

# CASE SCHOOL OF ENGINEERING

Annual Report 2013-2014

# *DRIVEN*



CASE SCHOOL  
OF ENGINEERING

CASE WESTERN RESERVE  
UNIVERSITY



**Dear Colleagues and Friends:**

*Drive.*

It's that motivation to make it happen.

That hope that there's a better way, a better world.

A refusal to settle.

It's the essential trait of an engineer. To see not only the challenges we face, but all the possible ways we can surmount all obstacles. To relentlessly pursue the solutions that don't come easily, the ones that may need us to think differently, to ponder endlessly, to try (and fail) countless times before we succeed. It's that determination that makes it impossible to give up.

At the Case School of Engineering, we're driven.

Driven to create the next generation of data super-processors to analyze more data than you and I can even dream to exist. Driven to turn every student into not just an engineer, but a maker, an entrepreneur, a communicator and a leader. Driven to develop ways to heal our injured faster, to advance smarter energy solutions, to turn research into real products quicker—and to share these problems and possibilities with our partners the world over.

We're driven to make a difference, and I invite you to explore here the many ways we're doing just that.

Warmest Regards,

**Jeffrey L. Duerk**

Dean, Case School of Engineering

Leonard Case Jr. Professor of Engineering



# CASE SCHOOL OF ENGINEERING

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# DRIVEN

[driv-uh n]

*adjective*

1 : propelled or motivated by something

2 : very determined to succeed

3 : **the Case School of Engineering**

# DATA DRIVEN



## New undergraduate programs in data science rev up the next generation of big-data experts

High-volume. High-velocity. Widely varied. That is the reality of data in this digital age. Data is big.

And, when properly leveraged, it can be the driver to millions of solutions, cures and better processes.

Data science is the convergence of math, statistics, advanced computing, scientific methods and subject-matter expertise, all aimed at analyzing large data sets. It involves the collection, management and transformation of “big data” into actionable information that can answer some of the world’s most pressing problems.

Yet for this to happen, **there is an overwhelming need for experts who can efficiently interpret the wealth of data currently at our fingertips.**

McKinsey Global Institute predicts a nationwide shortage of 140,000 to 190,000 workers with “deep analytical skills,” and a deficit of 1.5 million managers capable of using big data analytics for actionable insights in their decision-making. McKinsey also predicts a 40 percent annual growth in global data and \$300 billion in potential value-add of data analytics to the nation’s health care industry alone. Gartner Inc. indicates that by 2015,

4.4 million information technology jobs globally will be created to support data science and analytics, generating 1.9 million IT jobs in the United States.

This past year, while serving as the chair of the Business-Higher Education Forum (BHEF), **Case Western Reserve University President Barbara R. Snyder shone a spotlight on this need, and announced the university’s plans to launch interdisciplinary undergraduate data science programs**, to be anchored within the Case School of Engineering.

Shortly thereafter, the university got a significant boost toward this end when alumnus Bob Herbold (MS ’66, PhD ’68) committed \$2.6 million to endow the Robert J. Herbold Professorship in Informatics and Analytics, within the Department of Electrical Engineering and Computer Science (read more on page 39).

The program’s roll-out is already underway, with a new minor in applied data science open to all Case Western Reserve undergraduates that started this fall. The new Bachelor of Science degree in data

science, pending final approval by the Ohio Board of Regents, will focus on real-world applications and delve deeply into mathematical modeling of data sources, informatics, data analytics, visual analytics and user experiences.

***Learn more at [datascience.case.edu](http://datascience.case.edu).***



## HACKING FOR CREDIT

A new curriculum has students at Case Western Reserve University and Cleveland State University **hacking hardware, software and data in order to learn how to better protect computer systems.** The three-course program teaches better protection from viruses, phishing scams, counterfeit electronics, so-called Trojan horses and other cyber attacks.

Swarup Bhunia, the Timothy E. and Allison L. Schroeder Associate Professor in Computer Science and Engineering at Case Western Reserve, explained that while the university conducts a lot of computer security research, there is an important unfulfilled need to educate and train students who will be the future users, developers and controllers of computer systems on the diverse security issues and their defense mechanisms. Bhunia teamed up with colleagues at Cleveland State to **devise a curriculum that is among the first comprehensive cyber-security education programs in the country offered to undergraduates.**

***Read more at [engineering.case.edu/cyber-security-courses](http://engineering.case.edu/cyber-security-courses).***

## USING BIG DATA TO IDENTIFY CANCERS

Could MRI data be pooled and leveraged to better diagnose cancer?

Case Western Reserve University researchers and colleagues did just that, and were able to **predict with 95 percent accuracy if a patient is suffering from aggressive triple-negative breast cancer, slower-moving cancers or non-cancerous lesions.**

The technique, which uses tiny patterns found in magnetic resonance images, could enable doctors to use an MRI scan to diagnose more aggressive cancers earlier and fast-track these patients for therapy.

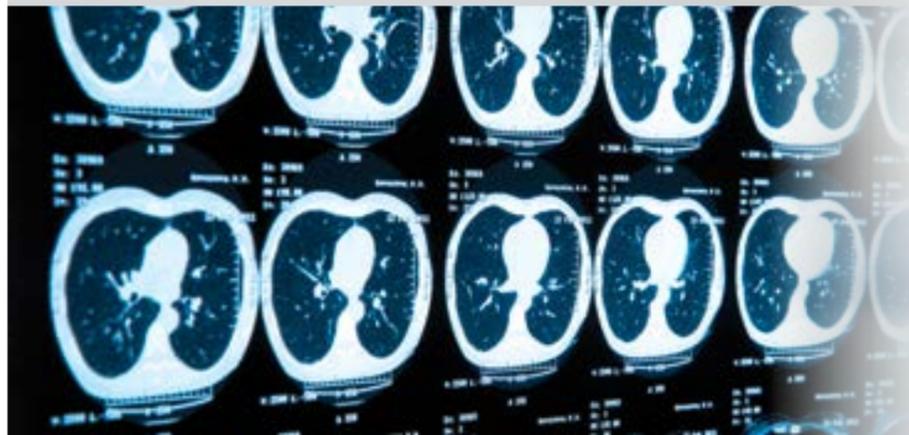
The work was published in the journal *Radiology*.

The finding comes shortly after senior author and biomedical engineering professor Anant Madabhushi and another group of researchers showed they can **detect differences between persistent and treatable forms of head and neck cancers caused by exposure to human papillomavirus, with 87.5 percent accuracy,** using digital images of patients' tumors. That work was published in the *American Journal of Surgical Pathology*.

Next, Madabhushi and his lab are **investigating patterns of indolent versus aggressive cancer in the lungs via CT scans alone,** thanks to a grant from the Department of Defense.

"Literally, what we're trying to do is squeeze out the information we're not able to see just by looking at an image," said Madabhushi. "Personalized medicine is possible using this. Using biopsy specimens, pathologists can't tell one from the other, but big data analytics can."

***Read more at [engineering.case.edu/big-data-cancer-ID](http://engineering.case.edu/big-data-cancer-ID).***



## NEW CYBER SEARCH TOOL DELIVERS MORE RELEVANT RESULTS

G.Q. Zhang

Traditional internet search methods can overwhelm users with long lists of links, leaving them to sift through pages of possibly irrelevant data to find what they want.

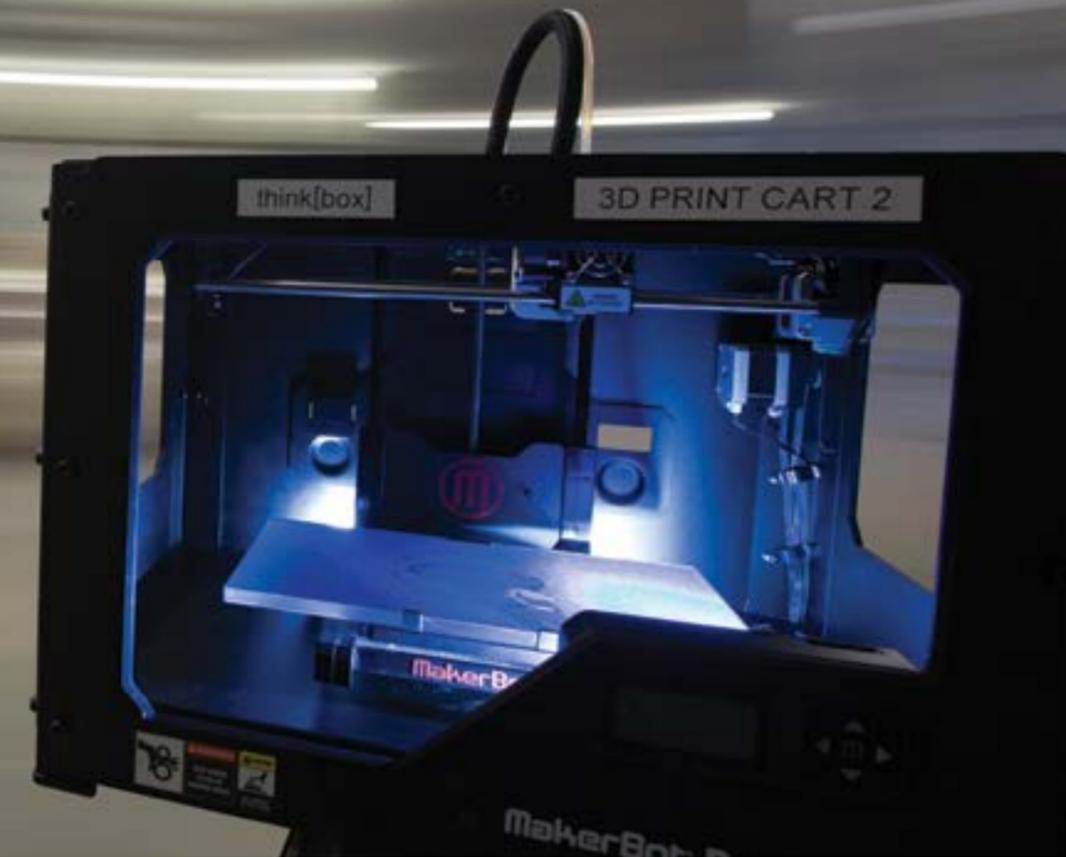
But a new search tool developed by electrical engineering and computer science professor G.Q. Zhang and fellow computer scientists at Case Western Reserve saves users time and frustration by quickly retrieving more relevant information than keyword-based searches.

The Conjunctive Exploratory Navigation Interface (CENI) **divides content into menus and allows data to be tagged into as many areas as relevant, providing a more focused search and delivering more pertinent information.**

Anonymous testers preferred the new system nearly two-to-one over a keyword-based interface and Google.

***Learn more at [engineering.case.edu/new-cyber-search](http://engineering.case.edu/new-cyber-search).***

# GROUNDBREAKING MAKING



## Case Western Reserve University highlighted at first National Maker Faire, think[box] expansion announced by White House

“Because the president likes it when you make stuff.”

The quirky comment from OK Go! band member Tim Nordwind when announcing the date—June 18, 2014—for the first-ever National Maker Faire and “Day of Making” pretty much sums up Case Western Reserve’s take on making, too. Actually, we love it.

Which is why the university was thrilled to get active in the celebration. Along with Carnegie Mellon University and eight other universities, **Case Western Reserve co-led an effort to bring together more than 150 leaders in higher**

**education to join President Obama’s initiative to help develop a “Nation of Makers”** by committing to a wide range of activities in support of makers on campus, from the opening of public makerspaces to the development of scholarships specifically for student makers.

On the day of the first annual National Maker Faire, Case School of Engineering Dean Jeffrey L. Duerk and Associate Dean for Strategic Initiatives Lisa Camp were invited to the White House to join other leaders of higher education and business.

At the same time, in Northeast Ohio, Case Western Reserve shared in the celebration of bringing

ideas to life with a Maker Open House on campus and participation in an online Google Hangout that brought together maker organizations and individuals across the region.

As part of the national event, the **White House released a statement sharing news that Case Western Reserve University will break ground in the fall of 2014 on the first phase of our expanded think[box] facility, a seven-story, 50,000-square-foot innovation hub designed to give visitors the space, technology and expert advice to imagine, prototype and transform their creations into actual products.**

Case Western Reserve’s initiative was among three

the administration highlighted; the others were at Carnegie Mellon University and the Massachusetts Institute of Technology.

Think[box]’s promise has been illustrated powerfully through a pilot effort, a 4,500-square-foot space featuring equipment ranging from 3-D printers and circuit-board routers to laser cutters, a 32-square-foot ShopBot and more.

Created to support ideas, innovation and design, the expanded think[box] will add meeting and workspace, manufacturing equipment and experts to help guide users. There will be floors for community outreach, collaboration, prototyping,

fabrication, project space, startup assistance—including business planning, intellectual property and legal advice—and a floor for incubating startup companies that develop both within and outside the university.

***Learn more about the National Day of Making and the think[box] expansion at [engineering.case.edu/National-Maker-Faire](http://engineering.case.edu/National-Maker-Faire).***



Rigoberto Advincula and  
Nicole Steinmetz

## NSF GRANT FOR NANOMANUFACTURING

Two engineering professors are collaborating on a research project to **scale up nanomanufacturing and assembly of plant-virus-based bio-nanoparticles, including higher-order structures.** Nicole F. Steinmetz, assistant professor of biomedical engineering, and Rigoberto Advincula, professor of macromolecular science and engineering, were awarded a grant from the nanomanufacturing program in the National Science Foundation's Division of Civil, Mechanical and Manufacturing Innovation, which funds nanoparticle research.

The team is experimenting with **industry-friendly methods to mass-produce two-sided Janus particles**—named for the Roman god of beginnings and transitions. Their complexity currently confines these tiny two-faced particles to the lab, but if they could be easily and economically reproduced in the outside world, they could have a number of applications in the pharmaceutical and electronics industries—from drug delivery to data storage.

## CASE WESTERN RESERVE PART OF NEW NATIONAL MANUFACTURING EFFORT FOR LIGHTWEIGHT METALS

A new federal manufacturing innovation hub focused on light metals was announced by President Barack Obama in February, with **Case Western Reserve providing faculty expertise and unique research resources.** This includes its Metals Processing Laboratory, which boasts a plethora of metalwork equipment like a 350-ton metal squeeze caster and magnesium-melting furnaces, and its array of alloy development and deformation processing facilities.

The **American Lightweight Materials Manufacturing Innovation Institute** will be located in Detroit, and is being led by the University of Michigan, the Ohio State University and EWI (formerly known as the Edison Welding Institute). The public-private institute, which includes more than 60 companies, universities and nonprofits from around the country, will **focus on the design and production of lightweight metals for future generations of cars, trucks, ships and airplanes.** The initiative could produce up to 10,000 new jobs over the next five years, mostly in Ohio and Michigan.

The new \$148-million research consortium, sponsored primarily by the Department of Defense, is the fourth national manufacturing innovation institute created by the Obama administration. The pilot institute is the additive manufacturing incubator America Makes, which launched in Youngstown last year and for which Case Western Reserve serves as a leader.

*Learn more at [engineering.case.edu/ALMMII](http://engineering.case.edu/ALMMII).*

## UNIVERSITY AND LINCOLN ELECTRIC LEAD AMERICA MAKES 3-D MANUFACTURING PROJECT

Case Western Reserve University, in alliance with the Lincoln Electric Co. and a group of business partners, has been selected to lead a project to **convert the laser hot-wire welding process developed by Lincoln Electric into a high-output, three-dimensional additive manufacturing process.**

Funding for the project comes from the second round of grants issued by America Makes, the National Additive Manufacturing Innovation Institute in Youngstown, which is spearheading next-generation manufacturing technologies based on 3-D printing and for which the university is a lead partner.

"The goal is to have an impact on commercial manufacturing as soon as possible," said James McGuffin-Cawley, chair of the university's Department of Materials Science and Engineering and one of the project leaders.

In this new process, metal parts are built up using a combination of wire-feed, laser melting and resistance heating to achieve a high degree of metallurgical control in concert with a high deposition rate. **The project will explore the adaptability of this process for building parts with titanium- and nickel-based alloys for aerospace and marine applications.**

*Learn more at [engineering.case.edu/Lincoln-Electric-3-D-manufacturing](http://engineering.case.edu/Lincoln-Electric-3-D-manufacturing).*

## REDEFINING HIGH-KNOWLEDGE MANUFACTURING

Case Western Reserve University is partnering with Rapid Prototype + Manufacturing (rp+m) to move the company's research and development arm to the university. **The new approach to university-industry relations will mingle rp+m employees with faculty researchers and students on campus to more rapidly develop new technologies in the growing additive manufacturing market.** The collaboration will also increase research opportunities, assist students in entrepreneurship, and boost regional economic development.

The company has moved eight pieces of 3-D additive manufacturing equipment into think[box], the high-tech invention center on campus. That triples the number of 3-D printers in think[box], and increases the breadth of materials that can be used, including bringing the first metal-printing machines to campus.

*Learn more at [engineering.case.edu/rpm-thinkbox](http://engineering.case.edu/rpm-thinkbox).*



# RACING TO HEAL

## Biomedical engineering researchers create artificial platelets that mimic natural homing ability

When damaged, blood vessels sound a biological alarm that calls the body's platelets to action. These tiny cells bind together—rallying to the injury site and forming clots to stop the bleeding. The process works fine for everyday nicks and cuts, but the body's natural healing power is overwhelmed in cases of traumatic injury or bleeding disorders like thrombocytopenia and hemophilia.

Biomedical researchers at Case Western Reserve University **won a five-year, \$1.9-million grant from the National Institutes of Health to develop injectable artificial platelets that mimic and**

**amplify the unique site-homing ability of their natural counterparts.**

Most artificial platelet research focuses on imitating platelet clustering—the way the cells stick to each other to form clots. Anirban Sen Gupta, an associate professor of biomedical engineering, is concentrating on the platelets' knack for finding and adhering selectively to the injury site itself first, before promoting clustering.

Without the site-selectivity, Sen Gupta says the clustering alone can create free-floating platelet clumps—which creates a risk for embolisms.

He will use the award to study how platelet adhesion and clustering work together for maximum performance.

His current artificial platelet is constructed from biocompatible molecules called lipids, which are used in several drug formulations already approved for cancer therapies. The surface coating is made of three kinds of peptides: two that promote injury site-selective "stickiness" under blood flow, and a third that causes platelet clustering. **In preliminary testing, this current design increased clotting effectiveness by**

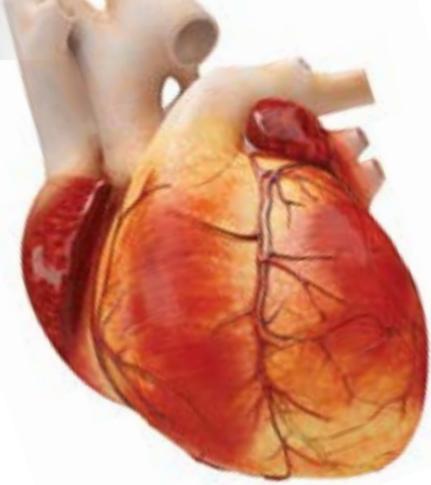
**70 percent.** The research group has filed a patent on the artificial platelet technology.

Sen Gupta, along with collaborators Keith McCrae in the Department of Hematologic Oncology and Blood Disorders at Cleveland Clinic, and Marvin Nieman, an assistant professor of pharmacology at Case Western Reserve School of Medicine, will use the grant to refine the design through additional testing in biologic models.

In addition to managing bleeding, the scientists believe the research could have other clinical applications by taking advantage of the site-

selective involvement of platelets in multiple diseases to design drug-delivery systems for targeted therapies.

***Learn more at [engineering.case.edu/NIH-platelet](http://engineering.case.edu/NIH-platelet).***



## ROBOTIC CATHETER NAVIGATES HEART IN REAL TIME

In atrial fibrillation, electrical misfires in the heart's upper chambers throw off the heart's rhythm, putting people at elevated risk for heart attacks and strokes. To treat the problem, doctors use catheters to travel the body's veins to reach the heart, and burn off faulty tissues to restore a steady heartbeat and blood flow. But a beating heart is a tricky target and flowing blood makes for a turbulent trip—doctors often have trouble maintaining contact with the target tissues and end up burning off too much or not enough.

Researchers at Case Western Reserve won a **\$1.3-million grant from the NIH to refine technology that could help doctors navigate through the heart's chambers in real time, improving treatment for atrial fibrillation.**

M. Cenk Cavusoglu, professor of electrical engineering and computer science, is developing a robotic catheter that is guided by the magnetic forces generated by MRI that lets clinicians see exactly where they are in the heart—and the tissues they're ablating—in real time.

His lab has also developed algorithms that automatically compensate for the contracting and expanding heart muscles and pulsing blood to keep the catheter on a steady course.

*Learn more at [engineering.case.edu/robotic-heart-catheter](http://engineering.case.edu/robotic-heart-catheter).*

## DEVICE RESTORES FUNCTION AFTER BRAIN INJURY

Researchers at Case Western Reserve University developed a microelectronic detour around brain injuries that reestablishes communication between neurons and restores function.

The prosthesis—called a brain-machine-brain-interface—built by Pedram Mohseni, associate professor of electrical engineering and computer science, **records signals from one part of the brain and transmits them to another, artificially connecting two brain regions by bridging the injury site.**

Mohseni and his team hope to develop the device into a commercially viable treatment for millions of Americans who've sustained neurological damage from either traumatic brain injuries or strokes.

*Learn more at [engineering.case.edu/neural-prosthesis](http://engineering.case.edu/neural-prosthesis).*

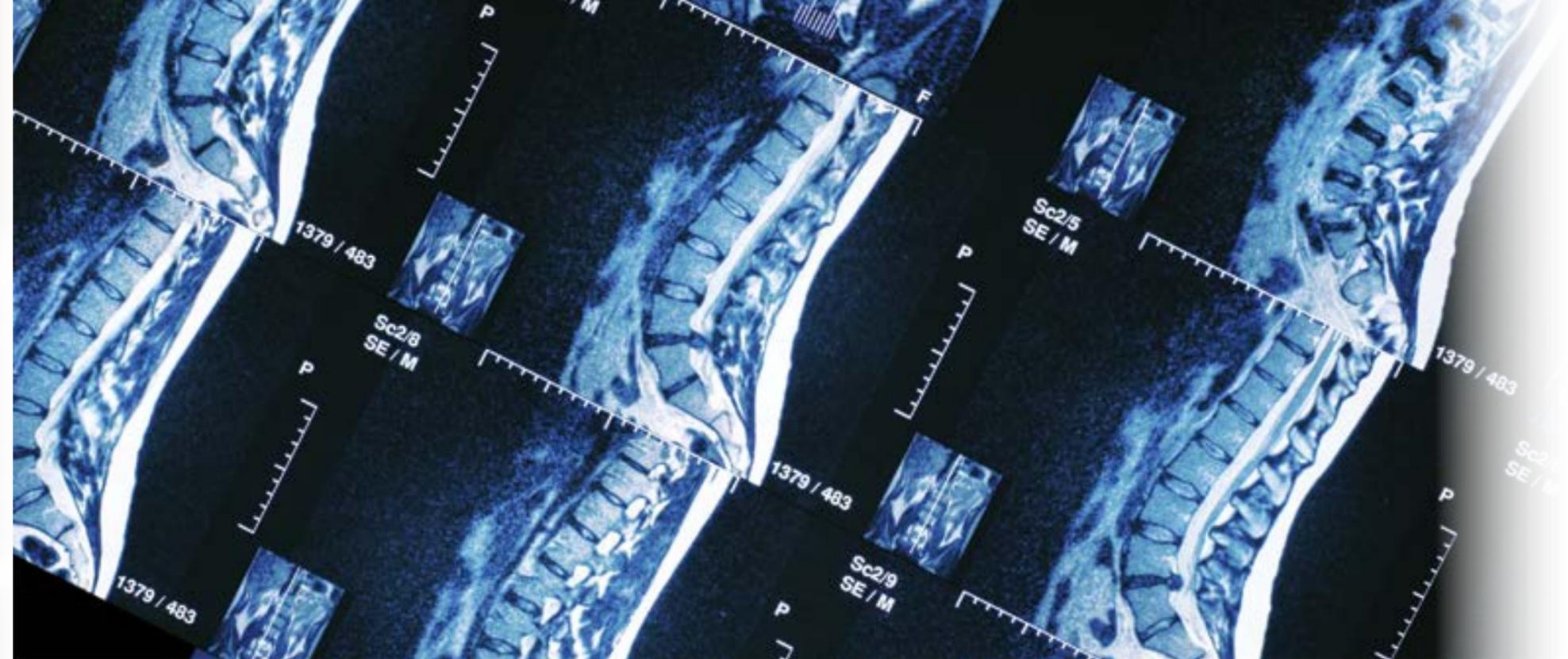
## RESEARCHERS DEVELOP TEST TO DETECT IMPENDING SICKLE CELL CRISIS BEFORE IT STARTS

In sickle cell disease, red blood cells change shape, morphing into sickles or crescents that stick on blood vessel walls or to each other and block the flow of healthy oxygen-carrying cells in the body's smallest blood vessels. This cellular traffic jam plunges the patient into an acute crisis—where oxygen starvation can kill tissues, causing severe pain and swelling in organs and joints.

A team of researchers from Case Western Reserve University **won funding from the Doris Duke Foundation to develop a test that could detect these changes in cellular shape and stickiness quickly**—before the painful episode starts—which could help prevent the crisis entirely and monitor patients more effectively.

Project leader Umut Gurkan, assistant professor of mechanical and aerospace engineering, and his team are trying to measure just how sticky cells have to become before they start to block blood flow. Once they've established this stickiness threshold, they will **design an at-home test that will provide information about the physical properties of red blood cells in minutes.**

*Learn more at [engineering.case.edu/Gurkan-Doris-Duke](http://engineering.case.edu/Gurkan-Doris-Duke).*



## NERVE CUFF TECHNOLOGY RESTORES MOVEMENT IN LOWER LIMBS

Stand up.

It sounds so simple, but the symphony of neurological signals that allow us to perform that one single task is mind-bogglingly complex. Each nerve in our body is actually several bundles of many nerve fibers called fascicles, each governing the intricate muscular movements of our hips, knees, ankles and more. This complexity is why restoring movements of multiple muscle groups after paralysis has been such a challenge for scientists.

A team of researchers at Case Western Reserve University and the Louis Stokes Cleveland Veterans Affairs Medical Center won a **\$2.6-million grant from the National Institutes of Health to develop nerve cuff technology that will allow people paralyzed by spinal cord injuries to stand and take steps.**

The high-resolution nerve cuff electrodes are fitted around the actual nerves themselves, and have multiple contact points for activating individual fascicles within the nerve. It's made from a very thin layer of biocompatible plastic, so it's flexible enough to bend and move with the nerve as the hips, knees or ankles bend and straighten.

Dustin Tyler, associate professor of biomedical engineering, and Ronald Triolo, professor of orthopaedics and biomedical engineering, are leading the effort. They will use the funding to put the device to the test in its first in-human clinical application. They will start by **implanting the device on femoral nerves to test its ability to activate different muscles that control hip and knee motion.** They'll use the same approach to control more complicated motions of the ankle and eventually, design a system for the sciatic nerve, which controls even more complex movements.

*Learn more at [engineering.case.edu/CWRU-VA-nerve-cuff-electrodes](http://engineering.case.edu/CWRU-VA-nerve-cuff-electrodes).*



# HIGHWAYS TO THE HEART

## New imaging technique gives doctors an unprecedented look at coronary stents

Each year, doctors deploy hundreds of thousands of stents in ischemic heart disease patients. These tiny mesh devices prop open clogged coronary arteries and keep blood flowing through these vital highways to the heart.

Treatment has come a long way since the first coronary stents were introduced in the mid-1980s, but a variety of factors—from blood clots forming at the site to persistent narrowing of arteries—still causes some stents to fail within the first year of implantation.

The problem? Once implanted, a stent is nearly impossible to monitor without hours of testing and analysis. A team of biomedical researchers at Case Western Reserve University and University Hospitals Case Medical Center **won a \$1.7-million grant from the National Institutes of Health to refine an imaging technique that will give clinicians a better look at the stents they place and help them identify arterial trouble spots in minutes.**

The system pairs intravascular Optical Coherence Tomography (OCT)—which uses infrared lasers to create 3-D images in the same way ultrasound

uses sound waves—with high-speed analysis software. The OCT captures as many as 500 images of each stent, while the tailored software analyzes every detail, looking for problems like plaque buildup, which could mean stents are at risk for rupture. While this kind of analysis would take a trained doctor anywhere from eight to 15 hours, the software can kick back answers in minutes. **This rapid response could allow cardiologists to optimize stent deployment during the implantation procedure itself or help identify problems quickly for patients during follow-up visits.**

The researchers leading the effort are David Wilson, the Robert J. Herbold Professor of biomedical engineering and radiology; Andrew Rollins, professor of biomedical engineering; and Hiram G. Bezerra, assistant professor of cardiology at Case Western Reserve School of Medicine and medical director of the Harrington Heart and Vascular Institute at University Hospitals Case Medical Center.

**The team's grant-winning proposal earned a perfect score of 10 out of 10 from the NIH reviewers—a rarity among the more than 50,000**

grant applications the NIH receives every year.

In addition to clinical applications, the technology could also be used to guide research and development of new stent designs.

***Learn more at [engineering.case.edu/NIH-artery-imaging](http://engineering.case.edu/NIH-artery-imaging).***



Erin Lavik

## CLOT-BUILDING NANOPARTICLES BOOST SURVIVAL RATE

The body's natural healing process can handle run-of-the-mill wounds, but it's no match for the devastation of blast trauma. Explosions account for 79 percent of combat-related injuries and are the leading cause of death on the battlefield. Even more challenging, victims of blast trauma are tough to treat far away from the resources of a hospital since most artificial blood products doctors use to staunch internal bleeding need to be refrigerated.

Biomedical researchers at Case Western Reserve University developed **clot-building nanoparticles that can be stored safely at room temperature. These polymer-based particles bind to the body's natural platelets—forming strong clots faster, which could help battlefield medics and other first responders save lives.**

In preclinical tests, the hemostatic nanoparticles developed by Erin Lavik, the Elmer Lincoln Lindseth Associate Professor of Biomedical Engineering, were injected into models of blast trauma, where they increased the survival rate to 95 percent, compared with 60 percent for the untreated models.

Furthermore, the nanoparticle-powered platelets dramatically increased survival rates without unwanted side effects like an accumulation of foreign matter, free-floating clots or aberrant healing.

***Learn more at [engineering.case.edu/clot-building-nanoparticles](https://engineering.case.edu/clot-building-nanoparticles).***

## FIGHTING FAILURE IN BRAIN IMPLANTS

Designed to destroy intruders, the immune system defends the body against disease, but it can also fight against devices meant to help. Medical implants like brain-computer interfaces use electrodes to connect patients to machines—using the technology to restore movement to paralyzed limbs, provide deep brain stimulation to eliminate the symptoms of Parkinson's disease or to record brain activity. When the body recognizes an electrode as a foreign object, the immune system's inflammatory response undermines the implant's effectiveness, and can even cause it to fail completely.

Biomedical researchers from Case Western Reserve won a **\$1.8 million grant from the National Institutes of Health to discover how to keep neurons healthy where electrodes connect to the brain's surface, paving the way for implants that function better and last longer.**

Brain cells sustain damage when an electrode is implanted, causing pro-inflammatory molecules to accumulate around the implant site, further damaging surrounding cells and compromising the device's ability to record high-quality signals—eventually leading to implant failure.

A research team led by assistant professor of biomedical engineering Jeffrey Capadona identified a class of proteins that coordinates immune cell recognition and the binding of damaged cells to blood serum proteins—part of the inflammatory response that interferes with implants. The team will use the grant to investigate whether inhibiting those proteins—either genetically or with an experimental drug—can limit damage and improve the longevity of many types of brain implants.

***Learn more at [engineering.case.edu/NIH-brain-implants](https://engineering.case.edu/NIH-brain-implants).***

## TRACKING EPILEPSY THROUGH THE BRAIN

Typically, signals buzz along from brain cell to brain cell, relying on an intricate traffic control system that regulates the activity. In diseases like epilepsy, the neurological traffic system malfunctions, and the resulting imbalance leads to electrical surges that cause debilitating—and even life-threatening—seizures.

Case Western Reserve researchers **discovered a new way epileptic activity moves through the brain, holding promise for new treatment avenues for the 65 million people around the world living with epilepsy.**

Dominique Durand, Distinguished Research Professor and the Elmer Lincoln Lindseth Professor of biomedical engineering, and his team tracked epileptic activity through several modes of cellular communication, and found that cells in the hippocampus use a small electrical field to stimulate and synchronize neighboring cells, spreading activity layer by layer through the brain.

The findings could point researchers to a new target for seizure-blocking medications—by inhibiting the electrical fields, clinicians might be able to halt seizures before they start.

***Learn more at [engineering.case.edu/epileptic-activity-spread](https://engineering.case.edu/epileptic-activity-spread).***

## GROWING REPLACEMENT TISSUE FOR TORN ROTATOR CUFFS

If a rotator cuff injury has put the top shelf out of reach, science might have the answer: a way to regrow new tendon tissue.

Ozan Akkus, professor of mechanical and aerospace engineering, won **funding from the NIH and NSF to test and refine his tendon-rebuilding technique, which reconstitutes collagen—the building block of tendons—into fibers tough enough to serve as scaffolds for growing new tendon tissue from adult stem cells.** Akkus' lab uses electrical currents to align and compact collagen molecules as threads, mimicking the natural tendon and making the threads as dense and as strong as those found in nature.

These heavy-duty threads alone could be used as sutures to repair simple tears. In more serious injuries where more tissue is needed, adult mesenchymal stem cells could be placed on the threads where they differentiate into new tendon cells.

***Learn more at [engineering.case.edu/replacement-rotator-cuffs](https://engineering.case.edu/replacement-rotator-cuffs).***



# ADVANCING ENERGY

## Three ARPA-E awards put CWRU among top five U.S. universities leading ARPA-E projects

Globalization may be making our planet feel smaller, but the world's energy demands have never been bigger.

Case Western Reserve University researchers won three awards this year from the U.S. Department of Energy's Advanced Research Projects Agency – Energy (ARPA-E), a federal funding body that supports energy-related projects that are near market-ready. These awards brought the university's total ARPA-E grants to four, **putting Case Western Reserve in elite company as one of the top five universities leading ARPA-E projects nationally.**

This year's awards include a grant to a team of researchers that developed a new **method for extracting titanium that is more efficient and could cut the cost of the metal by up to 60 percent.** Titanium's strength and unparalleled chemical stability make it a critical component in many aerospace, transportation and defense applications. But drawing the element out of its natural ore for use in products is energy-intensive—and costly. The electrowinning process developed by associate professor of chemical engineering Rohan Akolkar and his team directly extracts titanium from molten titanium salts,

which cuts out the most expensive step in the extraction process and significantly reduces the overall cost of production, making titanium attractive for applications requiring light-weight, high-strength materials.

The second award renewed ARPA-E funding to **create cost-efficient, green magnets for renewable energy technology like wind turbines and electric cars.** The \$1-million renewal grant will let principal investigator David Matthiesen, associate professor of materials science, and his team continue work on a more eco-friendly magnetic powder made from iron and nitrogen that costs about 80 percent

less than neodymium, the rare-earth element that's currently a key ingredient in the world's lightest, strongest magnets, which are in high demand for use in generators and motors.

The third award renewed ARPA-E funding to **refine an iron-and-water flow battery that could accelerate the addition of green energy sources into the grid.** The research team, which includes principal investigators Robert Savinell, Distinguished University Professor and the George S. Dively Professor of Engineering, and Jesse Wainright, associate research professor in chemical engineering, proved the concept's feasibility in the first round of

ARPA-E funding, and the \$1.5-million renewal grant will help the team develop a full prototype.

Previously funded ARPA-E initiatives at the university include a titanium capacitor that could power the next generation of electronic devices and a partnership with Univenture/Algae Venture Systems to co-investigate a project that developed technology to derive biofuel from algae.

***Learn more at [engineering.case.edu/ARPA-E-lead](http://engineering.case.edu/ARPA-E-lead).***



## LAB-GROWN NANODIAMONDS: JUST ADD PLASMA

Growing diamonds the natural way takes colossal pressure and volcanic heat—not to mention a couple billion years of wait-time. Researchers at Case Western Reserve University **developed a synthetic short cut that produces nanodiamonds in the environment of an everyday lab.**

The process holds promise for uses in a number of technologies and industrial applications, from ultrafine diamond powder coatings for advanced plastics to biomedical implants to drug-delivery devices.

Developed by R. Mohan Sankaran, professor of chemical engineering, the process forms nanodiamonds directly from a mixture of ethanol vapor and hydrogen gas. The secret ingredient? Plasma. Flowing the ethanol vapor through a stable microplasma releases the carbon in the vapor from surrounding molecules, yielding particles small enough to turn into diamond. A quick dose of hydrogen gas stabilizes the diamond particles' surface—resulting in nanodiamonds grown at atmospheric pressure and room temperature.

**Learn more at [engineering.case.edu/nanodiamonds](http://engineering.case.edu/nanodiamonds).**

## FLEXIBLE SUPERCAPACITOR COULD PROVIDE POWER ON THE GO

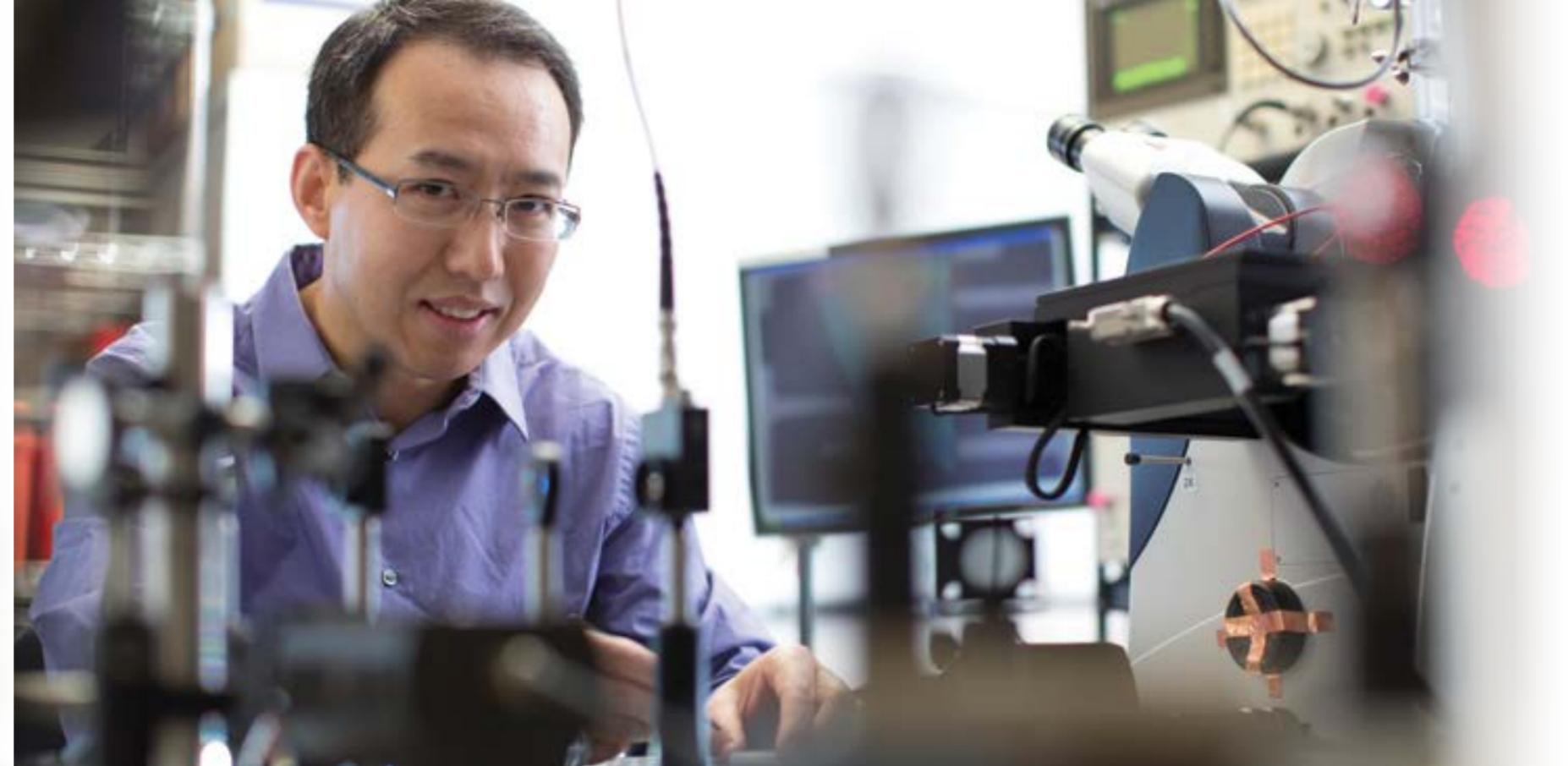
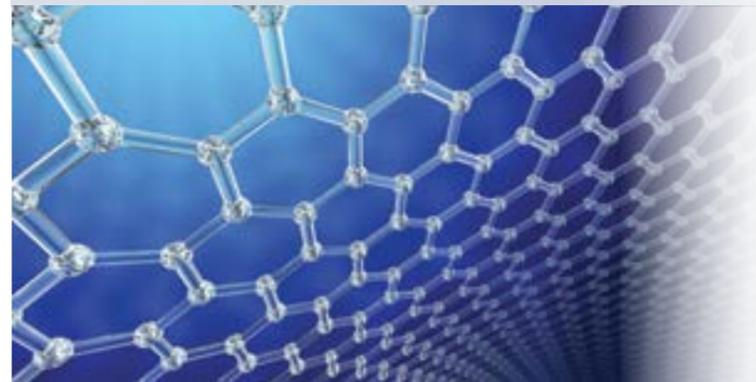
Scientists are closing in on an energy storage device that's more than just portable—it's wearable.

The fiber-like supercapacitor developed by an international team, including researchers at Case Western Reserve University, **could be woven into clothing to power medical implants or communications equipment.**

According to Liming Dai, the Kent Hale Smith Professor of macromolecular science and engineering at Case Western Reserve and co-author on the project, most supercapacitors pack a powerful punch, but don't last long; whereas their battery cousins last longer, but can't deliver a big boost of energy quickly.

The team's flexible supercapacitor could offer the best of both: high power density and high energy density. A flexible fiber made from a tightly packed network of graphene and carbon nanotubes, **the supercapacitor boasts the highest-reported energy storage capacity—or energy density—by volume for a device of its kind, rivaling some thin-film lithium batteries**, which typically dominate the market when it comes to storage capacity.

**Learn more at [engineering.case.edu/flexible-supercapacitor](http://engineering.case.edu/flexible-supercapacitor).**



## NANOSCALE SWITCHES HOLD PROMISE FOR ENERGY-EFFICIENT ELECTRONICS

Philip Feng

A new take on historic technology could power the next generation of electronic devices.

Researchers at Case Western Reserve University **built nanoscale electromechanical switches that operate more efficiently than the devices currently used by the billions in computers, tablets and smartphones.** And they took a page out of electronics history to do it—constructing a nanometer-sized version of the technology that dominated the electronics industry before the development of the solid-state transistor during the Second World War.

Philip Feng, assistant professor of electrical engineering and computer science, built the ultra-tiny switch from silicon carbide. Its only moving part is about one cubic micron in volume—more

than a thousand times smaller than the devices made in today's mainstream microelectromechanical systems (MEMS). Feng's switch is smaller and much lighter, so it can **flip faster than MEMS switches.** And since it only draws power when it's on, the switch **prevents energy-wasting current leakage, making it more energy-efficient than its transistor-based counterparts.**

Feng and his team reported their findings at the International Electron Devices Meeting in December 2013, and the work was featured in *IEEE Spectrum*, the flagship publication for the Institute of Electrical and Electronics Engineers (IEEE).

**Learn more at [engineering.case.edu/switches-IEDM-2013](http://engineering.case.edu/switches-IEDM-2013).**



## PROFESSOR AND ENGINEERING GRAD STUDENTS HELP MYANMAR STEER CURRICULUM INTO THE 21ST CENTURY

The streets of Yangon, Myanmar, are packed with cars, and a Mercedes-Benz dealership has opened. People carry smart phones and tablets. Yet electricity is sporadic and unreliable, and the city has open sewers.

The contrast of high and low tech as Myanmar reopens to the rest of the world was obvious to Case Western Reserve Master of Engineering and Management students, who traveled to the Southeast Asian country with Daniel Lacks, the C. Benson Branch Professor of Chemical Engineering, to **teach a class in engineering entrepreneurship—the first U.S. college course taught in the country’s history**, according to the U.S. State Department.

Lacks developed the class—called International Engineering Entrepreneurship—through the State Department’s Fulbright Specialist Program, after helping to train faculty at Myanmar’s Yangon Technological University. He was the first U.S. engineering professor involved in that effort.

The country, also known as Burma, is emerging from isolation after decades under a repressive political regime. Last year, it held its first

free, peaceful elections since the military government took control in the early 1960s, and has reopened universities that were shuttered after violent student protests. Decades of economic sanctions have been lifted, creating a dynamic atmosphere for new businesses and promoting cultural exchange.

Lacks first traveled to Myanmar to **assist in curriculum development at the newly reopened Yangon Technological University, one of the country’s top engineering schools**. He found an engineering program that didn’t have access to the latest technology and where students learned almost exclusively in lecture halls—logging nearly double the classroom hours of a standard U.S. program. So he developed the entrepreneurship class to bring an international perspective to the curriculum and break from Myanmar’s lecture-based educational traditions by incorporating more experiential learning, like opportunities for students to visit factories and companies to learn first-hand how they operate.

***Learn more at [engineering.case.edu/first-Myanmar-class](http://engineering.case.edu/first-Myanmar-class).***

## COLLABORATIVE CLASS STUDIES ENGINEERING IN ACTION IN INDIA

Problems don’t occur in a vacuum, and neither do their solutions.

To fully understand the engineering needs of a project and find solutions that will stand the test of time, context is crucial. With this in mind, the Case School of Engineering created a **new permanent course for undergraduates that combines engineering, social sciences and health communications with a travel experience to India**.

Global Issues, Health and Sustainability in India has students travel to South India over their winter break to observe the implementation of engineering projects, including infrastructure to support green energy and access to water. The course is designed to give them first-hand experience studying these issues within a cultural context.

Twenty students participated in the pilot course last year, which was so successful that the course was permanently added to the curriculum as an elective; the new class is on track to enroll 30 students.



## NEW DEGREE TRACK IN WEARABLE TECH

The latest trend in high-tech devices isn’t just something you carry, it’s something you wear. Case Western Reserve University is at the forefront of this movement with a new a master’s degree track in wireless health.

The nine-course, 27-credit-hour program, based in San Diego, gives students a chance to hone their expertise in multiple aspects of this growing industry. From design challenges, such as miniaturization and power delivery, to the supply chain and manufacturing processes, the **curriculum covers the gamut of building wearable technology and bringing new products to market**.

The program is the latest offering from Case Western Reserve in San Diego, which includes leading-edge graduate programs like a master’s degree track in wireless health, as well as graduate certificate programs in wireless health, wearable computing, health information technology and security in computing.

***Learn more at [engineering.case.edu/sandiego](http://engineering.case.edu/sandiego).***

## PARTNERSHIP WITH BRAZIL CREATES INTERNATIONAL OPPORTUNITIES

Soon, qualified **Brazilian students will be able to take graduate courses and earn advanced degrees in a variety of disciplines—including engineering—at Case Western Reserve’s campus**.

At the same time, university faculty and students will be able to pursue research collaborations and other projects in Brazil, thanks to an academic partnership the university launched with the South American country’s education agency.





## UNIVERSITY FORGES RESEARCH COMMERCIALIZATION PARTNERSHIP WITH INTWINE CONNECT

A new partnership between Case Western Reserve University and Intwine Connect LLC represents a fresh twist to how ideas developed by university researchers are brought to the commercial market.

As part of the agreement—which builds on an existing collaboration between the company and Kenneth A. Loparo, professor and chair of the Department of Electrical Engineering and Computer Science—**Intwine Connect is leasing lab and office space on campus. The company also employs graduate and post-graduate engineering students to help develop technology and analyze potential new business markets.**

“Technology transfer offices nationally are trying to be more creative in how to engage industry partners,” said Michael Haag, Case Western Reserve’s executive director of technology management. “What we’re really trying to do is grow a Case Western Reserve-centric enterprise.”

Intwine Connect, based in the Cleveland suburb of Chagrin Falls, develops hardware, software and services that allow consumers and businesses to monitor and manage electronics, energy use and indoor air quality through their Internet-connected devices.

“Our strong partnership with Intwine provides a unique opportunity for faculty and students to experience innovation in a new product development setting, and to learn first-hand that it’s often not just about the technology,” Loparo said. “In fact, the technology is often the easy part, and the more difficult part is managing expectations across a diverse university/industry team and the integration of the technology in a meaningful way to solve a real-world problem.”

Haag said he expects the Technology Transfer Office to use the Intwine Connect arrangement as a **template for similar alliances that allow business and industry to tap into the technology, innovation and bright young minds at the university.**

***Learn more at [engineering.case.edu/Intwine-Connect-partnership](http://engineering.case.edu/Intwine-Connect-partnership).***

## CARDIOINSIGHT RAISES \$15 MILLION TO HELP GET PRODUCT TO U.S. MARKET

CardioInsight Technologies, a spin-off company based on technology developed at Case Western Reserve, has raised \$15 million as part of a long-term financing deal to complete ongoing multi-center clinical studies in Europe and get U.S. market clearance for its noninvasive cardiac mapping product.

The company’s “EKG vest,” developed with assistance from Nottingham Spirk, generates high-resolution 3-D images of the heart’s electrical activity to improve the diagnosis of electrical disorders of the heart.

***Learn more at [cardioinsight.com](http://cardioinsight.com).***



## CWRU GRANTS EXCLUSIVE LICENSE TO FOLIO PHOTONICS

Folio Photonics LLC, a startup company spun off from research in the Center for Layered Polymer Systems (CLiPS) at Case Western Reserve University, received an exclusive license from the university to commercialize products for a large and evolving archival optical data storage market.

Folio Photonics is **developing an optical data storage disc with terabyte scale capacity.** The company’s initial focus is to increase storage and access to archival data, a vital need for cloud storage, business and government.

***Learn more at [engineering.case.edu/Folio-Photonics-license](http://engineering.case.edu/Folio-Photonics-license).***

## TECHNOLOGY TRANSFER STATS: 2013-14

In FY2014, Case School of Engineering faculty contributed to:

- **90 invention disclosures**—4.6 times the national per-dollar proficiency average\*
- **124 patent filings**—9.8 times the national per-dollar proficiency average\*
- **26 deals** (options and non-exclusive and exclusive licenses)—4.9 times the national per-dollar proficiency average\*
- **3 startups**—3.6 times the national per-dollar proficiency average\*

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



### SPINOFF COMPANY AFFINITY THERAPEUTICS WINS NIH AWARD, EARNING PERFECT SCORE ON PROPOSAL

Researchers at Affinity Therapeutics, a Case Western Reserve University spinoff whose **technology allows the release of drug therapy to be customized and better controlled**, recently received another round of federal funding, through the **National Institutes of Health Small Business Innovation Research (SBIR) award**.

Affinity Therapeutics received a SHIFT (Small Businesses Helping Investigators to Fuel the Translation of Scientific Discoveries) award, marking the second time the biotech company has earned one, and the third time since 2011 that the NIH or NSF has funded the company's work.

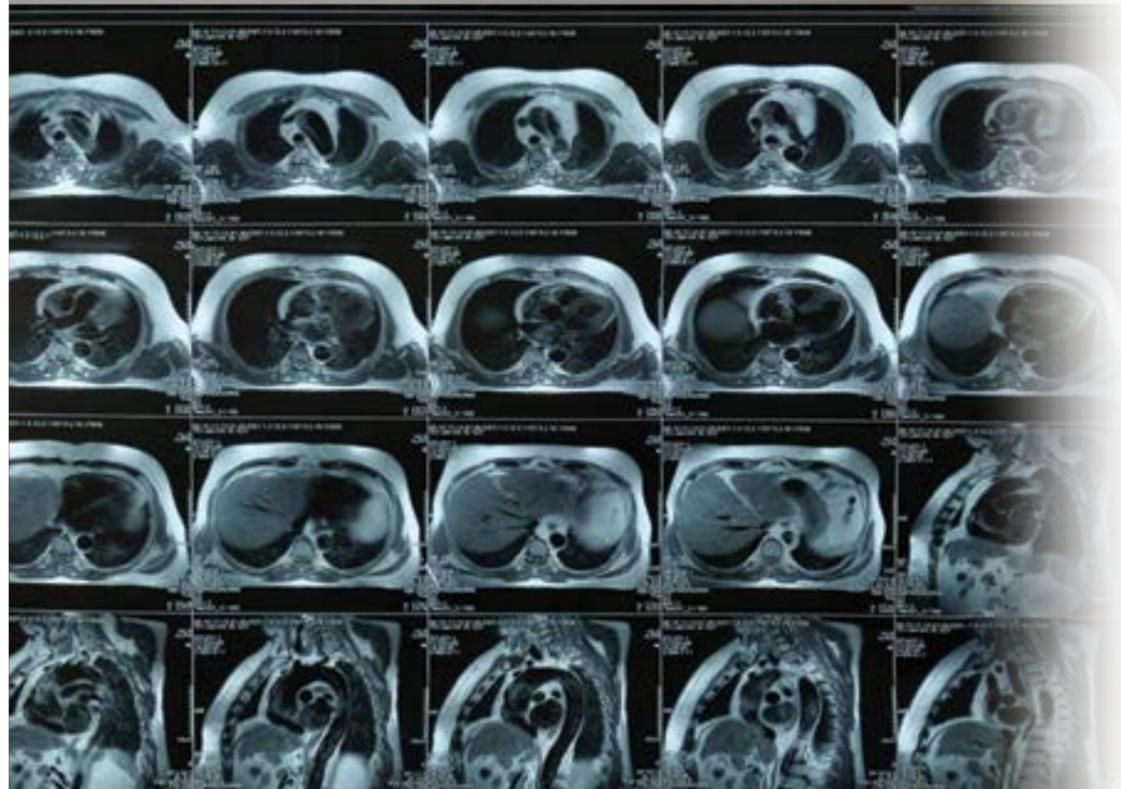
*For more information, visit [affinitytherapeutics.com](http://affinitytherapeutics.com).*

### CWRU HOSTS MEDICAL IMAGING TECH FORUM

Technology managers at companies and research institutions got a chance to express their visions for medical imaging when the **Association of University Technology Managers (AUTM) brought its inaugural partnering forum to Cleveland in collaboration with Case Western Reserve University's Technology Transfer Office** on April 24, 2014.

More than 30 institutions—including GE Healthcare, Philips, Siemens and Toshiba—participated in the full day of business development activities, which was held at the new Global Center for Health Innovation, part of the recently redesigned Cleveland Convention Center.

The medical imaging industry partnering forum included exhibits, panel discussions and time for one-on-one meetings. The aim of AUTM's new partnering forum series is to build industry partnerships necessary to advance technology more quickly for commercial use.



### EXCLUSIVE LICENSE GRANTED TO COMPADRE; AEROCLAY LLC IS FORMED

Compadre, a company best known for transit packaging solutions, has obtained an exclusive license to pursue commercial uses for AeroClay, an innovative technology developed in a Case Western Reserve University materials lab.

About two years ago, executives of Compadre, a privately held company based in Austin, Texas, became fascinated with the research of David Schiraldi, professor and chair of the Department of Macromolecular Science and Engineering. Schiraldi and his lab developed AeroClay—the trademarked name for an array of lightweight, durable and environmentally friendly aerogel materials.

**AeroClay technology uses freeze-drying and polymer additives to turn clay into a versatile material that is sturdy, malleable, heat- and flame-resistant and eco-friendly.** It can be used as an absorbent, insulator, packing material, industrial catalyst, or even as an electrical conductor.

The transformational license significantly advances the technology from its initial startup phase. **AeroClay LLC will be a subsidiary of Compadre. The agreement allows AeroClay products to be marketed more quickly and efficiently.**

Compadre is exploring the potential of a new type of packaging and protection for containers or devices containing hazardous materials by using a durable AeroClay material that also acts as a fire retardant.

Although AeroClay will be part of Compadre in Austin, Schiraldi's lab will have a role in the research and development of AeroClay products.

*Learn more at [engineering.case.edu/AeroClay-Compadre](http://engineering.case.edu/AeroClay-Compadre).*



## STUDENT-RUN COMPANIES SHOW OFF BRIGHT IDEAS AT INTERNATIONAL CONSUMER ELECTRONICS SHOW IN LAS VEGAS

Most college students spend their winter breaks catching up on laundry. A group of student entrepreneurs from Case Western Reserve University spent theirs preparing to fly cross-country to showcase their companies at one of the biggest trade shows in the world.

Held every year in Las Vegas, the International Consumer Electronics Show (CES) is the Christmas morning of the high-tech world—where the industry's biggest names unveil their buzz-worthy offerings. **Student-run companies from Case Western Reserve displayed their products alongside tech's elite**—rubbing elbows with the likes of Apple, Intel, GoPro and Samsung—showcasing their ideas to more than 150,000 show attendees, including potential partners and investors.

The young entrepreneurs were located in a new section of the CES exhibit hall dedicated to higher education called the Academia Tech Zone, and the Case Western Reserve booths were dominated by students and student-made products.

**Many of the student entrepreneurs used the resources in think[box], the university's innovation center, to create their projects, and received guidance on business development from Blackstone LaunchPad, a campus entrepreneurship assistance program.**

The Case Western Reserve companies on display included Carbon Origins, which designs reusable suborbital rockets; Disease Diagnostic Group LLC, which developed a hand-held malaria detection device; EcoSpinners, which is producing a fuel-cell-powered electric bike; EveryKey, which created a wireless wristband that can unlock phones, bike locks or other personal property; Sprav Water LLC, which developed a smart water meter for showers; and Widdle, an app that cleans up social networks.

**Learn more at [engineering.case.edu/CES-2014](http://engineering.case.edu/CES-2014).**

## ENGINEERING A BETTER NEIGHBORHOOD

A group of chemical engineering students helped bring a splash of color and life to a neighborhood dotted with abandoned buildings and empty land by **transforming a vacant lot in East Cleveland into a community garden.**

**Five Case Western Reserve University seniors used their capstone project to build the garden.**

They tested the soil, obtained permits, raised money, and installed raised beds, benches, a fence and a slow-drip irrigation system.

**Learn more at [engineering.case.edu/chemical-engineering-garden](http://engineering.case.edu/chemical-engineering-garden).**



## ON THE FAST TRACK

One gear, no freewheel and no brakes: track bikes are specially designed for riders to whip around the steeply banked curves of a track. **A team of mechanical engineering students from Case Western Reserve constructed a race-ready machine for one local cyclist to put to the test.**

For their senior project, the students designed and built the bike—sizing the frame to fit the rider and analyzing frame designs for maximum speed and safety—for Ryan Pierce, a Case Western Reserve alumnus and employee, and a competitive track cyclist and coach of the Case Cycling Club. Pierce rode the student-built bike in the Ohio State Track Championship at the Cleveland Velodrome in June, where he medaled in three events. After the contest, the bike was donated to the Case Cycling Club.

Support for this project came from the William Armbruster Endowment Fund, created to assist mechanical and aerospace engineering student projects.

## HACKERS <3 CWRU

What do you get when you mix student programmers with a pile of pizzas and a couple cases of Red Bull? Some first-rate computer wizardry at **Case Western Reserve University's first-ever hackathon.**

HackCWRU brought a crowd of coders together in March for a weekend of open computer creativity—inviting them to program or build any project in any language, with no rubrics, rules, requirements or hassle. Prize-winning projects included a student who hacked his dorm lock to allow him entry through his phone, an app that automatically adjusts a cell phone's ringer volume and a twitter crawler that helps users follow trending news by geographic region.

## STUDENT WINS BEST PAPER AT IEEE CONFERENCE

Jaesung Lee, a PhD student in the Department of Electrical Engineering and Computer Science at Case Western Reserve University, won the Best Student Paper Award at the 2014 Institute of Electrical and Electronics Engineers International Frequency Control Symposium.



CWRU alumnus and employee Ryan Pierce, second rider from the left

## HIGH-FASHION MEETS HIGH-TECH

Technology worked it on the runway this spring as **three Case Western Reserve engineering students teamed up with students from the Cleveland Institute of Art to weave cutting-edge tech into avant-garde fashion for an art exhibit and competition at Cleveland's Museum of Contemporary Art.**

"In the Dark" featured the students' illuminated designs, which incorporated LED lighting triggered by the wearer's biometrics and movements.



## ENGINEERING STUDENTS TAKE ON CHAINLESS CHALLENGE

A team of **engineering undergraduates tackled Parker Hannifin's Chainless Challenge this spring**—the first team from Case Western Reserve to enter the contest. The challenge has participants build a bike in which the pedaling power is transmitted to the wheel using fluid power instead of chains.

The Case Western Reserve team, which consisted of mechanical engineering students Kate Schmitmeyer, David Takahashi and Christopher Fann, finished strong in a number of categories, including **ranking in the top two-to-four spots out of nine teams in Manufacturability and Workmanship, Best Design and the second-best time overall.**

## STUDENT-CREATED APP

For some students, an assignment ends when the final grade is submitted. For Allison Kipling, the assignment was just the start—**the second-year student in Case Western Reserve University's master's degree track in translational health technology launched a company along with her classmates to take what started as a class project into the medical marketplace.**

Kipling and classmates Vickie Hau and Ming Wang developed the original model for their Imprint app as part of their Clinical Information Systems class. The app creates digital study guides that medical students and doctors can use to review for exams or medical procedures. The team drafted a business plan that won them first place in the Brien Holden Vision Competition—and a \$10,000 prize that they used to launch 306 LLC, named for the classroom where the project first started.

***Learn more at [engineering.case.edu/Kipling-translational-health-company](http://engineering.case.edu/Kipling-translational-health-company).***

## A SOLAR SOLUTION

A family in the village of Mmanoko in Botswana has access to safe, renewable electric power thanks to the efforts of engineering students from Case Western Reserve University and the University of Botswana.

The prohibitively high cost of running power lines to remote villages has left 85 percent of Botswana's rural households without access to electricity. As part of a National Science Foundation-funded research initiative that addresses sustainability issues in the region, **students installed a 100-watt solar electrical system in a one-room hut shared by a single mother and her three children.** The system will allow the family to light their home, charge their cell phone, and perhaps one day even watch TV.

Joe Toth, a senior chemical engineering major at Case Western Reserve, designed the system, and he and his fellow students in the research program teamed up for the installation.

***Learn more at [engineering.case.edu/Botswana-solar-installation](http://engineering.case.edu/Botswana-solar-installation).***



## SMART SHOWER METER WINS OHIO CLEAN ENERGY CHALLENGE

The average shower blasts out more than two gallons per minute, which means homeowners can watch a lot of money in wasted water go down the drain fast. **Case Western Reserve engineering students designed a device that promises smarter, more eco-friendly showers, and their idea earned them the top prize at this year's Ohio Clean Energy Challenge.**

The Sprav shower meter—created by engineering students Craig Lewis and CJ Valle—clips onto your showerhead and measures water temperature and use, then wirelessly transmits that data to your smartphone or tablet, warning you when too much water is being used. The student entrepreneurs say the device could help consumers cut shower costs by as much as 20 percent.

The team plans to put the \$10,000 prize toward intellectual property protection and beta testing the product. The state-level win secured them a spot in the regional contest, hosted by the Clean Energy Trust, in Chicago in April. They were named the runner-up team for the Midwest, which earned them a chance to travel to the national competition in Washington, D.C., in June where they networked with green technology investors.

The Ohio Clean Energy challenge is part of the Department of Energy's National Clean Energy Business Plan Competition. **Case Western Reserve students, supported by the university's Great Lakes Energy Institute and campus entrepreneurship program Blackstone LaunchPad, dominated the field of competitors this year—the university was represented by six of the 10 teams that made the semi-finals.**

Other Case Western Reserve teams included:

- **Carbon Origins** – developing reusable suborbital rockets to carry scientific and engineering payloads to space
- **Brisa** – developing a solar-powered air conditioner
- **EcoSpinners** – building a commercially viable fuel-cell-powered bike
- **FGC Plasma Solutions** – integrating plasma-assisted combustion topology with a jet engine fuel nozzle to improve fuel economy and safety
- **Transtorage** – networking car batteries to turn parking lots into energy storage devices

***Learn more at [engineering.case.edu/Sprav-Ohio-Clean-Energy-Challenge](http://engineering.case.edu/Sprav-Ohio-Clean-Energy-Challenge).***



Kenneth A. Loparo (left) and Robert F. Kirsch (right)

## CHAIRS APPOINTED FOR BIOMEDICAL ENGINEERING AND ELECTRICAL ENGINEERING AND COMPUTER SCIENCE DEPARTMENTS

Case Western Reserve University appointed **Robert F. Kirsch chair of the Department of Biomedical Engineering** and **Kenneth A. Loparo chair of the Department of Electrical Engineering and Computer Science**.

Kirsch and Loparo are both prolific researchers, proven leaders among their peers and consistently highly regarded in annual student reviews.

**The two lead the engineering school's largest departments.** The electrical engineering and computer science department was established from three departments and continues to offer four different undergraduate and graduate degree programs. Biomedical engineering is a joint department between the Case School of Engineering and the School of Medicine, with faculty appointed from each.

Kirsch has earned an international reputation in the field of rehabilitation and functional neural restoration. He is director of the Functional Electrical Stimulation Center at the Louis Stokes Cleveland Veterans Affairs Medical Center and has won major awards in new methods to connect the brain to paralyzed or prosthetic limbs and restore movement and control.

Loparo is a fellow of the IEEE and his research in systems and control engineering spans all aspects of the department, with applications to energy, health care and more. Loparo has been chair of the former systems engineering department, associate dean of engineering, chair of the faculty senate and president of the Case Alumni Association. He is also a sought-after consultant to national companies.

## WATERFALL SWING MAKES SPLASH IN AUSTRIA

Engineering met art in the Waterfall Swing that was on display for a five-month exhibition at the OK Center for Contemporary Art in Linz, Austria.

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.

The team of designers behind the swing includes think[box] manager and Case Western Reserve University alumnus Ian Charnas; fellow alumni Mike O'Toole and Andrew Witte—who is the chief engineer of the Pebble smart watch; and Andrew Ratcliff.

The swing has been featured around the world, including installations at Cleveland's IngenuityFest, a guest spot on the TODAY Show, in a Honda commercial and at events for Swatch and RayBan. Next up, the Waterfall Swing will travel to Paris and then Australia.



## GLOBAL AND ACCOMPLISHED: THE CLASS OF 2017

The first-year students who arrived on campus at Case Western Reserve University in the fall of 2013 **boast the strongest academic credentials of any entering class in the university's history**.

The Class of 2017 hails from 893 high schools, 45 states and 18 countries. Nearly 75 percent come from outside Ohio, while almost 12 percent are from outside the United States. The class is so global that the list of top 10 hometowns is led by Beijing, with Shanghai and Seoul, South Korea, also making the list.





## ENGINEERING GRADUATE PROGRAMS NAMED AMONG BEST IN NATION BY GRADUATEPROGRAMS.COM

Case Western Reserve earned top spots in GraduatePrograms.com's lists of the country's best graduate school programs.

**The university was named the No. 2 engineering school in the country, as well as garnering the No. 2 spots for both career support and academic competitiveness.**

GraduatePrograms.com compiled and analyzed more than 40,000 ratings posted on the site by graduate students attending more than 1,200 different programs across the country to develop its lists.

## ENHANCED SERVICES AND NEW NAME: THE DIVISION OF ENGINEERING LEADERSHIP AND PROFESSIONAL PRACTICE

The school's office for student engagement, hands-on learning and out-of-the-classroom training received a name change prior to the start of the fall semester. Formerly known as the Division of Education and Student Programs, the office now holds the moniker the Division of Engineering Leadership and Professional Practice.

The change better reflects the office's goal to help turn students not just into highly capable engineers, but engineering leaders. Housed within the division are student programs such as engineering-focused study abroad opportunities, internships, co-ops and student organizations.

**"The new name really puts the emphasis on our focus on students and career preparation,"** said Gary Wnek, associate dean for academics.

With the updated name, the division is streamlining services with the staff of the Master of Engineering and Management program to increase the breadth of companies and institutions engaged for co-ops, internships and other real-world learning opportunities. "There's a strong overlap in missions between the two offices," said Wnek. "It's all about getting young engineers ready for the world, so it makes sense to leverage resources so we can do more for our students."

The division is also poised to offer more mentoring, coaching and preparation for multiple industry experiences, so students can hone their leadership skills to go further in their careers.

***Learn more at [engineering.case.edu/delpp](http://engineering.case.edu/delpp).***



## UNIVERSITY MAKES STRIDES IN U.S. NEWS & WORLD REPORT ENGINEERING RANKINGS

When *U.S. News & World Report* issued its 2014 undergraduate education program rankings in the fall of 2013, **Case Western Reserve University saw a move up nine spots in the category of undergraduate engineering education**—from No. 44 to No. 35. The leap was an unprecedented year-over-year improvement for the Case School of Engineering.

And the move up the rankings ladder didn't end there. The news outlet issued its 2015 best graduate school rankings in the spring of 2014, and **Case Western Reserve's graduate engineering program saw one of the largest climbs, moving up five spots to 46th nationwide.**

The intensity of the competition in this area is evident in that the school was one of seven tied for that ranking (the others were Brown, Iowa State, New York University, Northeastern, Notre Dame and Washington University in St. Louis). The school improved its figures

for school assessment, average quantitative GRE score, faculty membership in the National Academy of Engineering, and overall research funding, as well as research funding per faculty member.

In 2010, the university and school collaborated on a strategic hiring initiative that focused on recruiting new faculty in key areas of strength and opportunity. Out of more than 400 applicants, the school appointed 11 in such areas as advanced materials, energy and human health.

"The *U.S. News* rankings reflect the achievements we have been able to make by drawing on the intellect and inventiveness of existing and new faculty, increasing focus on industry needs and new funding opportunities, and impressive engagement of our alumni and other stakeholders," Dean Jeffrey L. Duerk said.



The new Tinkham Veale University Center

## CASE SCHOOL OF ENGINEERING HITS CAMPAIGN GOAL EARLY AND SETS FUNDRAISING RECORD FOR THIRD CONSECUTIVE YEAR

The Case School of Engineering broke its all-time fundraising record for a third year in a row in 2013-2014—and the **\$32.8 million committed allowed the school to reach its \$170-million campaign goal two-and-a-half years ahead of schedule.**

Case Western Reserve University launched the public phase of its \$1-billion capital campaign, Forward Thinking, in October 2011 aimed to increase financial support for students, grow the number of endowed professorships and support significant capital projects.

Generous support from alumni and friends allowed the Case School of Engineering to top last year's record-setting fundraising total by more than \$1 million. This included **4,446 total gifts from a diverse group of donors, including alumni, friends, corporations and foundations.** Highlights of individual alumni philanthropy included gifts of more than \$2 million to support the university's think[box] innovation center and new academic programs in data science, as well as hundreds of thousands of dollars toward lab renovations.

The State of Ohio also showed support for think[box] by committing \$1 million in its capital budget to fund moving the innovation center into its permanent space.

The **annual fund received support from approximately 2,971 donors,** which helped fund scholarships and fellowships to attract the best and brightest students, as well as provide vital support for infrastructure and new programs to keep the school on the cutting edge.

Not only has the engineering school reached its overall campaign goal early, so has Case Western Reserve as a whole. In August 2014, at the grand opening of the Tinkham Veale University Center, named in honor of engineering alumnus Tinkham Veale, the university announced it had raised more than \$1.04 billion in total gifts and pledges. This inspired **Case Western Reserve to expand the five-year Forward Thinking campaign goal to \$1.5 billion. The Case School of Engineering now seeks to raise at least \$300 million** to further advance education and strategic hiring at the school.

## ALUMNI HELP MOVE THINK[BOX] TOWARD ITS NEW HOME

Major gifts from two prominent engineering alumni will help make Case Western Reserve University's innovation center, think[box], one of the largest campus-based invention centers in the country.

In 2010, **Barry Romich, a 1967 biomedical engineering grad, made a \$1-million commitment to establish the first iteration of think[box].** Romich was so impressed with think[box]'s early performance—drawing more than 60,000 visitors since it opened its doors in 2012 and spawning numerous student startups—that this year, **he made a second \$1 million gift.**

Inspired by think[box]'s entrepreneurial activities, Cloud L. "Bud" Cray, a 1943 chemical engineering graduate, made a **\$2-million commitment to think[box] to create the Cloud Cray (CIT '43) and Sally Hunter Cray (FSM '45) Center for Innovation and Entrepreneurship.**

The first phase of renovations that will start to move think[box] into its permanent, 50,000-square-foot location begin in October 2014.

***Learn more at [thinkbox.case.edu](http://thinkbox.case.edu).***



## BIG NEWS FOR STUDYING BIG DATA

This year, a big name in technology—and a dual Case Western Reserve University alumnus—created an endowed professorship that will help prepare students to be leaders in the rapidly growing field of data analytics.

**Bob Herbold, chief operating officer of Microsoft during its period of greatest growth, committed \$2.6 million to endow the Robert J. Herbold Professor of Informatics and Analytics at the Case School of Engineering.**

"The unprecedented amount of information available today demands far more sophisticated approaches to analysis and execution," Herbold said. "Case Western Reserve's historic strengths give the university a unique advantage in preparing students to seize these emerging opportunities."

***Learn more about Case Western Reserve's data science programs on page 6.***

## LAB UPGRADES FOR CHEMICAL AND CIVIL ENGINEERING

Chemical and civil engineering students will be putting their engineering skills to work in new lab facilities thanks to the generous support of alumni donors.

**Chemical engineering alumnus Bill James and his wife Mary Jane made the lead gift that launched the renovation and upgrade of the James Family Undergraduate Design and Control Laboratory.** James earned his bachelor's degree in chemical engineering in 1967 before launching his 37-year career at Procter & Gamble.

**Funded by James' initial gift and other alumni donations—including 1951 Case Institute of Technology chemical engineering graduate James Kauer and his wife Elisabeth—this 1,500-square-foot facility will serve as state-of-the-art teaching and design space for students.** At least three formal classes will use the space, and students will also have access to it for work on other special design projects. The lab was unveiled in the fall of 2014.

**The Department of Civil Engineering's geotechnical lab also got an upgrade, thanks to a gift from the Rollin M. Gerstacker Foundation, along with a lead gift from civil engineering professor Adel S. Saada, that funded renovation of the space and named the lab in honor of alumnus and philanthropist Frank Gerace.**

Gerace graduated with a degree in civil engineering in 1948 and went on to a successful career in the construction industry. Renovations to the new Francis Edward Gerace Geotechnical Laboratory are underway and are expected to be completed by early 2015.

## HONORS &amp; AWARDS



From left to right: Basilion, Triolo, Lavik, Lu and Akkus

Five Case Western Reserve University faculty members have been **inducted into the 2014 class of the prestigious American Institute for Medical and Biological Engineering (AIMBE)'s College of Fellows**. This year's inductees include **Ozan Akkus**, professor of mechanical and aerospace engineering, **James P. Basilion**, professor of biomedical engineering and professor of radiology, **Erin Lavik**, the Elmer Lincoln Lindseth Associate Professor in Biomedical Engineering, **Zheng-Rong Lu**, the M. Frank and Margaret Domiter Rudy Professor of Biomedical Engineering, and **Ronald Triolo**, professor of orthopaedics and biomedical engineering.

**Alexis Abramson**, professor in the Department of Mechanical and Aerospace Engineering and faculty director of the university's Great Lakes Energy Institute, graduated from Drexel University's yearlong Executive Leadership in Academic Technology and Engineering program (**ELATE at Drexel**).

**Maurice Adams**, professor of mechanical and aerospace engineering, won the **Jack Frarey Memorial Award for Excellence** from the Vibration Institute in recognition of his contributions to the field of rotor dynamics.

**Rigoberto C. Advincula**, professor of macromolecular science and engineering, received the **Herman Mark Scholars Award** from the American Chemical Society's Polymer Chemistry Division for his accomplishments in the field of polymer science.

**Eben Alsberg**, associate professor of biomedical engineering, was awarded a fellowship from the **Lady Davis Fellowship Trust** at the Technion-Israel Institute of Technology.

**Eric Baer**, Distinguished University Professor and the Herbert Henry Dow Professor of Science and Engineering in the Department of Macromolecular Science and Engineering, was awarded the **Paul J. Flory Polymer Research Prize** at the 22nd World Forum on Advanced Materials (POLYCHAR 22) and presented the event's keynote address.

Timothy E. and Allison L. Schroeder Associate Professor in Computer Science and Engineering **Swarup Bhunia** was awarded a **2013 IBM Faculty Award**.

The Minerals, Metals and Materials Society (TMS) named **Jennifer Carter**, assistant professor of materials science and engineering, as one of 28 recipients of the **2014 TMS Young Leader Professional Development Award**.

**Philip Feng**, assistant professor in the Department of Electrical Engineering and Computer Science, was one of 81 of the nation's brightest young engineers selected to participate in the **National Academy of Engineering's 2013 U.S. Frontiers of Engineering (FOE) Symposium**. Feng also received a **Grainger Foundation Frontiers of Engineering Grant** from the NAE to support a research project that emerged from attending the event.

**Umut Gurkan**, assistant professor of mechanical and aerospace engineering, was named the **founding associate editor of *Nanobiomedicine***.

**Daniel Lacks**, the C. Benson Branch Professor of Chemical Engineering, was appointed **associate editor of the *Journal of Electrostatics***.

**Erin Lavik**, the Elmer Lincoln Lindseth Associate Professor in Biomedical Engineering, was named an **associate editor of the American Chemical Society journal, *Bioconjugate Chemistry***.

**John J. Lewandowski**, the Arthur P. Armington Professor of Engineering II in the Department of Materials Science and Engineering, received the **2014 Leadership Award from the Minerals, Metals and Materials Society (TMS)**.

**Anant Madabhushi**, professor of biomedical engineering and director of the Center for Computational Imaging and Personalized Diagnostics, has been appointed as **associate editor for both the *Journal of Medical Imaging* and IEEE's *Journal of Translational Engineering in Health and Medicine*.**

Professor of electrical engineering and computer science **Wyatt Newman** was appointed as the **Hung Hing Ying Distinguished Visiting Professor** in Science and Engineering at the University of Hong Kong.

**Michael Pollino**, assistant professor of civil engineering, has been named the **American Institute of Steel Construction Milek Fellow** for 2014.

**Clare Rimnac**, associate dean of research and the Wilbert J. Austin Professor of Engineering, was elected to the **Board of Directors of the American Society for Engineering Education (ASEE) Engineering Research Council**.

**Robert Savinell**, Distinguished University Professor and the George S. Dively Professor of Engineering in the Department of Chemical Engineering, was named a **fellow of the International Society of Electrochemistry** and appointed **editor of the *Journal of the Electrochemical Society***.

**David Schiraldi**, professor and chair of the Department of Macromolecular Science and Engineering, was selected as a member of the 2013 class of **American Chemical Society (ACS) Fellows** in recognition of two decades of industrial polymer work contributing to the development and understanding of polymer/clay aerogels.

**Horst von Recum**, associate professor of biomedical engineering, was elected the **member-at-large for the Society for Biomaterials**, which is one of the five positions on the society's Board of Directors.

**Gary Wnek**, associate dean of academics, traveled to the Philippines in May as the **first visiting professor at Mapua Institute of Technology** under the PhilDev Innovation Development through the Entrepreneurship Acceleration (IDEA) program. He visited two additional universities in the fall under the same program.



**Sunniva Collins**, associate professor in the Department of Mechanical and Aerospace Engineering, has been elected **president of ASM International**—only the second woman to lead the world's largest association of metals-focused materials scientists and engineers. Collins assumes the presidency in October 2014.

**P. Hunter Peckham**, Distinguished University Professor, the Donnell Institute Professor of biomedical engineering and orthopedics, and founder of the Cleveland Functional Electrical Stimulation Center, was named a **fellow of the National Academy of Inventors** in recognition of decades of research on restoring function following spinal cord injury. He and collaborators have developed implantable neural prostheses that use electrical impulses to activate nerves and control muscles—discoveries that have helped restore some essential functions for patients with paralyzed arms and hands.

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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

**Gary E. Wnek**

Associate Dean, Academics

Joseph F. Toot Jr. Professor of Engineering

**Clare M. Rinnac**

Associate Dean, Research

Wilbert J. Austin Professor of Engineering

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**Daniel M. Ducoff**

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Associate Vice President, Strategic Development Initiatives,

Case Western Reserve University

**Lisa Camp**

Associate Dean, Strategic Initiatives

**Deborah J. Fatica**

Assistant Dean, Engineering Student Programs

FACULTY

as of September 1, 2014

Biomedical Engineering



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



**Abidemi Bolu Ajiboye**  
Assistant Professor



**Eben Alsberg**  
Associate Professor



**James P. Basilion**  
Associate Professor\*



**Jeffrey R. Capadona**  
Assistant Professor



**Patrick E. Crago**  
Professor



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



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



**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**  
Elmer Lincoln Lindseth Associate Professor of Biomedical Engineering



**Anant Madabhushi**  
Professor



**Cameron McIntyre**  
Associate 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**  
Associate Professor



**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**  
Vice Provost and Professor



**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



**Syed Qutubuddin**  
Professor

\*Case Western Reserve University School of Medicine campus

**Chemical and Biomolecular Engineering, continued**



**R. Mohan Sankaran**  
Professor



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

**Civil Engineering**



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



**Dario A. Gasparini**  
Professor



**YeongAe Heo**  
Assistant Professor



**Aaron A. Jennings**  
Professor



**Brian Metrovich**  
Associate Professor

**Electrical Engineering and Computer Science, continued**



**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



**H. Andy Podgurski**  
Professor



**Marija Prica**  
Assistant Professor



**Michael Rabinovich**  
Professor



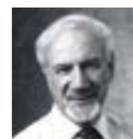
**Soumya Ray**  
Associate Professor



**Michael Pollino**  
Assistant Professor



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



**Adel S. Saada**  
Professor



**Xiong "Bill" Yu**  
Associate Professor

**Electrical Engineering and Computer Science**



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**Swarup Bhunia**  
*Timothy E. and Allison L. Schroeder Associate Professor in Computer Science and Engineering*



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Associate Professor



**M. Cenk Cavusoglu**  
Professor



**Daniel G. Saab**  
Associate Professor



**Narasingarao Sreenath**  
Professor



**Guo-Qiang "G.Q." Zhang**  
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



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*Milton and Tamar Maltz Professor in Energy Innovation*



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Associate Professor



**Ming-Chun Huang**  
Assistant Professor



**Mehmet Koyuturk**  
Associate Professor



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*Kent Hale Smith Professor*



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Assistant Professor



**Hatsuo "Ken" Ishida**  
*Distinguished Research Professor*



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Professor



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*Climo Associate Professor*



**João Maia**  
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**Ica Manas-Zloczower**  
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Assistant Professor



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**Jing Li**  
Associate 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**  
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**Pedram Mohseni**  
Associate Professor



**Stuart J. Rowan**  
*Kent Hale Smith Professor*



**Gary E. Wnek**  
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**Lei Zhu**  
Professor

**Materials Science and Engineering**



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*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*



**Pirouz Pirouz**  
*Professor*



**Alp Sehrioglu**  
*Warren E. Rupp Assistant Professor*



**Gerhard E. Welsch**  
*Professor*



**Matthew Willard**  
*Associate Professor*

**Mechanical and Aerospace Engineering**



**Dwight Davy**  
*Interim Chair and Professor Emeritus*



**Alexis Abramson**  
*Professor*



**Maurice L. Adams**  
*Professor*



**Ozan Akkus**  
*Professor*



**Paul J. Barnhart**  
*Associate Professor*



**Sunniva Collins**  
*Associate Professor*



**Malcolm N. Cooke**  
*Associate Professor*



**Umut Atakan Gurkan**  
*Assistant Professor*



**J. R. Kadambi**  
*Professor*



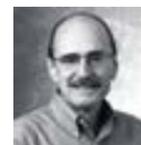
**Yasuhiro Kamotani**  
*Professor*



**Kiju Lee**  
*Nord Distinguished Assistant Professor*



**Bo Li**  
*Assistant Professor*



**Joseph M. Mansour**  
*Professor*



**Joseph M. Pahl**  
*Professor*



**Vikas Prakash**  
*Professor*



**Roger D. Quinn**  
*Arthur P. Armington Professor of Engineering*



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



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

**NOT PICTURED**

**James M. Anderson**  
*Distinguished University Professor and Professor, Biomedical Engineering*

**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 hands-on 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.

**Learn more at [engineering.case.edu](http://engineering.case.edu).**

**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)**

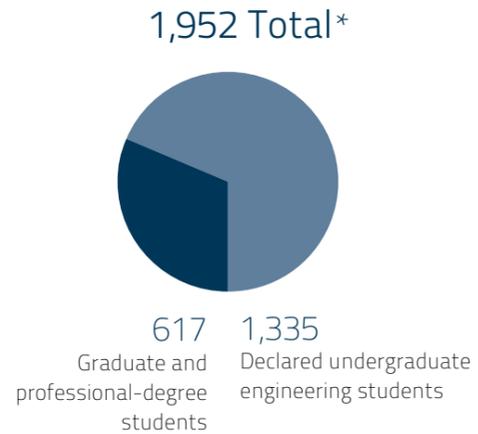
**Master of Engineering and Management (MEM)**

**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

## ENROLLMENT FALL 2014



\*In addition, 709 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 2014**  
115

**TOTAL REVENUE  
FY 2014**  
\$91.8 million

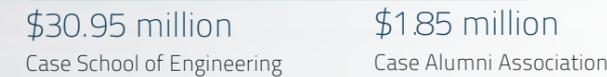
**RESEARCH, TRAINING AND  
GRANT REVENUE  
FY 2014**  
\$46.5 million

## CENTERS AND INSTITUTES

- Advanced Manufacturing and Mechanical Reliability Center (AMMRC)
- Advanced Platform Technology Center
- Case Center for Surface Engineering
- 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
- Electronics Design Center
- Great Lakes Energy Institute
- Institute for Advanced Materials
- Materials for Opto/Electronics Research and Education (MORE) Center
- Microfabrication Laboratory
- Neural Engineering Center
- NSF Center for Layered Polymeric Systems (CLiPS)
- 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 2014

Total: \$32.8 million



In FY2014, the Case Alumni Foundation/Association provided \$1.7 million from its endowment to the Case School of Engineering.

## U.S. NEWS & WORLD REPORT FY2014 RANKINGS

- 46th**  
for engineering graduate schools\*
- 35th**  
for undergraduate engineering programs\*\*
- 15th**  
for graduate biomedical engineering programs\*
- 11th**  
for undergraduate biomedical engineering programs\*\*

\*published spring 2014

\*\*published fall 2013

## VISITING COMMITTEE

- Thomas W. Seitz (CIT '70), chair
- Gerald Wasserman (CIT '76), vice-chair
- Chi-Foon Chan (GRS '74, '77)
- Howard Jay Chizeck (CIT '74, GRS '77)
- Archie G. Co (CIT '63)
- Walter J. Culver (GRS '62, '64)
- John F. X. Daly (CWR '89, GRS '91)
- Myra A. Dria (CIT '76)
- Laura J. Flanagan (CWR '90)
- Daryll T. Fogal
- James H. Garrett Jr.
- Robert A. Gingell Jr. (CIT '77)
- Jennie S. Hwang (GRS '76)
- Joseph P. Keithley
- Martin P. Kress
- Kenneth R. Lutchen (GRS '80, '83)
- Edward P. McHenry (CIT '67, MGT '71), *ex-officio*
- Gerald McNichols (CIT '65)
- David C. Munson Jr.
- Somsak Naviroj (GRS '83)
- Charles H. Phipps (CIT '49)
- Claiborne R. Rankin
- Richard T. Schwarz (MGT '78)
- Laura J. Steinberg
- Diana P. Strongosky
- Karl R. Van Horn
- Russell J. Warren (CIT '60)
- John M. Wiencek (CIT '86, GRS '89)
- Simon Yeung (CWR '93)

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[engineering.case.edu](http://engineering.case.edu)

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Christine Coolick

Assistant Director, Marketing & Communications:

Jackie Fitch

Graphic Designer:

Cindy Young

Principal Photography:

Russell Lee (covers, p. 1, 2, 3-5, 7-10, 13, 16-18, 21, 23, 29, 34, 40, 43, 49-52)

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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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CASE SCHOOL  
OF ENGINEERING

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CASE WESTERN RESERVE  
UNIVERSITY

10900 Euclid Avenue  
Cleveland, OH 44106-7220