

2014-15 ANNUAL REPORT

CASE SCHOOL OF ENGINEERING



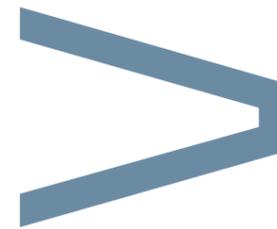
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CASE SCHOOL
OF ENGINEERING

CASE WESTERN RESERVE
UNIVERSITY

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We are thinkers,
doers, makers—
envelope pushing,
status-quo-crushing
and dedicated to turning
“what if?” into what is.

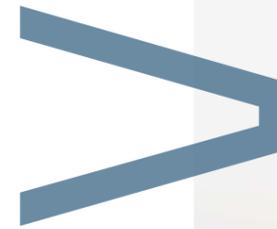
We are the
Case School of Engineering.
We are **innovators**.

CASE SCHOOL OF ENGINEERING

Annual Report 2014-15



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Dear Colleagues and Friends:

Anyone can have a great idea. It takes a certain kind of person to transform that idea into an innovation.

As engineers, we think beyond ideas because we know even the most powerful idea—the most brilliant conceptualization—can't change the world unless we actually make it happen. And that takes more than just inventive thinking—it takes determination, dedication and tenacity. It means going back to the drawing board again and again and again, and refusing to take "no" for an answer.

That's the kind of spirit we celebrate at the Case School of Engineering—a community of envelope-pushers that hears "that's impossible" and says "not for long."

We've committed to cultivating an entire ecosystem of innovation by creating one of the largest campus-based innovation and entrepreneurship centers in the world—think[box], which moved into its new 50,000-square-foot home this fall. Four floors packed with everything budding entrepreneurs need to bring their ideas to life are now open, and the second phase of renovation is about to begin. It's truly a tremendous space, and one I welcome you to visit in person the next time you're on campus.

Not surprisingly, all the innovation happening here is attracting other innovators. We're thrilled to host more than 70 of the nation's most inventive minds as speakers and presenters at our inaugural Innovation Summit, taking place Oct. 26-28, 2015. We're excited to be at the center of a national conversation around innovation and helping drive the discussion about where, how and why innovation thrives.

We're dedicated to nurturing the entrepreneurial spirit of our faculty, and empowering the next generation of innovators. Because innovation is bigger than our campus—it's a national priority and it's how we move society forward and create a better, brighter future.

Warmest Regards,

Jeffrey L. Duerk

Dean, Case School of Engineering
Leonard Case Jr. Professor of Engineering

Students think
with their feet
to deliver cheap electricity
in developing countries.



Left to right: Sam Crisanti, Ian Ferre and Evan Harris

SAM CRISANTI, IAN FERRE AND EVAN HARRIS: > > > > > PEDAL PUSHERS

Meet team Greenlite Technologies: Sam, Ian and Evan—an undergraduate student trio that hails from the worlds of engineering, math and business, and turned toe tapping into a cheap, reliable energy source for those without access to electricity.

Sam and Ian first developed their foot-powered generator in a class called Engineering for the World's Poorest, where they were challenged to come up with a solution to an energy problem in the developing world. They honed in on a technological disconnect—the fact that **while cell phones provide the primary mode of connection and commerce in many developing countries, the people who use them often have no access to the electricity needed to charge them.** In fact, some rural villagers have to go to extremes to charge the phones they rely on—taking daylong trips by carts into cities where they have to pay to power up.

The duo spent hours in the university's think[box] innovation center, churning out a working prototype of a pedal-based generator that could drum up enough wattage to charge phones, at a cost of less than \$5 to manufacture. And when they showed their progress to their professor, Daniel J. Lacks, the C. Benson Branch Professor of Chemical Engineering, he was so impressed he offered them an alternative to the traditional final paper: writing an EPA grant proposal to continue the project.

Crisanti and Ferre won the \$15,000 grant and used the funding to refine their prototype and travel to Lesotho, a small, land-locked country entirely surrounded by South Africa, to conduct some market research.

Armed with new data, they **launched startup Greenlite Technologies** to work on a new-and-improved version of the device, adding college roommate and business finance major Evan to the team to help refine the business plan.

After winning the \$10,000 first prize at the university's Spartan Challenge business plan competition this year, they **won a second grant from the EPA, this time for \$75,000.** They'll use their winnings to continue to work on the product and head back overseas to conduct more intensive research in multiple villages.

Learn more at
engineering.case.edu/meet-our-innovators/pedal-generator.

GIFT STRENGTHENS THINK[BOX] CONNECTION TO CAMPUS

Ian Ferre and Sam Crisanti spent an entire semester in the first iteration of think[box] perfecting the prototype of the foot-powered generator that launched their entrepreneurial venture—Greenlite Technologies. For them, frequent visits to the university's chief innovation space were just part of the day-to-day foot traffic of a pair of student entrepreneurs.

Thanks to a generous gift from an engineering school alumnus, future generations will enjoy the same kind of ready access to one of the country's largest campus-based innovation centers.

James C. Wyant (CIT '65) made a \$3-million pledge to support the construction of a bridge connecting the new think[box] in the Richey Mixon Building to its nearest campus neighbor, the Veale Convocation, Recreation and Athletic Center, as well as the floor onto which the bridge opens—essentially the front door of the 50,000-square-foot space.

Both spaces are near to Wyant's heart as an entrepreneur himself and as a former student athlete—a four-year varsity letter winner in both cross country and track and an accomplished optics researcher who founded two optics companies in addition to building and maintaining a robust, 40-year career at the University of Arizona.

Artist Andrew Reach's 3-D Model Citizens sculptures, on display in the Humphrey Atrium Gallery in University Hospitals Case Medical Center, and his 2-D piece, "Seven Model Citizens."



ARTIST USES THINK[BOX] TO SHIFT INTO NEW DIMENSION

As an architect, Andrew Reach spent a career bringing beautiful ideas to life. When a debilitating spinal condition left him unable to practice his profession, he turned to technology to re-channel his creative energy into the world of fine art—and used Case Western Reserve University's think[box] innovation center to bring his work into a whole new dimension.

Reach's first forays into fine art started on the screen, using design software to create sprawling geometric prints—explorations of color and pattern with a digital touch. The work provided a new and much-needed creative outlet for Reach, but as an architect, he was used to creating in three dimensions. The physical demands of sculpture seemed out of the question—surgeries to correct Reach's spinal condition had left him with severe limitations. The power of 3-D printing took the physical work out of the picture, allowing Reach to bring his "Model Citizens" off the canvas and into physical space as mixed-media sculptures, using think[box]'s 3-D printers and CNC router. These pieces, along with his digital print work, appeared in his solo exhibition this winter, "Bits in Pieces," at the Maria Neil Art Project in Cleveland's Waterloo Arts District, and then travelled to another solo exhibition of his work this spring at the Humphrey Atrium Gallery at University Hospitals Case Medical Center in Cleveland.

Reach's work has been exhibited in solo and group exhibitions throughout the United States, including Miami, New Orleans, New York, Washington, D.C., San Francisco, Chicago and Cleveland. His work is in the permanent collection of The Patricia and Phillip Frost Art Museum in Miami.

Learn more about Reach and check out his work at andrewreach.com.

THINK[BOX] VISITS NASA

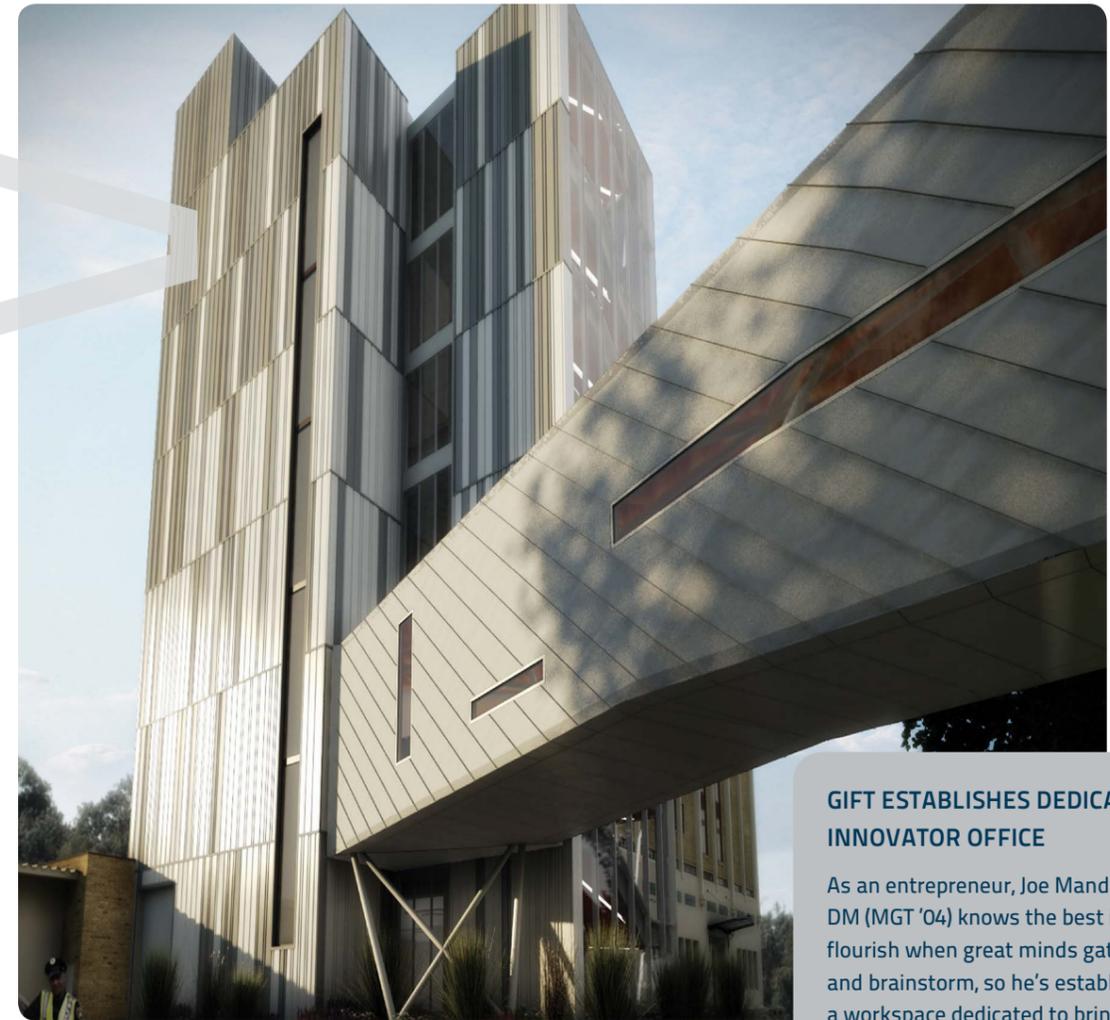
Case Western Reserve University's think[box] piqued the interest of some of the nation's top minds at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif. JPL researchers were so impressed by the innovation center's reputation for moving inventions quickly along the tech-readiness scale that they wanted to learn if those successes might hold promise for improving the lab's own innovation process.

JPL featured think[box] as part of its series of LEAP Innovation seminars. Think[box] manager Ian Charnas (CWR '05) fielded questions about the campus innovation model from JPL scientists and engineers—focusing on think[box]'s particular strengths in 3-D printing and rapid prototyping.

Case Western Reserve regularly consults on the design and management of innovation centers like think[box] and has shared its expertise with more than 100 institutions.

100,000 VISITS AND COUNTING!

When Case Western Reserve student Ben Roytenberg stepped into think[box] this summer, he walked into a surprise party! His stop marked think[box]'s 100,000th visit since the innovation center began counting on Dec. 12, 2012—just months after the makerspace celebrated its 90,000th visit from a Cleveland State University junior.



THINK[BOX] CELEBRATED AS FALL OPENING APPROACHES

The White House once again turned its spotlight on Case Western Reserve University's think[box] this summer, highlighting the innovation center as part of the National Week of Making and National Maker Faire, just as the facility is preparing to welcome even more inspired makers, budding entrepreneurs and innovative thinkers of all kinds to its new home.

Construction started in the fall of 2014 on the first phase of the renovation project that is turning a 50,000-square-foot historic building on Case Western Reserve's campus into one of the world's largest university-based innovation centers. Four of a total seven floors of think[box]'s Richey Mixon Building open to the public this fall: each floor highlighting a phase in an overall ecosystem of innovation that puts all the resources innovators need to bring their ideas to life under one roof.

The floors dedicated to collaboration and ideation, prototyping, fabrication and dedicated space for the university's many student groups and design competition teams will open as part of the first phase this fall. Floors housing community programs, entrepreneurship resources and startup incubator space will be included in the second phase of construction.

See think[box] in its new home—visit thinkbox.case.edu to schedule a tour.

GIFT ESTABLISHES DEDICATED INNOVATOR OFFICE

As an entrepreneur, Joe Mandato, DM (MGT '04) knows the best ideas flourish when great minds gather and brainstorm, so he's established a workspace dedicated to bringing innovators together inside Case Western Reserve's think[box].

Mandato is among the university's Case Distinguished Innovators—an elite group of industry leaders who are helping cultivate the university's ecosystem of innovation. The entire environment of think[box] is designed to inspire creative collisions, and the Mandato Family Innovator Office will provide a dedicated meeting space for innovators of all kinds to kick start ideas, work with mentors, fine-tune business plans and pitch products.

A member of the university's Board of Trustees and Silicon Valley Think Tank, Mandato is a managing director of the venture capital firm De Novo Ventures and teaches a class in medical device innovation at Stanford University. He holds the 2015-2016 Carlo Rossi Chair in Entrepreneurial Management at the University of San Francisco.

FELIPE GOMEZ DEL CAMPO: > > > > > JET-FUEL MIXOLOGIST

RENEWED THINK[BOX] STUDENT PROJECT FUND FUELS FUTURE INNOVATORS

Felipe Gomez del Campo used the **think[box] Student Project Fund** to finance the first prototype of his jet-fuel-saving plasma injection device. Now, thanks to a **\$50,000 gift from the George W. Codrington Charitable Foundation, the Student Project Fund has been renewed and expanded**, promising crucial support to future students like Gomez del Campo looking to get their great ideas off the ground.

The fund—initially created in 2013 via a gift from Ben Gomes (CWR '90)—offers material support to Case Western Reserve students—undergraduate and graduate—for personal projects, team projects, design competitions, entrepreneurial activities and more.

The new gift from the Codrington Foundation has enabled the fund to offer expanded support at a maximum of \$2,500 per project.

Since its inception, the fund has helped bring more than 65 projects to life, from health care inventions like a rapid blood testing device (read more on page 32) and a laser-based bone quality meter, to rockets and robots for student competitions.

Meet Felipe: a 22-year-old combustion connoisseur who's rubbing elbows with the biggest names in business—and the president of the United States.

Gomez del Campo, a mechanical and aerospace engineering major at Case Western Reserve, grew up engineering—taking apart garage-sale-fodder electronics just to see how they worked, why they worked and generating ideas on how to make them work better.

It's that drive to improve that pushed him into the role of inventor/CEO—the designer and marketer of a product that promises to **reduce fuel consumption in jet engines by up to 10 percent per flight, along with a 25 percent cut in emissions.**

Gomez del Campo's invention—essentially a component that could be fitted to an existing engine or constructed as part of a new one—shoots a precise amount of plasma into the stream of fuel, blowing the fuel apart into its component molecules, which allows the engine to burn the deconstructed bits more efficiently.

He used the university's innovation center, think[box], to construct his first prototype, and tapped other campus resources like entrepreneurship hub LaunchPad, the university's Great Lakes Energy Institute and the IP Venture Clinic for crucial support to launch his startup—FGC Plasma Solutions—to commercialize the product.

This year, he took his patent-pending product on the road, pitching it to engine manufacturers and combustion research scientists at NASA, as well as **raking in prizes from local and national business competitions**—including a \$100,000 win at the regional finals of the Clean Energy Challenge, which qualified him to advance to the nationals.

On top of those winnings, the student entrepreneur and varsity swimmer **pitched his startup to President Obama and some of the biggest names in business**, including investors from ABC's hit show *Shark Tank*, at a White House entrepreneurship event in May.

Learn more about Felipe and watch him pitch his invention to Shark Tank investors at engineering.case.edu/meet-our-innovators/fuel-injector.

For the right mix of jet engine efficiency and emission reduction—just add plasma, discovers one savvy senior.



Felipe Gomez del Campo

METAL-FREE CATALYSTS COULD CUT COSTS FOR CLEAN ENERGY TECH

Since the earliest efforts to tap the potential of cleaner energy sources, cost has been an imposing barrier. Researchers at Case Western Reserve University have created metal-free catalysts—cost-saving alternative components that could bring cleaner, more efficient energy a step closer to commercialized reality.

Liming Dai, the Kent Hale Smith Professor of macromolecular science and engineering, is leading two teams developing metal-free catalysts for energy applications.

One team has developed a **nitrogen-infused carbon catalyst built with graphene sheets, carbon nanotubes and carbon black particles that performs as well as its costlier metal counterparts in PEM fuel cells**, the standard-bearer among fuel cells used most commonly in cars and stationary power plants.

Researchers found that the carbon-based catalyst also corrodes less than metal-based materials and proved more durable.

A second team created **the first metal-free, bifunctional catalyst for rechargeable zinc-air batteries—technology that is expected to be safer, lighter, cheaper and more powerful than the lithium-ion batteries** found in today's mobile phones, laptops and increasingly in hybrid and electric cars. Made from a stable carbon aerogel, this catalyst is inexpensive, easy to make and more ecological than most alternative materials, according to the researchers.

Both projects aim to reduce the cost of their respective technologies—bringing energy innovations closer to mass commercialization.

Learn more at engineering.case.edu/Dai-PEM-catalyst and engineering.case.edu/zinc-air-battery-catalyst.



Alexis Abramson

NEW GRAD COURSE HELPS STUDENTS BRING ENERGY IDEAS TO MARKET

The world needs energy solutions—fast. A new graduate course at Case Western Reserve University combines engineering expertise, business savvy and innovative design thinking to help students create market-ready energy technology solutions.

Energy, Engineering and Entrepreneurship is a collaborative effort between the university's Case School of Engineering, Weatherhead School of Management and Great Lakes Energy Institute (GLEI), launched with the support of a two-year grant from VentureWell, an organization that cultivates ideas and inventions in higher education.

Alexis Abramson, the F. Alex Nason Professor and Ohio Eminent Scholar in Advanced Energy Research and director of GLEI, leads the program along with Michael Goldberg, venture-capitalist expert and assistant professor of design and innovation from the management school.

Learn more at engineering.case.edu/Energy-Engineering-Entrepreneurship-class.

SMART SENSORS FOR SMART BUILDINGS

A stray light left on, small appliances leeching power even when they're not operating, heat cranking when no one's home—little energy leaks in our homes and commercial buildings can lead to big costs in terms of wasted resources and real dollars.

A team of researchers at Case Western Reserve University is building wireless sensors that can relay environmental information to a central hub that would provide controls for HVAC systems, lighting and more—transforming ordinary buildings into energy-saving, environmentally smart powerhouses.

Philip Feng, assistant professor of electrical engineering and computer science, leads the team, which includes electrical engineering and computer science department chair and Nord Professor of Engineering Kenneth Loparo and tech firm Intwine Connect.

Funded by the U.S. Department of Energy, they're building a network of low-cost, light-weight sensors with integrated electronics that are powered by ambient movement within a building itself, vibrations from a swinging door, ventilation fan or TV speaker—no batteries or other electrical source required.

These small, self-contained sensors would enable measuring of temperature (and other physical parameters such as humidity, if needed) and signal the wireless gateway, so that the central system can adjust lighting, heating, cooling and ventilation accordingly—either automatically or manually by alerting the user via a smartphone.

Learn more at engineering.case.edu/Feng-smart-building-sensors.



REFINING OFFSHORE WIND TURBINE FOUNDATION DESIGN

There's a lot of real estate on the open water primed to house clean-energy-generating wind farms. **An international team, including civil engineering researchers at Case Western Reserve University, is refining its offshore wind turbine foundation design with the help of a \$2.8-million grant from the U.S. Department of Energy (DOE).**

Case Western Reserve researchers, including civil engineering department chair and Frank H. Neff Professor Xiangwu "David" Zeng, are working with the Lake Erie Energy Development Corporation (LEEDCo) to continue a project they started last year as part of a DOE-sponsored competition.

The new grant will help the team optimize the original design for the turbine foundations in Lake Erie.

Learn more at engineering.case.edu/LEEDCo-partnership.

BUILDING FUEL CELLS WITH MORE STAYING POWER

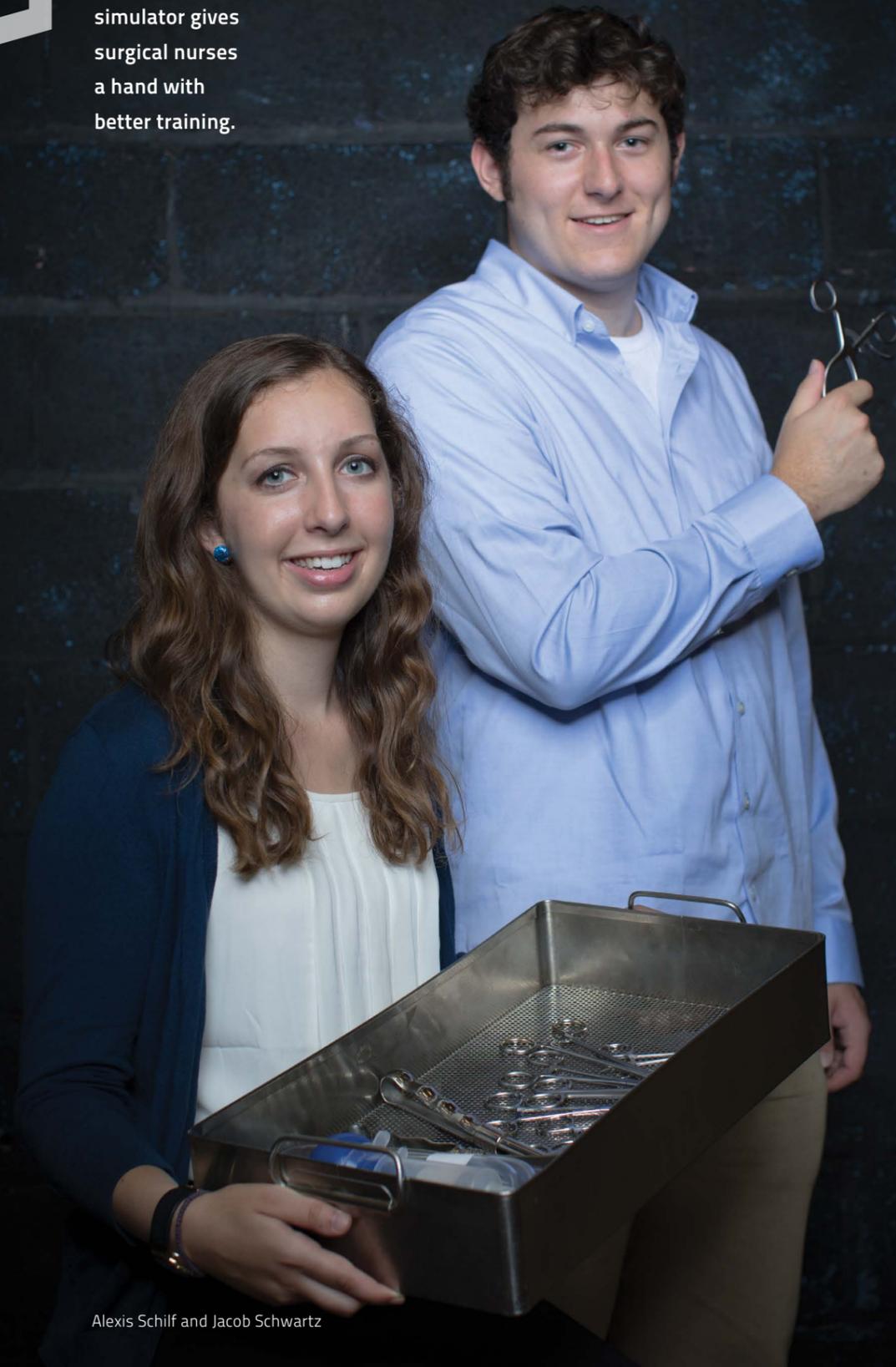
Fuel cells generate electricity more efficiently and with fewer emissions per watt than traditional fossil fuels. But efficiency decreases as the cells age, cutting their competitive edge over conventional power technologies.

With the help of an \$800,000 grant from the U.S. Department of Energy, materials science researchers at Case Western Reserve University will use accelerated testing to uncover why fuel cell performance suffers over time.

Mark De Guire, associate professor of materials science and engineering, and Arthur Heuer, Distinguished University Professor and Kyocera Professor in Ceramics, will focus on solid oxide cells—fuel cells that operate at high temperatures and use a ceramic electrolyte, a ceramic cathode and a nickel-based cermet anode to produce electricity. They'll attempt to replicate 5,000 hours of use in about one-tenth the time, using equipment in the university's Swagelok Center for Surface Analysis of Materials to identify what changes take place in the components and how those changes can be arrested to extend the lifetime performance of the fuel cell.

Learn more at engineering.case.edu/ceramic-fuel-cells.

Student-designed simulator gives surgical nurses a hand with better training.



Alexis Schilf and Jacob Schwartz

ALEXIS SCHILF AND JACOB SCHWARTZ: > > > > > O.R. OPTIMIZERS

Meet Alexis Schilf and Jacob Schwartz: a business-savvy duo who wants to change the industry standard for training operating room nurses.

Schilf, a Case Western Reserve University biomedical engineering major, has always had business and design on the brain, she just never envisioned starting a company as a college student. But when a summer project showed potential to turn into something bigger, she had to try.

SensID grew out of her involvement in Case Western Reserve's CREATE program—a summer design experience that matches budding engineering entrepreneurs with physicians, putting the teams to work on real problems in clinical settings.

Her team's partner physician told them that **perioperative nurses don't get sufficient hands-on training** before going into real operating rooms. So she and company co-founder Jacob Schwartz, a computer science and economics double major, **developed a physical simulator that mimics a surgeon's hand, giving nurses the chance to practice passing instruments in a surgical setting before they step into the O.R.**

In surgery, it's not just a matter of handing a scalpel handle first. There are hundreds of surgical instruments, each with its own unique passing procedure—angled scissors are passed one way, straight-edged scissors another, and so on. Knowing all the details of these complex handoffs makes for a smoother, more efficient operation overall, which **improves patient care and reduces the amount of time nurses have to be supervised during surgeries.**

SensID earned strong showings in local business plan competitions: the company won third place in the Spartan Challenge at Case Western Reserve, second place at the university's Saint Gobain design competition, and was one of 20 national finalists to pitch their products at Blackstone LaunchPad Demo Day in New York City.

Schilf and Schwartz have been working with the perioperative nursing program at University Hospitals Case Medical Center and with nursing students at Case Western Reserve's Frances Payne Bolton School of Nursing, getting feedback on the simulator. Next they plan to start field-testing it in other hospitals across the region.

Learn more about SensID at engineering.case.edu/meet-our-innovators/nurse-training-simulator.

CWRU AND NOTTINGHAM SPIRK TEAM UP TO INSPIRE FUTURE INVENTORS

Before the start of their senior years in college, Alexis Schilf and Jacob Schwartz had parlayed a promising project into a serious startup, winning awards—and funding—from local and national business plan competitions. And by tapping into **Case Western Reserve's new partnership with global design powerhouse Nottingham Spirk**, they got to pick some of the best brains in the business as they worked to refine their nurse training simulator.

Nottingham Spirk—known for creating some of the world's most popular consumer products, including the Swiffer SweeperVac and SpinBrush electric toothbrush line—announced the Case Western Reserve collaboration this year.

The company will create an environment of partnership and innovation on the first floor of the newly renovated think[box], providing mentorship to students like Alexis and Jacob, as well as faculty members, helping them to develop high-quality concepts into marketable products faster.

Learn more at engineering.case.edu/Nottingham-Spirk-partnership.



ARTIFICIAL PLATELET COPYCATS HELP STAUNCH BLEEDING FASTER

Platelets facilitate the body's natural clotting and healing process—and like so many of the microscopic dramas that play out within our bodies, the precise biological cues that drive this process are staggeringly complex. Building on previous success creating artificial platelets that mimic natural cells' ability to home in on wounds, biomedical engineering researchers at Case Western Reserve in collaboration with researchers at the University of California, Santa Barbara, have refined their focus and **built the first artificial platelets that mimic the size, shape, flexibility and surface chemistry of the real thing.**

Anirban Sen Gupta, associate professor of biomedical engineering and the project lead, believes **these four design factors are key to understanding how platelets navigate to injury sites and stick there, while preventing harmful rouge clots from forming elsewhere in the body.**

The researchers' platelet-like nanoparticles (PLNs) are built on albumin-based particle platforms and have been carefully crafted to imitate the morphological and mechanical factors that draw natural platelets to ruptured blood vessel walls where clot-promoting chemical reactions take place—copying platelet behavior in addition to construction. **In lab tests, the PLNs stopped bleeding 65 percent faster than their natural counterparts alone.**

The new technology, reported in *ACS Nano*, aims at stemming bleeding in patients suffering from traumatic injuries, undergoing surgeries or suffering clotting disorders. The researchers also believe the artificial platelets could deliver clot-busting medicines directly to clots to treat heart attack or stroke, or could carry cancer medicines to metastatic tumors that have high platelet interactions.

Learn more at engineering.case.edu/Sen-Gupta-platelet-mimicry.

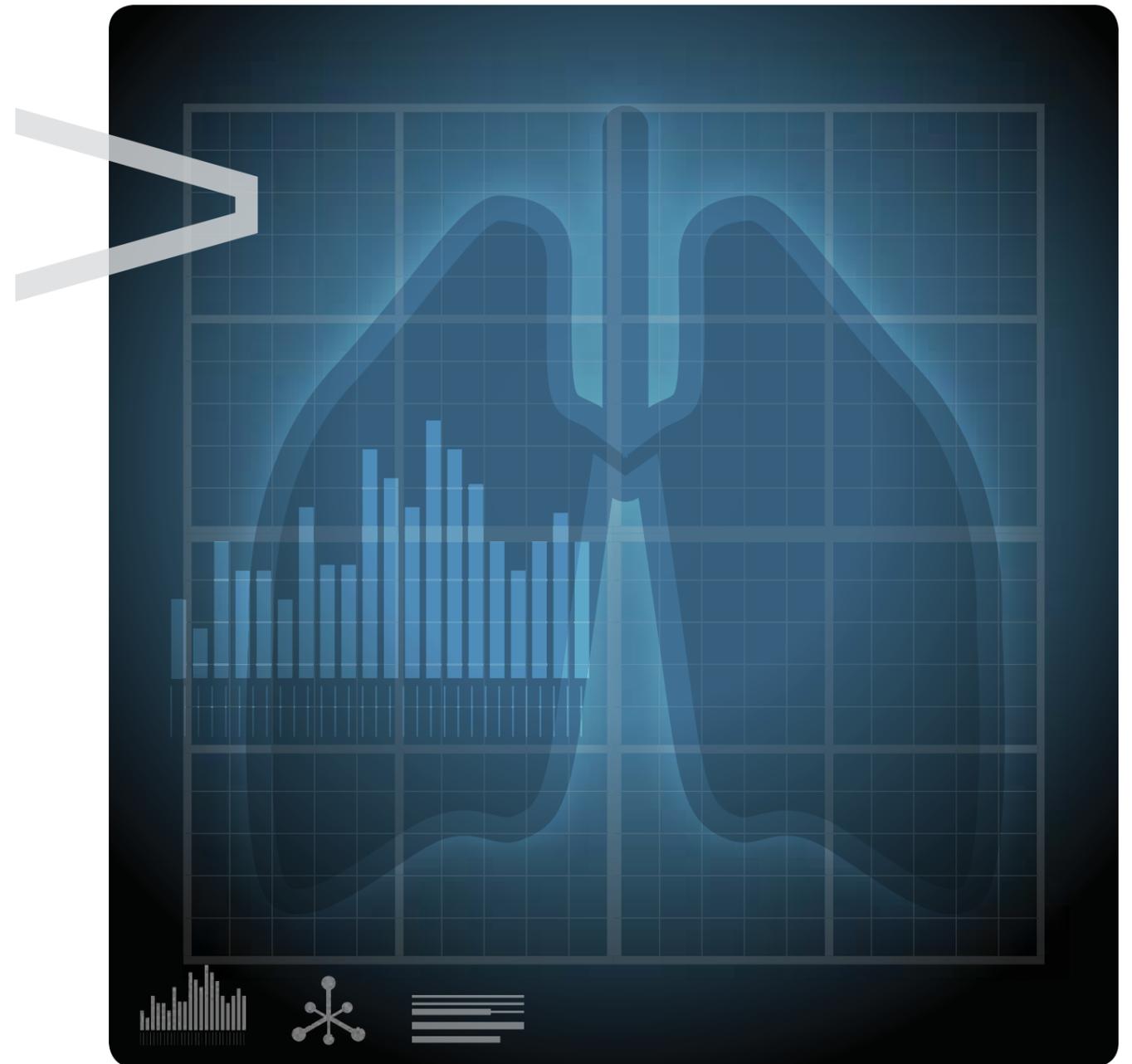
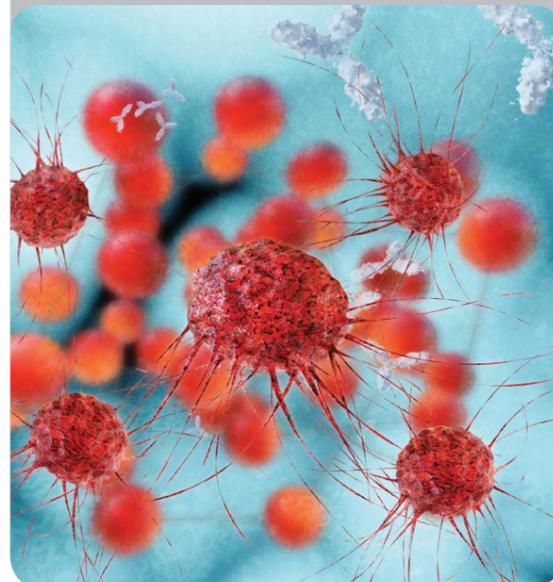
NANOPARTICLE-BASED ROADBLOCKS STOP THE SPREAD OF CANCER

Metastatic breast cancer—or stage IV cancer—is a particularly harrowing diagnosis. Even if caught early, once breast cancer has spread to other parts of the body, it's even tougher to treat, and advanced metastatic cancer is considered incurable by today's arsenal of treatment options. Triple-negative breast cancer accounts for 15 percent of all breast cancer diagnoses, and since this particular cancer type lacks all three of the usual treatment targets within cancer cells—estrogen, progesterone and the HER-2/neu gene—it's especially aggressive and more likely to spread.

Biomedical engineering researchers at Case Western Reserve University have **created a new weapon in the fight against this deadly disease—lipid-based nanoparticles loaded with silencing RNA designed to shut down metastasis.**

The therapeutic RNA-carrying ECO nanoparticles created by Zheng-Rong Lu, the M. Frank Rudy and Margaret Domiter Rudy Professor of Biomedical Engineering, and researchers at the Case Comprehensive Cancer Center act like something of a set of road spikes put down to stop a speeding car in its tracks: **delivering a payload of silencing RNA—one of nature's most potent disrupters—to the cancer cells.** The research team found that the silencing RNA blocked the expression of a specific protein, which shuts off an essential step in the spread of cancer—putting up a biological roadblock to metastasis.

Learn more at engineering.case.edu/siRNA-nanoparticles-breast-cancer.



USING IMAGING, DIGITAL PATHOLOGY AND BIG DATA TO COMBAT CANCER

Big data holds big promise in the fight against cancer. Researchers at Case Western Reserve University's Center for Computational Imaging and Personalized Diagnostics (CCIPD), led by biomedical engineering professor Anant Madabhushi, are **exploring new ways to put data derived from imaging and digital pathology to work for earlier and more precise diagnoses that lead to more targeted treatment.**

Research teams from the lab **won three separate grants from the U.S. Department of Defense**—one to develop computational tools and algorithms for analyzing and combining image- and molecular-based biomarkers to better predict outcomes for prostate cancer patients; a second grant to explore using imaging data to diagnose the presence of lung cancer from

CT scans alone; and a third post-doctoral grant to explore the combination of MRI and mechanical imaging for better diagnosis of prostate cancer. In addition, a **VeloSano Pilot Grant will help another team study resistance to targeted therapy in lung cancer patients.**

Madabhushi also received two grants from the National Cancer Institute: one to develop computerized image analysis tools for identifying aggressive head and neck cancers and a second grant to develop computational tools with digital pathology for identifying which pre-malignant breast cancers might progress to invasive disease.

Learn more at engineering.case.edu/centers/ccipd.

> > > > NICOLE SEIBERLICH: IMAGING GAME CHANGER

Meet Nicole Seiberlich: a biomedical status-quo buster who's using the latest breakthrough in magnetic resonance imaging (MRI) to change the way we look at the heart.

MRI revolutionized medical imaging when it was introduced 40 years ago—and it's still one of the most valuable tools in the modern health care arsenal. Yet the technology has limitations, particularly when it comes to organs in motion, like the heart. Even if MRI could correct for the constant motion, irregularities in heartbeat and even the minute motions of a patient's breathing can disrupt the scan. All these challenges mean that today, only 4 percent of MRIs are conducted on the heart.

Seiberlich, a fast-MRI expert and assistant professor of biomedical engineering, sees that other 96 percent as untapped potential. She has been awarded a \$1.6-million R01 grant from the National Institutes of Health to explore applying a new MRI technique that she helped develop at Case Western Reserve to expand the use of cardiac MRI and capture better, more accurate images for quicker, more precise diagnoses.

Seiberlich was part of a team led by biomedical engineering and radiology professor Mark Griswold that first developed a new MRI technique called magnetic resonance fingerprinting (MRF). She's now taking the lead in applying the technology to cardiac imaging. A new spin on traditional MRI, MRF scans for a set of specific and unique properties within body tissues and disease. By identifying these values, MRF provides more than just a picture—it creates a map informed by quantitative data in the numeric values measured by the scan that identify what properties are present and at what levels. MRF transcends the standard qualitative images of traditional MRI, which rely on a radiologist's interpretation of an image's appearance—cancer showing up as brighter than healthy tissue, for example. In MRF, scans measure values associated with physical properties that differ between healthy and diseased tissue, which provides a more exact, quicker diagnosis.

By using MRF to measure specific physical properties in cardiac tissue, Seiberlich hopes to increase the use of cardiac magnetic resonance imaging to help diagnose conditions like cardiac fibrosis and myocarditis, spot areas of reduced blood flow and detect cardiac tumors.

Biomedical engineering researcher uses new MRI technique to capture more accurate images of organs in motion.



Nicole Seiberlich



SENSE-RESTORING PROSTHESIS AMONG YEAR'S BEST INVENTIONS

Without the sense of touch, users of prosthetic hands have trouble controlling the power of their grip, making the handling of delicate objects a challenge.

A prosthetic system developed by researchers at Case Western Reserve and the Louis Stokes Cleveland Veterans Affairs Medical Center restores a sense of touch to amputees and gives users additional control.

MSN hailed the system as one of the “best inventions of 2014,” and the team, led by Dustin Tyler, the Elmer Lincoln Lindseth Associate Professor of Biomedical Engineering, won a \$4.4-million grant from the Defense Advanced Research Projects Agency (DARPA) to develop a mobile system.

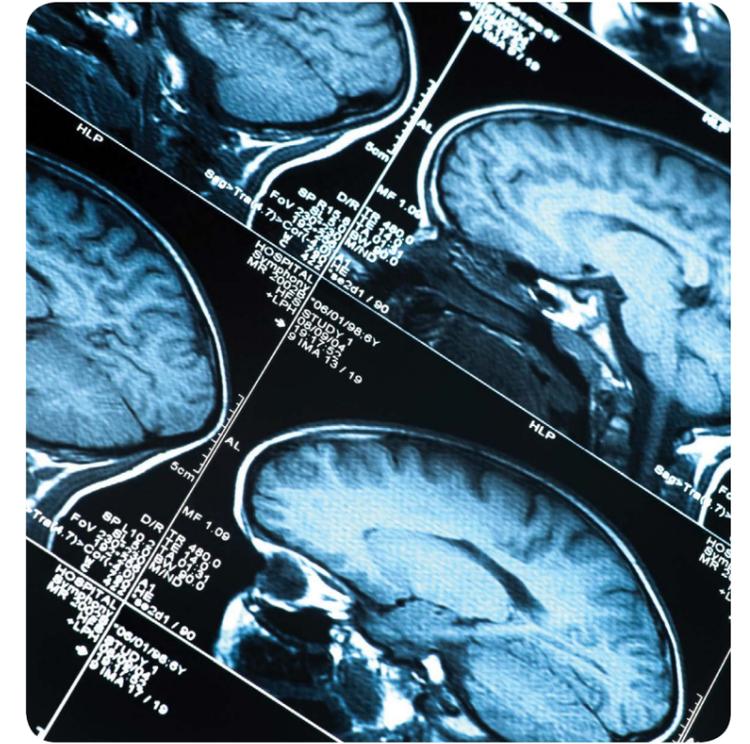
Learn more and watch the system in action at engineering.case.edu/DARPA-prosthetics.

RESEARCHERS USE NANOTECHNOLOGY TO BATTLE CHILDHOOD BRAIN CANCER

Brain tumors are the second most common tumor found in children—making up nearly 20 percent of pediatric cancers. When it comes to treatment, methods that aim to simply scale down adult doses and procedures are prone to failure. With the help of a grant from the Prayers from Maria Children’s Glioma Cancer Foundation, a team of Case Western Reserve University researchers will explore using nanotechnology for a more targeted treatment tailored specifically to the unique needs of young patients battling glioma brain tumors.

Case Comprehensive Cancer Center researchers James P. Basilion, professor of biomedical engineering and radiology, Efsthios Karathanasis, assistant professor of biomedical engineering, and John Letterio, professor of pediatrics, are developing a nanochain that smuggles cancer-killing drugs directly into tumors. Preclinical studies have shown that 5 percent of the medication delivered by the nanochain accumulates in gliomas, compared with current treatment methods that achieve less than 1 percent tumor penetration.

Learn more at engineering.case.edu/pediatric-glioma-grant.



INTERNATIONAL EFFORT COMBATS DEADLY EPILEPSY COMPLICATION

Each year SUDEP—Sudden Unexpected Death in Epilepsy—claims the lives of one out of every 1,000 people with epilepsy. This phenomenon strikes without warning, does not appear to be associated with seizure activity, and leaves no trace to explain the cause of death. The National Institutes of Health have launched an international effort to pool the best research resources from around the world to combat this mysterious and deadly complication, and Case Western Reserve University has been selected to co-lead the \$27.3-million project.

Case Western Reserve and the Baylor College of Medicine will manage the research efforts of 13 U.S. institutions and one London center. Samden Lhatoo, professor of neurology at the Case Western Reserve School of Medicine, will lead the university’s efforts. A team of researchers at the Case School of Engineering, led by electrical engineering and computer science department chair and Nord Professor of Engineering Kenneth Loparo, will be responsible for managing and analyzing the signal data acquired from all the clinical centers participating in the project, and will lead the research component focused on the discovery of biomarkers for the condition.

Learn more at engineering.case.edu/SUDEP.



Xin Yu

IMAGING TECHNIQUE TARGETS BODY'S ENERGY CURRENCY

In a house, structural damage is hard to miss—a crack in the wall, a bowing foundation. In the human body, clinicians use several magnetic resonance imaging (MRI) techniques to detect changes in tissue structure to help diagnose disease. But in many diseases, these structural changes aren't the first signs of trouble—rather, they are the consequences of metabolic changes that happen at a much earlier stage. Biomedical engineering researchers at Case Western Reserve are **developing new imaging methods to capture subtle metabolic fluctuations that occur before the structural changes detected by today's MRIs.**

Traditional MRI acquires its signals from water protons, which are in ample supply thanks to the body's abundant water content. With the help of a **pilot grant from the National Institutes of Health, Xin Yu, a professor of biomedical engineering at Case Western Reserve, is developing non-proton based MR spectroscopy techniques that evaluate cellular metabolism**—in particular, the generation of ATP. Known as the body's "energy currency," ATP provides the chemical energy cells use for a variety of biochemical processes that will keep the structural integrity of the cells and maintain normal tissue function.

Monitoring ATP production within cells could serve as an early warning system for conditions like cardiovascular disease, stroke and diabetes and could give clinicians a better way to monitor treatment for these diseases.

BIOMEDICAL AND NURSING STUDENTS TEAM UP

The real world of health care is a dynamic tapestry of interactions—clinicians and engineers bouncing bright ideas off one another to create solutions to the world's most pressing problems. **Case Western Reserve University has launched a collaborative senior design program that brings biomedical engineering and nursing students together to tackle real-world health care challenges.**

Colin Drummond, professor and assistant chair in the Department of Biomedical Engineering, is spearheading the initiative with Jesse Honsky, assistant director of the undergraduate nursing program at the university's Frances Payne Bolton School of Nursing. **The program places senior nursing students as clinical advisers on the senior design projects biomedical engineering students undertake as their capstone course.** These projects are assigned by local health care companies, hospitals and other clinical partners. By joining forces, nursing and biomedical engineering students have a chance to work together—and learn from each other—while putting their classroom lessons to work in the real world.

Student teams have tackled projects from health care delivery in impoverished areas of Myanmar to improving drug delivery to ease chronic pain to mapping the exchange of oxygen and carbon dioxide within the lungs.



PITTING PLANT VIRUSES AGAINST DEADLY HUMAN DISEASES

In health care, viruses are usually the enemy—crafty microorganisms that hijack healthy cells. Assistant professor of biomedical engineering **Nicole Steinmetz has received three separate grants to explore novel ways to harness the power of these infective agents—transforming plant viruses into formidable weapons against human disease.**

In one project, funded by the Susan G. Komen breast cancer organization, Steinmetz is looking to **create the ultimate power-salad—an edible vaccine against a particularly aggressive form of breast cancer**—that uses potato virus X nanoparticles to deliver a payload of proteins designed to activate the human body's immune system to attack the disease.

With funding from the American Heart Association and National Institutes of Health, Steinmetz is also **using another of nature's nanoparticles—the tobacco mosaic virus—to deliver clot-**

busting medications directly to clots to prevent heart attack and stroke.

She is also **studying how plant viruses could aid in the fight against one of the most deadly human viruses—Ebola.** This year's Ebola outbreak killed more than 11,000 people, and the disease can have a 90 percent mortality rate. Without a cure, accurate, fast detection is key to containing Ebola, but the quickest, most sensitive test available produces a small percentage of false-negative results, which undermine efforts to control the deadly disease.

Steinmetz won a National Science Foundation grant to use plant virus nanoparticles to develop a more accurate test to help reduce the risk of the disease going undetected.

Learn more at engineering.case.edu/plant-viruses-cancer-and-heart and engineering.case.edu/ebola-detection-grant.

Student-turned-CEO's wireless wristband provides secure access with style.



Chris Wentz

> > > > > CHRIS WENTZ: DIGITAL LOCKSMITH

Meet Chris Wentz: A tech-savvy designer who turned a class project into a **stylish solution to a common problem—losing track of the alphabet-and-character soups that make up the passwords we use to access our digital devices and accounts.**

Cyber security experts advise creating account-specific strings of random letters, numbers and characters to secure our digital information, which are harder for data thieves to hack, but nearly impossible for most people to remember.

So Wentz (CWR '13) created Everykey, a Bluetooth-enabled wristband that **uses military-grade encryption to store passwords, providing secure access to phones, computers, bank accounts, online retail sites and more**—empowering wearers to conveniently use passwords that are complicated enough to thwart thieves.

The idea originally came out of an entrepreneurship class Wentz took during the first semester of his senior year. By the end of the semester, his professor, Walt Sokira, was so impressed that he signed up to be the team's first investor—providing essential seed funding to get Everykey off the ground.

So Wentz made the most of his dual role as a student entrepreneur—he rolled Everykey into a senior design project, refining the product and building the company in and outside the classroom, using the university's think[box] innovation center and the business resources at LaunchPad.

Now, as CEO of his own company, he's taking Everykey on the road and pulling in hundreds of thousands of dollars in funding. He wowed tech's elite at the International Consumer Electronics Show in Las Vegas and made a strong showing at this year's national Blackstone LaunchPad Demo Day business plan competition in New York City. His Kickstarter campaign raised more than \$25,000 in just two days before going on to pull in more than \$117,000, and he's raised more than \$700,000 in venture capital support as he prepares the product for launch this fall.

Learn more at engineering.case.edu/meet-our-innovators/everykey.

BURTON D. MORGAN FOUNDATION SUPPORTS ENTREPRENEURSHIP AT THINK[BOX]

Chris Wentz (CWR '13) went from college senior to CEO thanks in part to campus resources like think[box] and the university's entrepreneurship hub LaunchPad.

A \$1-million gift from the Burton D. Morgan Foundation will ensure that future generations of inventor/CEOs have access to the same kinds of crucial resources to launch their own startups.

The foundation's gift will **establish the Burton D. Morgan Suite for Entrepreneurship, located in the Cloud L. Cray Jr. and Sally Hunter Cray Center for Innovation and Entrepreneurship, in think[box]'s new home in the Richey Mixon Building.** This space will house LaunchPad and the university's Intellectual Property Venture Clinic—programs that provide mentoring, resources and advice to student entrepreneurs on the business end of their innovations, from patent filings to business plans to finances.

The foundation has worked to support student entrepreneurship across the region, and helped bring the LaunchPad program to Case Western Reserve four years ago.

STUDENT TEAM DESIGNS BETTER DRIVING EXPERIENCE

Hitting the road with young children can be a challenge for all parents, and physical limitations can make car journeys even tougher. A group of engineering and art students teamed up to make driving a little easier for parents with physical disabilities.

The students are part of Design for America—a nationwide extracurricular program that puts interdisciplinary student teams to work solving a whole range of societal problems. Case Western Reserve's chapter is a collaboration with the neighboring Cleveland Institute of Art, and the group was among just five teams across the country to participate in a challenge sponsored by Fiat Chrysler.

The auto manufacturer tasked the student teams to come up with a design solution to make driving easier for people with disabilities, and the **Case Western Reserve team focused on parents—designing an automated shelf that slides out of the trunk of a car, making storage access easier from a wheelchair.**

The team travelled to Detroit to pitch the idea to Fiat Chrysler execs at the company's headquarters and tour the automaker's innovation labs. They tested their design with Fiat Chrysler employees and got valuable feedback from representatives from multiple departments across the company. Fiat Chrysler plans to review the design for potential use in future car models.



CIVIL ENGINEERING RESEARCHERS TAKE HISTORIC BRIDGE DESIGN TO BREAKING POINT

Sometimes, to fix something, you first have to break it. Civil engineering researchers at Case Western Reserve University **load tested a scale model of the most common type of historic covered bridge in the country—taking the truss to failure to help engineers better gauge a bridge's strength and inform improved rehabilitation** practices for these national treasures.

Theodore Burr patented his wooden truss system in 1817, and hundreds of historic covered bridges built using his design are still in use today. The team, led by civil engineering professor emeritus Dario Gasparini, won funding from the National Park Service to put the structure to the test without damaging any actual pieces of history. They hit the road, surveying Burr arch truss bridges in Ohio, Indiana and Pennsylvania, and they used the details they gathered to design a two-thirds-scale model of a Burr arch truss.

They then fixed the model truss to the strong wall inside the university's Richard '39 and Opal Vanderhoof Infrastructure Research and Education Facility and William H. Schuette '33 Structural Laboratory, where they applied 40 tons of force, using a system of jacks and a load tree to distribute the load evenly.

As expected, the truss cracked under pressure—a delayed failure occurring minutes after the team quit applying the load—**delivering valuable observations and data the team can use to help engineers predict failure modes and improve load-rating of historic bridges.**



Michael Pollino

HELPING BUILDINGS STAND STRONGER

Structures are meant to shelter us from the elements, but sometimes the elements are just too much for buildings to handle. Natural disasters can wreak billions of dollars in damage, and, of course, no quantitative scale can measure the emotional toll they can take.

Michael Pollino, an assistant professor of civil engineering at Case Western Reserve University, is exploring **new ways to help buildings survive some of nature's most severe tests.**

All buildings are designed to withstand vertical forces—namely gravity. But when it comes to earthquakes, the horizontal forces can topple even the strongest of structures if they're not properly designed.

Pollino is among a growing number of researchers who **believe that a design that lets a building roll with the seismic forces**

could fare better than traditional designs. He developed a computer model that compares these "rocking steel-braced frames" to current earthquake standards for low- to mid-rise buildings, and found that they better withstand the shaking and could be more rapidly and cheaply repaired after a seismic event.

In addition to these findings, published in *Engineering Structures*, Pollino is developing a more holistic design/retrofit strategy for steel buildings to withstand demands from various hazardous events—earthquakes, blasts, tornados and more—with the support of a **Milek Fellow award from the American Institute of Steel Construction.**

Learn more at engineering.case.edu/Pollino-rocking-frame and engineering.case.edu/Pollino-Milek-fellow.

MEHMET KOYUTURK: BIG DATA TAMER



ALUMNUS ESTABLISHES PROFESSORSHIP IN ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Endowed professorships are key to helping universities attract high-caliber researchers. **Thanks to the generous support of alumnus Clyde Kenneth Walter Jr. (CIT '64)** through his bequest to Case Western Reserve University, the Department of Electrical Engineering and Computer Science will be able to offer more of this essential type of faculty support with the **establishment of a new endowed chair.**

Walter earned his Bachelor of Science degree from the Case Institute of Technology in 1964 before launching a long, distinguished career at Iowa State University as a professor of logistics, operations and management information systems. Walter is also a long-standing supporter of his alma mater—he has supported the school through annual gifts to the Case Alumni Association every year since 1976.

Meet Mehmet Koyuturk: a tech titan who has big dreams for big data.

The biomedical research community has hit the mother lode in terms of information. The technological explosion of the last two decades has created something of a data geyser—with revolutionary technologies from the high-end imaging equipment found in the country's best hospitals to the wearable fitness trackers counting calories on the wrists of amateur athletes delivering billions upon billions of data points. In fact, **there's so much biomedical data being generated that researchers are struggling to keep up.**

With the help of a **National Institutes of Health's Big Data to Knowledge (BD2K) grant**, Koyuturk, the Timothy E. and Allison L. Schroeder Associate Professor in Computer Science and Engineering at Case Western Reserve, is **helping his fellow scientists get a better handle on big data** and put it to work developing the next generation of life-changing cures, treatments, medical devices and diagnostic tools.

Biomedical big data consists of everything from details on the human genome to disease-based biomarkers to hours of sleep logged a night. But the data points are only part of big data's big picture—big medical data is also concerned with how whole systems interact—how allergens impact the body's immune system and how drugs interact with one another. These networks showcase the relationships between the data points and entire data systems, and that's where Koyuturk's expertise comes in.

He's been exploring the kind of high-efficiency algorithms needed to search gargantuan data networks since he was a PhD student at Purdue University. He's leading a team made up of some of his former mentors from that early work—three researchers now based at Purdue and the University of California, San Diego—that's **building storage schemes and a system of algorithms that will help researchers sift through these billions of data points and related networks, turning an unfathomable amount of information into a highly organized, searchable resource. And they'll package those programs into a user-friendly, open-source software package** that will allow researchers to access multiple versions of massive amounts of network data quickly and query them efficiently. The software will also include a "version control" feature that enables users to duplicate earlier work or past versions of network data so they won't have to start from scratch with each new project.

Learn more at engineering.case.edu/Koyuturk-NIH.

A computer science expert explores how better storage and search will help biomedical researchers get the most of out of big data



Mehmet Koyuturk



Stephanie Hippo

COMPUTER SCIENCE STUDENT STEPS UP TO HELP CLOSE THE TECH GENDER GAP

The IT gender gap is well documented—according to the National Center for Women and Information Technology, women account for barely a quarter of the computing workforce; only 20 percent of software developers are women, and women hold a mere 6 percent of corporate CIO positions. As far as future tech titans, female students comprise just 20.6 percent of undergraduate engineering enrollment nationwide.

That trend is shifting at Case Western Reserve—this year, females made up 30 percent of the incoming class looking to major in engineering and computer science. And right at their own university, they'll see an excellent example of women in IT leadership, as the university recently appointed a female CIO, Sue B. Workman.

Entering her senior year, computer science student Stephanie Hippo was accustomed to seeing fellow female techies in the classroom, yet she couldn't help but wonder why, when she looked around at the weekly meetings of her campus extra curricular computer club, she was often the only female face in the crowd.

So like any true hacker, Hippo dove in to address the issue from the inside out.

Case Western Reserve's Hacker Society brings like-minded students together for tech talks, hackathons and other chances to meet and mingle with computer-savvy peers and mentors. Hippo became the club's public relations chair—the first female

member of the group's leadership team.

As head of PR, she pitched sending students to the Grace Hopper Celebration for Women in Computing, the largest women in technology conference in the country, and secured funding for the trip from university leadership and supportive alumni, who were eager to help. She increased the number of female speakers at the Hacker Society's annual Link-State conference and created beginner-friendly Open Hack events for interested students of all skill levels. And she spent hours building relationships over email and social media with incoming first-year women who were interested in computer science.

She also wrote a popular blog post about her efforts for Medium, which made waves across multiple social media channels and earned her attention from traditional media outlets, including a feature story in the regional newspaper *The News-Herald*.

The club is on track to send twice as many women to this year's Grace Hopper conference, and there are now two women on the Hacker Society leadership team—Dina Benayad-Cherif and Katherine Cass—who are picking up where Hippo left off when she graduated in May.

Hippo's happy to be a part of an overall demographic shift in who engineers are—from her impact on the campus club to landing her first post-graduation gig at Google, where she'll be working as an engineering resident.

YOUNG WOMEN SCIENTISTS SHINE AT INNOVATION OLYMPIAD

More than 40 of Northeast Ohio's brightest female STEM middle- and high-school students vied for cash prizes at the Cleveland OneCommunity IoT Innovation Olympiad held at Case Western Reserve University this spring.

IoT stands for Internet of Things—tech's new world order of digital connectivity—and it served as the focal point for the event, which invited girls ages 13 to 18 to bring their technology A-games to a *Shark-Tank*-style competition. The girls and their families also heard from and interacted with local women in STEM fields, focused on exploring career options and advanced education in the 21st century.

Winning app ideas included a retail-based application that promotes smarter shopping, an app that enables communication through muscle movement, a program that aims to combat depression through an uplifting playlist, and an app that provides real-time language translations during phone conversations.

The event was sponsored by Case Western Reserve, OneCommunity, BlueBridge, OEConnection and *CBC Magazine*.

Learn more at onecommunity.org/the-innovation-of-our-youth-promising-ideas-at-the-iot-olympiad.



SOMETHING ABOUT MERRY

Say hello to the newest member of Case Western Reserve University's Integrated Robotics Lab: Merry.

Named in honor of one of the generous supporters who helped bring her to campus—Meredith Seikel, who provided the support along with her husband Oliver—Merry is a human-friendly, interactive Baxter model robot from Rethink Robotics. Since she arrived on campus this summer, **Merry has been helping students and faculty at Case Western Reserve explore 3-D perception, machine learning, artificial intelligence and more.** She's also the centerpiece of a new combined undergraduate/graduate course called Modern Robot Programming that debuted this fall.

In addition to Merry, the Seikels helped bring another addition into the robotics lab—a Da Vinci surgical system that's being used in faculty research projects on medical robotics and human-machine interfaces.

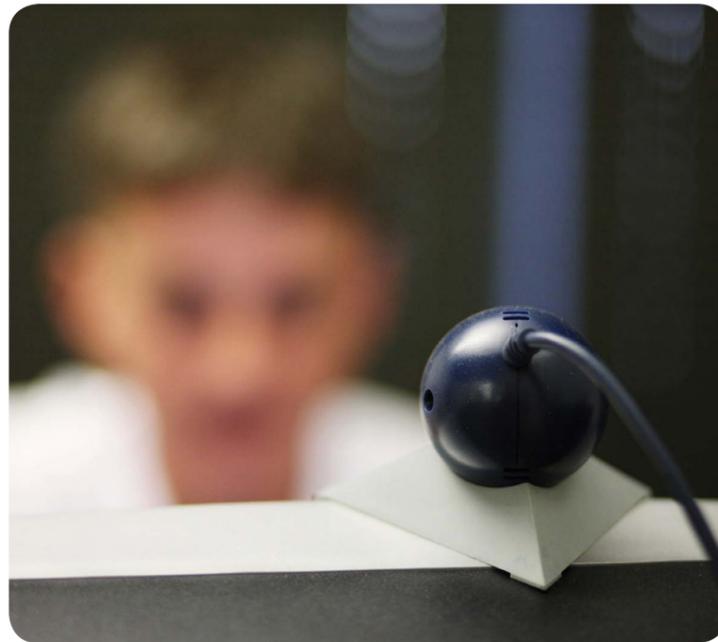
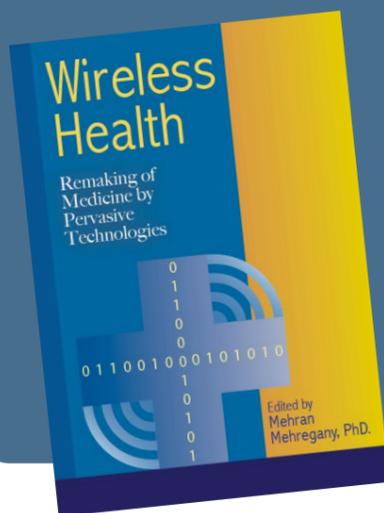
WRITING THE BOOK ON WIRELESS HEALTH

Mehran Mehregany, the Goodrich Professor for Engineering Innovation at Case Western Reserve and director of the university's San Diego program, **published the first textbook on the subject of wireless health**, titled *Wireless Health: Remaking of Medicine by Pervasive Technologies*.

Mehregany developed and launched the university's graduate program in wireless health in 2010. The program is now one of several high-tech academic offerings run by Case Western Reserve out of San Diego.

The textbook came out of teaching the first course of the curriculum. It covers topics from product design to policy to the U.S. health care landscape in 18 chapters written by a collection of top industry and academic experts.

Learn more at engineering.case.edu/Mehregany-wireless-health-textbook.



COMPUTER SCIENCE STUDENT WOWS INDIE GAME FEST

Case Western Reserve University **computer science student John Billingsley and his teammates from the University of Southern California won a top prize at IndieCade, an independent video game festival in Los Angeles.**

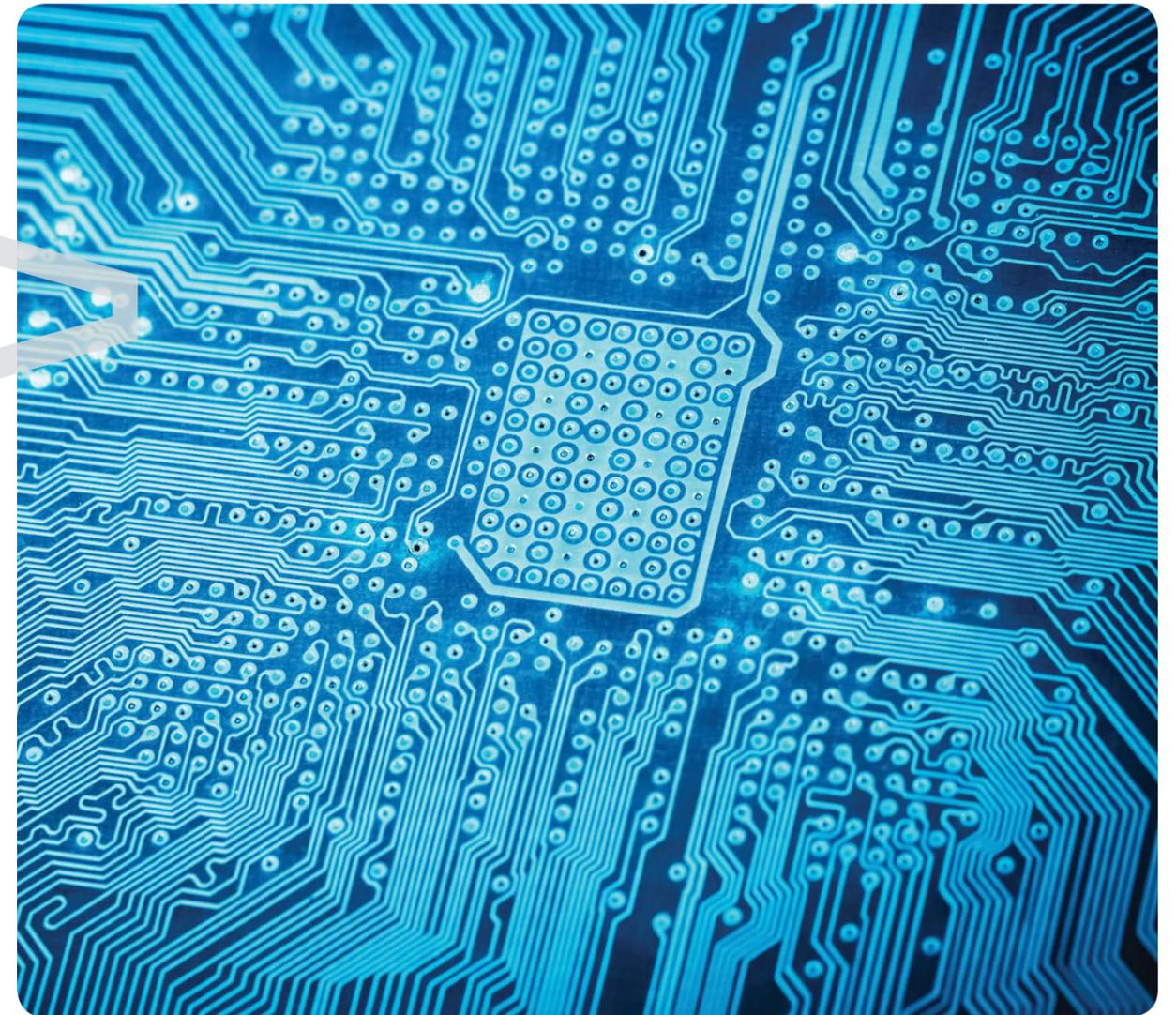
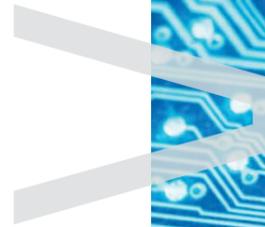
Billingsley and his team put their game, "Close Your," before the judges at the annual juried competition and won the Developer's Choice Award, the event's highest honor. The game is a first-person fictional narrative that follows a character suffering from a severe form of memory loss and uses a webcam to track a player's eye, advancing the scenes at every blink.

The team plans to revise the game based on feedback from IndieCade and submit it to more festivals before making the game available for download.

HAND-HELD HEALTH CARE

Researchers at Case Western Reserve University have **developed a palm-sized processing system for health monitoring** and maintenance that will be a fraction of the cost of devices currently in use.

The dielectric spectroscopy system created by associate professor of electrical engineering and computer science Pedram Mohseni, senior research associate Michael Suster and their team is designed to monitor blood coagulation disorders at the point of care. Not only is it **small enough to fit in the palm of your hand, it can be manufactured for just \$50 per unit**—and it can kick back accurate results within minutes using only a drop of blood from a finger prick.



RESEARCHERS MAKE BIG DISCOVERIES IN MICRO-SIZED RESONATORS

Big-impact technology is getting smaller as it evolves, and to produce smaller tech that still packs major processing capacity, ultra-tiny components are needed. Electrical engineering and computer science researchers at Case Western Reserve University made two **discoveries that could lead to improved micromechanical systems for next-generation electronics and photonics.**

A team led by Philip Feng, assistant professor of electrical engineering and computer science, **created a new kind of micro-resonator using drumheads made from atomic layer semiconducting crystals**, including molybdenum disulphide and black phosphorus. According to the team, these ultra-tiny devices are the first of their kind to use semi-conductive 2-D materials, which could open up a whole new range of possibilities and potential functions. For instance, Feng's resonators should be able to operate in a wider range of modes than their conventionally made counterparts.

Feng's 2-D drumheads were featured as an invited talk at the IEEE 2014 International Electron Devices Meeting (IEDM), the leading technical conference for advanced semiconductor devices, and the

work was also featured in *IEEE Spectrum*, the flagship publication for the Institute of Electrical and Electronics Engineers (IEEE).

Feng's team also **developed a new ultra-sensitive measurement technology that allows researchers to spatially map and visualize the shapes and fine features of high-order modes of Brownian motions** in devices that have multiple resonant modes, which previously have been elusive to detect, since the motions are vanishingly small.

Brownian motions are the haphazard ways that thermally agitated particles and molecules zigzag around in fluids. Using new optical interferometry techniques and silicon carbide microresonators, Feng and his team were able to observe and precisely measure these movements, creating vivid maps of multiple mode shapes that could be used to help identify minute structural imperfections and defects hidden in micro and nanodevices.

The research was published in the November issue of *Nature Communications*.

Learn more at engineering.case.edu/Feng-2D-NEMS-IEDM and engineering.case.edu/Feng-Brownian-motions.

Student, faculty and finance minds come together to bring a faster blood test device to market.



Left to right: Punkaj Ahuja, Miklos Gratzl and Patrick Leimkuehler

PUNKAJ AHUJA, PATRICK LEIMKUEHLER AND MIKLOS GRATZL: > > > > > **DIAGNOSIS DETECTIVES**

Meet the minds behind Apollo Medical Devices: Punkaj Ahuja, Patrick Leimkuehler and Miklos Gratzl, a faculty-student-entrepreneur combo that's **inked an exclusive technology transfer agreement with Case Western Reserve to move its point-of-care blood analyzer from a university lab to the market.**

Like many promising products before it, the technology was born in a research lab: specifically Case Western Reserve's Laboratory for Biomedical Sensing, which is led by associate professor of biomedical engineering Miklos Gratzl, and specializes in drug-cell interactions, tumor-tissue modeling and electrochemistry and optical techniques—research that can provide the foundation for such high-tech diagnostic tools. Five years ago, as an undergraduate student in Gratzl's lab, Ahuja started tinkering with a project on continuous glucose monitoring. Soon commercial potential for something with an even bigger impact began to emerge.

Imagine a patient arriving at an emergency room presenting a list of vague symptoms—extreme fatigue, weakness and nausea. **Apollo Medical Devices has developed a rapid-fire blood test that provides a valuable snapshot of what's going on inside the body**—from glucose and potassium levels to sodium content to kidney function—that could help put ER clinicians on the right track to a correct diagnosis.

It also requires a super-small sample, just a drop of blood from a finger prick, which means it could make a huge impact in situations where blood testing is restricted by volume, like in cases of blood loss or in neonatal care.

Ahuja continued working on the product as an undergraduate and then as a graduate student in Gratzl's lab. He met up with Leimkuehler at a regional entrepreneurship event in 2014. Finance consultant Leimkuehler had just returned to Cleveland and was looking to get involved in a promising biotech startup, so the pair got to work on a business plan for the blood tester. They launched Apollo in October 2014 and began pulling in funding, including more than \$150,000 from Northeast Ohio's MAGNET, Lorain County Community College's Innovation Fund and a \$100,000 grant from the Ohio Third Frontier Program. Leimkuehler and Ahuja are now both working full time as the startup's leadership team, as CEO and CTO respectively, and Gratzl remains active as an adviser.

In pre-clinical tests, **the prototype has delivered results in just five minutes that are as accurate as traditional tests.** The team is refining the technology and plans to have a full system designed by next summer when it will begin clinical trials.

Learn more at engineering.case.edu/Apollo-Medical-Devices-license-option.



TECHNOLOGY TRANSFER STATS: 2014-15

In FY2015, Case School of Engineering faculty contributed to:

- 98 invention disclosures—5 times the national per-dollar proficiency average*
- 193 patent filings—15.3 times the national per-dollar proficiency average*
- 22 deals (options and non-exclusive and exclusive licenses)—4.2 times the national per-dollar proficiency average*
- 2 startups —2.4 times the national per-dollar proficiency average*

*AUTM U.S. Licensing Activity Survey, FY13. (latest data available)

COMPUTATIONAL IMAGING INNOVATIONS SECURE PATENTS, LAND LICENSURE AGREEMENTS

A number of technologies developed in Case Western Reserve University's Center for Computational Imaging and Personalized Diagnostics, led by biomedical engineering professor Anant Madabhushi, have advanced toward commercial readiness.

A total of six technologies relating to different aspects of computational imaging and analysis of medical imaging data developed in the lab have been jointly licensed by Rutgers University and the University of Pennsylvania to the Boston-based medical imaging startup company Elucid Bioimaging.

Madabhushi was the lead inventor on these six technologies. In addition, he was awarded a patent for an image-based computer-aided prognosis system and method that seeks to replicate the prognostic power of molecular assays in histopathology and pathological processes, including but not limited to cancer.

Learn more at engineering.case.edu/Madabhushi-tech-license-and-patent.

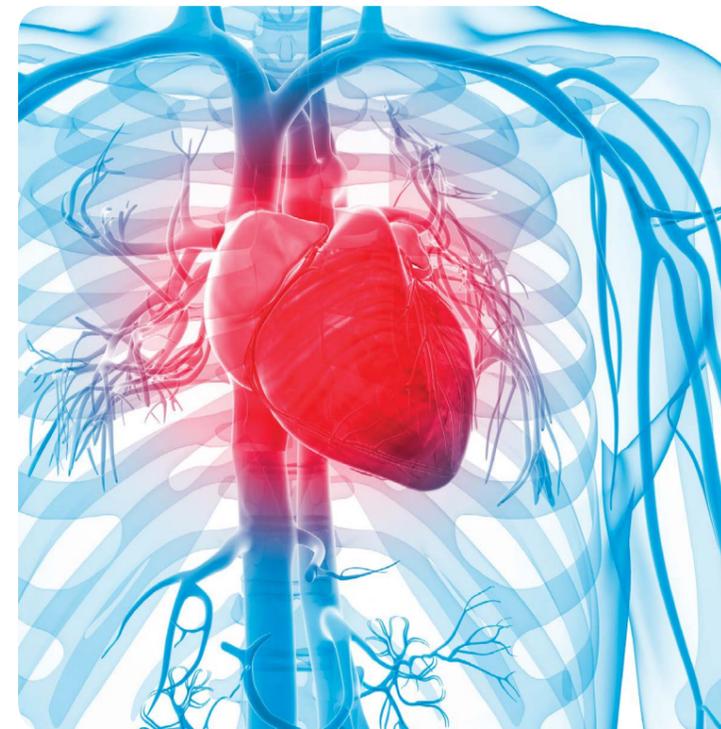
Case Western Reserve University ranked among the world's top 50 universities to receive U.S. utility patents in 2014, according to the National Academy of Inventors and the Intellectual Property Owners Association.

GLOBAL MEDICAL TECHNOLOGY FIRM MEDTRONIC ACQUIRES STARTUP CARDIOINSIGHT

Global health technology powerhouse Medtronic has acquired CardioInsight—a Cleveland-based startup that spun out of biomedical engineering technology originally developed at Case Western Reserve—putting the company's cardiac mapping system one step closer to market.

CardioInsight will become part of the Medtronic Atrial Fibrillation Solutions business in the firm's Cardiac Rhythm and Heart Failure division, as part of a \$93-million acquisition deal announced this summer. CardioInsight's ECVUE system is a non-invasive imaging device—an EKG vest—that delivers high-resolution 3-D images of the heart's electrical activity.

Learn more at newsroom.medtronic.com.



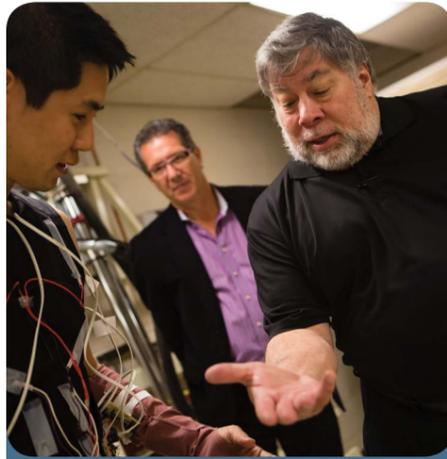
LUBRIZOL, KENT AND KELVIN SMITH FOUNDATIONS FUND PRODUCT DEVELOPMENT AT THINK[BOX]

When it comes to moving an idea to market, innovators have little time to waste. If they want to usher their product along the tech readiness scale, they need the ability to put prototypes to the test fast—they need to discover what works and what doesn't, tweak their design accordingly and put a new prototype through its paces.

Budding innovators at Case Western Reserve will have access to this kind of powerfully fast prototyping, thanks to the generous support of the Lubrizol Foundation, the Kent H. Smith Charitable Trust and the Kelvin and Eleanor Smith Foundation, which committed a combined \$2 million to the university's think[box] innovation and entrepreneurship center. The Lubrizol Foundation contributed a leadership grant of \$1 million, and the Kent H. Smith Charitable Trust and the Kelvin and Eleanor Smith Foundation each contributed \$500,000.

In recognition of the support, Case Western Reserve will name think[box]'s fourth floor—which is dedicated to providing individuals and teams the ability to assemble and fabricate products and devices—the Lubrizol Foundation and Kent H. Smith and Kelvin Smith Fabrication Floor.

Learn more at engineering.case.edu/thinkbox-renovation-support.



WORDS OF WOZDOM: APPLE CO-FOUNDER IMPARTS KNOWLEDGE AT STUDENT Q&A

Case Western Reserve University students got to chat with a tech industry legend when **Apple co-founder Steve Wozniak visited campus.**

Wozniak toured the university's own innovation hub, think[box], before fielding questions in front of a sold-out crowd at an hour-long Q&A with students held at the Tinkham Veale University Center, where he encouraged students to embrace creativity and warned against yielding to the status quo.

Before departing, Woz left his mark on campus—autographing think[box]'s circuit board router.

UNIVERSITY LAUNCHES FIVE ALL-ONLINE ENGINEERING MASTER'S DEGREES

Four years into medical school, Renik Delisser knew he wanted to pursue an advanced degree from a top-notch biomedical engineering program to help him bring an engineer's perspective to his future career as a practicing neurosurgeon. He was willing to take a break from his med school coursework before beginning his residency, but uprooting his entire life in California was out of the question. This year, **Case Western Reserve launched five of its engineering master's degree programs entirely online**, giving Delisser and students like him a chance to advance their careers from anywhere.

Delisser is working on his **Master of Science in biomedical engineering**—one of four Master of Science majors now offered 100 percent online from Case Western Reserve: others include civil engineering, mechanical engineering and systems and control engineering. The university is also offering its Master of Engineering degree entirely online.

Delisser is taking courses taught by the same world-renowned faculty who teach graduate students on Case Western Reserve's Cleveland campus from his home in Loma Linda, Calif., using a convenient online platform. He plans to use his master's degree to help him work in both spheres of medicine—in the clinic as a surgeon and in creating the next generation of devices that will continue to impact patients' lives long after his days in the operating room are over.

The master's programs in biomedical and mechanical engineering, and the Master of Engineering degree all started classes in the spring, drawing an incoming class of students from across the country, including California, Michigan, Oregon, Maryland and Florida, in addition to Case Western Reserve's home state of Ohio. The master's programs in civil engineering and systems and control engineering began classes in August.

Learn more at online-engineering.case.edu.



MAJOR MEDIA OUTLETS AGREE—CLEVELAND ROCKS!

Cleveland had a big year in the spotlight, and it wasn't all about LeBron James and the Cavs. From *The New York Times* to top travel pubs, major media outlets are singing the praises of this rustbelt Renaissance story, from its fast-growing reputation as a hotbed of innovation to its famous food scene.

The New York Times named Cleveland one of its "52 Places to Go in 2015," alongside other must-visit tourist destinations like Milan, Singapore and Lower Manhattan. Praising the city's "comeback fueled by art, culture and King James," the news outlet labeled the Uptown district—right in the middle of Case Western Reserve's campus in University Circle—as official 'hip.'

Travel and Leisure also presented Cleveland in its "50 incredible destinations for 2015," citing the city's revival in terms of urban living, innovative food scene and cultural expansions in Uptown. *Fodor's* was also on the Cleveland bandwagon, placing the city on its "25 can't-miss spots" for 2015.

And it's not just a great place to visit, according to *Popular Mechanics*, which named the city one of the best startup locations in the nation. Stating "Be Like Cleveland. Seriously," *PM* points to Cleveland as a maker-haven—a city with a built-in big manufacturing infrastructure that's a perfect fit for today's hungry startups. The magazine also lauds Cleveland's dedication to business incubators and its thriving biomedical and biotechnical sectors—Cleveland's burgeoning Health-Tech Corridor spans 1,600 acres and is home to some eight business incubators and about 125 high-tech companies focused on innovation. *PM* also praises Cleveland's collaborative maker scene and lively community of small manufacturers, as well as the city's low cost of living and running a business.

Learn more about why Cleveland is the place to be for innovators at engineering.case.edu/whycleveland.

ALUMNI FUND STUDENT SCHOLARSHIPS

Scholarships can put a college education within reach, and thanks to two generous alumni, future generations of Case Western Reserve University students will be able to benefit from this kind of valuable support.

Elena S. Lobl (CIT '70) knows exactly how big a difference a scholarship can make. The 1970 grad earned her PhD in physics with the help of a Huntington Foundation Scholarship. This inspired her to make a bequest to the university that will **establish the Elena S. Lobl '70 Graduate Scholarship**, which will provide unrestricted funding to the Case School of Engineering for graduate scholarship support.

In addition, the **Carl E. Podwoski Scholarship Fund**, established by its namesake, Carl E. Podwoski (CIT '61) in 2007, awarded its 10th undergraduate scholarship this year. Podwoski earned his bachelor's degree in electrical engineering in 1961, and his fund provides substantial support to undergraduates in need of financial aid.

ROBERT X. GAO NAMED MECHANICAL AND AEROSPACE ENGINEERING CHAIR

Case Western Reserve University **appointed Robert X. Gao chair of the Department of Mechanical and Aerospace Engineering.**

An esteemed scholar, Gao has extensive research expertise in the areas of physics-based sensing methodology; design, modeling and characterization of measurement systems; multi-resolution data analysis; and energy-efficient sensor networks for the in-situ monitoring of dynamical systems—from manufacturing equipment and processes to cyber physical systems (CPS) and human physical activities. He has led more than 50 projects funded by federal agencies and industrial partners. In addition to his research accomplishments, Gao is a well-respected educator and mentor, having supervised more than 35 PhD and master's students to the completion of their graduate studies. He has two books, more than 300 papers and 12 awarded and pending patents to his name, as well as several editorial appointments in his field's leading journals.

Gao joins Case Western Reserve from the University of Connecticut, where he served as the Pratt and Whitney Chair Professor in the Department of Mechanical Engineering for seven years.



Robert X. Gao



WATERFALL SWING MAKES SPLASH IN SYDNEY

The Waterfall Swing—part art installation, part science experiment and part engineering showpiece—was a featured attraction at the Sydney Festival held this January in Sydney, Australia's Darling Harbour.

Designed by a team of Case Western Reserve and Cleveland Institute of Art alumni, the 18-foot-tall steel structure suspends riders beneath a wall of water, which—with the help of high-tech sensors—stops for every swing, letting the rider pass through without getting soaked.

Watch the Waterfall Swing in action at engineering.case.edu/Waterfall-Swing-Sydney.



CASE WESTERN RESERVE HOSTS NATIONAL CONCUSSION CONFERENCE

Science has drummed up overwhelming evidence that there's no such thing as a "mild" brain injury—concussions are serious business and can lead to permanent cognitive damage. More alarming? The number of reported concussions has doubled in the last decade.

Case Western Reserve University hosted and co-sponsored **Concussion: A National Challenge**, an event that convened top concussion scientists, engineers, clinicians and researchers to share the latest science about the detection, treatment and prevention of concussions with the public, including athletes, coaches, parents, veterans and physicians.

More than 500 people attended the free public event in June, which was presented by the National Academy of Engineering and the Institute of Medicine, co-sponsored by Case Western Reserve and held at Cleveland's Global Center for Health Innovation.

NEW MEM FACULTY DIRECTOR APPOINTED

Colin Drummond was appointed faculty director of the **Master of Engineering and Management program**, a joint degree between the Case School of Engineering and Weatherhead School of Management. **Drummond was also appointed assistant chair of the biomedical engineering department.** Previously, he had served as the director of Case Western Reserve University's Coulter-Case Translational Research Partnership and a professor of nursing.



CASE WESTERN RESERVE LAUNCHES ACADEMIC PARTNERSHIPS IN ASIA

Case Western Reserve University added two new global partners to its extensive international network this year, announcing academic partnerships with Mapua Institute of Technology in the Philippines and China's Beijing University of Chemical Technology.

Gary Wnek, the Joseph F. Toot Jr. Professor in the Department of Macromolecular Science and Engineering, visited Mapua in May 2014 as the first visiting professor under the country's PhilDev Innovation Development through Entrepreneurship Acceleration (IDEA) program, an initiative that brings U.S.-based faculty experts in the STEM fields to work with institutions in the Philippines to help promote innovation and entrepreneurship. Wnek's visit laid the groundwork for the academic partnership, which will focus on integrating those elements into the curriculum at Mapua through faculty and student exchange programs and joint research projects.

The university also signed a memorandum of understanding with the Beijing University of Chemical Technology to open its 3+2 Early Entry Master's Program there, allowing the partner university's students to complete their undergraduate degree for their home institution and earn a master's degree with two years of study at Case Western Reserve. Beijing University of Chemical Technology joins other 3+2 program partners, including Hunan University and Tianjin University.

ALUM'S UNMANNED AIRCRAFT COMPANY FLYING HIGH

Case Western Reserve University alumnus Jeff Taylor's (CWR '09) startup, **Event 38**, got a financial boost this year with a \$25,000 Innovation Fund grant from the Great Lakes Innovation and Development Enterprise. Taylor's company designs and manufactures unmanned aircraft, or drones, for aerial mapping, land surveying and agricultural planning. He also inked a deal with a South African distributor to make his products available in Africa.

Taylor was also among the Case Western Reserve student and alumni companies who showcased innovations with the university at this year's International Consumer Electronics Show in Las Vegas.

Learn more at event38.com.

ANTHROPOLOGY AND ENGINEERING STUDENTS TACKLE GLOBAL HEALTH

Case Western Reserve students of two very different sciences used their spring break to tackle global health challenges—traveling to Uganda to work alongside local students on solving health problems in the region.

A team of engineering and anthropology students, led by Andrew Rollins, professor of biomedical engineering, and Janet McGrath, professor of anthropology, made the trip to build the foundation for a new collaborative course at the university that will prepare students to work in global health.

The Case Western Reserve students teamed up with biomedical engineering students at Makerere University in Kampala, Uganda, tackling two pressing problems in the region: vaccine storage and medical waste disposal. This new effort has grown out of the Case-Uganda Research Collaboration—a 25-year partnership shared by the two institutions.

Students visited local health centers to assess the needs of rural clinics. They're designing a vaccine cooler to help preserve essential vaccines in areas without access to electricity for refrigeration, and they are working to improve and standardize medical waste disposal practices. These projects will help inform the curriculum of the new class, which will be offered initially in the spring 2016 semester, with an option to travel to Uganda during spring break.

Learn more at engineering.case.edu/engineering-anthropology-global-health.



A 3-D REVOLUTION IN MEDICAL EDUCATION

The most detailed medical illustration still only paints a flat picture, and dissection can't show the body's systems in action. New augmented reality technology from Microsoft promises to revolutionize the way medical students learn about the body, and Case Western Reserve University has partnered with Microsoft to bring this innovation into the classroom.

The Microsoft HoloLens projects 3-D holographic images—giving users the opportunity to view and interact with 3-D digital content in real space. They will be able to explore human anatomy, separating systems to study them independently and see how they all work together—and even isolate organs and zoom in to illuminate minute details.

Mark Griswold, professor of radiology and biomedical engineering, discussed the technology and its possible educational applications at Microsoft's annual Build Conference. He is working with a team of researchers at Case Western Reserve, including electrical engineering and computer science associate professor Marc Buchner, and Cleveland Clinic to apply HoloLens first to medical education. The effort is part of a broader partnership between Case Western Reserve and Cleveland Clinic to create a new Health Education Campus—a collaborative project that will include the schools of nursing, dental medicine and medicine, as well as the Cleveland Clinic Lerner College of Medicine, a track within Case Western Reserve's medical school. The university is also exploring using HoloLens in other academic applications, including engineering.

Learn more and watch HoloLens in action at engineering.case.edu/HoloLens-video.

HARTMAN FOUNDATION SUPPORTS GROWING CO-OP PROGRAM

David Hartman, a 1958 graduate of Case Institute of Technology, has ensured future engineering students will benefit from the real-world learning that cooperative education provides with a generous investment of time and funding from the Hartman Foundation Inc., which he founded, and which is now led by his son, Douglas.

Foundation directors approved a second \$300,000 donation to the Case School of Engineering co-op program. Current foundation president Douglas Hartman will regularly visit campus to meet with students, faculty and staff involved in the program and meet with officials of companies that do—or are considering—offering co-ops, to help promote the program.

David Hartman put a premium on cooperative education and sought to increase participation by students and companies when the foundation donated its first \$300,000 in 2011. He believes that students become significantly more marketable by participating in co-op, which places them in full-time, paid work experiences at top employers, giving them a chance to put classroom lessons into practice on the job.

Learn more at engineering.case.edu/Hartman-Foundation-co-op.



Sylvester Amponsah

SUPERCONDUCTIVITY WITHOUT SUPER COLD TEMPERATURES

Science is the pursuit of answers to impossible problems, and Case Western Reserve University electrical engineering student Sylvester Amponsah has found his: developing a superconductor that works at room temperature.

All superconductors currently on the market need to be kept super cold to move electricity along. Amponsah won an OZY Genius Award to seek out an alloy that serves as a superconductor without the frigid temperature requirements.

Learn more at engineering.case.edu/OZY-Genius.

PHD STUDENT WINS INTERNATIONAL HONORS

Jaesung Lee, a PhD candidate in the Department of Electrical Engineering and Computer Science, who is mentored by Assistant Professor of Electrical Engineering and Computer Science Philip Feng, won a Best Paper Award at the American Vacuum Society's 61st International Symposium & Exhibition for his talk, titled "Temperature-Compensated Graphene Nanomechanical Resonators."

BIG BUSINESS IN THE BIG APPLE

Student entrepreneurs from Case Western Reserve pitched their products to potential investors and industry experts as finalists at Blackstone LaunchPad Demo Day—a national entrepreneurship competition held in New York City.

Case Western Reserve had the second-most teams at the event, with three companies in the running for the top prize out of a total of 20 competitors.

Carbon Origins, a company that grew out of the university's student rocket club into a startup that designs onboard computer technology, took third place and a \$10,000 prize to invest in its flagship technology.—an Arduino-compatible device packed with 11 sensors that measure and record a host of data from temperature, pressure and humidity to ultraviolet, infrared and visible light.

Everykey, a Bluetooth-enabled wristband that securely unlocks password-protected devices, finished in the top seven, and SensID showcased a simulator designed to help nurses train for the operating room.

Learn more at engineering.case.edu/finalists-national-LaunchPad-Demo-Day-2014.

ROAD WARRIORS

The Case Western Reserve Baja Team hit the road for a record-setting season, attending all three official Baja SAE events for the first time in its 14-year history and placing in the top 15 overall at one of them.

The team earned top spots in the year's first event in Auburn, Ala., before moving on to a record-setting showing in Mechanicsville, Md., where they finished fifth in a four-hour endurance race against more than 100 teams. This feat earned them a 14th-place finish overall, putting them in good company along other top competitors from Cornell University and the Rochester Institute of Technology.

The Case Western Reserve team also put on a strong showing in the season's third and final event in Portland, Ore., placing 20th in the dynamic events category and eighth in the sales and marketing event.

Learn more at cwрубaja.com.



STUDENT TEAM AIMS TO SPEED SICKLE CELL DISEASE DIAGNOSIS

More than 800 children are born with sickle cell disease in Africa every day, and more than half of them die before the age of 5 due to lack of diagnosis and early treatment. A student team from Case Western Reserve University is developing a new, low-cost device that can rapidly diagnose sickle cell disease and other hemoglobin disorders in newborns, getting them needed treatment faster.

The team, led by mechanical and aerospace engineering graduate student and PhD candidate Yunus Alapan, won two high-profile awards to support the work. First, the team has been named a finalist for the Student Technology Prize for Primary Health Care, winning \$10,000 to move the project forward and a chance to compete for three top prizes in the fall.

The team also won the first prize in the medical category of the 2014 NASA Tech Briefs Create the Future Design Contest.

Alapan leads the group under faculty adviser Umut Gurkan, assistant professor of mechanical and aerospace engineering.

Learn more at engineering.case.edu/finalists-CIMIT-Student-Technology-Prize.



Janet Gbur

MATERIALS PHD STUDENT WINS INDUSTRY ACCOLADES

Janet Gbur, a fourth-year PhD student in the Department of Materials Science and Engineering, won the M.R. "Mitch" Mitchell Best Student Paper Award from the ASTM Committee on Fatigue and Fracture for her research on fatigue of wires, strands and cables in biomedical devices, a three-year project she has been conducting with adviser John Lewandowski, the Arthur P. Armington Professor of Engineering II in the materials science and engineering department.

ENGINEERING STUDENT NAMED ONE OF AVIATION WEEK'S TWENTY20S

Aviation Week magazine named Case Western Reserve University graduate student Lauren Smith to its Twenty20s List, which recognizes top engineering, math, science and technology students and connects the next generation of aerospace and defense talent with established leaders in the field.

Smith earned her bachelor's degree as a mechanical and aerospace engineering double major in 2013, and was honored by *Aviation Week* while pursuing her master's in mechanical engineering, conducting her thesis research at the NASA Glenn Research Center in Cleveland, where she developed a novel robotic locomotion concept for search and rescue missions.

Mohsen Seifi, a doctoral researcher in the Department of Materials Science and Engineering, was selected as one of the two 2015 Henry DeWitt Smith Scholars by the Minerals, Metals and Materials Society and won an American Society for Testing and Materials International Graduate Scholarship for the second year in a row.

STUDYING WIND POWER—FROM 156 FEET UP

A group of students from Case Western Reserve University and Lorain County Community College (LCCC) got a bird's eye view of campus—and an up-close look at wind energy technology—by climbing the 156-foot-tall campus wind turbine.

The joint training session between Case Western Reserve engineering students and students enrolled in LCCC's alternative energy technology associate degree program was organized by Wind Energy Research Center director and materials science and engineering associate professor David Matthiesen.

Watch the students scale the turbine at engineering.case.edu/LCCC-wind-turbine-climb.



CASE WESTERN RESERVE SHOWCASES INNOVATIONS ALONGSIDE TECH'S ELITE

For a certain tech-savvy, gizmo-centric segment of the population, the annual International Consumer Electronics Show (CES) in Las Vegas is like the Super Bowl, Academy Awards and a technology Olympics all rolled into one—innovation's big dance where companies show off their latest and greatest. And for the second year in a row, Case Western Reserve showcased its own inventions as part of the mega-trade show.

Last year, the university made its CES debut with seven student-run companies. This year, Case Western Reserve launched an innovation full-court press, filling six booths with nine student and alumni teams showcasing their products to more than 160,000 attendees from around the world.

The results of class projects, design competition entries, years of research and various other sparks of inspiration, many of the inventions were created using the resources in Case Western Reserve's think[box] innovation center.

Teams also received funding and support from the university's entrepreneurship program LaunchPad, the Blackstone Charitable Foundation and the Burton D. Morgan Foundation.

Companies on display included:

- Everykey, a Bluetooth-enabled wristband that securely unlocks password protected devices
- SpiroSano, which helps patients monitor their health digitally at home
- Doppler Yoyo, which produces 3-D printed, competition-grade yoyos
- Carbon Origins, which develops onboard computer technology for rockets, robotics and more
- Event 38 Unmanned Systems, which builds unmanned aircraft systems for agricultural surveying
- Boxcast, a company that's developed a plug-and-play broadcast box for live streaming events
- The maker of the 360x360 Selfie Stick, and
- Hema Imaging LLC, which helps homeowners and contractors use thermal imaging to uncover household problems.

Learn more at engineering.case.edu/CES-2015-announcement.

HONORS & AWARDS



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Ica Manas-Zloczower, Distinguished University Professor and the Thomas W. and Nancy P. Seitz Professor of Advanced Materials and Energy, was awarded a fellowship from the **Lady Davis Fellowship Trust at the Technion-Israel Institute of Technology**.

Electrical engineering and computer science chair and Nord Professor of Engineering **Kenneth Loparo** and biomedical engineering professor **Anant Madabhushi** were inducted into the **2015 class of fellows of the American Institute for Medical and Biological Engineering (AIMBE)**—an elite group of scholars that is comprised of the top 2 percent of medical and biological engineers in the country.

Jeffrey L. Duerk, dean of the Case School of Engineering, was named a **fellow of the Institute of Electrical and Electronics Engineers (IEEE)** for his contributions to rapid magnetic resonance (MR) imaging technologies. He has devoted his career to developing new MR imaging techniques that facilitate immediate clinical utilization to improve patient care, with a strong emphasis on expanding the role of MR imaging into new applications. Duerk joins an exclusive group of scholars in this honor: no more than one-tenth of 1 percent of the institute's total voting membership can be elevated to an IEEE fellow in any one year.



^
Mark De Guire, associate professor of materials science and engineering, was elected to the **2015 class of fellows of ASM International**—the world's largest association of materials scientists and engineers—in honor of his significant contributions in the synthesis, processing, phase equilibria, defect structure, and characterization of functional ceramic films for electrical, magnetic, optical and energy applications.

Stuart J. Rowan, Distinguished Research Professor and the Kent Hale Smith Professor in the Department of Macromolecular Science and Engineering, won the **2015 Mark Scholar Award from the American Chemical Society Polymer Division**, honoring his outstanding research contributions and leadership in the field of polymer science.

Philip Feng, assistant professor of electrical engineering and computer science, won a **National Science Foundation Early Career Development Award** for his five-year project, "Dynamically Tuning 2D Semiconducting Crystals and Heterostructures for Atomically-Thin Signal Processing Devices and Systems."



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Distinguished Research Professor in the Department of Macromolecular Science and Engineering **Hatsuo "Ken" Ishida** was elected to the **2015 class of fellows of the Polymeric Materials Science and Engineering (PMSE) Division of the American Chemical Society** in recognition of more than three decades of breakthrough contributions to the field of polymeric materials, including seminal work in composite interfaces, polymer spectroscopy and in the development of polybenzoxazine resins.

P. Hunter Peckham, Distinguished University Professor and the Donnell Institute Professor of Engineering, won the **2015 Lifetime Achievement Award from the American Spinal Injury Association** for his distinguished career in research on the use of functional electrical stimulation to restore hand and arm control in paralyzed individuals. As director of the Cleveland Functional Electrical Stimulation (FES) Center, Peckham has built a model of successful research collaboration among scientists, engineers and clinicians from the Cleveland Veteran's Administration Medical Center, Case Western Reserve and MetroHealth Medical Center.

HONORS & AWARDS



Nicole Steinmetz, assistant professor of biomedical engineering, won a **National Science Foundation Faculty Early Career Development Grant** for her five-year project “Nanoparticle-antibody Conjugates in Medical Imaging and Environmental Sensing.”

Matthew Willard, associate professor of materials science and engineering, won a **2015 Brimacombe Medal from the Minerals, Metals and Materials Society** and was named a **senior member of the Institute of Electrical and Electronics Engineers**.

Timothy Peshek, research assistant professor of materials science and engineering, won funding through **Google’s Little Box Challenge Academic Awards**—one of just 10 researchers from around the world to do so.

Mechanical and Aerospace Engineering Professor **J. R. Kadambi** won the **American Society of Mechanical Engineers Fluids Engineering Division’s Sankaraiyer Gopalakrishnan-Flowserve Pump Technology Award**.



Donald L. Feke, Distinguished University Professor, Vice Provost and Professor of Chemical Engineering, was elected a **fellow of the American Institute of Chemical Engineers**, the highest grade of membership within the organization, which recognizes long-term excellence in chemical engineering.

James McGuffin-Cawley, chair of the Department of Materials Science and Engineering and Arthur S. Holden Jr. Professor in Engineering, was **re-elected to the executive committee of America Makes**, a federal initiative to develop advanced manufacturing techniques in the United States.

Pedram Mohseni, associate professor of electrical engineering and computer science, was selected to serve as general co-chair of the **2018 IEEE Biomedical Circuits and Systems (BioCAS) Conference**.

Umut Atakan Gurkan, assistant professor of mechanical and aerospace engineering, was named to **MIT Technology Review** magazine’s **Innovators Under 35–Turkey** list.

EDITORIAL APPOINTMENTS

Daniel J. Lacks, the C. Benson Branch Professor of Chemical Engineering – Editor-in-Chief, *Journal of Electrostatics*

Joseph Mansour, professor of mechanical and aerospace engineering – Deputy Editor-in-Chief, *Journal of Medical and Biological Engineering*

Hatsuo “Ken” Ishida, Distinguished Research Professor in the Department of Macromolecular Science and Engineering – Associate Editor, *Frontiers in Materials: Composites*

Anant Madabhushi, professor of biomedical engineering – Associate Editor, *BMC Medical Imaging*; Associate Editor, *IEEE International Symposium on Biomedical Imaging*; Associate Editor, *IEEE Journal of Translational Engineering in Health and Medicine*

Xiangwu “David” Zeng, civil engineering chair and Frank H. Neff Professor – Associate Editor, *ASCE Journal of Aerospace Engineering*

Umut Atakan Gurkan, assistant professor of mechanical and aerospace engineering, Founding Associate Editor, *Nanobiomedicine Journal*

ADMINISTRATION

Case Western Reserve University

Barbara R. Snyder
President

William A. "Bud" Baeslack III
Provost and Executive Vice President
Professor of Materials Science and Engineering

Case School of Engineering

Jeffrey L. Duerk
Dean and Leonard Case Jr. Professor of Engineering

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

Clare M. Rimnac
Associate Dean, Research
Wilbert J. Austin Professor of Engineering

Lisa A. Camp
Associate Dean, Strategic Initiatives

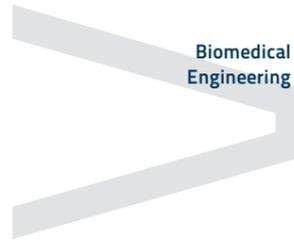
Daniel M. Ducoff
Associate Dean, Development and Global Relations
Associate Vice President, Strategic Development Initiatives,
Case Western Reserve University

Cena Hilliard
Associate Dean, Finance and Administration

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

FACULTY

as of September 1, 2015



Biomedical Engineering



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



Colin Drummond
Assistant Chair and Professor



Abidemi Bolu Ajiboye
Assistant Professor



Eben Alsberg
Professor



James M. Anderson
Distinguished University Professor



James P. Basilion
*Professor**



Jeffrey R. Capadona
Associate Professor



Jeffrey L. Duerk
Dean and Leonard Case Jr. Professor of Engineering



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



Steven J. Eppell
Associate Professor



Miklos Gratzl
Associate Professor



Kenneth J. Gustafson
Associate Professor



Efstathios "Stathis" Karathanasis
*Assistant Professor**



Erin B. Lavik
Professor



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



Anant Madabhushi
Professor



Cameron McIntyre
*Professor**



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



Andrew M. Rollins
Professor



Gerald M. Saidel
Professor



Nicole Seiberlich
Assistant Professor



Anirban Sen Gupta
Associate Professor



Nicole F. Steinmetz
*Assistant Professor**



Dustin J. Tyler
Elmer Lincoln Lindseth Associate Professor of Biomedical Engineering



Horst von Recum
Associate Professor

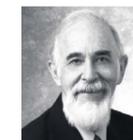


David L. Wilson
Robert J. Herbold Professor



Xin Yu
Professor

Chemical and Biomolecular Engineering



Uziel Landau
Chair and Professor



Rohan Akolkar
Associate Professor



Harihara Baskaran
Professor



Donald L. Feke
Distinguished University Professor and Vice Provost



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



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



Heidi B. Martin
Associate Professor

*Case Western Reserve University School of Medicine campus

Chemical and Biomolecular Engineering, continued



Syed Qutubuddin
Professor



R. Mohan Sankaran
Professor



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

Civil Engineering



Xiangwu "David" Zeng
Chair and Frank H. Neff Professor

Electrical Engineering and Computer Science, continued



Pedram Mohseni
Associate Professor



Wyatt S. Newman
Professor



Gultekin Özsoyoğlu
Professor



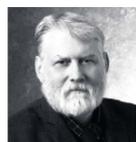
Zehra Meral Özsoyoğlu
Distinguished Research Professor and Andrew R. Jennings Professor of Computing Sciences



Christos A. Papachristou
Professor



YeongAe Heo
Assistant Professor



Aaron A. Jennings
Professor



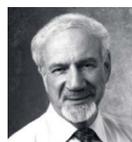
Brian Metrovich
Associate Professor



Michael Pollino
Assistant Professor



Kurt R. Rhoads
George B. Mayer Assistant Professor of Urban and Environmental Studies



Adel S. Saada
Professor



H. Andy Podgurski
Professor



Marija Prica
Assistant Professor



Michael Rabinovich
Professor



Soumya Ray
Associate Professor



Daniel G. Saab
Associate Professor



Narasingarao Sreenath
Professor



Katie Wheaton
Instructor



Xiong "Bill" Yu
Professor

Electrical Engineering and Computer Science



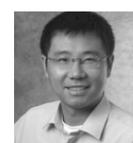
Kenneth A. Loparo
Chair and Nord Professor of Engineering



Marcus R. Buchner
Associate Dean of Academics and Associate Professor



M. Cenk Cavusoglu
Professor



Xiang Zhang
Theodore L. and Dana J. Schroeder Assistant Professor in Computer Science and Engineering



Hongping Zhao
Assistant Professor



Christian A. Zorman
Professor

Macromolecular Science and Engineering



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



Rigoberto C. Advincula
Professor



Vira Chankong
Associate Professor



Harold Connamacher
Assistant Professor



Evren Gurkan-Cavusoglu
Assistant Professor



Philip X.L. Feng
Assistant Professor



Chris Fietkiewicz
Assistant Professor



Mario Garcia-Sanz
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



Alexander M. Jamieson
Professor



LaShanda T.J. Korley
Climo Associate Professor



Mingguo Hong
Associate Professor



Ming-Chun Huang
Assistant Professor



Mehmet Koyuturk
Timothy E. and Allison L. Schroeder Associate Professor in Computer Science and Engineering



Michael Lewicki
Professor



Jing Li
Associate Professor



Pan Li
Assistant Professor



João Maia
Associate Professor



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



Jon Pokorski
Assistant Professor



Stuart J. Rowan
Distinguished Research Professor and Kent Hale Smith Professor



Gary E. Wnek
Joseph F. Toot Jr. Professor



Lei Zhu
Professor



Vincenzo Liberatore
Associate Professor



Wei Lin
Professor



Behnam Malakooti
Professor



Soumyajit Mandal
Assistant Professor



Mehran Mehregany
Goodrich Professor for Engineering Innovation

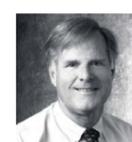


Francis L. Merat
Associate Professor

Materials Science and Engineering



James D. McGuffin-Cawley
Chair and Arthur S. Holden Jr. Professor in Engineering



William A. "Bud" Baeslack III
Provost and Executive Vice President and Professor



Jennifer L.W. Carter
Assistant Professor



Mark R. De Guire
Associate Professor

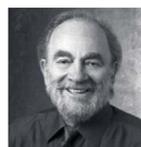


Frank Ernst
Leonard Case Jr. Professor of Engineering

Materials Science and Engineering, continued



Roger French
F. Alex Nason Professor



Arthur H. Heuer
Distinguished University Professor and Kyocera Professor in Ceramics



Peter D. Lagerlof
Associate Professor



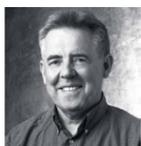
John J. Lewandowski
Arthur P. Armington Professor of Engineering



David H. Matthiesen
Associate Professor



Alp Sehirlioglu
Warren E. Rupp Assistant Professor



Gerhard E. Welsch
Professor



Matthew Willard
Associate Professor

Mechanical and Aerospace Engineering



Robert X. Gao
Chair and Cady Staley Professor of Engineering



Alexis Abramson
F. Alex Nason Professor and Ohio Eminent Scholar in Advanced Energy Research



Ozan Akkus
Professor



Richard Bachmann
Assistant Professor



Paul J. Barnhart
Associate Professor



Sunniva Collins
Associate Professor



Malcolm N. Cooke
Associate Professor



Umut Atakan Gurkan
Assistant Professor



J. R. Kadambi
Professor



Yasuhiro Kamotani
Professor



Kiju Lee
Nord Distinguished Assistant Professor



Ya-Ting Liao
Assistant Professor



Bo Li
Assistant Professor



Joseph M. Mansour
Professor



Joseph M. Prah
Professor



Vikas Prakash
Professor



Roger D. Quinn
Arthur P. Armington Professor of Engineering



Clare M. Rimnac
Associate Dean of Research and Wilbert J. Austin Professor of Engineering



James S. T'ien
Leonard Case Jr. Professor of Engineering



Fumiaki Takahashi
Professor

NOT PICTURED

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

CASE SCHOOL OF ENGINEERING AT A GLANCE

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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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

DEGREES AND MAJORS

Bachelor of Science in Engineering (BSE)

Available majors:

- Aerospace Engineering
- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Electrical Engineering
- Engineering Physics
- Materials Science and Engineering
- Mechanical Engineering
- Polymer Science and Engineering
- Systems and Control Engineering
- Bachelor of Science in Engineering without designation

Bachelor of Science in Computer Science (BS)

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)

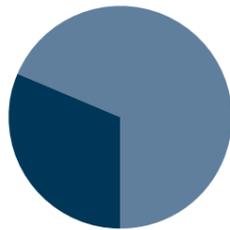
Doctor of Philosophy (PhD)

Available majors:

- Aerospace Engineering
- Biomedical Engineering
- Ceramics and Materials Science
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Computing and Information Sciences
- Electrical Engineering
- Engineering Mechanics
- Fluid and Thermal Engineering Science
- Macromolecular Science
- Materials Science and Engineering
- Mechanical Engineering
- Systems and Control Engineering

STUDENT ENROLLMENT FALL 2015

2,187 Total*



697 Graduate and professional-degree students
1,490 Declared undergraduate engineering students

*In addition, 741 undergraduate students expressed interest in engineering majors but are not expected to declare majors until the end of their sophomore year.

FULL-TIME FACULTY FY 2015

112

TOTAL REVENUE FY 2015

\$91.8 million

RESEARCH, TRAINING AND GRANT REVENUE FY 2015

\$43 million

CENTERS AND INSTITUTES

Advanced Manufacturing and Mechanical Reliability Center (AMMRC)
Advanced Platform Technology Center
Case Metal Casting Laboratory
Center for Advanced Polymer Processing
Center for Advanced Science and Engineering for Carbon
Center for Biomaterials
Center for Computational Imaging and Personalized Diagnostics
Center for Modeling Integrated Metabolic Systems
Center for the Evaluation of Implant Performance
Cleveland Functional Electrical Stimulation Center
Control and Energy Systems Center
Electro-Ceramics for Sustainable Energy Solutions
Electronics Design Center
Great Lakes Energy Institute
Institute for Advanced Materials
Magnetic Materials Characterization Laboratory
Materials for Opto/Electronics Research and Education (MORE) Center
Microfabrication Laboratory
Neural Engineering Center
Nitinol Commercialization Accelerator
NSF Center for Layered Polymeric Systems (CLiPS)
Rapid Solidification Laboratory
Solar-Durability and Lifetime Extension Center
Swagelok Center for Surface Analysis of Materials
The Institute for Management and Engineering think[box]
Wind Energy Research and Commercialization Center
Yeager Center for Electrochemical Sciences

FUNDRAISING FY 2015

Total: \$33 million

\$31.1 million

Case School of Engineering

\$1.9 million

Case Alumni Association

In FY2015, the Case Alumni Foundation/Association provided \$1.8 million from its endowment to the Case School of Engineering.

U.S. NEWS & WORLD REPORT RANKINGS

47th

for engineering graduate schools*

41st

for undergraduate engineering programs**

16th

for graduate biomedical engineering programs*

12th

for undergraduate biomedical engineering programs**

*published spring 2015

**published fall 2015

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Gerald Wasserman (CIT '76), vice-chair
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Every effort has been made to ensure the accuracy of this report. If you have any questions or concerns, please contact Christine Coolick, director of marketing and communications, Case School of Engineering, Case Western Reserve University, 10900 Euclid Ave., Cleveland, Ohio 44106-7220, 216.368.8694; cmc174@case.edu.
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