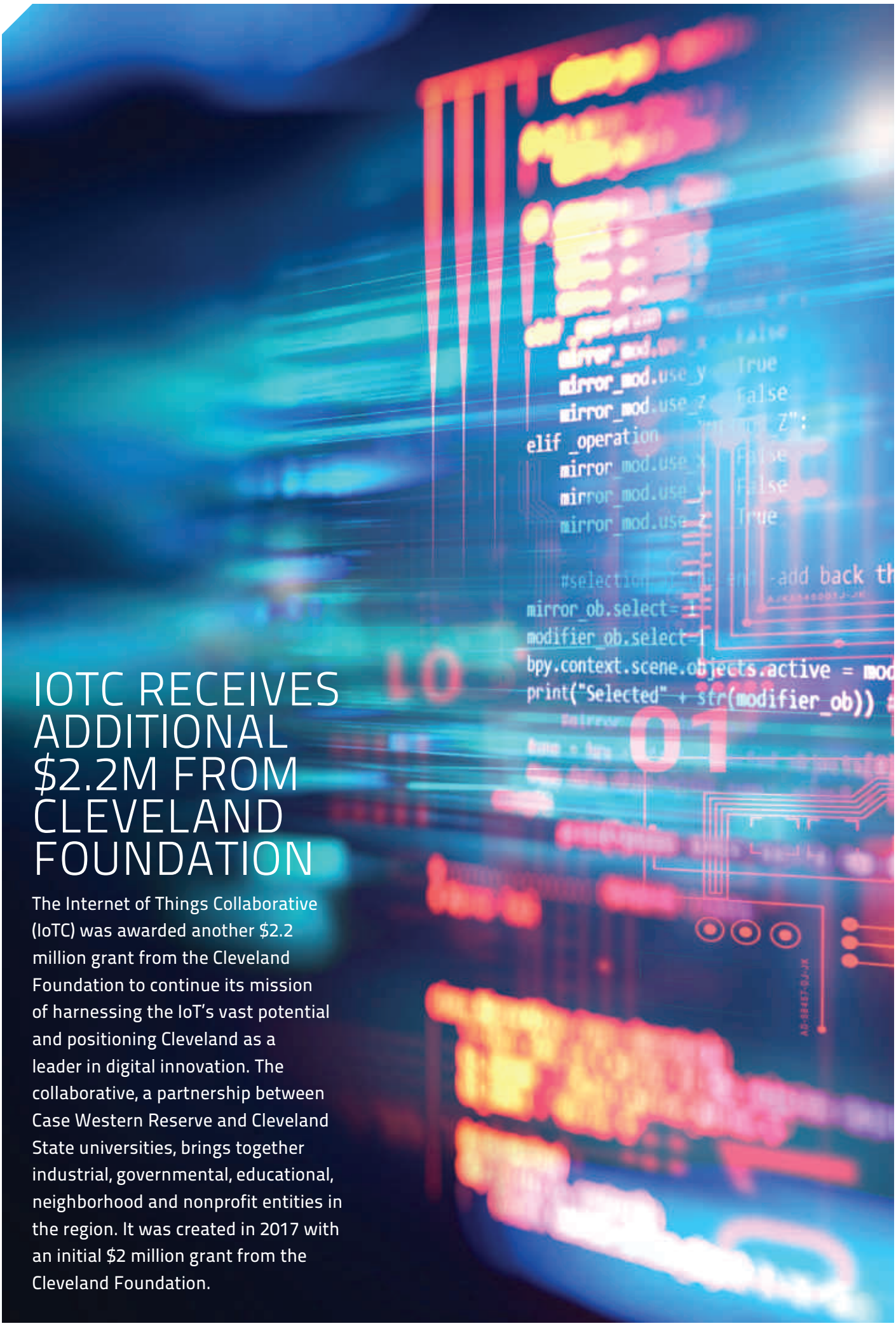


RECONNECTING BODY AND MIND

A damaged spinal cord leaves the brain isolated from the body it's meant to control. But a team at Case Western Reserve is pioneering a new brain-computer interface (BCI) neuroprosthesis that could reconnect the brain to limbs—restoring an unprecedented amount of function and sensation to paralyzed patients.

Bolu Ajiboye, associate professor of biomedical engineering, Robert Kirsch, professor and chair of biomedical engineering executive director of the Cleveland Functional Electrical Stimulation (FES) Center, and Jonathan Miller, professor of neurosurgery, received a $3 million grant from the U.S. Department of Defense to develop a system called ReHAB (for Reconnecting the Hand and Arm to the Brain)—an extensive array of sensors surgically implanted into the brain along with high-density stimulating electrodes placed directly on hand, arm and shoulder nerves that will allow the user to move their hand and arm naturally just by thinking about it. The new project builds on their work with BrainGate2, an earlier BCI system.

This new system uses innovative peripheral nerve electrodes that can selectively stimulate nerve fibers to produce precise movements. And the team hopes to restore sensation within the hand as well as proprioception—perception and awareness of where the limb is located. The researchers are launching a clinical trial to refine the system in collaboration with University Hospitals Cleveland Medical Center and Case Western Reserve School of Medicine.



IOTC RECEIVES ADDITIONAL $2.2M FROM CLEVELAND FOUNDATION

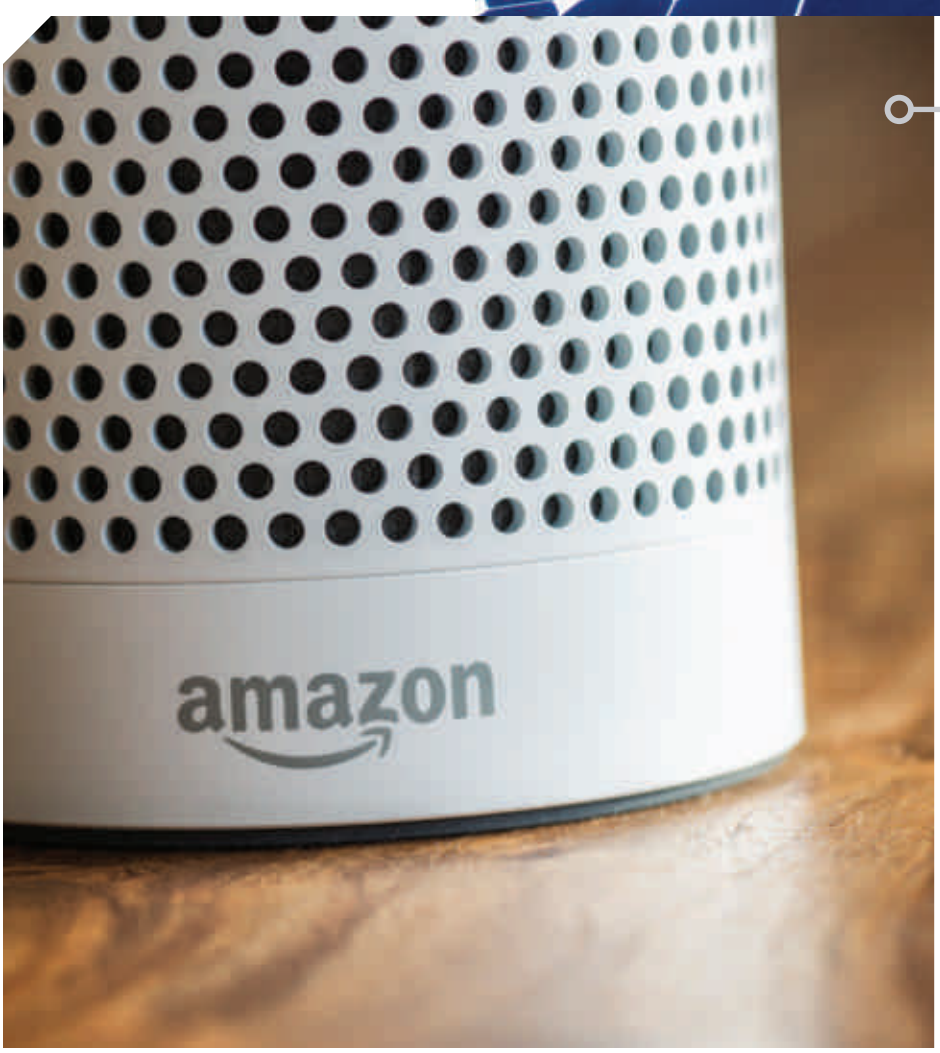
The Internet of Things Collaborative (IoTC) was awarded another $2.2 million grant from the Cleveland Foundation to continue its mission of harnessing the IoT's vast potential and positioning Cleveland as a leader in digital innovation. The collaborative, a partnership between Case Western Reserve and Cleveland State universities, brings together industrial, governmental, educational, neighborhood and nonprofit entities in the region. It was created in 2017 with an initial $2 million grant from the Cleveland Foundation.

TRAINING THE NEXT GENERATION OF DIGITAL GRID EXPERTS

Case Western Reserve and Siemens have partnered to provide students with the skills needed to plan, operate and advance the nation's energy grid. The power grid, faced with the growth of renewable energy and the threat of outages from extreme weather, is becoming more reliant than ever on intelligent, digital technologies to smoothly operate the country's critical infrastructure. A new academic track will prepare students for this shifting energy landscape by providing them with both new classroom curriculum and hands-on learning via real-world software and hardware tools in a new state-of-the-art Digital Grid Lab. The total value of the partnership is about $1.2 million.

A SMART ENERGY BUILDING SYSTEM

Case Western Reserve's engineering and applied social sciences schools teamed up with a utility service to investigate the creation of a **"smart" energy building system—one that integrates cutting-edge, solar-energy technology with battery energy storage and building energy management**. The Jack, Joseph and Morton Mandel School of Applied Social Sciences' building was upgraded with more than 200 solar panels and 40 modular lithium-ion batteries designed to store energy and distribute excess power back to the grid as needed while smoothing out power from the solar panels. The project was funded by a $2.3 million Department of Energy grant awarded to Marija Prica, assistant professor of electrical engineering and computer science.



UNDERGRADUATE STUDENT WOWS AMAZON WITH ALEXA SAVVY

First-year Case Western Reserve computer science student Austin Wilson was only 16 years old when his ability to use Alexa to move a K'nex-constructed car won him second place in Hackster's Internet of Voice Challenge and cemented his interest in Amazon's voice service.

Since then, he's honed his skills on more complex projects, collecting more prizes along the way and attracting the attention of publications like *PC Magazine*, *International Business Times UK* and *Popular Mechanics*. Amazon itself has taken notice of Wilson's work—**the company named him an Alexa Champion**, a title bestowed on a select group of individuals who have been most engaged with the voice service. He was even highlighted in Amazon's Alexa Pioneers series.

TECH TAKES ON CIGARETTE SMOKING

Researchers at Case Western Reserve led by Ming-Chun Huang, assistant professor of electrical engineering and computer science, are **using wearable sensor technology to develop an automatic alert system to help people quit smoking.** The smartphone app automatically texts video messages to smokers when sensors detect specific arm and body motions associated with smoking. The platform combines online mindfulness training with a personalized plan for quitting, as well as armband sensors to detect smoking actions, a technology that demonstrated more than 98-percent accuracy in differentiating "lighting up" from other similar motions.

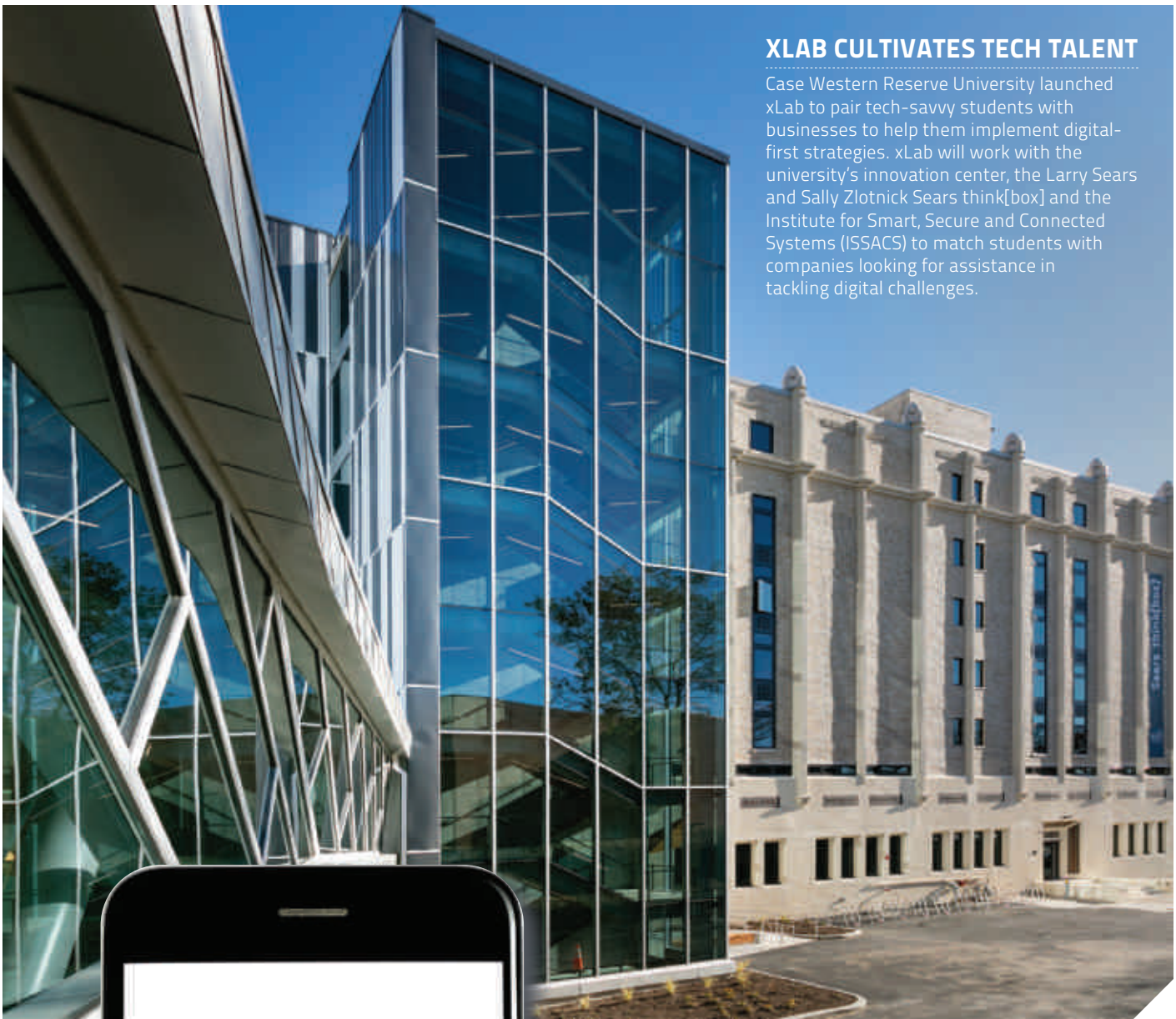
TURNING IDEAS INTO INNOVATIONS AT SEARS THINK[BOX]

The Larry Sears and Sally Zlotnick Sears think[box] in the Richey-Mixon Building at Case Western Reserve gives innovators of all stripes the resources they need to bring their ideas to life. This year, the campus innovation center helped a local veterinarian get an injured puppy back on his paws by 3-D printing a model of his injured leg to guide his treatment. Path Robotics, a startup founded by a team of student entrepreneurs, used the facility to refine its autonomous robotic welder. Also, robotics researchers from the university's Department of Mechanical and Aerospace Engineering used think[box] 3-D printers to print structural components of a fruit fly-inspired robot called Drosophibot, which they are using as a testing platform for robot controllers based on insect nervous systems. See more innovations at thinkbox.case.edu.

Out of this world: Mechanical and aerospace engineering student Evan Rose got the chance to test his flame spread experiment in outer space. By winning the Ken Souza Memorial Research Competition from the American Society for Gravitational and Space Research (ASGSR), his team secured a spot for his experiment on Blue Origin's New Shepard rocket. His project, "Effect of Longitudinal Oscillations on Flame Spread in Microgravity," along with 37 other winning experiments from universities across the country, launched into low-Earth orbit in May. Vedha Nayagam, research associate professor in the Department of Mechanical and Aerospace Engineering, served as adviser to the team.

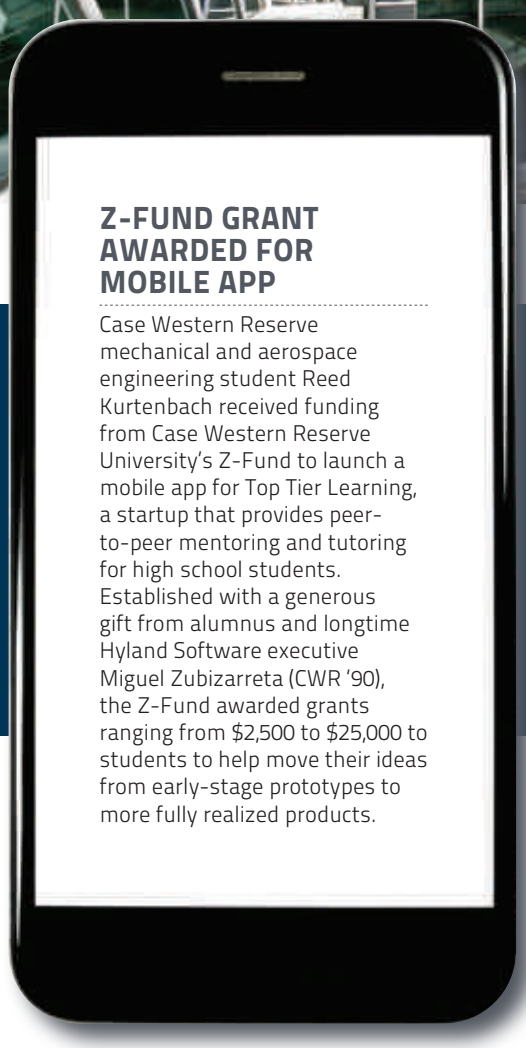
REUTERS NAMED **CASE WESTERN RESERVE** AMONG THE WORLD'S **MOST INNOVATIVE** UNIVERSITIES.

Robotic exoskeletons, refining self-powered energy sensors, a UV-sensitive adhesive and more: Student, alumni and faculty innovators from Case Western Reserve packed 12 booths at CES 2019—the largest innovation and breakthrough technology show and convention in North America. This marks the sixth year the university has brought its student and alumni entrepreneurs to the show.



XLAB CULTIVATES TECH TALENT

Case Western Reserve University launched xLab to pair tech-savvy students with businesses to help them implement digital-first strategies. xLab will work with the university's innovation center, the Larry Sears and Sally Zlotnick Sears think[box] and the Institute for Smart, Secure and Connected Systems (ISSACS) to match students with companies looking for assistance in tackling digital challenges.

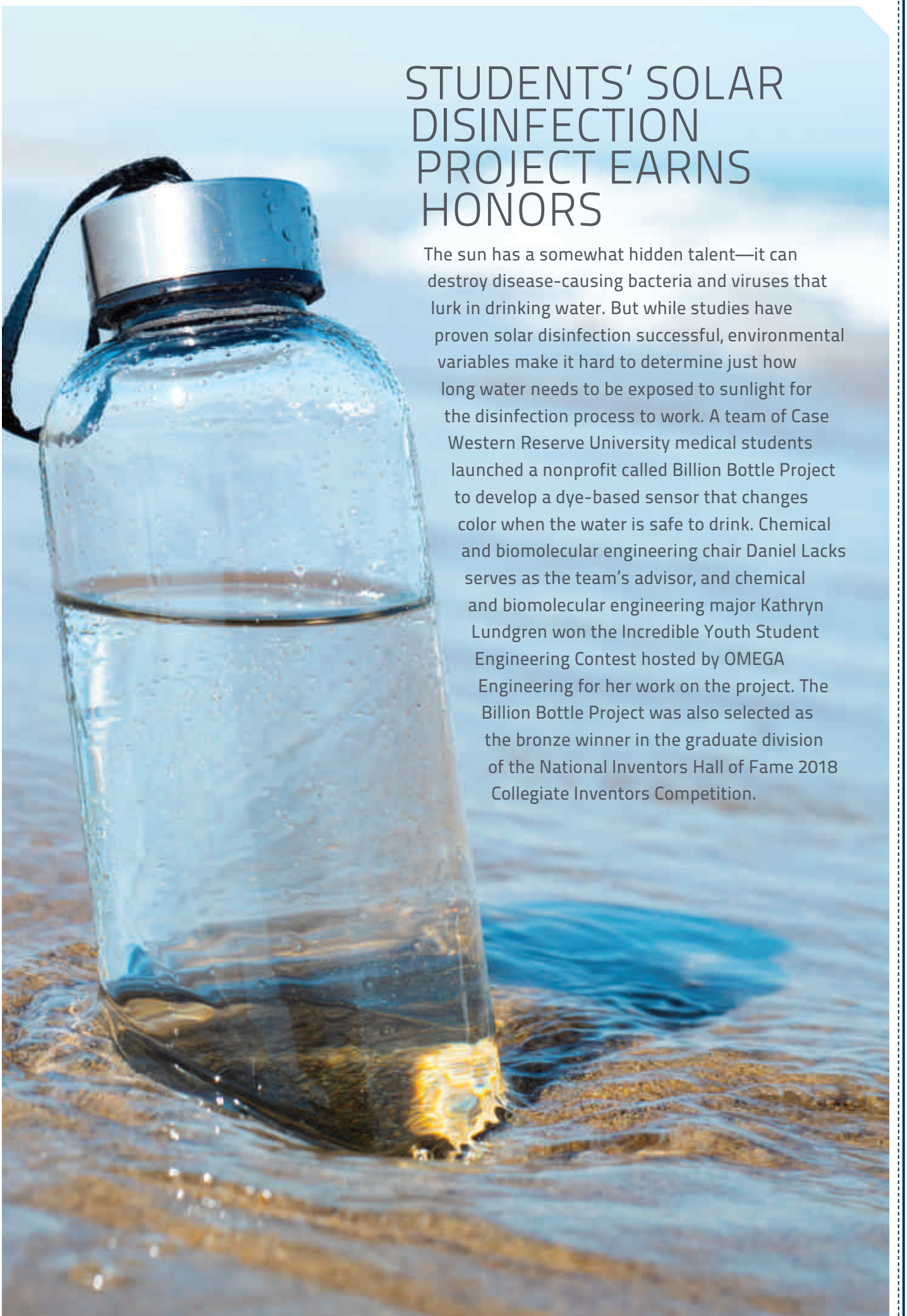


Z-FUND GRANT AWARDED FOR MOBILE APP

Case Western Reserve mechanical and aerospace engineering student Reed Kurtenbach received funding from Case Western Reserve University's Z-Fund to launch a mobile app for Top Tier Learning, a startup that provides peer-to-peer mentoring and tutoring for high school students. Established with a generous gift from alumnus and longtime Hyland Software executive Miguel Zubizarreta (CWR '90), the Z-Fund awarded grants ranging from $2,500 to $25,000 to students to help move their ideas from early-stage prototypes to more fully realized products.

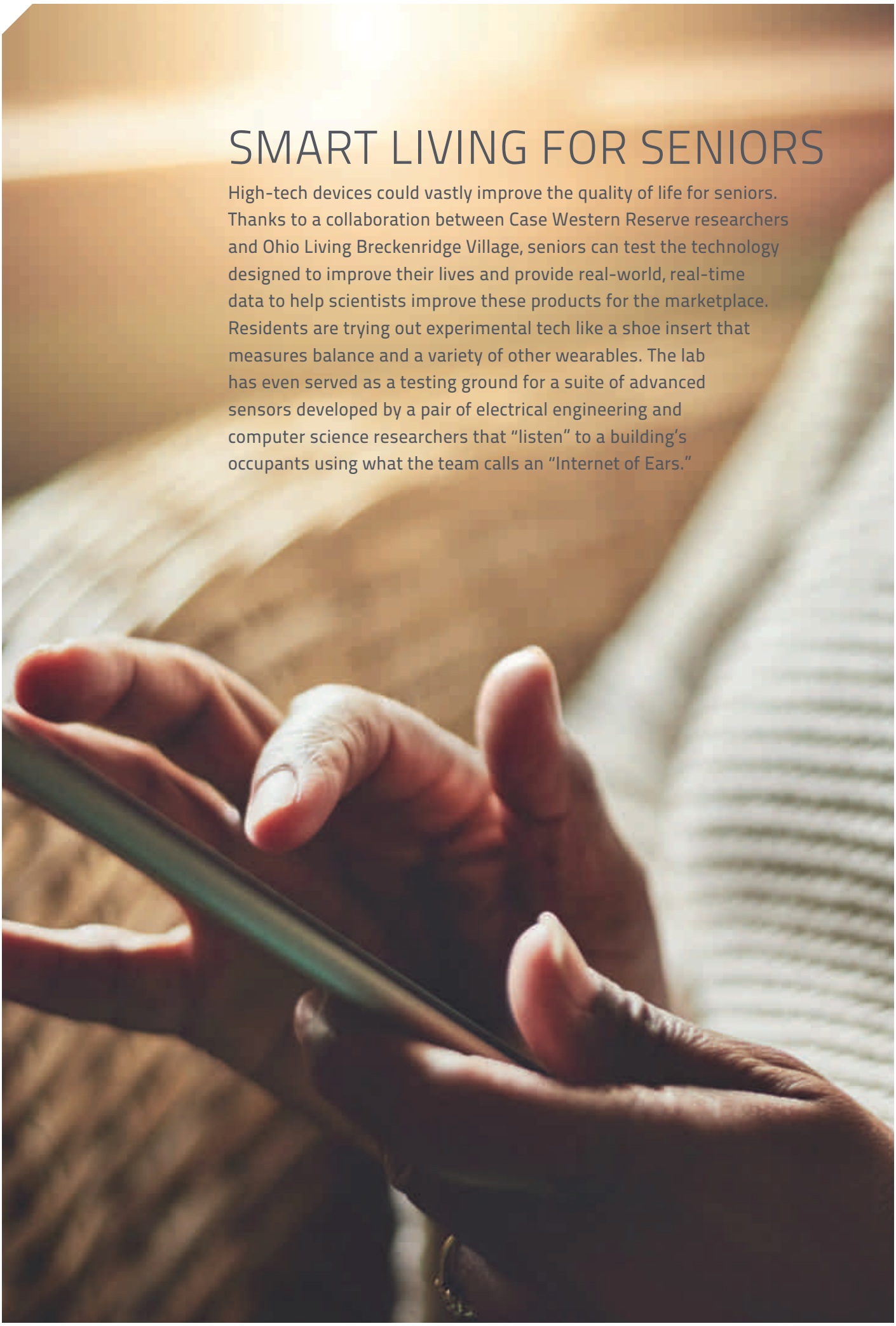
SUPPORT FOR WOMEN ENTREPRENEURS

Case Western Reserve's Women in Science and Engineering Roundtable launched a new initiative to support women entrepreneurs. Developed in collaboration with the university's Sears think[box], CWRU LaunchNET and the Flora Stone Mather Center for Women, the Program Rewarding Innovation in STEM Entrepreneurship (PRISE) will help female undergraduate students hone their entrepreneurial skills and give them access to coaching with industry professionals.



STUDENTS' SOLAR DISINFECTION PROJECT EARNS HONORS

The sun has a somewhat hidden talent—it can destroy disease-causing bacteria and viruses that lurk in drinking water. But while studies have proven solar disinfection successful, environmental variables make it hard to determine just how long water needs to be exposed to sunlight for the disinfection process to work. A team of Case Western Reserve University medical students launched a nonprofit called Billion Bottle Project to develop a dye-based sensor that changes color when the water is safe to drink. Chemical and biomolecular engineering chair Daniel Lacks serves as the team's advisor, and chemical and biomolecular engineering major Kathryn Lundgren won the Incredible Youth Student Engineering Contest hosted by OMEGA Engineering for her work on the project. The Billion Bottle Project was also selected as the bronze winner in the graduate division of the National Inventors Hall of Fame 2018 Collegiate Inventors Competition.



SMART LIVING FOR SENIORS

High-tech devices could vastly improve the quality of life for seniors. Thanks to a collaboration between Case Western Reserve researchers and Ohio Living Breckenridge Village, seniors can test the technology designed to improve their lives and provide real-world, real-time data to help scientists improve these products for the marketplace. Residents are trying out experimental tech like a shoe insert that measures balance and a variety of other wearables. The lab has even served as a testing ground for a suite of advanced sensors developed by a pair of electrical engineering and computer science researchers that "listen" to a building's occupants using what the team calls an "Internet of Ears."

EARLY CAREER HONORS IN ROBOTICS

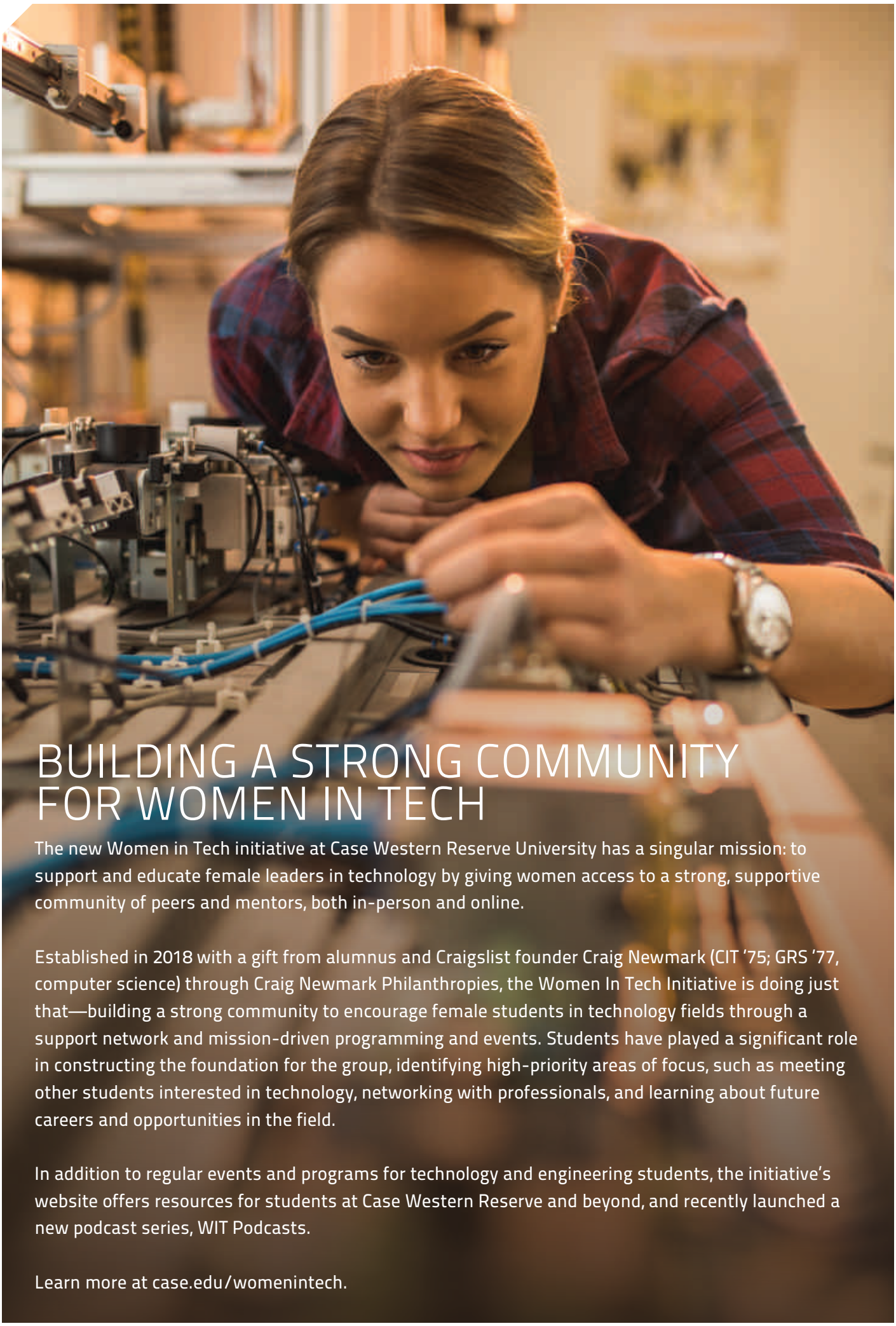
Kathryn Daltorio, assistant professor of mechanical and aerospace engineering, received a 2019 Young Investigator Award from the Office of Naval Research. She was recognized among 25 recipients—from an application pool of more than 260—who will share $16.5 million in funding to conduct research with direct benefits for sailors and marines. Daltorio will use the grant to advance crab-like robots for amphibious terrain.

ADVANCING NEW MATERIALS FOR MANUFACTURING

Materials scientists won a TechConnect Defense Innovation Award for research exploring the processing of third-generation aluminum-lithium alloys for use in advanced manufacturing. John Lewandowski, the Arthur P. Armington Professor of Engineering II in the Department of Materials Science and Engineering, led Case Western Reserve's efforts on the project, in collaboration with other universities, industrial members and government labs with the support of Lightweight Innovations for Tomorrow (LIFT), a public-private partnership dedicated to advancing new lightweight materials manufacturing technologies.

BETTER HUMAN-ROBOT RELATIONS FOR SMARTER MANUFACTURING

Mechanical engineering researchers at Case Western Reserve want to create a better work environment—for robots and their human coworkers. Robert Gao, chair of the Department of Mechanical and Aerospace Engineering and the Cady Staley Professor, is leading Case Western Reserve's efforts on a multi-institution project funded by the National Science Foundation examining various aspects of robot-human collaborations in manufacturing operations. Gao and his team will focus on how to teach robots to reliably recognize sometimes random human motions in a variety of different workplaces scenarios.



BUILDING A STRONG COMMUNITY FOR WOMEN IN TECH

The new Women in Tech initiative at Case Western Reserve University has a singular mission: to support and educate female leaders in technology by giving women access to a strong, supportive community of peers and mentors, both in-person and online.

Established in 2018 with a gift from alumnus and Craigslist founder Craig Newmark (CIT '75; GRS '77, computer science) through Craig Newmark Philanthropies, the Women In Tech Initiative is doing just that—building a strong community to encourage female students in technology fields through a support network and mission-driven programming and events. Students have played a significant role in constructing the foundation for the group, identifying high-priority areas of focus, such as meeting other students interested in technology, networking with professionals, and learning about future careers and opportunities in the field.

In addition to regular events and programs for technology and engineering students, the initiative's website offers resources for students at Case Western Reserve and beyond, and recently launched a new podcast series, WIT Podcasts.

Learn more at case.edu/womenintech.

CASE WESTERN RESERVE RECEIVES HIGH RANKINGS

Case Western Reserve was ranked No. 13 in *Forbes*' top 25 universities that emphasize STEM—science, technology, engineering and math—putting it in elite company along with MIT, Georgia Tech and Johns Hopkins University. And the *Wall Street Journal* and *Times Higher Education* higher-education rankings positioned the university at 32nd nationally—and the top-ranked university in Ohio. Also in 2018, Reuters named Case Western Reserve among the world's most innovative universities.

$20M CHALLENGE GRANT TO ENGINEERING AND MEDICINE SUPPORTS NEW ENDOWED PROFESSORSHIPS

A $20 million challenge grant from two anonymous donors has given Case Western Reserve the opportunity to establish 20 new endowed professorships in engineering and medicine. One of the donors—an alumnus of both the engineering and medical schools—wrote "much of what I have been able to achieve in life is the result of the education I received and the experiences I enjoyed at Case Western Reserve University."

The gift aims to catalyze the creation of 10 new endowed professorships in engineering, and 10 in medicine. Through the gift, for each dollar given to a professorship, the grant will provide an equal amount toward the $2 million needed to create an endowed faculty position.

"Transformational support such as this speaks to the depth of commitment and loyalty our alumni feel to their alma mater, and to their belief and trust in the future of our school," said Venkataramanan "Ragu" Balakrishnan, the Charles H. Phipps Dean of the Case School of Engineering.

ENDOWED GRADUATE FELLOWSHIPS AIM TO IMPROVE ENGINEERING EDUCATION IN ETHIOPIA

Ethiopia has an abundance of raw materials, but does not yet have the engineering infrastructure to turn that material into a thriving economy and jobs. But a new initiative funded by longtime university benefactor Mark Gelfand aims to help grow that infrastructure to encourage broad and lasting economic development in the East African nation.

The new Gelfand Global STEMPower Initiative will endow fellowships for Case Western Reserve chemical engineering graduate students, who will connect with constituencies in Ethiopia to develop innovative engineering curricula for high school students there—focused on encouraging young entrepreneurs to industrialize their raw, natural resources in ways that stimulate the local economy.

JAMES MCGUFFIN-CAWLEY APPOINTED SENIOR ASSOCIATE DEAN

James McGuffin-Cawley was appointed senior associate dean of the Case School of Engineering. McGuffin-Cawley has been a faculty member for more than 25 years, and currently holds the Arthur S. Holden Jr. Professor of Engineering endowed chair. He has served as the school's interim dean, associate dean for research, associate dean for academics and spent nine years as chair of the Department of Materials Science and Engineering.

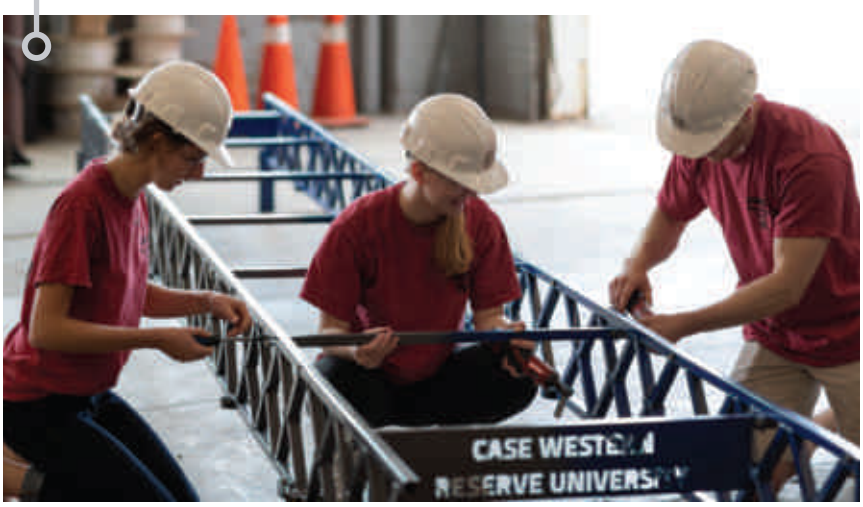
"Jim is an accomplished researcher, beloved teacher and leader in developing teams and building the school's ties with industry," said Venkataramanan "Ragu" Balakrishnan, the Charles H. Phipps Dean of the Case School of Engineering. "I am delighted that Jim will continue in a leadership role at the school, as his experience and service to the school are remarkable."

In this new position, McGuffin-Cawley will tackle strategic portfolios with over-the-horizon foci to position the school for future success. Some of the initiatives he will oversee include furthering efforts in big ideas and teaming for new areas and styles of research, handling issues of compliance, using technology in new ways, distance learning, and promoting and assessing diversity initiatives.

STEEL BRIDGE TEAM PLACES AT NATIONALS

Case Western Reserve's Steel Bridge Team finished second in the regional competition hosted by the American Institute of Steel Construction this past spring, allowing it to advance to the national competition this summer. There, it improved its scores in construction speed, stiffness and construction economy, and placed in the top 10 in lightness and top 20 in aesthetics.

The team designed and fabricated the 22-foot-long bridge utilizing the Vanderhoof Infrastructure Research and Education Facility and Bingham structures laboratory, and the Larry Sears and Sally Zlotnick Sears think[box]. Students on the team represent the civil, mechanical and aerospace, and electrical engineering and computer science departments across five years of study.



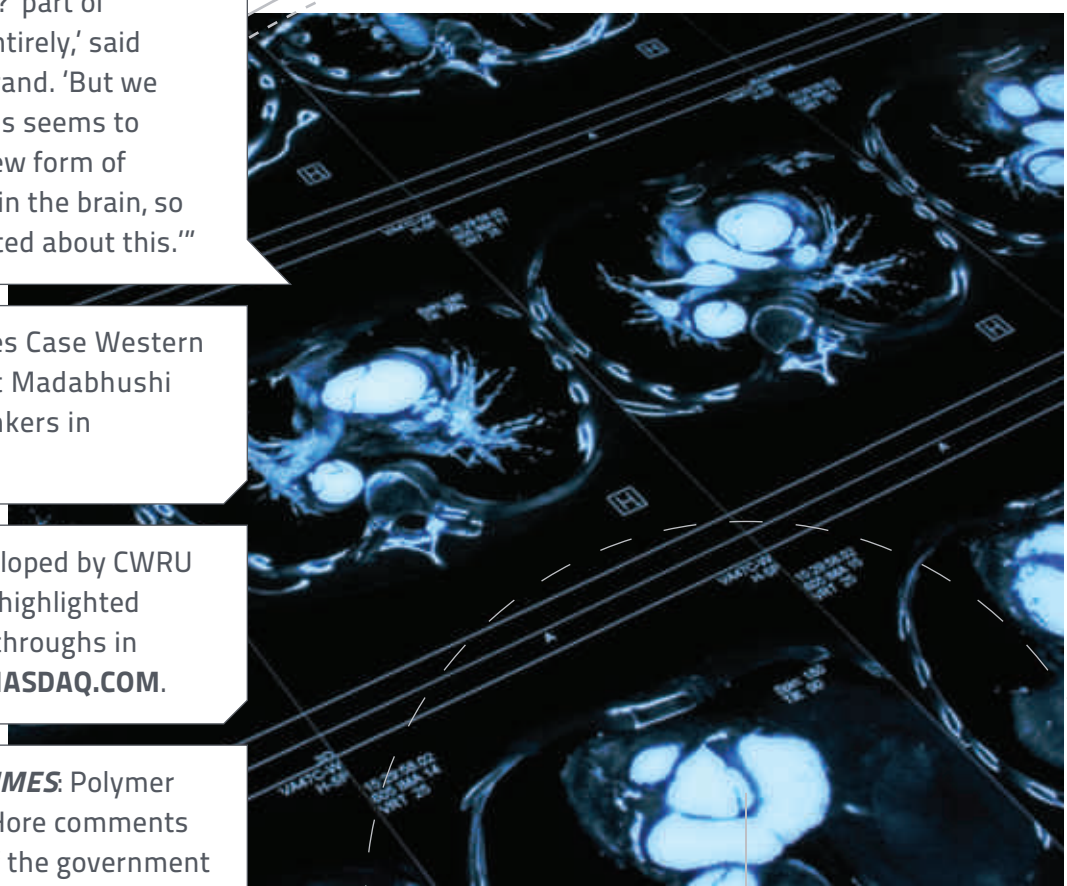
CENTER FOR ENGINEERING ACTION LAUNCHED

With the launch of the new Center for Engineering Action, the university has ratcheted up its support for students to use their technological skills to help improve the lives of others. The center mentors and guides students interested in humanitarian design initiatives, and helps pair students and faculty with projects across the globe to tackle problems such as unclean water, inaccessible medical care and unsafe infrastructure.

"We are among a select group of schools that have chosen to make this an important part of engineering education," said James McGuffin-Cawley, senior associate dean at the Case School of Engineering and the Arthur S. Holden Professor of Engineering.

The center's mission includes: encouraging the development of new projects—and bolstering existing ones—that draw students and faculty from disciplines across the university; serving as adviser and troubleshooter; organizing short study-abroad courses; connecting creators to funding sources and faculty to potential research partners in low-resource countries; and fostering ongoing collaborations with communities where projects are based. Learn more at engineering.case.edu/cenga.

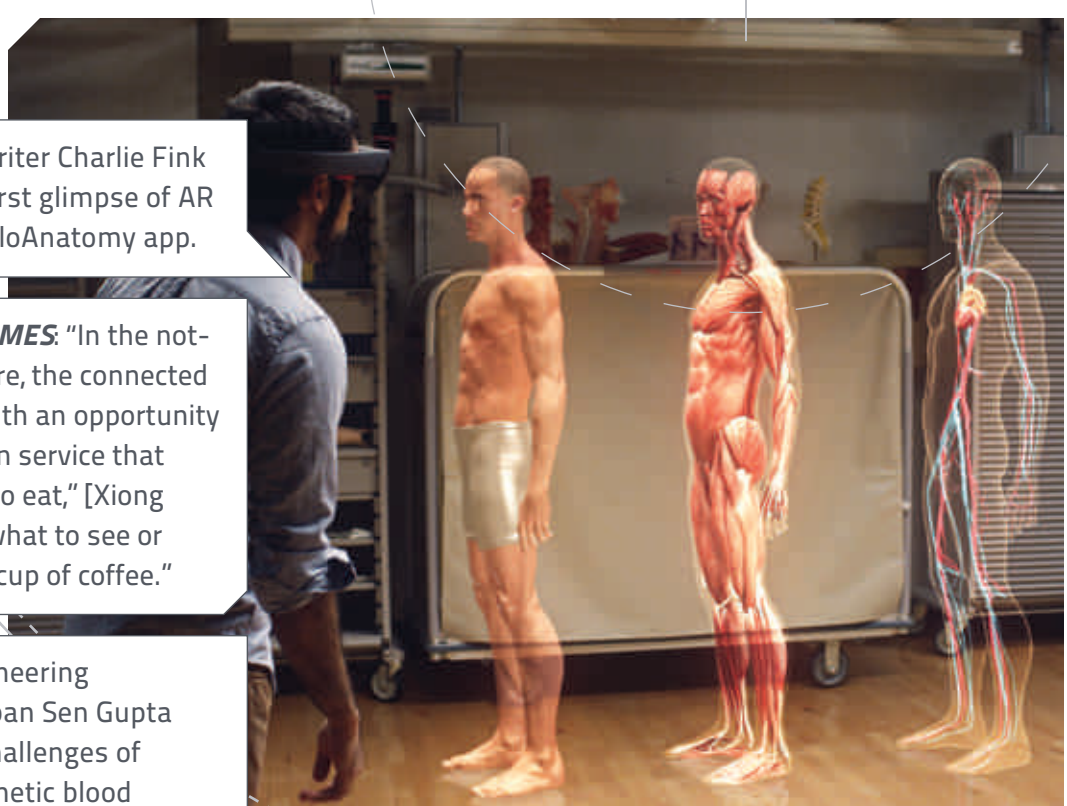
EARTH.COM: "'We don't know yet the 'So what?' part of this discovery entirely,' said [Dominique] Durand. 'But we do know that this seems to be an entirely new form of communication in the brain, so we are very excited about this.'"



NATURE features Case Western Reserve's Anant Madabhushi among bold thinkers in cancer care.

Algorithms developed by CWRU researchers are highlighted among AI breakthroughs in diagnostics by **NASDAQ.COM**.

LOS ANGELES TIMES: Polymer expert Michael Hore comments on the impact of the government shutdown on research



FORBES: Tech writer Charlie Fink recalls getting first glimpse of AR with CWRU's HoloAnatomy app.

LOS ANGELES TIMES: "In the not-too-distant future, the connected car may come with an opportunity for a subscription service that tells you where to eat," [Xiong "Bill"] Yu said, "what to see or where to grab a cup of coffee."

Biomedical engineering researcher Anirban Sen Gupta discusses the challenges of developing synthetic blood products with ***POPULAR SCIENCE***.

CWRU alum and computer science icon Don Knuth is celebrated for his legacy in the field of computer programming in ***THE NEW YORK TIMES***.

THE WEEK: CWRU researchers develop high-tech alert system to help curb smoking.

Brain-computer interface research by CWRU biomedical engineering faculty was featured in ***I AM HUMAN***—a neurotechnology documentary that debuted at the 2019 Tribeca Film Festival.

PREVENTION MAGAZINE names predictive algorithms developed at CWRU a top 10 incredible medical breakthrough.

CWRU student innovator Xyla Foxlin talks about breaking engineering stereotypes and supporting women in STEM in ***FORBES***.

REUTERS features biomedical engineering researchers at CWRU advancing brain implants.

BIZTECH MAGAZINE: "We've seen some companies put sensors on everything, collect all of this data and plan to figure out what it's used for later," [ISSACS director Nick] Barendt, says. Instead, he suggests, "really try to be thoughtful about the business problems you want to solve and what data will help solve them."


UMUT GURKAN


ANANT MADABHUSHI


ROBERT GAO


JENNIFER CARTER

CHRIS YINGCHUN YUAN, professor of mechanical and aerospace engineering, received the **Chao and Trigger Young Manufacturing Engineering Award** from the American Society of Mechanical Engineers.

RIGOBERTO ADVINCULA, professor of macromolecular science and engineering, was **elected to membership in the National Academy of Science and Technology, Philippines**.

UMUT GURKAN, the Warren E. Rupp Associate Professor of Mechanical and Aerospace Engineering, received an honorable mention in the U.S. Patent and Trademark Office's **2018 Patents for Humanity Award** program for creating a portable, quick hemoglobin scanner that can detect sickle cell disease and other hemoglobin disorders.

ANANT MADABHUSHI, the F. Alex Nason Professor II of Biomedical Engineering, was named a **fellow of the Institute of Electrical and Electronics Engineers** for his contributions in image analysis and machine learning tools for diagnosis and prognosis of disease.

ROBERT GAO, chair of the Department of Mechanical and Aerospace Engineering and the Cady Staley Professor, received the **Eli Whitney Productivity Award** from the Society of Manufacturing Engineers and the IEEE Instrument & Measurement Society's **Best Application in Instrumentation and Measurement Award**.

JENNIFER L.W. CARTER, assistant professor of materials science and engineering, was named among the nation's most promising young scientists as a recipient of a **Presidential Early Career Award for Scientists and Engineers and as the 2019 Young Leaders International Scholar** by the Metals, Minerals and Material Society and the Federation of European Materials Societies.


MIKE POLLINO


CLARE RIMNAC


JUDY ZHANG


BILL YU

DANIEL LACKS, the C. Benson Branch Professor and chair of the Department of Chemical and Biomolecular Engineering, received the **Award for Service to Society** from the American Institute of Chemical Engineers and the **Distinguished Service Award** from the Electrostatics Society of America.

RONALD TRIOLO, professor of biomedical engineering and orthopaedics, received the **2019 Paul B. Magnuson Award** from the Veterans' Affairs Office of Rehabilitation Research and Development.

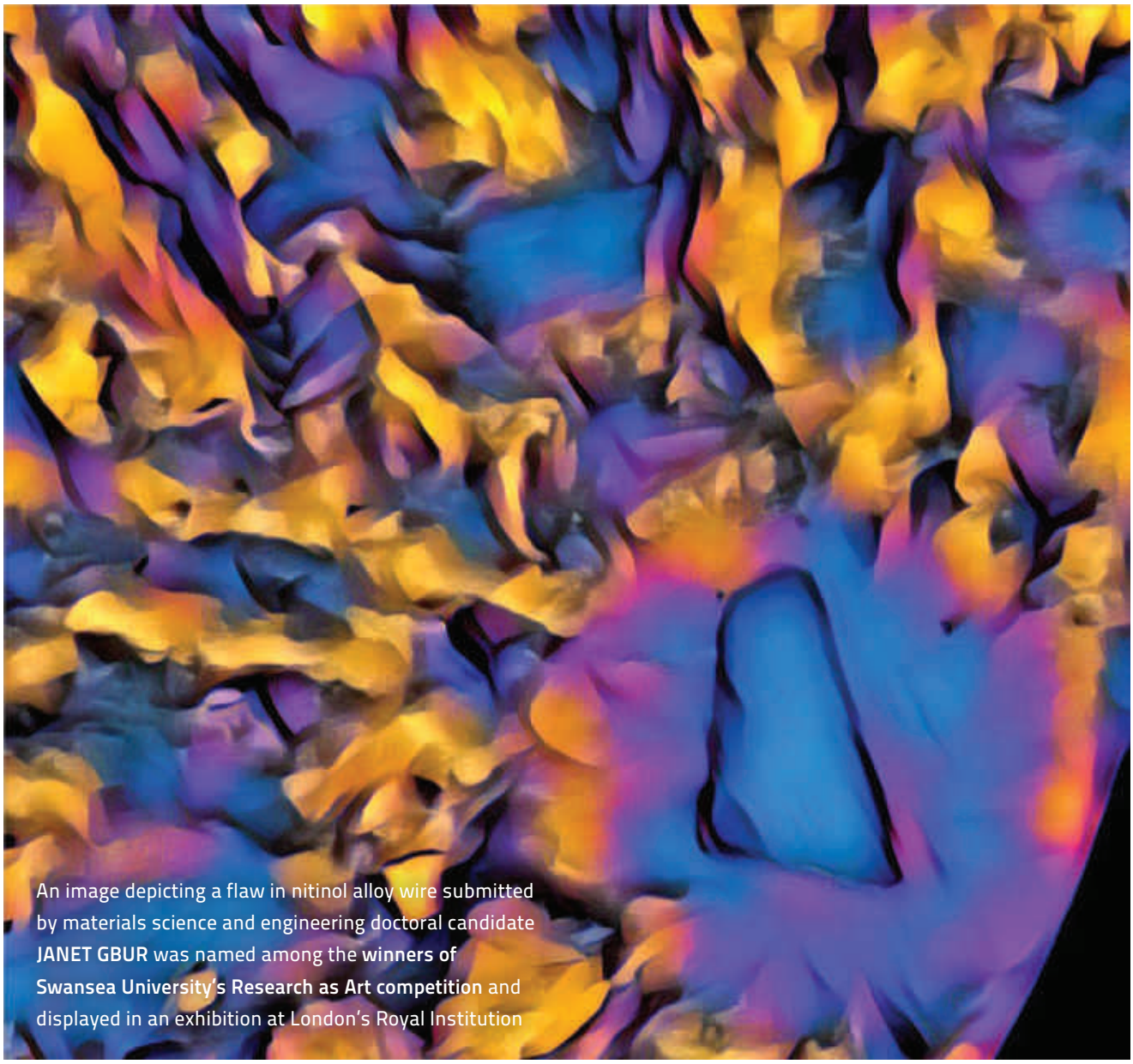
MICHAEL POLLINO, associate professor of civil engineering, was named a recipient of the **American Society of Civil Engineers Moisseiff Award**.

CLARE RIMNAC, Distinguished University Professor and the Wilbert J. Austin Professor of Engineering in the Department of Mechanical and Aerospace Engineering, was named a **Fellow of International Orthopaedic Research** of the International Combined Orthopaedic Research Societies (ICORS) International College of Fellows.

LIMING DAI, the Kent Hale Smith Professor in the Department of Macromolecular Science and Engineering, received the **Somiya Award** from the International Union of Materials Research Societies.

HUICHUN (JUDY) ZHANG, associate professor of civil engineering, received the **Nanova/CAPEES Frontier Research Award** from the Chinese-American Professors in Environmental Engineering and Science organization.

XIONG "BILL" YU, interim chair of the Department of Civil Engineering, was elected as a **senior member of the IEEE**.



An image depicting a flaw in nitinol alloy wire submitted by materials science and engineering doctoral candidate **JANET GBUR** was named among the **winners of Swansea University's Research as Art competition** and displayed in an exhibition at London's Royal Institution

LAURA WILSON, a graduate student in the Department of Materials Science and Engineering, was awarded one of five **NASA Aeronautics Research Mission Directorate Fellowships**.

Mechanical and aerospace engineering PhD student **ERDEM KUCUKAL** received a **predoctoral fellowship from the American Heart Association**.

XINYOU KE, a PhD student in the Department of Mechanical and Aerospace Engineering, was awarded the **2019 Industrial Electrochemistry and Electrochemical Engineering Division Student Achievement Award** from the Electrochemical Society.

The **National Science Foundation** named four current engineering students at Case Western Reserve University to the **Graduate Research Fellowship Program** for 2019:

Vivian Zhou
(Department of Electrical Engineering and Computer Science)

MARINA YU
(Department of Biomedical Engineering)

KATHLEEN YOUNG
(Department of Biomedical Engineering)

KATHERINE STEINBERG
(Department of Chemical and Biomolecular Engineering)

KIMBERLY GLIEBE, a PhD student in the Department of Materials Science and Engineering, was awarded the **National Defense Science and Engineering Graduate Fellowship** for 2019.

CASE WESTERN RESERVE UNIVERSITY

Barbara R. Snyder
President

Ben Vinson III
Provost and Executive Vice President

CASE SCHOOL OF ENGINEERING

Venkataramanan "Ragu" Balakrishnan
Charles H. Phipps Dean
Professor of Electrical, Computer and Systems Engineering

James D. McGuffin-Cawley
Senior Associate Dean
Arthur S. Holden Professor of Engineering

Marc Buchner
Associate Dean, Academics
Associate Professor, Electrical Engineering and Computer Science

Christian Zorman
Associate Dean, Research
Professor, Electrical Engineering and Computer Science

Daniel M. Ducoff
Vice Dean, External Relations
Vice President, Strategic Initiatives and Global Principal Gifts

Anne E. Cunningham
Associate Dean of Development and External Relations,
Office of Development and External Affairs
Associate Vice President, Development

Cena Hilliard
Associate Dean, Finance and Administration

Deborah J. Fatica
Assistant Dean,
Division of Engineering Leadership and Professional Practice

BIOMEDICAL ENGINEERING

Robert F. Kirsch
Chair and Allen H. and Constance T. Ford Professor of Biomedical Engineering

Horst von Recum
Executive Vice Chair
Professor

Andrew M. Rollins
Associate Chair and Professor

Colin Drummond
Assistant Chair and Professor

Abidemi Bolu Ajiboye
Associate Professor

James M. Anderson
Distinguished University Professor

James P. Basilion
Professor*

Zheng-Rong Lu
M. Frank Rudy and Margaret Domiter Rudy Professor

Anant Madabhushi
F. Alex Nason Professor II

Cameron McIntyre
Professor*

P. Hunter Peckham
Distinguished University Professor and Donnell Institute Professor of Engineering

Gerald M. Saidel
Professor

Anirban Sen Gupta
Professor

Sam E. Senyo
Assistant Professor

CHEMICAL AND BIOMOLECULAR ENGINEERING

Daniel J. Lacks
Chair and C. Benson Branch Professor of Chemical Engineering

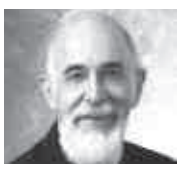
Rohan Akolkar
F. Alex Nason Professor and Ohio Eminent Scholar for Advanced Energy Research

Harihara Baskaran
Professor

Christine Duval
Assistant Professor

Donald L. Feke
Distinguished University Professor and Vice Provost

Burcu Gurkan
Assistant Professor



Uziel Landau
Professor

CIVIL ENGINEERING

Xiong "Bill" Yu
Interim Chair and Frank H. Neff Professor

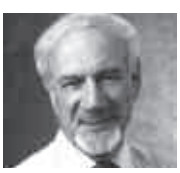
Christian Carloni
Associate Professor

YeongAe Heo
Assistant Professor

Yue Li
Professor

Michael Pollino
Associate Professor

Kurt R. Rhoads
Assistant Professor, Division of Engineering Leadership and Professional Practice



Adel S. Saada
Professor

COMPUTER AND DATA SCIENCES

Jing Li
Interim Chair and Professor

Erman Ayday
Assistant Professor

Harold Connamacher
Associate Professor

Mehmet Koyuturk
Andrew R. Jennings Professor in the Computing Sciences

Michael Lewicki
Professor

Vincenzo Liberatore
Associate Professor

H. Andy Podgurski
Professor

**School of Medicine Campus*

Jeffrey R. Capadona
Professor

Dominique Durand
Distinguished Research Professor and Elmer Lincoln Lindseth Professor of Biomedical Engineering

Steven J. Eppell
Associate Professor

Steven J. Fening
Associate Professor

Miklos Gratzl
Associate Professor

Kenneth J. Gustafson
Associate Professor

Efstathios "Stathis" Karathanasis
Associate Professor*

NOT PICTURED

Andrew J. Shoffstall
Assistant Professor

Pallavi Tiwari
Assistant Professor*

Dustin J. Tyler
Kent H. Smith Professor of Engineering II

Satish Viswanath
Assistant Professor*

David L. Wilson
Robert J. Herbold Professor

Xin Yu
Professor

Chung-Chiun "C.C." Liu
Distinguished University Professor and Wallace R. Persons Professor of Sensor Technology and Control

Heidi B. Martin
Associate Professor

Julie Renner
Climo Assistant Professor

R. Mohan Sankaran
Goodrich Professor for Engineering Innovation

Robert Savinell
Distinguished University Professor and George S. Dively Professor of Engineering

Katie Wheaton
Instructor

Huichun "Judy" Zhang
Associate Professor

Michael Rabinovich
Professor

Soumya Ray
Associate Professor

An Wang
Assistant Professor

Yinghui Wu
Assistant Professor

Xusheng Xiao
Assistant Professor

Shuai Xu
Instructor

Yanfang (Fanny) Ye
Associate Professor

ELECTRICAL, COMPUTER, AND SYSTEMS ENGINEERING

Pedram Mohseni
Interim Chair and Professor

Venkataramanan "Ragu" Balakrishnan
Charles H. Phipps Dean and Professor

Marcus R. Buchner
Associate Dean of Academics and Associate Professor

M. Cenk Cavusoglu
Nord Professor of Engineering

Vira Chankong
Associate Professor

Michael Fu
Assistant Professor

Mario Garcia-Sanz
Professor

Soumyajit Mandal
Timothy E. & Allison L. Assistant Professor in Computer Science & Engineering

Mehran Mehregany
Veale Professor of Wireless Health Innovation

Wyatt S. Newman
Professor

Christos A. Papachristou
Professor

Marija Prica
Assistant Professor

Daniel G. Saab
Associate Professor

Narasingarao Sreenath
Professor

MACROMOLECULAR SCIENCE AND ENGINEERING

Gary E. Wnek
Chair and Joseph F. Toot Jr. Professor

Rigoberto C. Advincula
Professor

Eric Baer
Distinguished University Professor and Herbert Henry Dow Professor of Science and Engineering

Liming Dai
Kent Hale Smith Professor

Michael J.A. Hore
Assistant Professor

Hatsuo "Ken" Ishida
Distinguished Research Professor

João Maia
Professor

MATERIALS SCIENCE AND ENGINEERING

Frank Ernst
Chair and Leonard Case Jr. Professor of Engineering

William A. "Bud" Baeslack III
Professor

Jennifer L.W. Carter
Assistant Professor

Mark R. De Guire
Associate Professor

Roger French
Kyocera Professor of Ceramics

Peter D. Lagerlof
Associate Professor

John J. Lewandowski
Arthur P. Armington Professor of Engineering

MECHANICAL AND AEROSPACE ENGINEERING

Robert X. Gao
Chair and Cady Staley Professor of Engineering

Ozan Akkus
Leonard Case Jr. Professor of Engineering

Richard Bachmann
Assistant Professor

Paul J. Barnhart
Professor

Sunniva Collins
Associate Professor

Malcolm N. Cooke
Associate Professor

Kathryn A. Daltorio
Assistant Professor

Roger D. Quinn
Distinguished Research Professor and Arthur P. Armington Professor of Engineering

Clare M. Rimnac
Distinguished University Professor and Wilbert J. Austin Professor of Engineering

Fumiaki Takahashi
Professor

Chris Yingchun Yuan
Professor

Evren Gurkan-Cavusoglu
Associate Professor

Ming-Chun Huang
Assistant Professor

Hossein Miri Lavasani
Assistant Professor

Pan Li
Associate Professor

Wei Lin
Professor

Kenneth A. Loparo
Arthur L. Parker Professor

Behnam Malakooti
Professor

Christian A. Zorman
Associate Dean of Research and Leonard Case Jr. Professor of Engineering

NOT PICTURED

Gregory S. Lee
Assistant Professor, Electrical Engineering and Computer Science

Ica Manas-Zloczower
Distinguished University Professor and Thomas W. and Nancy P. Seitz Professor of Advanced Materials and Energy

Svetlana Morozova
Assistant Professor

Valentin Radinov
Assistant Professor

David Schiraldi
Peter A. Asseff, PhD, Professor of Organic Chemistry

Lei Zhu
Professor

David H. Matthiesen
Associate Professor

James D. McGuffin-Cawley
Senior Associate Dean and Arthur S. Holden Jr. Professor in Engineering

Alp Sehirlioglu
Associate Professor

Gerhard E. Welsch
Professor

Matthew Willard
Associate Professor

Umut Atakan Gurkan
Warren E. Rupp Asociate Professor

Yasuhiro Kamotani
Professor

Chirag Kharangate
Assistant Professor

Bo Li
Assistant Professor

Ya-Ting Liao
Assistant Professor

Brian Maxwell
Assistant Professor

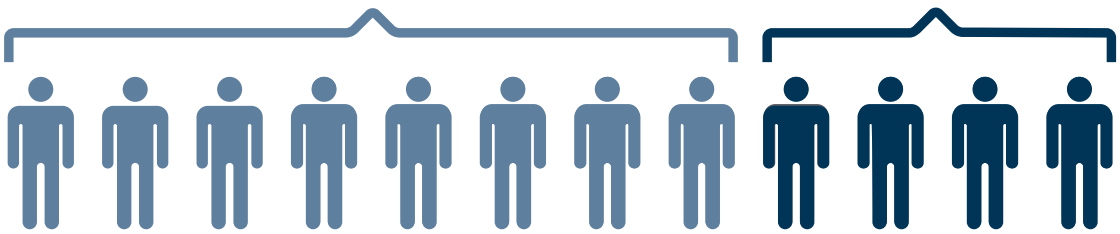
Vikas Prakash
Professor

Student Enrollment Fall 2019

2,210 Total*

1,471
Declared undergraduate engineering students
Declared 1,627 engineering majors, 150 students with more than one engineering major

738
Graduate and professional-degree students



*In addition, 672 undergraduate students expressed interest in engineering majors but are not expected to declare majors until the end of their sophomore year.

FY 2019 Fundraising

Total: $43.2 million

In FY 2019, the Case Alumni Foundation/Association provided $2.9 million from annual and endowed gifts to the Case School of Engineering.

FY 2019 Research, training and grant revenue

$46.7 million

FY 2019 Full-time faculty

122

FY 2019 Total revenue

$109.3 million

Technology Transfer

In FY 2019 Case School of Engineering faculty contributed to:

116 invention disclosures

5.19 times the national per-dollar proficiency average*

183 patent applications

9.16 times the national per-dollar proficiency average*

4 startup companies

3.68 times the national per-dollar proficiency average*

*AUTM U.S. Licensing Activity Survey, FY17 (latest data available)

16 deals with industry

2.47 times the national per-dollar proficiency average*

VISITING COMMITTEE

Gerald Wasserman (CIT '76), chair
Russell J. Warren (CIT '60), vice-chair
Chi-Foon Chan (GRS '74, '77)
Howard Jay Chizeck (CIT '74, GRS '77)
Archie G. Co (CIT '63)
Sunniva R. Collins (GRS '91, '94) ex officio
Walter J. Culver (GRS '62, '64)
John F. X. Daly (CWR '89, GRS '91)
Myra A. Dria (CIT '76)
Laura J. Flanagan (CWR '90)
Alec D. Gallimore
Robert A. Gingell Jr. (CIT '77)
Joseph M. Gingo (CIT '66)
Jennie S. Hwang (GRS '76)
William M. James (CIT '64)
Joseph P. Keithley
Kenneth R. Lutchen (GRS '80, '83)
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Somsak Naviroj (GRS '83)
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Simon Yeung (CWR '93)

The Case School of Engineering has a proud 125-year history as one of America's top engineering schools. We are innovators and educators—tackling the world's most challenging engineering problems through groundbreaking research while balancing a rigorous academic curriculum with ample experiential learning opportunities that bring those lessons to life for tomorrow's engineers. More than 100 full-time faculty represent the best minds in their fields, and our students are among the brightest and most ambitious in the nation.

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MAJORS

Bachelor of Science in Engineering (BSE)

Available majors:

Aerospace Engineering
Biomedical Engineering
Chemical Engineering
Civil Engineering
Computer Engineering
Electrical Engineering
Engineering Physics
General Engineering
Materials Science and Engineering
Mechanical Engineering
Polymer Science and Engineering
Systems and Control Engineering

Bachelor of Science (BS)

Available majors:

Computer Science
Data Science and Analytics

Bachelor of Arts (BA)

Available majors:

Computer Science

Master of Science (MS)

Available majors:

Aerospace Engineering
Biomedical Engineering, with optional specialization in Translational Health Technology or Wireless Health
Chemical Engineering
Civil Engineering
Computer Engineering
Computing and Information Science
Electrical Engineering, with optional specialization in Wearable Computing or Wireless Health
Macromolecular Science and Engineering, with optional specialization in Fire Science and Engineering
Materials Science and Engineering
Mechanical Engineering, with optional specialization in Fire Science and Engineering
Systems and Control Engineering
Undesignated

Master of Engineering (ME)

Master of Engineering and Management (MEM)

Doctor of Medicine/Master of Science in Biomedical Engineering (MD/MS)

Doctor of Philosophy (PhD)

Available majors:

Aerospace Engineering
Biomedical Engineering
Chemical Engineering
Civil Engineering
Computer Engineering
Computing and Information Science
Electrical Engineering
Macromolecular Science
Materials Science and Engineering
Mechanical Engineering
Systems and Control Engineering

Doctor of Medicine/Doctor of Philosophy (MD/PhD)

Available majors:

Biomedical Engineering

DEPARTMENTS

Biomedical Engineering
Chemical and Biomolecular Engineering
Civil Engineering
Electrical Engineering and Computer Science
Macromolecular Science and Engineering
Materials Science and Engineering
Mechanical and Aerospace Engineering

CENTERS AND INSTITUTES

Advanced Manufacturing and Mechanical Reliability Center
Advanced Platform Technology Center
Center for Advanced Polymer Processing
Center for Advanced Science and Engineering for Carbon
Center for Breakthrough Energy Storage
Center for Computational Imaging and Personalized Diagnostics
Center for Control and Energy Systems
Center for Layered Polymeric Systems (CLiPS)
Center for the Evaluation of Implant Performance
Cleveland Functional Electrical Stimulation Center
Electro-Ceramics for Sustainable Energy Solutions
Electronics Design Center
Great Lakes Energy Institute
Institute for Advanced Materials
Institute for Smart, Secure and Connected Systems
Integrated Robotics Center
Materials for Opto/Electronics Research and Education (MORE) Center
Microfabrication Laboratory
Neural Engineering Center
Richard '39 and Opal Vanderhoof Infrastructure Research and Education Facility
SDLE Research Center
Sears think[box]
Swagelok Center for Surface Analysis of Materials
Wind Energy Research and Commercialization Center

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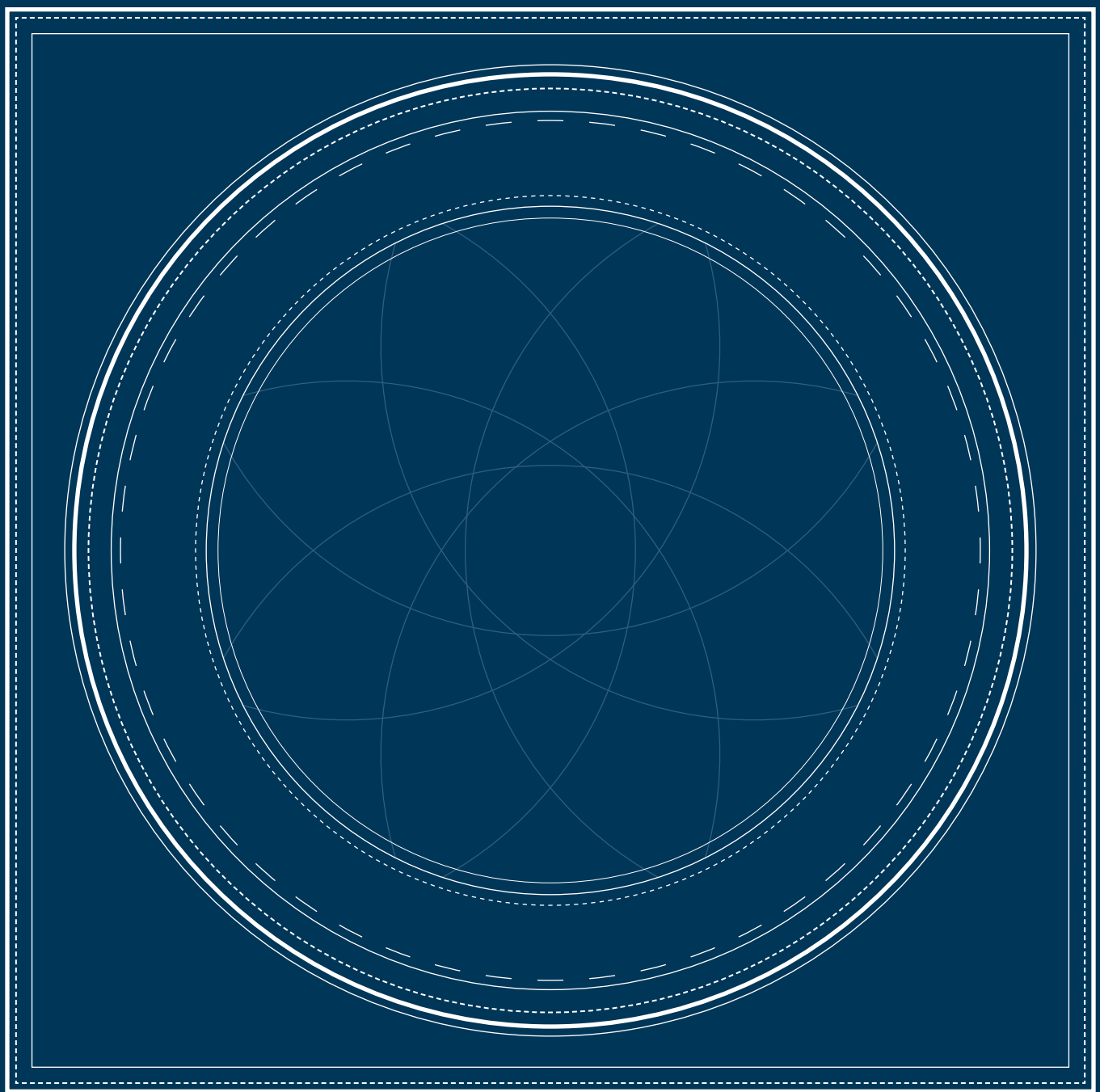

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OF ENGINEERING
CASE WESTERN RESERVE
UNIVERSITY

10900 Euclid Avenue, Nord Hall 524
Cleveland, Ohio 44106-7220