2017

UNIVERSITY OF UTAH COLLEGE OF ENGINEERING

RESEARCH REPORT

From the Dean

The University of Utah "has quietly evolved into one of the most prestigious research universities in the nation with a strong emphasis on commercializing its research."

Concept to Commercialization
The Best Universities for Technology Transfer
April 2017, Milken Institute

In its April 2017 report, the Milken Institute ranked the University of Utah No. 1 among U.S. institutions of higher education in technology transfer and commercialization, based on an index that included patents, licenses, licensing income and start-ups. In a field that includes such institutions as Stanford, Cal Tech and MIT, what makes Utah so distinctive?

An entrepreneurial spirit that dates back to its pioneering founders is embedded in the College of Engineering's DNA. With a desire to put new ideas into practical use for the benefit of humanity, our faculty have created an environment in which translational research is both fostered and rewarded. Success in technology commercialization at the U isn't new. For more than 120 years, University of Utah engineers and computer scientists have been first in leading our nation's strategic defense; in the development of artificial organs, neural prosthetics, and molecular diagnostics; and in pioneering the internet, digital sound, LED's, and computer graphics.

Today, the entrepreneurial spirit burns even brighter in a new generation of faculty and graduates who are working on the frontiers of new materials, nanoscience, cancer treatment, alternative energy, robotics and smart materials, among others, and whose commitment to making the world better is stronger than ever.

In 2016, College of Engineering faculty filed 46 invention disclosures and obtained 22 U.S. patents. Engineering has also been the largest contributor to university-launched companies, with 60 new startups since 2006. With nearly $80 million in annual research expenditures, the College of Engineering ranks 38th out of 206 schools in research volume in the 2016 ASEE Profiles.

In addition to technology commercialization, the College is fueling the fastest growing economy in America by adding more than 1,000 BS, MS and Ph.D. graduates each year to the technical workforce. In 2000, Utah was home to 1,500 high-tech companies compared with 5,700 of these companies today, which are responsible for producing a significant part of the state's economic output. The Wasatch Front is becoming known as "Silicon Slopes," and Utah's tech sector employment has risen from 46,000 to 70,000 in just a decade. College of Engineering graduates and faculty are a critical factor in Utah's economic equation.

The following 2017 Research Report celebrates the entrepreneurial spirit that is contributing to the University of Utah's reputation as the nation's best university for technology transfer.

Richard B. Brown
DEAN, COLLEGE OF ENGINEERING

Contents

Feature Story

Pg. 12

Dean, College of Engineering: **RICHARD B. BROWN**
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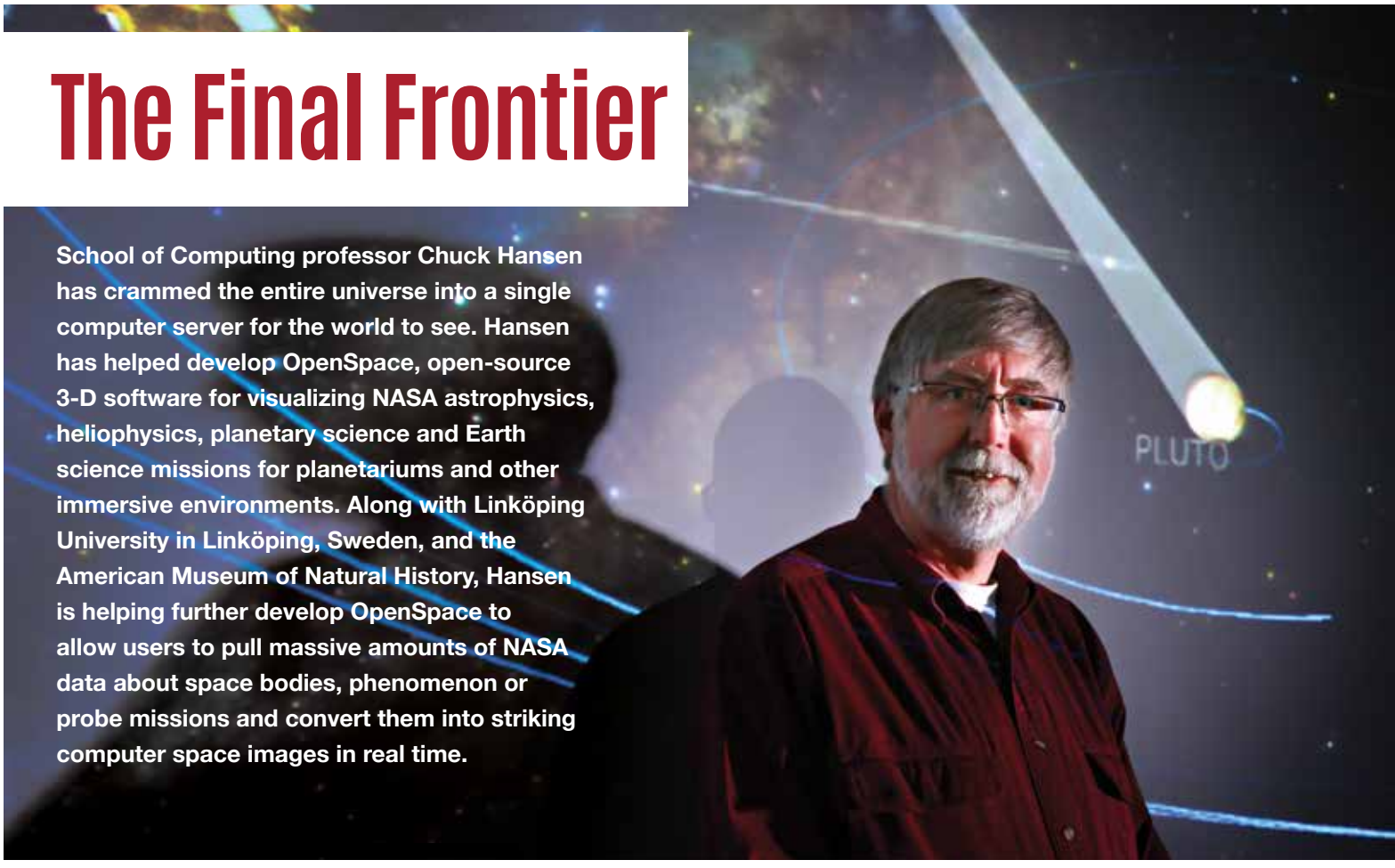
THE LEADING edge

The University of Utah's College of Engineering is at the forefront of some of the world's most advanced technological research, ventures that one day will be commercialized and marketed to consumers to enhance their lives. Here are some recent projects involving our faculty and students that have garnered global headlines as well as other research ideas that will eventually lead to important game-changing products. Details on these projects can be found at www.coe.utah.edu/news.

The Final Frontier



School of Computing professor Chuck Hansen has crammed the entire universe into a single computer server for the world to see. Hansen has helped develop OpenSpace, open-source 3-D software for visualizing NASA astrophysics, heliophysics, planetary science and Earth science missions for planetariums and other immersive environments. Along with Linköping University in Linköping, Sweden, and the American Museum of Natural History, Hansen is helping further develop OpenSpace to allow users to pull massive amounts of NASA data about space bodies, phenomenon or probe missions and convert them into striking computer space images in real time.

Smart Drill

This is one steady hand. Mechanical engineering associate professor A. K. Balaji is developing with University of Utah neurosurgeon William Couldwell a computer-driven automated robotic drill that can perform certain cranial surgeries quicker and with more precision and cleaner cuts. The new machine can make one type of complex cranial surgery 50 times faster than standard procedures, from two hours to two and a half minutes. This could reduce the time the wound is open and the patient is anesthetized, thereby decreasing the incidence of infection, human error and surgical cost.

Biodegradable Pad

Each year, nearly 20 billion sanitary pads, tampons and applicators are dumped into North American landfills, and it takes centuries for them to biodegrade. A team of students led by materials science and engineering assistant professor (lecturer) Jeff Bates has devised a new 100-percent biodegradable sanitary maxi pad made of all-natural materials such as cotton and a form of brown algae. This feminine hygiene product, which will be produced by Bates' company, SHERO, can break down in as little as 45 days. it could land on U.S. store shelves within a year but also benefit women in developing countries.

Eyes on the Future

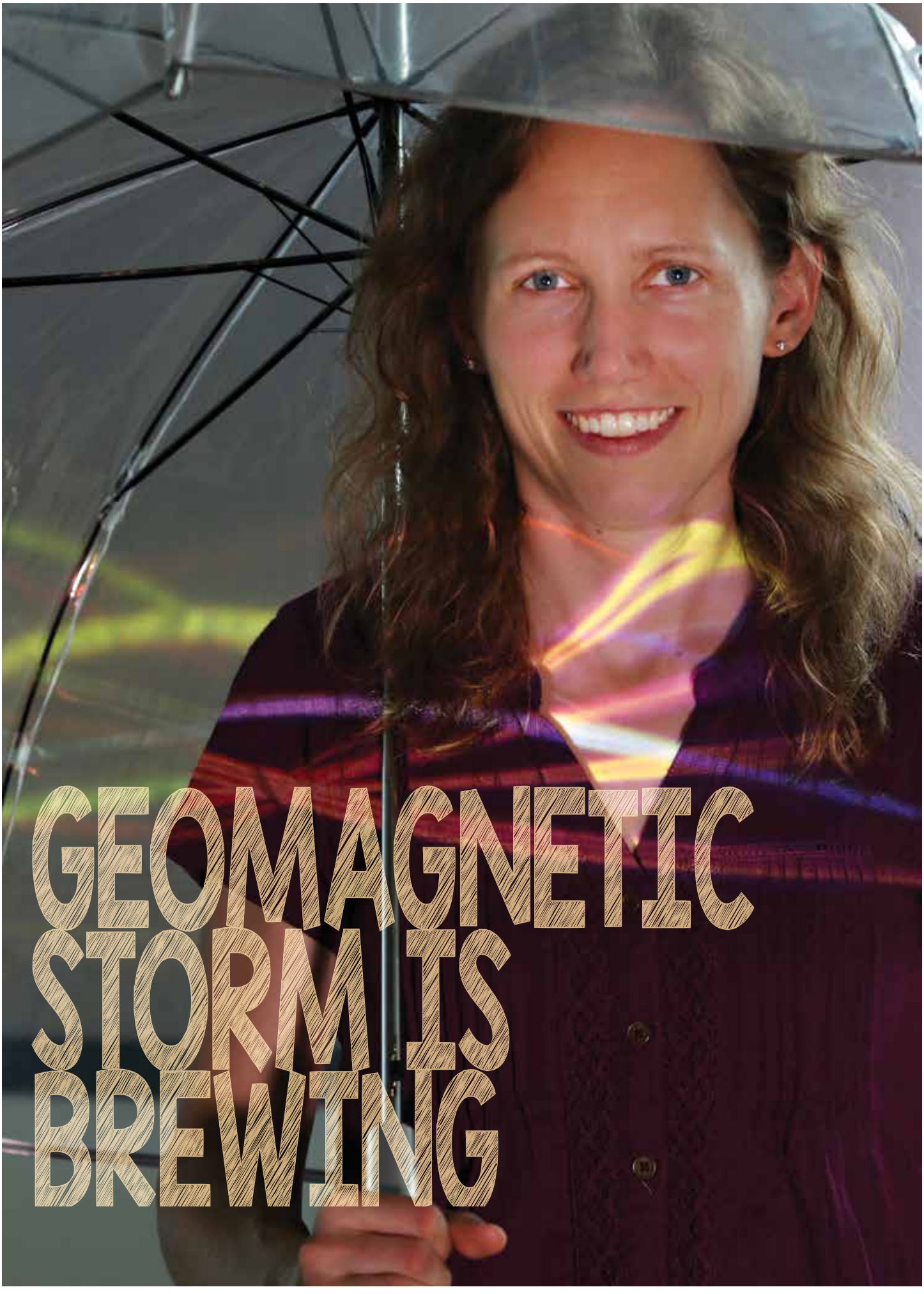
Material Magic

Materials science and engineering professor Ashutosh Tiwari, has found that a combination of the chemical elements calcium, cobalt and terbium can create an efficient, inexpensive and bio-friendly material that can generate electricity through a thermoelectric process involving heat and cold. Imagine a piece of jewelry such as a ring and your body heat generating enough electricity to power a body sensor, or a cooking pan that could charge a cellphone in just a few hours.

Presbyopia, the loss of the eye's ability to focus on objects near or far, is the inevitable curse of aging, requiring the use of glasses or bifocals. But University of Utah electrical and computer engineering professor Carlos Mastrangelo is developing a pair of unique eyeglasses that can automatically adjust for farsightedness or nearsightedness. Using gel-based lenses that change shape and sophisticated electronics that measure distance and adjust the lenses in microseconds, these glasses could revolutionize eyewear. He has launched Sharpeyes LLC to bring it to market.

WASTE OF ENERGY

Americans waste a lot of electricity because many home devices consume power even when they are turned off. University of Utah electrical and computer engineering professor Massood Tabib-Azar has come up with a way to produce microscopic electronic switches for appliances and devices that can grow and dissolve wires inside the circuitry that instantly connect and disconnect electrical flow. Products such as smartphones and laptops could run at least twice as long on a single battery charge, and all-digital appliances such as televisions could be much more power efficient.


GEOMAGNETIC
STORM IS
BREWING

In 1859, a solar event known as a coronal mass ejection caused a storm of ionospheric currents on Earth that wreaked havoc over Europe and North America, crippling telegraph systems that shocked operators and shut down communications. University of Utah electrical and computer engineering associate professor Jamesina Simpson says we're destined to have another similar storm, and she's researching the phenomenon so power grids can be protected.

This form of space weather event occurs often — at least monthly on average — though most incidents are not nearly as catastrophic as the one in 1859, known as the "Carrington Event." When a geomagnetic storm happens, electrically-charged particles travel to Earth from the sun and create disturbed currents in the ionosphere (the layer of the Earth's atmosphere that is ionized by solar and cosmic radiation). When they interact with the Earth's upper crust, the event can create powerful electrical currents in the electric power grids, causing power surges in transformers. In 1989, such a storm crippled the power grid in Quebec, Canada, for nine hours.

"The kind of storm in which we're really interested tends to happen at least once every few years," Simpson says, referring to a storm that would temporarily knock out power in a city. "There was one in July of 2012 that bypassed the Earth, but if it had been angled closer it would have caused a lot of problems."

Simpson has been researching how electromagnetic waves are generated when the charged particles enter the Earth's ionosphere, data that ultimately can be invaluable to power companies that want to know when and where electrical currents will reach a high enough amplitude to damage the power grid.

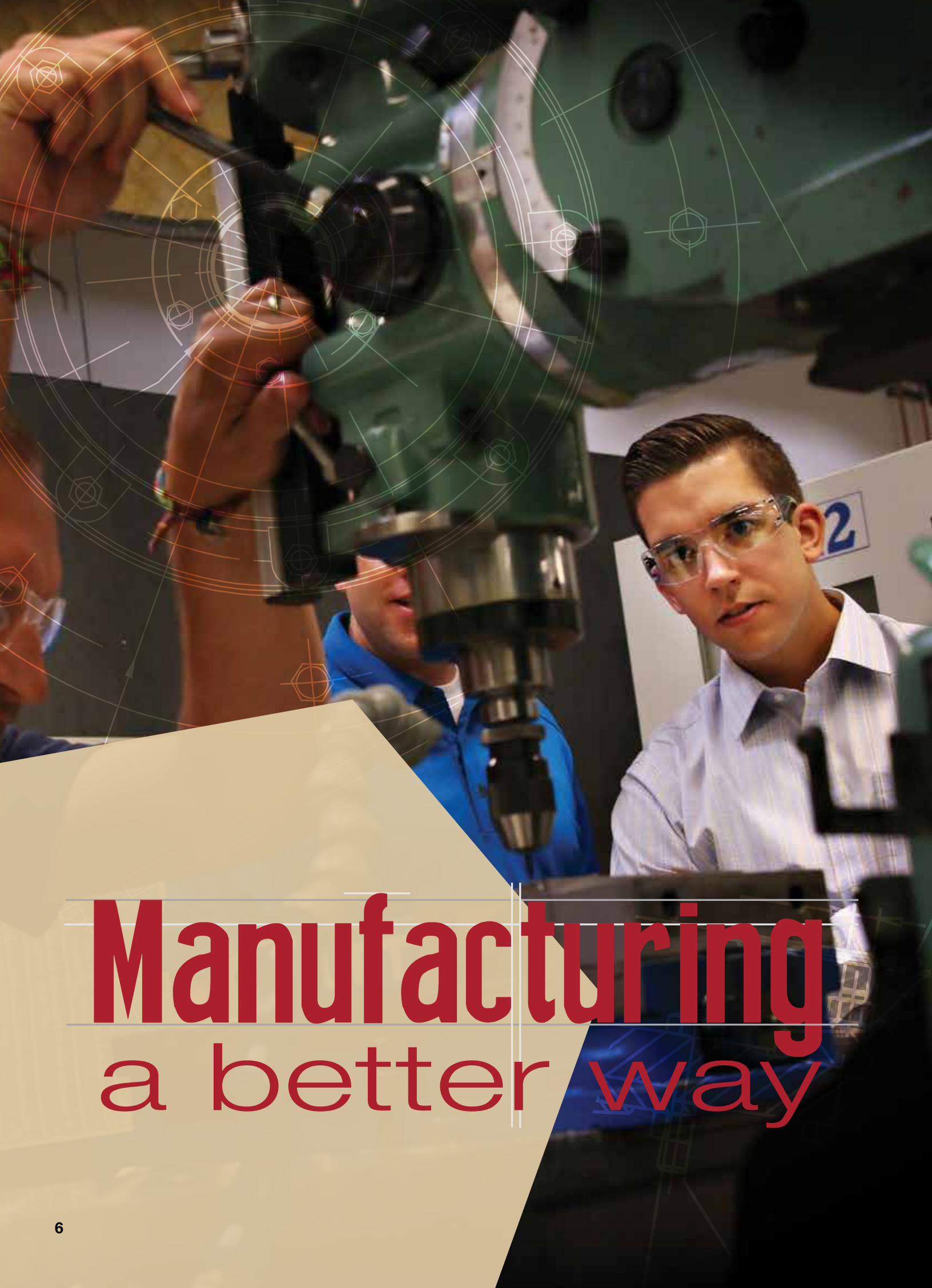
"In the past, people have had very simple models. Something we're trying to do is add more detail and physics," she said. "So, if I'm on a specific point on the Earth and I'm a power company, then I can expect a particular range of current amplitudes, and I can take appropriate measures to protect my grid."

Simpson also recently received a collaborative grant to develop a model of what happens during an entire event, from when a coronal mass ejection happens on the sun, to how the particles travel through space, all the way to how they create the electrical currents on Earth.

Researching the effect geomagnetic storms have on Earth is just one of a few research projects Simpson is looking at that are related to her expertise on electromagnetic waves. For example, she is also looking at improving the accuracy of an older form of a global positioning system (GPS) that uses electromagnetic waves propagating along the ground instead of from satellites in hopes of developing a more robust system. The possible advantage over the current GPS with satellites is it could be used inside buildings. It would also be more difficult to transmit fake signals.

A graduate from Northwestern University with bachelor's and doctorate degrees in electrical engineering, Simpson was an assistant professor of electrical engineering at the University of New Mexico in Albuquerque before she arrived at the University of Utah in 2012. She has focused her research on this unique but critical problem because she felt more answers could be found in better simulation models.

"I felt that what people were using to estimate this was over-simplified, and they were missing a lot of the physics, and there's still so much to understand," she said. "The model we created over the years could make a good contribution to this area. I felt there is enough evidence that another big geomagnetic storm is going to happen in the future."



Manufacturing a better way

It's one of the most talked-about issues today: How do we keep manufacturing jobs in the U.S.? The University of Utah's College of Engineering has been working diligently to find the right answer through better technologies and processes.

The College is focusing on innovation in manufacturing, from researching new forms of composite materials to establishing a center that helps local manufacturers perform more efficiently. The importance of manufacturing to the U.S. is clear. Last year, manufacturers contributed $2.18 trillion to the U.S. economy, and there are 12.3 million American manufacturing workers, making up 9 percent of the country's total workforce, according to the National Association of Manufacturers.

"We can show companies how to innovate on making higher-quality products and how to use the most up-to-date technology," University of Utah mechanical engineering chair, Tim Ameel, said about why the College has been funneling resources into manufacturing initiatives. "Improving manufacturing in Utah is something the U can do that will make a difference."

Here is a sample of what has happened in the University of Utah's College of Engineering in the past year to stimulate manufacturing in Utah and the U.S.

- The U.S. Department of Commerce named the University of Utah the host of the state's new Manufacturing Extension Partnership (MEP) Center, which delivers services for small and medium-sized manufacturing companies. The center, which is run by College of Engineering faculty and local manufacturing professionals, provides expertise in advanced manufacturing technology, innovation, worker education, operational excellence, and investor opportunities.

  "The goal of the program is provide these services so businesses can remain competitive against cheap overseas labor and to keep those manufacturing jobs here," says University of Utah mechanical engineering associate professor Bart Raeymaekers, principal investigator of the center.

- University of Utah chemical engineering professor Eric Eddings, along with the University of Kentucky's Center for Applied Energy Research, has launched a $1.6 million research project to develop cost-effective, carbon-friendly methods of turning coal-derived pitch into carbon-fiber composite material. The research team is working with the Utah Advanced Materials and Manufacturing Initiative (UAMMI), a consortium of materials companies, research institutions and state agencies, to examine the market potential for producing this composite material from Utah coal and if other coal communities can benefit from this technology. Carbon-fiber composite material, which is extremely light but strong, can be used in products from aircraft parts to skis, bicycle frames, outdoor recreational equipment, even prosthetics.

- Mechanical engineering researchers from the College will be joining 11 other institutions to establish a new NASA-funded Space Technology Research Institute to develop carbon nanotube-based materials that are lightweight and strong and to educate other engineers and scientists about these new materials. The institute will be partnering with NASA, other federal agencies, industry, and research institutions.

- The School of Computing and Department of Mechanical Engineering have recently launched the University of Utah Robotics Center, which is focusing on manufacturing robots, as well as other technologies ranging from haptic interfaces to humanoid robots."

- Mechanical engineering assistant professor Ashley Spear and Bart Raeymaekers have received a $3 million federal government grant to develop new methods of additive manufacturing, a process of building an object by adding ultrathin layers of material one by one with a 3D printer. This process can be used to produce everything from aircraft and automotive parts to microscale objects.

NEED *for* SPEED

Whether it's coming up with the best design for a Formula 1 race car or understanding the effects of atrial fibrillation on the heart, developing the right simulation model for research sometimes involves equal parts applied math, engineering and computer science.

University of Utah School of Computing professor Mike Kirby sees himself as the person who connects these disciplines so he can take trailblazing ideas and help create better simulation software to aid researchers.

"They're the pathfinders," he said of the engineers he works with every day, "and I'm right behind them building the bridges that connect them with good computational tools and rigorous applied math."

In order to help scientists build the right simulation tools for their work, Kirby, along with research partner, Imperial College London computational fluid mechanics professor Spencer Sherwin, has created an open-source software package called Nektar++ that enables engineers and industry professionals to create better simulation models for aerodynamic to biomedical applications.

Kirby is currently working with the U.S. Army, for example, to help engineers simulate the effects of "vortex structures," the swirling clouds you sometimes see behind the tip of an aircraft wing. In the case of helicopters, the giant rotor creates these vortices that move downward, which can weaken the aircraft body. Army engineers want to know how that continual "shock" might ultimately affect the body over time, so Kirby and his team are using Nektar++ to recreate air flow along a wing similar to a helicopter rotor and then providing the software code to Army engineers who can use it in their own simulations.

"The end goal is to have computational tools that allow designers to do what-if experiments," said Kirby, who is also the associate director for the University of Utah's School of Computing. This can help engineers understand what design changes need to be made so helicopter bodies can be more robust or so Army officials can implement new policies to better protect the aircraft.

Nektar++ is also being explored by car manufacturer McLaren Automotive for designing better Formula 1 race cars that produce less air drag and can hug the track better. The front wings of the famous car type are designed to create downforce to prevent it from flying up. The wings also can create those same vortex structures so the swirling air can create downforce when they strike the rear wheels.

For decades, McLaren has been using in-house proprietary simulation software to study air flow around their race cars. They now are exploring Kirby's software and his partner's expertise to make better simulation models for future car designs.

"They acknowledge that they are starting to reach the limits of their current in-house computational tools, and they're exploring higher-fidelity tools, one of which is ours," Kirby said.

The software also is being used by medical researchers to better understand what happens to the heart when it goes into atrial fibrillation (an irregular heartbeat). In addition, a UK manufacturer which produces jet engines for aviation is turning to Nektar++ to help its engineers design the next generation of turbines. Both Kirby and Sherwin have expressed interest in starting a new consulting firm that would work with companies who want to use Nektar++.

With Kirby's educational background — dual master's degrees in applied mathematics and computer science and a doctorate in applied mathematics at Brown University — he turned out to be the perfect bridge builder that ties those disciplines to engineering. At the U, he became a faculty member of the university's Scientific Computing and Imaging Institute in addition to the associate director of the School of Computing, and he is an adjunct professor in both bioengineering and mathematics. He was also named one of 2016's Funded Research Honorees for the university.

"The university wanted me to be the best I can be here, and they weren't going to try and put me in a box," he said. "This has been a great university to be at."

A Calming EFFECT

For many who suffer from debilitating neurological disorders such as Parkinson's Disease, the constant muscular tremors are an unbearable symptom. Just drinking from a cup can be an overwhelming challenge.

When medication doesn't work, brain surgery to destroy certain cells can be risky, and the results are irreversible. But there has been an emerging third option — deep brain stimulation (DBS), a therapy in which electrodes are implanted in the patient's brain that deliver continuous electrical pulses to control motor function.

University of Utah bioengineering associate professor Christopher Butson has been researching ways to improve DBS systems to make them more effective and convenient for patients who wear them. He believes an answer lies in mobile tablets and smartphones.

A member of the university's Scientific Computing and Imaging Institute (SCI) and director of Neuromodulation Research, Butson and his team are developing mobile apps that allow physicians to view a 3D model of a patient's brain based on MRI and CT images. They then can figure out which regions of the brain will react best to the impulses by testing the settings on the iPad app before changing them on the person's DBS system.

Deep brain stimulation involves a procedure in which tiny electrodes on two metallic leads are implanted in the patient's brain, one lead in each hemisphere. The leads are connected to a small battery-powered pulse generator (IPG) that's also implanted in the chest. The IPG sends small milliamp pulses — an average of 130 per second — to the brain to suppress the patient's trembling. Butson said it is possible that as many as 150,000 people worldwide have DBS implants, and patients who use them also include those who suffer from essential tremor or Tourette Syndrome.

After a patient is implanted with a system, he or she has to return to the hospital as often as three to four times in the first six months and about once every six months afterwards to have the unit's settings adjusted.

"These DBS devices need to be programmed after surgery, and that can be a long process and much more complicated with new technology that's coming out," he said. "Before, doctors were doing advanced trial and error [on the patient]."

But with the app "ImageVis3D Mobile" — which Butson co-developed with SCI colleague Jens Krüger — and a newer version called "Duality," doctors will be able to make more accurate adjustments in a fraction of the time. "ImageVis3D Mobile" is now available for free on the iTunes App Store while "Duality" is still being developed.

One of the advantages of these applications is the patient can now have the DBS settings adjusted at a nearby clinic or by even a home healthcare worker instead of at a major hospital. "Duality" also allows the clinician to wirelessly connect with servers that can calculate better DBS settings for the patient in near real time.

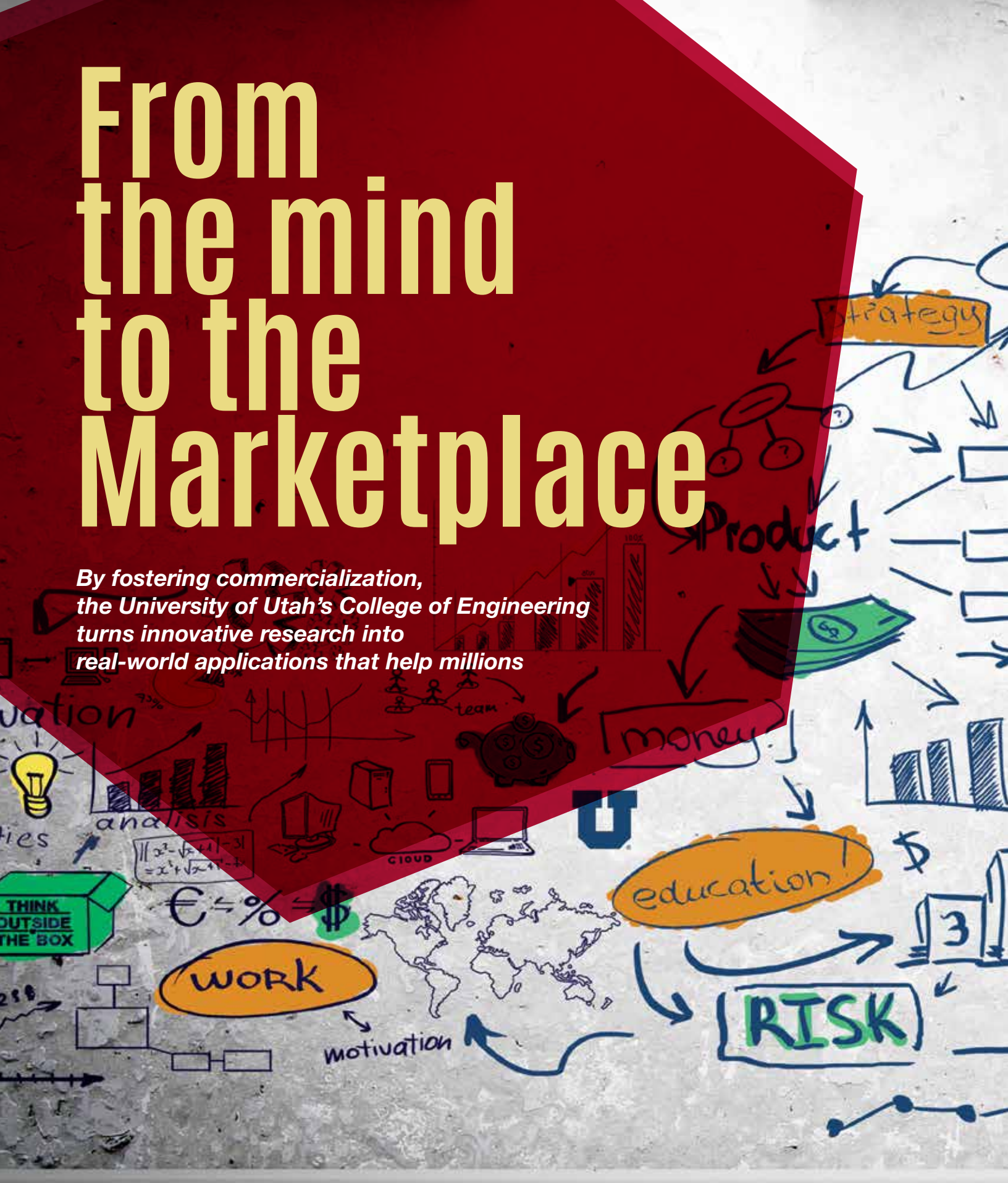
"Right now, if you're a patient who gets deep brain stimulation you pretty much have to travel to a major academic medical center for the rest of your life for treatment because that's the only place that can manage these devices," Butson said. "With the iPad, we have one study where we are going to give this to nurses who travel to patients' homes."

Butson, who received his doctorate in bioengineering from the University of Utah, said he plans to launch a company to distribute his new software, and has already successfully used "Duality" with a patient in South Jordan, Utah.

"There are a lot of neurological conditions that have limited treatment options," he said. "I felt that by providing better designed devices we could really improve patients' lives."

From the mind to the Marketplace

By fostering commercialization, the University of Utah's College of Engineering turns innovative research into real-world applications that help millions




team
Product
ASSURANCE
TREND
-best ideas
People
management
yes
time
partnership
BUSINESS
50%
30%

When the world needs innovation, it turns to research universities.

Law enforcement needs better ways to detect bombs and toxic chemicals. University of Utah materials science and engineering professor Ling Zang has created new chemical sensors that can do that. People are looking for methods to display more vibrant, realistic 3D images. U electrical and computer engineering associate professor Rajesh Menon has found the answer in a new 3D hologram technology.

The best way these exciting new technologies can reach the masses and affect change is through commercialization, and Zang and Menon are just two examples of faculty at the University of Utah's College of Engineering who are turning their groundbreaking research into viable products by launching a startup.

"The University of Utah's College of Engineering has created an ecosystem that supports entrepreneurism," said U College of Engineering Dean Richard B. Brown. "Commercialization puts the new invention directly to use for the public. Our faculty are not only excellent researchers, but they are driven to see their work make a difference in the world."

The University of Utah supports the commercialization of research by giving faculty credit for published articles as well as issued patents through its renowned Technology and Venture Commercialization office. In addition, faculty receive advice from Entrepreneurial Faculty Scholars and support from many innovation and entrepreneurship centers. The university provides a maker space and entrepreneurial dorms and sponsors design contests for students as well as a Distinguished Innovation and Impact Award for faculty.

In 2011, Zang launched Vaporsens based on his research of discovering new materials that can more effectively detect certain chemicals. His company, which produces sensors that can more accurately locate bombs, illicit drugs or toxic industrial chemicals, got help and encouragement from the university to secure the necessary patents, find seed funding, and learn about certain marketing strategies, he said.

"When I interviewed here, I learned they have a small army of people who offer a whole range of support. I thought this would be a good source for my commercialization prospects," he said about the assistance he could get from the university. "It was a big reason I moved from my previous university to this one."

Universities didn't always encourage their faculty to seek out entrepreneurial opportunities from their research. Legalities that prevented technology transfer proved to be difficult roadblocks. And it used to be that universities focused on research for the educational good rather than for commercialization.

The Bayh-Dole Act in 1981 changed the laws of ownership concerning government-funded research. In an effort to help boost the economy, the law permits a university or business to pursue the intellectual property of its own federally-funded research. Today, the growth of commercialized university research is skyrocketing, according to the 2017 Milken Institute's report on the Best Universities for Technology Transfer. More than 1,000 firms were launched in fiscal 2015 from research universities, according to the report, and about 6,600 patents were issued, more than double from 20 years ago.

Leading the charge is the University of Utah. The U was ranked the No. 1 university in the nation when it comes to commercializing technology innovations, according to the Milken report. Since 2006, 60 companies were

launched from research at the University of Utah's College of Engineering, according to the university's Technology, Venture & Commercialization office. Just last year, 46 invention disclosures were filed from the College of Engineering and 22 patents were issued to researchers.

"[The university] consistently ranked high across all indicators; patents, licenses, licensing income, and start-ups in both absolute size and normalized by research expenditures," the report stated. "Utah has a strong entrepreneurial culture and an incentive system that makes it attractive for research faculty and students alike."

That entrepreneurial spirit also extends to student researchers who want to turn their bright ideas into tangible, marketable products. To help them along, the College of Engineering has introduced a new Engineering Entrepreneurship Certificate in conjunction with the university's David Eccles School of Business that is geared specifically for the engineering student. This 20-credit-hour curriculum gives students the fundamentals in marketing, funding, business law, intellectual property, writing and presentation skills so they can operate effectively in the corporate world.

"By providing the students with the skills and knowledge necessary — from finance, to marketing, to operations and strategy — they can be prepared for several of the pitfalls that come up when people try to start an enterprise," said University of Utah electrical and computer engineering department chair, Gianluca Lazzi, who is the program director for the certificate.

Meanwhile, the university's Lassonde Entrepreneur Institute recently opened its Lassonde Studios, a new $45 million home for student entrepreneurs and innovators that is designed to spur creativity with residential living space for 400 students and a 20,000-square-foot area for developing prototypes and launching new companies. This upcoming school year, 66 engineering students will be living and working in the studios.

"The university has been really good, and they offer these opportunities for students to get involved," said U materials science and engineering assistant professor (lecturer) Jeff Bates, who also is an entrepreneur who launched his own company based on his research. "There is a real spirit of entrepreneurism here."

"So many research projects stem from problems in the world, and those problems always have a market associated with them," he added. "As a researcher, I don't want to see it just sit in a book somewhere. I want it to go somewhere that helps people. That's what makes me tick."

With resources available to faculty and a thriving entrepreneurial environment, the University of Utah's College of Engineering is taking its pioneering research to new heights, spinning exciting concepts into real-world products that benefit us all.

FLOYD MELDRUM

TOGETHER, FLOYD MELDRUM AND HIS WIFE JERI BUILT A FAMILY, A BUSINESS AND A LEGACY

No one knows more than Floyd Meldrum that launching a dream begins with a sound foundation.

The 85-year old University of Utah College of Engineering alum spent his entire adult life taking a seat at the table with the visionaries who conceived, designed and built the most significant infrastructure and destination projects in the history of Las Vegas.

His company, Southern Nevada Paving performed engineering, excavation and aggregate mining, processing and sales of materials for 80 percent of the hotels and destination resorts on the famous Las Vegas Strip.

“I was fortunate enough to have a team of great people to work with and to get some of the early

projects in the city," he said about his work paving, grading and excavating the grounds for the city's most well-known casinos. "I had people in my organization who could do the job, sell the job, and complete the job."

Gaze along the famous Las Vegas Strip and you can marvel at Southern Nevada Paving's work, including Mirage, Rio, Treasure Island, Circus Circus, Venetian, City Center, Bellagio, Arizona Charlie's, MGM Grand, Sunset Station, Boulder Station, Palace Station, South Point, New York New York, Excalibur, Silverton, Stratosphere, and the Wynn Las Vegas.

In addition to the long list of private sector projects, Southern Nevada Paving completed work on countless Clark County School District schools and other facilities, as well as Cashman Field, UNLV buildings, the Las Vegas Convention Center, McCarran Airport runway and roadway expansions and other projects. His company performed roadway construction and improvement work for the State of Nevada and in every local jurisdiction in southern Nevada during the 42 years the Meldrum family owned and operated the company. There was not a municipal government in Clark County for which he has not built valuable, quality improvements. In addition to his building and construction activities, Meldrum located, developed and maintained several of the most important sand and gravel claims and related trucking operations in the entire Nevada region.

Meldrum's work in construction began right after graduation from high school in Provo, Utah, when he got a job in Las Vegas as a heavy equipment operator. A short time later, he fulfilled a two-year tour of duty in the Korean War as a mechanic and then returned to Utah where he worked, got married in 1957 and later received his bachelor's degree in civil engineering at the University of Utah in 1962. He credits the people he knew in the military as well as his army scholarship for allowing him to go to college and gain the skills he needed to pursue his engineering degree.

"Going to school was something I always wanted to do, but I didn't think that was in the realm of possibility until I got the GI Bill," he said. "And the one thing I'm grateful for is these guys who were in World War II and from the Depression who helped me. They trained my generation. In fact, five professors who taught me were former officers in World War II."

In 1967, Meldrum's company won an important job working on Area 51, the top-secret government proving and testing facility constructing infrastructure for buildings, roadways and the runway. "Everybody wants to know if I saw aliens," he said, laughing. "I tell them I didn't see anything unusual."

When the work on the base was completed, Meldrum bought his three other partners out. In 2003, Southern Nevada Paving was 500 employees strong, owned one of the largest construction fleets in Nevada including 264 pieces of major Caterpillar equipment, some of the most valuable gravel claims, four asphalt hot plants, six quarry operations and a trucking division consisting of 120 trucks to support its operation when Meldrum decided to sell his business to Aggregate Industries. Today, he is still very active in real estate development and management having secured design build projects for Fortune 500 companies. But he adds he's most proud of providing work and careers for those hundreds of employees.

Meanwhile, his family has now produced a third generation of civil engineers — his two granddaughters both received their master's degree in civil engineering from the University of Utah.

Meldrum says he's appreciative of the opportunities and technical know-how the University of Utah's civil and environmental engineering department gave him when he earned his bachelor's degree. Because of that, he stresses the importance to educate and train students with the skills to enable them to get into the workplace in a career they love.

In a gesture of gratitude and his passion to develop a new generation of engineers, he and his wife, Jeri, donated $3.3 million in 2007 to fund the 15,000-square-foot addition and renovation of an existing building that is now the Floyd and Jeri Meldrum Civil Engineering Building. They also endowed an undergraduate scholarship in civil engineering and a course in project management and contract administration.

"I'm grateful for what I learned at the University of Utah. Being an engineer helps you to think and focus on the problem. It was a difficult job running a company. But the training at the university prepared me to go through those tough times," he said.

NEW FACULTY

The University of Utah's College of Engineering continues to grow, and this year's new faculty represents some of the brightest minds in their respective fields.

XIANFENG YANG
Assistant Professor,
Civil and Environmental Engineering

Evacuation system design, traffic operations with connected vehicle technology, integrated traffic control, traffic incident management, and unconventional intersection design

ABBAS RASHIDI
Assistant Professor,
Civil and Environmental Engineering

Information and sensing technologies (IST) for construction engineering and management, video/image processing for 3D reconstruction of civil infrastructure systems, acoustical modeling of construction job sites, tracking, modeling and analysis of nano-particle dispersion at construction job sites

ARMIN TAJALLI
Assistant Professor,
Electrical and Computer Engineering

Ultra-low power circuits, analog/mixed-signal circuits, data converters, serial data transceivers, clock and data recovery, phase-locked loop, frequency synthesizer, RFID, RF/high-frequency circuits

SRIRAM KRISHNAMOORTHY
Assistant Professor,
Electrical and Computer Engineering

Energy-efficient electronic/optoelectronic/photonic devices, Molecular Beam Epitaxy of III - Nitrides, Gallium Oxide, Van der Waals epitaxy of 2D-layered materials and heterostructure devices

NEDA NATEGH
Assistant Professor,
Electrical and Computer Engineering

Vision science, systems and cognitive neuroscience, computational neuroscience, neuroengineering, applied probability and statistics, image, and information processing; computational and mathematical modeling

YONG LIN KONG
Assistant Professor,
Mechanical Engineering

Advanced manufacturing of nanomaterials-based biomedical devices, specifically the intersection of additive manufacturing, nanomaterials and biomedical engineering

CLAIRE ACEVEDO
Assistant Professor,
Mechanical Engineering

Stress and fatigue fracture, skeletal biomechanics, bone quality and bone fragility, multiscale approach - X-ray synchrotron, collagen and mineral deformation

SHANDIAN ZHE
Assistant Professor,
School of Computing

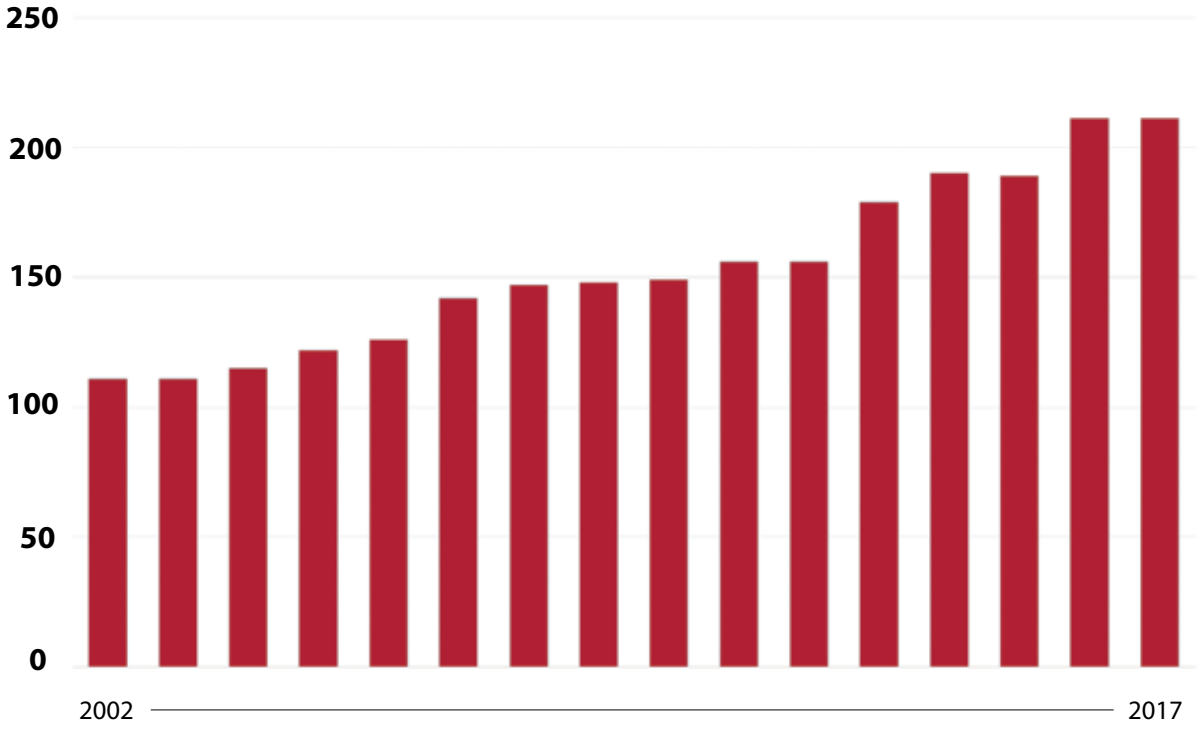
Bayesian machine learning, probabilistic graphical models, Bayesian nonparametrics, Bayesian sparse learning, data science, high-dimensional feature selection, large-scale tensor/matrix factorization, computational biology

ROGELIO CARDONA-RIVERA
Assistant Professor,
School of Computing

Discourse-driven procedural narrative generation, empirically-tested models of narrative roles and narrative genres, simulating memory recall performance for narrative events during online comprehension, procedural generation of interactive narrative artifacts to augment human creativity

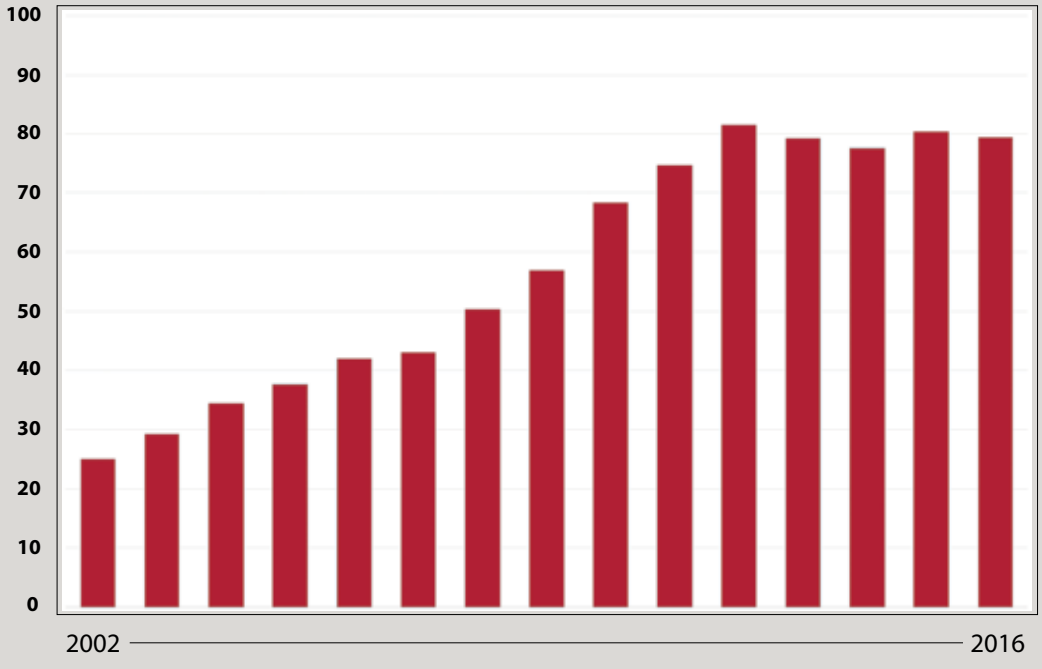
BY THE NUMBERS

TENURE TRACK FACULTY GROWTH



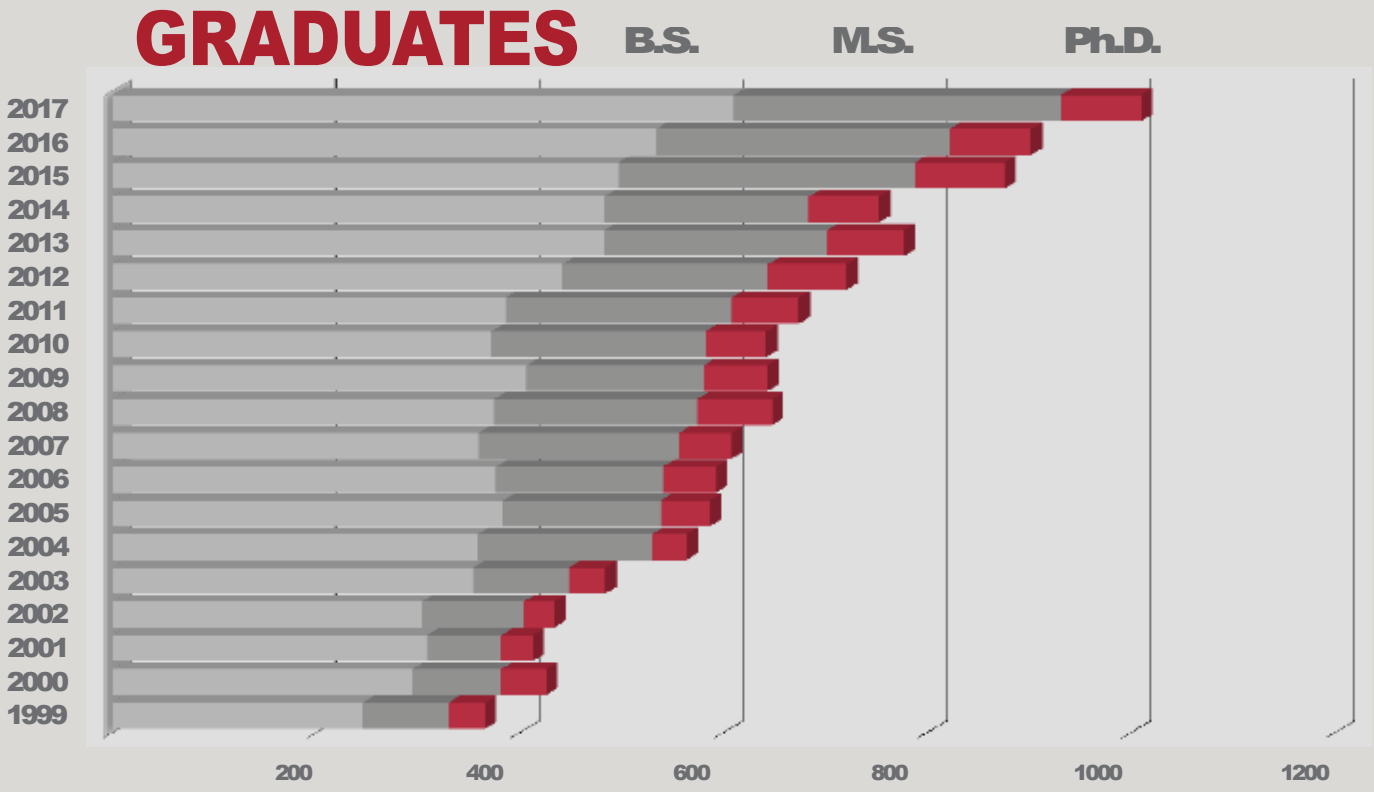
The University of Utah's College of Engineering has experienced explosive growth, nearly doubling the number of tenure-track faculty members in the last 15 years. In 2017, the College has 213 tenure-track faculty members to meet the needs of its growing student body.

RESEARCH EXPENDITURES



The College of Engineering continues to invest tens of millions of dollars in research, creating one of the most vibrant and visionary research institutions in the country. In 2016, the College reported $79.4 million in research funding, a 217 percent increase since 2002.

This year, the College awarded 1,010 undergraduate and graduate degrees, a 176 percent increase since 1999.

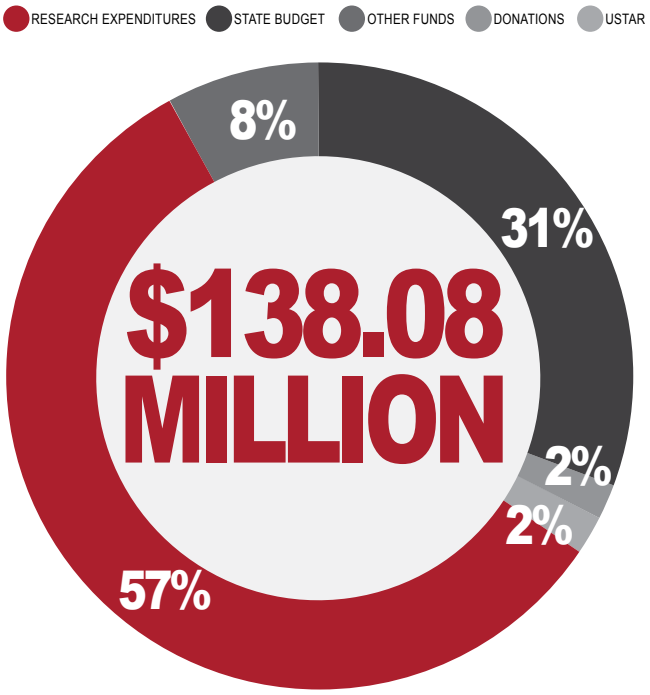


RANKINGS

The University of Utah College of Engineering continues to excel in a variety of areas, according to the 2016 U.S. rankings from Profiles of Engineering & Engineering Technology by the American Society for Engineering Education.

- **Research expenditures — #38 (out of 206 schools)**
- **Engineering doctoral degrees awarded — #44 (out of 194 schools)**
- **Graduate enrollment — #46 (out of 248 schools)**
- **Undergraduate enrollment — #50 (out of 300 schools)**
- **Tenured/tenure-track faculty members — #22 (out of 298 schools)**
- **Computer science degrees awarded — #41 (out of 166 schools)**

BUDGET 2015-2016



The University of Utah's College of Engineering continues to be one of the West's leaders in transforming research into marketable solutions. In 2017, faculty from the College filed 46 invention disclosures while 22 patents were issued to its researchers. Since 2006, 60 startups were launched from research conducted at the College. In 2016, the College was ranked 58th in U.S. News & World Report's "America's Best Colleges" ranking of undergraduate engineering programs, up from 70th in 2008. Meanwhile, the graduate program was ranked 60th in the country.

MULTIDISCIPLINARY RESEARCH CENTERS AND INSTITUTES

Biomedical Image and Data Analysis Center
Carbon Capture Multidisciplinary Simulation Center
Cardiovascular Research and Training Institute
Center for Controlled Chemical Delivery
Center for Engineering Innovation
Center for Extreme Data Management Analysis and Visualization
Center for Neural Interfaces
Center for Neuroimage Analysis
Center for Scalable Data Management, Analysis and Visualization
Center of Excellence for Biomedical Microfluidics
Energy & Geoscience Institute
Global Change & Sustainability Center
Institute for Clean and Secure Energy
Intel Parallel Computing Center
Intermountain Industrial Assessment Center
Manufacturing Extension Partnership
Nano Institute
NIH Center for Integrative Biomedical Computing
NSF Materials Research Science and Engineering Center
NVIDIA CUDA Center of Excellence
Scientific Computing and Imaging Institute
U.S.-Pakistan Centers for Advanced Studies in Water
University of Utah Robotics Center
Utah Center for Advanced Imaging Research
Utah Center for Interfacial Sciences
Utah Center for NanoBioSensors
Utah Center for Nanomaterials
Utah Center for Nanomedicine
Utah Center for System Integration
Utah Center of Trace Explosives Detection
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Marilyn K. Davies
Director Development
College of Engineering

John C. Sutherland
Chair - Industry Advisory Board
Assistant CIO
Brigham Young University

LIFE IN UTAH

There's a plethora of reasons why people are flocking to Utah to both work and play. From the rugged snow-capped Rocky Mountains that are home to some of the best skiing and hiking in the world to the heavenly landscapes of five national parks, Utah's scenery is an outdoor recreationalist's dream. Meanwhile, Utah and the stunning Salt Lake Valley are also the center of robust economic growth with one of the fastest-growing technology sectors in the country. Don't believe us? Utah and Salt Lake City have both received national accolades in recent years.

UTAH

#1 Best State for Employment — *U.S. News & World Report*
#1 America's Top States for Business — *CNBC*
#1 Best States for Business — *Forbes*
#1 Best States for Business — *24/7 Wall Street*
#1 Fastest-Growing Tech States — *Business Insider*
#1 Economic Outlook Ranking — *American Legislative Exchange Council*
#1 Most Entrepreneurial States — *NerdWallet*
#1 Top Destination in the World to Visit — *Fodor's Travel*
#1 Favorite Mountain Towns (Park City) — *Travel & Leisure*
#2 Best Business Climate — *Business Facilities Magazine*
#2 Economic Growth Potential — *Business Facilities Magazine*

SALT LAKE CITY

#1 America's 25 Best Cities for Young Professionals — *Forbes*
#1 Best Place to Start a Career — *CNBC*
#1 Best Cities to Start a Career — *WalletHub*
#3 Best Cities for Young Entrepreneurs — *NerdWallet*
#4 Most Attractive City — *Travel & Leisure*
#7 25 Best Cities for Jobs — *Glassdoor*
#10 Best Places to Live in the U.S. — *U.S. News & World Report*

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