ENGINEERING
Momentum
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NOWHERE TO HIDE

The end of privacy as we know it

Washington University in St. Louis

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New era in Engineering to begin at Washington University

"We are extraordinarily grateful to Jim Jr. and his family for their incredible history of generosity to the Engineering school. Particularly now, while we stand poised to truly transform our approach to research, innovation and learning, this new commitment will allow us to advance the McKelvey School of Engineering into the next tier of top engineering programs in this country and the world."

— Dean Aaron Bobick

Furthering its strong trajectory as a leader in research and innovation, the Engineering school at Washington University in St. Louis is taking a major leap forward and reaffirming its commitment to tackling the world's great engineering challenges with renewed vigor, an ambitious strategic vision and a new name.

The School of Engineering & Applied Science will be renamed the James McKelvey School of Engineering in honor of trustee and distinguished alumnus Jim McKelvey Jr., who has made an unprecedented and transformative investment in the school.

"The McKelvey name has become synonymous with innovation and entrepreneurship in the St. Louis region and well beyond," said Chancellor Mark Wrighton. "There is no better way to make a statement about what our Engineering school stands for than by giving it a name that represents being ahead of the curve and blazing a trail of creative problem solving through technology.

"This is a historic milestone for the university and comes at a perfect time — when we are sharpening our efforts to advance innovation and entrepreneurship, coupling science with technology in all fields from computer science to biomedical engineering and attacking global challenges such as energy and the environment. We are tremendously grateful to Jim for this investment, which expands the significant contributions the McKelvey family has made to this institution."

The commitment will be used to fund endowed scholarships and professorships, as well as the dean's highest priorities for advancing the school and its impact on lives and communities in St. Louis and around the world. In particular, the commitment will allow the school to create educational and research programs that integrate computing with the humanities, social sciences, arts and other disciplines, and it will support the school's effort to enhance the region's innovation and entrepreneurial ecosystem. In addition to major support for facilities, McKelvey Jr.'s past giving includes scholarships and general support for the Engineering school.

"Under the strong leadership of Dean Aaron Bobick, the Engineering school is positioned for true greatness, and this is the right time to step forward with this investment," McKelvey Jr. said.

"Engineering fields are moving at an exponential growth rate, and to keep up with that requires tremendous investment of resources: human, physical and financial."

— JIM MCKELVEY JR.

McKelvey Jr.'s family — including his wife, Anna; his father, James McKelvey Sr., an alumnus and iconic former dean of the Engineering school; his late mother, Edith McKelvey; and his stepmother, alumna Judith McKelvey, MD — has a long legacy of dedication to Washington University. "We are a Washington University family through and through," McKelvey Jr. said. "This university has meant so much to us, and it is my privilege to continue our role in providing for the Engineering school's future."

"This tremendous gift creates new opportunities for our students and faculty to tackle the world's greatest engineering challenges and to dramatically expand computing throughout the university. At the same time, it helps ensure that a diverse population of students will have access to a world-class engineering education and enable the school to be a catalyst for economic development for the St. Louis region and beyond," said Bobick, who also is the James M. McKelvey Professor.

About Jim McKelvey Jr.

Jim McKelvey Jr. is a successful serial entrepreneur and co-founder of Square, a revolutionary financial services and mobile payment company credited with empowering businesses of all sizes around the globe.

McKelvey Jr. is an independent director of the St. Louis Federal Reserve but is better known for his involvement in several St. Louis-based startups, including Six Thirty (co-founder), LaunchCode (founder), Third Degree Glass Factory (co-founder), Mira publishing (founded when he was a Washington University student), and Square, the company he founded in 2009 with Jack Dorsey. He also is the author of "The Art of Fire: Beginning Glassblowing," the leading textbook for novice glassblowers.

Jim McKelvey Jr.

As a child, McKelvey Jr. spent formative time at the Engineering school with his father during his tenure as dean. He applied early decision to Washington University and enrolled in 1983, graduating in 1987 with degrees in economics and computer science. While a student, McKelvey Jr. authored two computer programming textbooks.

In 2012, the Engineering school presented McKelvey Jr. with its Alumni Achievement Award to recognize his groundbreaking entrepreneurship. In 2017, the university recognized him with the Robert S. Brookings Award, which honors individuals for their extraordinary dedication and generosity to Washington University. In addition to currently serving as a university trustee, he also has served as a member of the Alumni Board of Governors.

Washington University in St. Louis
JAMES MCKELVEY SCHOOL OF ENGINEERING

Snapshot //

Computing large numbers of ion-channel trajectories at an atomistic scale is now possible with the help of artificial intelligence and machine learning. This image of different IKs cardiac ion-channel structures portrays the library of possible structures encountered during channel function. The trailing binary numbers represent the novel machine-learning approach used in the lab of Yoram Rudy in the Department of Biomedical Engineering.

SMIRUTHI RAMASUBRAMANIAN

From the dean //

Dear friends,

As every good engineer knows, no matter how good a plan, one always must be ready to adapt on the fly and find a new path as new constraints arise.

My original version of this letter focused on two elements of this edition. The first was a comment about the feature describing the challenges faced by some of our earliest African-American female Engineering students. I thought this was a fitting story given that in our last edition, we discussed the growth of the Women & Engineering program as well as continued efforts in achieving a gender and ethnic diversity in the school that reflects that of the country. My second mention was to be the story about privacy, AI and computing. The importance and urgency of these issues grows every day, and the work of our faculty in these areas highlights some of the challenges.

But just before this edition was to go to press, we publicly announced the renaming of the School of Engineering & Applied Science to be the James McKelvey School of Engineering, in recognition of a transformative gift by Jim McKelvey Jr. and his wife, Anna McKelvey. And, indeed, throughout this issue you will see the school referred to by its new name, or more colloquially as simply McKelvey Engineering. Ironically, there is brief coverage of Jim and his father, Dean Emeritus Jim McKelvey, at the groundbreaking for McKelvey Hall. Jim Jr. and Anna had originally provided the lead gift to name the new computing building in honor of Jim Sr., but the story has grown dramatically.

This is much more than a name change: There will be new opportunities and new aspirations. The title of the magazine — *Momentum* — says it all: The school is in motion and continues to grow in scale and impact. The next edition of the magazine will have extensive coverage of implications of this gift, including the potential strategic initiatives it will support.

But for now, enjoy the stories and news originally developed. Great work and learning are happening at McKelvey Engineering, and I know you'll enjoy hearing about it.

Aaron F. Bobick
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WINTER 2019

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THE BUZZ

#WashUengineers

Engineering project wins NASA prize

A collaboration between Washington University and Applied Particle Technology (APT), a company founded by university alumni, won the NASA Earth and Space Air Prize competition. The team received $100,000 to develop robust, efficient, durable and lightweight sensors that detect aerosols and monitor air quality in space and on Earth.

Society of Women Engineers shines at annual conference

"I really valued the opportunity to talk to so many companies and receive immediate positive feedback, sometimes in the form of an interview. The experience boosted my confidence, and I know in the future I will be even more comfortable approaching and interacting with companies."
— Julia Simpson, a junior chemical engineering student

Engineering's Communications & Marketing receives five CASE awards

The team recently won five awards in the Pride of CASE V competition, which includes universities in Illinois, Indiana, Wisconsin, Michigan and Ohio. The awards included Gold awards for *Engineering Momentum* magazine and for its electronic newsletter.

November snow at WashU!

Would somebody tell this student to get to class? They've been standing out here smiling for over an hour, and there's work to be done.

@WashUBME • Dec 12
Congratulations to Yoram Rudy, who was recently named a fellow of the National Academy of Inventors. Rudy was recognized for his "prolific spirit of innovation."

Mechanical engineering students win Gateway Arch design competition

A team of seven mechanical engineering students took first place in a student engineering design competition for the Gateway Arch, St. Louis' iconic monument.

BTW: WashU BME is now on Twitter @WashUBME

East End Transformation update

Looking east: View of Jubel Hall and the Sumers Welcome Center

Looking west: View of Jubel Hall and McKelvey Hall site

CyberPowered Home aims to save homeowners, utilities money, effort

Will Blanchard, who earned a bachelor's degree in computer engineering and in applied science in systems engineering in May 2018, credits his mother with the initial idea for a product to help enable microgrids, local energy grids that can operate in isolation from the grid. Blanchard, CEO and co-founder of CyberPowered Home, took the idea as fuel for thought, then collaborated with Engineering alumnus Allen Nikka late in 2017 to bring the idea into reality.

Over the past two years, the team has developed a patented smart breaker box designed to automatically sense, interpret and act on information about electrical use in a home. Such a box could save homeowners up to 25 percent on energy costs, while also benefiting electric utilities by allowing them to better manage demand for energy and ultimately streamline costs.

"We're living in the time of big data," said Nikka, who earned a bachelor's degree in electrical engineering at WashU in 2017 and is a graduate student at the University of California, Los Angeles. "Other systems claim to use data to calibrate for users' needs, but their scope is too limited, or they quite simply don't. We're trying to bring real-world data to bear on real-world problems."

With this contextual data, CyberPowered Home's product will, the team says, regulate appliances in the home to make homes more convenient and energy efficient for homeowners while offering residential demand management to utility companies.

Engineering alum Behnken to test flight commercial spacecraft

Engineering alumnus Bob Behnken has been chosen as one of NASA's astronauts who will fly American-made commercial spacecraft to and from the International Space Station.

Behnken, a St. Louis native who earned two bachelor's degrees in Engineering at WashU in 1992, was chosen as one of two astronauts to fly test flights on the Crew Dragon, designed by SpaceX. He is a flight test engineer and colonel in the Air Force and joined the astronaut corps in 2000.

Kim wins 2018 Doh Wonsuk Memorial Award

Doyoon Kim, a recent doctoral graduate in the Department of Energy, Environmental & Chemical Engineering, has been chosen to receive a 2018 Doh Wonsuk Memorial Award from the U.S. Chapter of the Korean Institute of Chemical Engineers. He will join the Massachusetts Institute of Technology for a postdoctoral research position.

Research comes full circle at International Aerosol Conference

Recently, more than 1,500 of the world's preeminent aerosol scientists gathered in St. Louis for the 10th International Aerosol Conference (IAC). Held every four years — and only every 12 years in the United States — the event took place Sept. 2-7 at the America's Center.

Pratim Biswas, chair of the Department of Energy, Environmental & Chemical Engineering, received the highest honor given to aerosol scientists, the Fuchs Award. The award is given out once in four years to a researcher who has made exemplary contributions in aerosol science and technology.

Washington University has one of the country's leading aerosol centers (Center for Aerosol Science and Engineering, or CASE), and its faculty in the McKelvey School of Engineering helped organize the program by presenting research and talks centered on aerosol science and engineering.

Written by Erika Ebsworth-Goold

Yang hosts Nature Communications photonics conference at WashU

Lan Yang (right), the Edwin H. & Florence G. Skinner Professor, hosted the global conference, sponsored by *Nature Communications*, a high-impact, peer-reviewed scientific journal that covers the natural sciences, such as physics, chemistry, biology and Earth sciences. In addition to photonics, the conference included sessions on topological effects in 2-D systems.

Groundbreaking held for James M. McKelvey Sr. Hall

A groundbreaking ceremony kicking off construction of James M. McKelvey Sr. Hall took place Sept. 28.

"I'm grateful for all that Dean Emeritus McKelvey has done to advance the stature and the impact of this school. For decades, he and his wife, Judy, have been deeply involved in the life of the university. Now, Jim McKelvey Jr., through his extraordinary support and dedication, is adding to this great family legacy," Chancellor Mark Wrighton said.

McKelvey Sr., a Washington University alumnus who served as dean for 27 years, led the effort to transform the McKelvey School of Engineering from a regional school to a nationally recognized research institution. McKelvey Hall will be located south of Preston M. Green Hall. While it will house the Department of Computer Science & Engineering, it also will include faculty spaces and labs from each of the school's five departments, promoting collaboration.

The building was made possible by a $15 million lead gift from McKelvey's son Jim Jr., who along with his father and family attended the event. McKelvey Jr. is an accomplished engineer, artist and entrepreneur, as well as a Washington University alumnus and a member of the university's Board of Trustees.

Written by Diane Toroian Keaggy

Changing how buildings are made

For eight months, seven students from the Sam Fox School of Design & Visual Arts and the McKelvey School of Engineering — with support from the International Center for Energy, Environment and Sustainability (InCEES) — used 3-D printing to design and fabricate elements of Lotus House, an energy-efficient prototype residence unveiled in August as part of Solar Decathlon China 2018.

Elevated attraction

Three WashU alumni — (from left) Anna Leavey, Eric Moraczeswski and Sarah Melinger — work for the Gateway Arch Park Foundation.

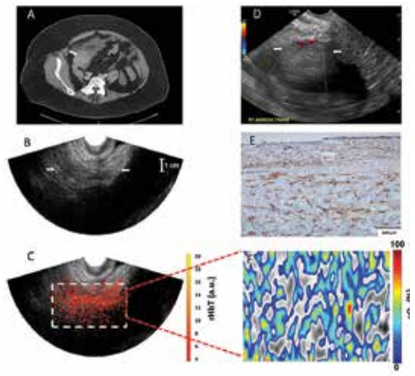
The nonprofit joined forces with local, state and federal entities, private donors and civic organizations to revitalize the Gateway Arch and the public spaces that surround it. So far, the foundation has unveiled a new visitor center and museum, installed new biking and jogging paths along the Arch grounds and launched new events such as the free Blues at the Arch concert series and

Arch Bark pet event. The foundation also has reimagined Kiener Plaza, adding a playground and splash pad, and made improvements to the riverfront.

WashU Racing team improves eight spots over 2017 at FSAE Michigan

The WashU Racing team made strides in improving its team in the Formula SAE Michigan competition May 9-12, moving up eight places from 2017 to finish 61st of 114 teams. Andrew Beukelman, vice president of WashU Racing, said heavy rain before the team's events led to slower-than-expected times. "We hope that with another summer of research and hard work, we will have an even better car than last year and hopefully we can continue moving up the leaderboard," Beukelman said.

‘Hopeful technology’ could change detection, diagnosis of deadly ovarian cancer



Quing Zhu, professor of biomedical engineering and of radiology, and a team of physicians and researchers at WashU’s School of Medicine recently conducted a pilot study using co-registered photoacoustic tomography with ultrasound to evaluate ovarian tumors on 16 patients at the School of Medicine and Barnes-Jewish Hospital. Results of the study are published online in *Radiology*.

“When ovarian cancer is detected at an early, localized stage — stage 1 or 2 — the five-year survival rate after surgery and chemotherapy is 70 to 90 percent, compared with 20 percent or less when it is diagnosed at later stages — stage 3 or 4,” said Zhu, a pioneer of combining ultrasound and near-infrared imaging modalities for cancer diagnosis and treatment assessment. “Clearly, early detection is critical, yet due to the lack of effective screening tools only 20-25 percent of ovarian cancers are diagnosed early. If detected in later stages, the survival rate is very low.”

In their approach, researchers use transvaginal ultrasound to obtain information about ovarian tumors, but ultrasound lacks accuracy in diagnosis of ovarian masses, Zhu said. Photoacoustic tomography, however, gives researchers a very detailed look at the tumor’s vasculature, or tumor angiogenesis, and blood oxygen saturation (SO_2) by lighting up the tumor’s vasculature bed and allowing for more accurate diagnoses of ovarian masses seen by ultrasound. Both tumor angiogenesis and tumor SO_2 are related to tumor growth, metabolism and therapeutic response. The WashU team is the only team using co-registered photoacoustic imaging and ultrasound to diagnose ovarian cancer.

New imaging technique to use bioinspired camera to study tendon, ligament damage

Tommy John surgery, or reconstruction of the ulnar collateral ligament (UCL) in the elbow, has been dubbed an epidemic among Major League Baseball pitchers. A mechanical engineer plans to develop a bioinspired imaging technique to study how damage accumulates in the UCL during loading, or the stress of activating the ligament. This could provide insight into what is progressively happening to these soft tissues when pitchers throw fastballs dozens of times during a game.

Spencer Lake, associate professor of mechanical engineering & materials science, is leading the research with a three-year, $388,541 grant from the National Science Foundation.

Building upon previous research that studied region-specific properties of the knee ligaments, the current project will shine light of a known polarization state off the surface of the UCL, then use the bioinspired camera to measure the properties of the reflected light. As the extreme aspects of the baseball pitching motion are thought to cause microdamage to the UCL, changes in light while the ligament goes through this motion can provide insight into how the UCL is injured.

NSF grants Chamberlain $1.2M to improve the efficiency of streaming computer applications

Roger Chamberlain, professor of computer science and engineering, received a $1.2 million National Science Foundation grant to improve the efficiency of streaming computer applications. His co-investigators, also in Engineering, are Jeremy Buhler, professor; Ron Cytron, professor; and Angelina Lee, assistant professor.

Agonafer receives $86,419 grant from Google

With a one-year, $86,419 grant from Google Inc., Assistant Professor Damena Agonafer will develop a prototype micropillar array in combination with a porous copper liquid delivery layer to promote evaporative cooling. Ultimately, the micropillar will measure 1 to 5 microns in diameter.

Bigger proteins, stronger threads: Synthetic spider silk

Spider silk is among the strongest and toughest materials in the natural world, as strong as some steel alloys with a toughness even greater than bulletproof Kevlar. Spider silk’s unmatched combination of strength and toughness have made this protein-based material desirable for many applications ranging from super thin surgical sutures to projectile resistant clothing. Unfortunately, due to spiders’ territorial and cannibalistic nature, their silk has been impossible to mass produce, so practical applications have yet to materialize.

Scientists have been able to create some forms of synthetic spider silk, but have been unable to engineer a material that included most, if not all, of the natural silk’s traits.

Until now.

Researchers have engineered bacteria that produce a biosynthetic spider silk with performance on par with its natural counterparts in all of the important measures. And they’ve discovered something exciting about the possibilities ahead.

The research, published Aug. 20 in *Biomacromolecules*, reveals that the tensile strength and toughness of spider silk remains positively correlated with its molecular weight — the bigger the molecule, the stronger the silk — even in synthetic silk with a weight nearly twice that of the previous record-holder.

“People already knew about this correlation, but only with smaller-sized proteins. We found that even at this large size, there is still a very good correlation,” said Fuzhong Zhang, associate professor.

Written by Brandie Jefferson

Moon and Dantas team receives $3.5M grant from NIH

Gautam Dantas and Thaddeus Stappenbeck, both at the School of Medicine, and Tae Seok Moon, at the McKelvey School of Engineering, received a $3.5 million grant from the National Center for Complementary and Integrative Health of the National Institutes of Health (NIH) to study how live bacteria can be used for drug delivery.

Pappu named 2019 Biophysical Society Fellow

Rohit Pappu, the Edwin H. Murty Professor of Engineering, will be honored along with the other BPS Fellows during the society’s annual meeting in March. The designation honors the society’s distinguished members who have demonstrated excellence in science, contributed to the expansion of the field of biophysics, and supported the Biophysical Society throughout their careers.

Making sense, pictures of medical data

To help patients better understand their health data and the risks and benefits of treatment options, the National Science Foundation has awarded a $174,254 grant to Alvitta Ottley, assistant professor of computer science and engineering and assistant professor of psychology and brain sciences at WashU.

“Lots of people are receiving test results, and they don’t understand them,” said Ottley. “They have to understand procedures and their risks, and then there are false positives and false negatives. My job is to take this somewhat complex statistical information and present it in ways people can understand.”

Ottley has worked on general visualization problems that ask how our individual psychology affects the way we receive information and make decisions. She has also built tools for facilitating communication between doctors and patients.

In this current project, however, the tools she is building are not for experts; they’re for patients with no expertise in medicine or statistics.

Written by Brandie Jefferson

Machine learning used for helping farmers select optimal products suited for their operation

Roman Garnett, assistant professor of Computer Science & Engineering in the McKelvey School of Engineering , has received a $97,771 grant from The Climate Corp. to apply active machine learning to help determine which hybrids have the probability of achieving maximum yield potential in every environment.

“By incorporating active machine learning, we can create a model that would offer a potential reduction in the footprint required for product characterization & commercialization and also provide valuable insights on predicted product deployment targets,” said Xiao Yang, placement advisement lead at The Climate Corp.

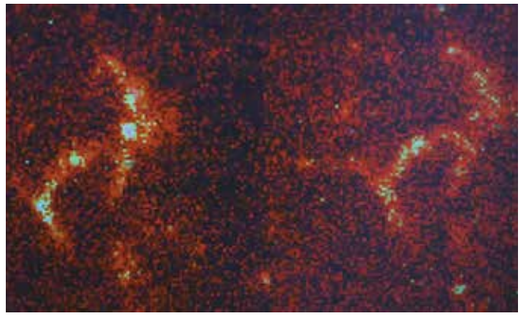
Role of cell group behavior target of $1.9 million award

Researchers have thought that cancer begins when a single cell goes rogue in the body then begins to grow and multiply. Now, they are investigating evidence of more damage when a group of cells breaks off from a colony and more follow, leading to large-scale metastasis.

Amit Pathak, a mechanical engineer who specializes in mechanobiology, plans to take a closer look at various aspects of cell group behavior with a prestigious five-year, $1.9 million grant for early-stage investigators from the National Institutes of Health (NIH). The Outstanding Investigator Award provides support for research that falls within the mission of the National Institute of General Medical Sciences Maximizing Investigators' Research Award (MIRA) program. The funding gives an investigator flexibility to conduct research without specific aims.

Pathak, an assistant professor in mechanical engineering & materials science in the McKelvey School of Engineering, plans to build on previous research into cell behavior in mechanically heterogeneous environments. His work centers around the epithelial-mesenchymal transition (EMT), or cells' transition from a group to independence. Epithelial cells, which are found in blood vessels and in the lining of various organs in the body, can change into mesenchymal cells, which are important in both embryonic development and cancer metastasis.

'Blink' and you won't miss amyloids



Tiny protein structures called amyloids are key to understanding certain devastating age-related diseases. Aggregates, or sticky clumped-up amyloids, form plaques in the brain, and are the main culprits in the progression of Alzheimer's and Huntington's diseases.

Amyloids are so tiny that they can't be visualized using conventional microscopic techniques. A team of engineers at Washington University in St. Louis has developed a new technique that uses temporary fluorescence, causing the amyloids to flash, or "blink," allowing researchers to better spot these problematic proteins.

"It has been pretty difficult, finding a way to image them in a non-invasive way — not changing the way they come together — and also figuring out a way to image them long-term to see how they clump and form larger structures," said Matthew Lew, assistant professor in the Preston M. Green Department of Electrical & Systems Engineering at the McKelvey School of Engineering. "That was the focus of our research."

Written by Erika Ebsworth-Goold

Chakrabarty earns Global Environmental Change Early Career Award from American Geophysical Union

Rajan Chakrabarty, assistant professor of energy, environmental & chemical engineering, has been selected to receive the 2018 Global Environmental Change Early Career Award from the American Geophysical Union. He was recognized for his substantive contributions to the award's three interconnected dimensions of research and educational and societal impacts.

In sync: How cells make connections could impact circadian rhythm

In research published Aug. 27 in *PNAS*, researchers at Washington University in St. Louis and collaborating institutions developed a unified, data-driven computational approach to infer and reveal connections in biological and chemical oscillatory networks, known as the topology of these complex networks, based on their time-series data. Once they establish the topology, they can infer how the agents, or cells, in the network work together in synchrony, an important state for the brain. Abnormal synchrony has been linked to a variety of brain disorders, such as epilepsy, Alzheimer's disease and Parkinson's disease.

Jr-Shin Li, professor of systems science & mathematics and an applied mathematician, developed an algorithm, called the ICON (infer connections of networks) method, that shows for the first time the strength of these connections over time. Previously, researchers could only determine whether a connection existed between networks.

Silva named fellow of the American Heart Association

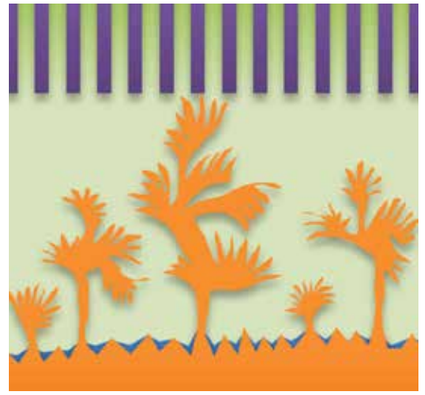
Jon Silva, associate professor of biomedical engineering, has been named a fellow of the American Heart Association. Silva's fellowship, granted by the Council on Basic Cardiovascular Sciences, recognizes and awards scientific and professional accomplishments, volunteer leadership and service.

Whiskers, surface growth and dendrites in lithium batteries

Lithium ion batteries already have a less-than-stellar reputation: think exploding cell phones or fires on airplanes. Beyond these existing problems, when researchers attempt to shrink these batteries without compromising the performance, the results are even more unstable and prone to short-circuiting; engineers have not been able to move past these issues.

Researchers at Washington University have new insights into the cause — or causes — of these issues, paving the way for smaller, safer, more energy-dense batteries. The result of their work was published online in the journal *Joule*.

Peng Bai, assistant professor of energy, environmental & chemical engineering, has identified three key current boundaries when



it comes to these energy-dense lithium metal batteries. It turns out, engineers had been looking for one solution to what turns out to be three problems.

Written by Brandie Jefferson

Focused delivery for brain cancers

New interdisciplinary research has shown a way to target drug delivery to an area of the brain using noninvasive measures, bolstered by a novel technology: focused ultrasound.

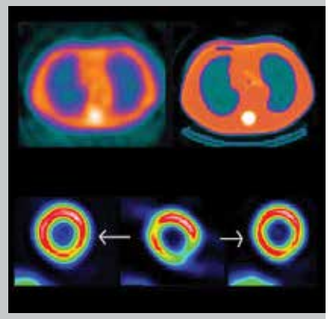
The research comes from the lab of Hong Chen, assistant professor of biomedical engineering in the McKelvey School of Engineering and assistant professor of radiation oncology at the School of Medicine. Chen has developed a novel way in which ultrasound and its contrast agent — consisting of tiny bubbles — can be paired with intranasal administration, to direct a drug to the brainstem and, potentially, any other part of the brain.

The research, which included faculty from the Mallinckrodt Institute of Radiology and the Department of Pediatrics at the School of Medicine, along with faculty from the Department of Energy, Environmental & Chemical Engineering, was published online this week and will be in the Sept. 28 issue of the *Journal of Controlled Release*.

Chen's technique combines Focused UltraSound with IntraNasal delivery (FUSIN). The intranasal delivery takes advantage of a unique property of the olfactory and trigeminal nerves: they can carry nanoparticles directly to the brain, bypassing the blood brain-barrier, an obstacle to drug delivery in the brain.

Written by Brandie Jefferson

Improving the imaging for coronary artery disease, America's No. 1 killer

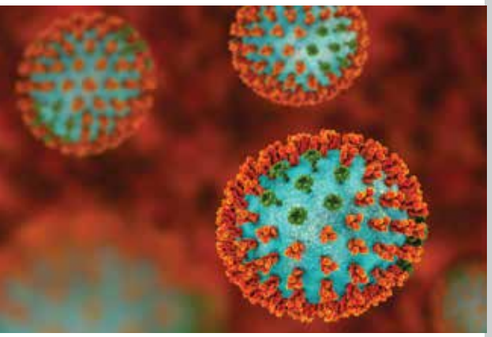


Abhinav Jha, assistant professor of biomedical engineering and of radiology in the School of Medicine, has received a two-year, $430,000 Trailblazer Award from the National Institutes of Health's National Institute of Biomedical Imaging and Bioengineering (NIBIB).

The Trailblazer Awards allow new and early-stage investigators to pursue research programs of high interest to the NIBIB that integrate engineering and the physical sciences with the life and behavioral sciences. Jha will collaborate with Richard LaForest, professor of radiology, and Thomas Schindler, associate professor of radiology in nuclear medicine, both at the School of Medicine.

Jha and his collaborators plan to develop a new method for attenuation and scatter compensation using only the data from the SPECT, eliminating the need for a CT scan.

Flu's clues: A new approach to studying influenza



Trying to attach fluorescent proteins to the molecules that make up a flu virus is like trying to get a third person on a tandem bike: There just isn't room. The fluorescent proteins are about the same size as the flu proteins; introducing such a relatively large element throws the virus out of whack.

A paper by Michael Vahey, assistant professor in the McKelvey School of Engineering, and Daniel A. Fletcher, the Purnendu Chatterjee Chair in Engineering Biological Systems and chair of bioengineering at the University of California, Berkeley, demonstrates that flu proteins can be tagged using a different method.

The process has already yielded information that hints to one advantage at minimum for having so many flu phenotypes, that is, various shapes and configurations found in genetically identical flu particles.

The paper was published Nov. 9 in the journal *Cell*.

"Under what circumstances is it adaptive, and how so?" Vahey asked. "This is a first step toward understanding that. But it's not a complete picture."

In order to move past the labeling difficulties, Vahey adapted a method that is typically used to label a specific area on a protein called, appropriately, "site-specific labeling." Instead of using a fluorescent protein, he inserted sequences five to 10 amino acids long into the proteins that make up influenza A virus. This is the most common flu virus and also the most dangerous to humans.

Written by Brandie Jefferson

In memoriam: I. Norman Katz

I. Norman Katz, longtime professor of electrical & systems engineering, died Tuesday, Jan. 15, 2019, in New Jersey. He was 86. Katz joined the university in 1967 as an associate professor in the Department of Applied Mathematics and Computer Science.

He was chair of the Department of Systems Science and Mathematics from 1987 to 2002 and was co-director of the BS program in Systems Science and Mathematics. Over the decades, he taught thousands of Engineering students to develop their reasoning and creative abilities and to think independently through dozens of courses.

"The school has a distinguished reputation in system science and analysis," said Aaron Bobick, James M. McKelvey Professor and Dean. "Professor Katz was critically important in developing that reputation and contributing to the rise of the school as both a research and education organization."

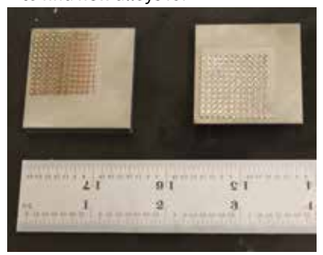
A New York native, Katz earned bachelor's and master's degrees in mathematics from Yeshiva University in 1952 and 1954, respectively, and a doctorate in mathematics from the Massachusetts Institute of Technology in 1959.

BRAIN Initiative grants Chen $2.7 million for neuroscience study

Hong Chen, assistant professor of biomedical engineering and of radiation oncology in the School of Medicine, has received a $2.7 million grant from the National Institutes of Health's BRAIN Initiative to develop a noninvasive neuromodulation tool that works on the cellular level and uses focused ultrasound, operating with high spatiotemporal precision. Chen is working across disciplines with Jianmin Cui, professor in biomedical engineering; Joseph Culver, professor of radiology, of physics and of biomedical engineering at the School of Medicine; and former WashU faculty member Michael Bruchas.

WashU materials scientists combine supercomputers, 3-D printers to create strong metallic alloys

Katharine Flores, professor of mechanical engineering & materials science, will build on some foundational work in high-entropy alloys — single-phase substances of five or more metallic elements in relatively equal parts — to find new alloys for structural, load-bearing applications, such as in aircraft, power generators and energy storage devices. Instead of the time-consuming trial-and-error method, Flores will work with Rohan Mishra, assistant professor of mechanical engineering & materials science, who will use quantum-mechanical computation to identify combinations of elements that have the most promise. Once identified, Flores will synthesize the alloys using a laser-aided metal-on-metal deposition technique to create a library of potential alloys for further testing.



With a three-year, $496,077 grant from the National Science Foundation, Flores and Mishra will use these methods to look for high-entropy alloys that can withstand high temperatures.

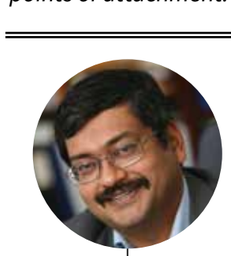
In the media //

npr

Bad Vibes: How Hits To The Head Are Transferred To The Brain

Phil Bayly, Department Chair and Professor

"What we saw, surprisingly, was that the brain wasn't colliding and bouncing against the walls of the skull, but it was pulling away from points of attachment."



CNN

Giant towers proposed to clean Delhi's toxic smog

Pratim Biswas, Assistant Vice Chancellor & Department Chair

"Delhi needs to focus on deploying effective air pollution control technology at the source."

FINANCIAL TIMES

Uber report looks to rebuild goodwill with regulators

Sanjoy Baruah, professor of computer science & engineering

"There is a strong likelihood that if testing on public infrastructure continues and other bad things happen there will be a strong consensus for developing some standardization or documentation for safe practices in the industry."

nature

Flu virus is a master shape-shifter

Michael Vahey, assistant professor of biomedical engineering

New antiviral therapies could be designed to target more than one surface protein and thus more effectively treat the flu virus.

AXIOS

State ballot measures on clean energy key to meeting UN climate goals

Dean Aaron Bobick

"But to address energy-driven environmental challenges, local, state, federal and even international authorities need to be aligned in pursuing climate-positive policies."

SCIENTIFIC AMERICAN

Creating Synthetic Silk from Microbes

Fuzhong Zhang, associate professor of energy, environmental & chemical engineering

Until now, however, the best engineered fibers have been only half as strong as the real thing.

Popular Mechanics

Will the Defiant Be the Helicopter That Finally Replaces the Black Hawk?

Swami Karumaoorthy, professor of practice

The strengths that the Defiant brings lies in that fact that it doesn't rely on one singular style of propulsion.

Setton's tenure as BMES president highlighted by landmark celebration, new award

Written by **DANIELLE LACEY**

After serving as president of the Biomedical Engineering Society (BMES) for two years, Lori Setton, the Lucy & Stanley Lopata Distinguished Professor at Washington University in St. Louis, is prepared to step aside.

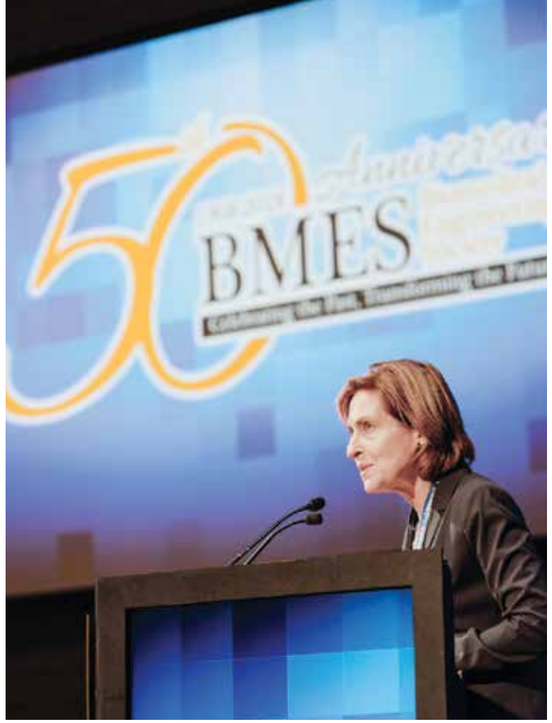
"Two years — plus the preceding president-elect period — is a good amount of time to achieve a few focused projects, and I think I did that." Setton said.

Setton joined the faculty at the McKelvey School of Engineering in 2015. In 2016, she was elected president of BMES, and in 2017, she was named chair of the Department of Biomedical Engineering. As president of BMES, she joins a prestigious group of biomedical engineers to serve in that role, including Frank Yin, MD, PhD, former department chair, who was BMES president in 2005-06 and has served on its board of directors.

Celebrating 50 years

With more than 7,000 members, BMES is the premier organization for biomedical engineering professionals in the United States. Not only did Setton need to manage the regular business of an organization that large, she also led the committee that organized the society's 50th anniversary celebration.

"BME and bioengineering emerged from communities of physicists, electrical engineers and mathematicians starting in 1968, who got together to talk about physiology and biology," she said.



Lori Setton speaks at the 2018 Biomedical Engineering Society's annual meeting in Atlanta.

> **"It really was extraordinary for these founders to find each other and to find a community of peers with whom they could share their passion and otherwise 'crazy' ideas."**

The yearlong celebration included special challenges, workshops and symposia, a time capsule donated by Clemson University and a digital timeline highlighting important moments in the society's history. Sponsored by Washington University, the timeline features photographs of people and events in the society's history. During the organization's 2018 annual meeting, the society hosted an anniversary reception for the organization's major contributors, including the Whitaker Foundation and Coulter Foundation.

According to Setton, both the timeline and the time capsule "generated unprecedented levels of interest in BMES and were a big leap forward for the society."

A new partnership

As part of a commitment to increase diversity and inclusion in the engineering student body, Setton signed a historic agreement with the National Society of Black Engineers (NSBE).

Under the terms of the arrangement, BMES will partner with NSBE to support the goal of graduating 10,000 black engineers by 2025, as well as offering discounted membership to NSBE members and supporting NSBE member travel to the society's annual meeting.

Already, the society has generated $60,000 in National Institutes of Health and National Science Foundation funding to increase the participation of minorities in the organization and another $35,000 from the United Engineering Foundation to develop materials for students in grades three through six from select regions across the country.

"No one is more excited to engage a broader constituency in biomedical engineering than our educators, employers and society leaders," Setton added.

Former presidents of BMES join to celebrate the 50th anniversary.

Recognizing rising leaders

And Setton is committed to identifying and preparing the industry's next generation of leaders. That's part of the reason she promoted the society's Mid-Career Award, which honors the achievements of academics 10 to 20 years into their careers.

"The mid-career period is when tomorrow's leaders will begin to emerge, those that are prepared to lead in the future," Setton said. "Everyone looked to the Mid-Career Award as a way for the society to identify those who can take all of us to the next level."

The award recipient receives free registration for the society's annual meeting, a crystal plaque, an honorarium of $5,000 and travel expenses up to $1,000.

Following her tenure as president, Setton will serve another term as past-president as a resource to the incoming president, Dawn Elliott from the University of Delaware. Her advice for the incoming president? Listen to her staff.

"They have the history and the breadth of experience to see where change is needed and to know how to make change," Setton said. "They need the support and empowerment that only the president can give."

WashU BME students, faculty and alumni connecting at BMES 2018 in Atlanta.

Bruno Sinopoli

Q&A with Bruno Sinopoli

Bruno Sinopoli, a renowned expert in cyber-physical systems and control systems, took over as chair of the Preston M. Green Department of Electrical & Systems Engineering in the McKelvey School of Engineering Jan. 1, 2019.

Q. What attracted you to McKelvey Engineering at WashU?

A. The energy and the opportunity for growth here in Engineering, as well as the tradition of the department, which is rooted in deep fundamental science on which engineering feeds. There is a commitment to growing and becoming a leading department and a leading school, and I've found that the faculty are very competent, enthusiastic and committed. Finally, it was the awareness that I can contribute to this growth. I'm looking forward to collaborating with other departments to complement the strength that we have in order to have a complete offering that can tackle today's and tomorrow's problems.

Q. What do you see are the strengths of the department?

A. The department comes from the union of engineering and applied science, with a great tradition and drive for impactful scientific achievements; I pleasantly found the faculty uncompromising from that regard. It is also within a school with resources to grow, and there is a very welcoming and collegial atmosphere.

Q. How do you envision growth for the department?

A. There is a lot of potential. The department has fantastic strength in several areas, including a number of faculty who are committed to the understanding of modeling and analysis design of large scale complex dynamical systems, and that has numerous applications to medicine — neuroscience, for example. There's also great strength at the photonics and nanomaterials level. Finally, the signal processing, communication and circuit faculty are taking traditional fields in new, exciting directions. We need to leverage the strength of the university and faculty in this department and with the medical school, biology department and all the other engineering departments. I think there's opportunity, too, for entrepreneurship with collaborations with the business school and with the economics department.

Q. What do you see are challenges for graduates of the department?

A. I think there are great opportunities. The world is changing, and technology is going to enable a number of applications and roles that do not exist today. That comes with challenges because the role of the electrical engineer is evolving dramatically, and I think it needs to adapt to this new world. Understanding such complexities requires a certain ability to distill knowledge, and that is what will distinguish the people who execute from the people who actually create. I would like our engineers to become leaders, and I think that is a challenge for the students but also a challenge for us as faculty to empower our students.

> "Most relevant problems are interdisciplinary at heart, so we're going to have to be able to talk to different groups of people that come from different domains and speak different scientific languages."

Q. What is your research focus?

A. I started working on problems of networked control systems with the goal of building systems that have more functionality, better performance and are overall more robust. With networked systems you have to worry about security because when you connect them, you offer an increased attack surface for malicious agents and attackers to intrude and create havoc. If we use computing and communication to control physical infrastructures, then attackers can compromise critical systems such as the power grid and our transportation system, and there's a lot of damage that can be done. I believe that, in this context, the risk is much higher than what we would encounter with simple cybersecurity because such infrastructures affect the lives of millions. As a consequence, a new paradigm is needed to deal with these problems.

Recently I've become interested in issues of social engineering. In particular, I wish to investigate the mechanisms of influence of people on each other. Nowadays several corporations have the power, with all the data they have, to understand these mechanisms and to further this understanding in ways that can really be beneficial to humanity.

Yes, he is from Italy!

Sinopoli earned a bachelor's in electrical engineering from Universitá di Padova in Padua, Italy. He earned a master's and doctorate in electrical engineering from the University of California, Berkeley.

Sinopoli comes to WashU from Carnegie Mellon University, where he was a professor in the Department of Electrical & Computer Engineering and co-director of the Smart Infrastructure Institute. He also had appointments in the Robotics Institute and in mechanical engineering.

NOWHERE TO HIDE

The end of privacy as we know it

Written by **BETH MILLER**

If you use the Internet or are one of the 3 billion people in the world who use a smartphone, you are generating data.

Every use of an app that provides directions, every phone call, every email and even how long you spend on social media is tracked and becomes data valuable to someone. Businesses pay social media apps such as Facebook and Instagram for data that reveals users' personal interests so they can place relevant ads in your feeds. For example, home chefs will see ads for kitchen tools and cookware, meal delivery services and the like, and those businesses make money when the user simply scrolls by the ad and even more if the user clicks through to learn more about the product or buy it. While this may be the new way to do business, it raises concerns of privacy and ethics. Who owns the data? What can others do with my personal data? How can I protect my data? Since this technology changes almost daily, the answers to these questions and many others remain unclear.

A NEW INDUSTRIAL REVOLUTION?

The exponential increase in computer-processing power, speed and storage, as well as the massive volume of data being created every second by millions of people and their devices, is described as another industrial revolution. From simple Google searches to online shopping to the 50 million smart speakers in use in the U.S., such as Amazon's Alexa and Echo and Google Home, each of these creates data. Some of this data creates benefits to society, such as access to nearly any kind of information from anywhere and improving health care, but also has a dark side: Cybercriminals can use your data to open credit card accounts or learn your running route. In addition, smart home devices generate data about your living habits, such as what times of day you use the most electricity and water, which gives clues about when you are at home and when you are not. Late last year, fitness app Strava discovered that its global heat map designed to show where it had the most users also revealed the locations of U.S. military bases worldwide, putting the military and those operations at risk.

At the 40th International Conference of Data Protection and Privacy Commissioners in Brussels last October, Apple CEO Tim Cook called for digital privacy laws in the United States to regulate the personal data companies collect from users. Cook said our personal information is being "weaponized against us with military efficiency," which has severe consequences.

"This is surveillance," he said at the conference. "And these stockpiles of personal data serve only to enrich the companies that collect them. This should make us very uncomfortable. It should unsettle us."

Ironically, Apple has a 14 percent worldwide market share of smartphones and holds one of the world's largest repositories of data. But there are concerns about how the tech giants use their data and how it is secured.

In April, Facebook CEO Mark Zuckerberg testified before Congress for five hours after British political consulting firm Cambridge Analytica gained access to nearly 87 million users' data from a Facebook app in an effort to sway political views. Zuckerberg told Congress that Facebook does not sell data to advertisers but allows advertisers to tell Facebook who they want to reach, then Facebook places ads in front of users who would be interested based on their personal data. In late November, news media reported that Facebook had discussed charging developers $250,000 annually for access to its platform application programming interfaces (API) to make apps that can ask users for access to their data. Facebook denied the claims. In mid-December, Facebook revealed it had given developers too much access to its users' photos for six days in September, affecting about 6.8 million users.

In October, Google revealed that between 2015 and March 2018, a software bug potentially exposed Google+ user information, such as name, email address, occupation, gender and age, to developers. Google later revealed that it chose not to inform its Google+ members fearing reputation damage and would only estimate the number of users potentially affected to be 500,000. But several weeks later, it revealed that an additional bug had exposed user data from about 52.5 million accounts for about six days.

On Nov. 30, in what may be one of the largest known data breaches, hotel chain Marriott revealed that up to 500 million guests at its Marriott Starwood hotels worldwide may have had their personal identifying information compromised. Since it was a global compromise, it also could be the first breach under the European Union's General Data Protection Regulation (GDPR), which establishes rules for how companies manage and share personal data and levies a substantial fine.

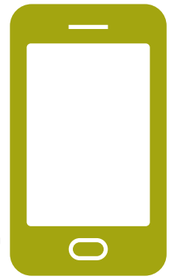
Automaker Tesla collects image and video data from its Model S and Model X vehicles to help it improve its autonomous-vehicle capabilities. The company did ask users for permission to collect the anonymized data, for which it built a cloud-based data infrastructure to process and use. McKinsey & Co. predicts that car data monetization will be as high as $750 billion globally by 2030.

With such leaks from the largest holders of data, can anything good come from collecting it? Computer scientists say it can.

> **"This is surveillance. And these stockpiles of personal data serve only to enrich the companies that collect them. This should make us very uncomfortable. It should unsettle us."**
>
> — TIM COOK, APPLE CEO

DATA

MACHINES



5 billion people have a mobile connection*

9 number of apps used per user per day**

30 number of apps used per user per month**

** VentureBeat 2017*

*** techcrunch 2016*

wearable health and fitness trackers have jumped in use among U.S. consumers***

9% in 2014

33% in 2018

**** Business Insider*

USING DATA FOR GOOD

Ning Zhang

Yixin Chen

Ning Zhang, assistant professor of computer science & engineering in the McKelvey School of Engineering, says users should have contextual privacy to their data.

"Users should be able to control when they share, what they share, with whom they share and under what conditions," he said. "I think that's what's being guaranteed by our work, which is called PrivacyGuard. This context is the key to enabling people's will and to incentivize them to share. Such transparency and confidentiality assurance will lead to a broader share of data to accomplish higher good to society."

Health care is one area in which big data has already been beneficial.

"In medical school, physicians learn theoretical analysis and rules," said Yixin Chen, professor of computer science & engineering. "Now we can collect a massive amount of data in the hospital and learn from it. With precision medicine, we can apply different doses and different treatment plans to different individuals. The future is to combine the strength of both ways."

> **"Such transparency and confidentiality assurance will lead to a broader share of data to accomplish higher good to society."**
>
> — NING ZHANG, ASSISTANT PROFESSOR

In the United States, our medical data is protected by the Health Insurance Portability and Accountability Act (HIPAA), but even that is not failsafe. Most recently, the Centers for Medicare & Medicaid Services announced Nov. 15 that the data of nearly 94,000 patients had been compromised by an attack on the website healthcare.gov in October. In 2017 alone, there were 359 health care data breaches reported. Stolen medical records can sell for up to $1,000 on the dark web, a hidden network of websites making up about 3 percent of the internet that requires special access. Criminals often buy and sell stolen data via the dark web, which uses encryption to keep their identities and locations hidden.

Breaches like these make it difficult for researchers such as Chen to share data with researchers at other institutions. He is working on a project to predict liver fibrosis in patients, but needs more data.

"We are trying to collaborate with other institutions that have more data so we could combine them into one big database," he said. "We see that the performance of a model will increase as you have more data, but we are facing some obstacles because of regulatory issues that prevent them from sharing their data."

Sanmay Das, associate professor of computer science & engineering, is using data to better understand human behavior to improve society. For example, he is collaborating with Patrick Fowler, associate professor in the Brown School, on a

project that uses artificial intelligence to better match homelessness services to households at the point of entry into the homelessness system. The project uses data from calls to a homelessness hotline in St. Louis and demonstrates the potential for reductions in future homelessness through better targeting of interventions.

> **“This ranges from vast amounts of data… This goes well beyond online shopping and Facebook.”**
>
> — SANMAY DAS, ASSOCIATE PROFESSOR

Das is director of the university’s new interdisciplinary Division of Computational and Data Sciences (DCDS) doctoral program designed to train students interested in disciplines that apply data and computing to some of today’s most important societal problems. In addition to the Department of Computer Science & Engineering, participants in the program include the Brown School, and the departments of political science and of psychological & brain sciences, both in Arts & Sciences.

“The motivation for DCDS is partly that we’re leaving digital traces and generating huge amounts of data about people and everything that we do,” Das said. “This ranges from vast amounts of data from neuroimaging studies to all the data collected through our online behavior and interactions. This goes well beyond online shopping and Facebook. For example, people trying to recover from opioid addiction may interact in online communities, giving us a unique lens on what kinds of strategies may work and how to support recovery.”

Ethical concerns also will be in the curriculum, Das said.

“What is the good and the bad of using this kind of data?” Das asked. “Could we be really infringing on people’s rights by having sentencing decisions being made on an algorithmic basis? I think to answer these questions you really need a transdisciplinary approach and need to understand all of these questions from the perspective of the people who are going to be designing, using and thinking about this kind algorithmic decision-making in society as a whole.”

Sanmay Das

Yevgeniy Vorobeychik

CAN BIG DATA BE CONTROLLED?

Short of discontinuing use of the internet, smart phones and social media altogether, individuals have a few options on how to protect their privacy, said Yevgeniy Vorobeychik, associate professor of computer science & engineering and an expert on security and privacy. Changing settings to determine who can see our activity is one way, but there is little we can do to prevent companies such as Facebook from using our data.

“Their entire business model is around getting highly detailed data about what you do on Facebook and off of Facebook and using that to help advertisers find you,” Vorobeychik said. “That’s how they make their money, and they’re going to presumably fight tooth and nail to preserve their business model because of it.”

Regulations similar to GDPR may not be the answer, Vorobeychik said. At the regulatory level, there has to be balance, he said.

“If you take GDPR to an extreme where companies have to ask permission to use every bit of your data and can’t share it without your express permission, that could prevent good things from happening, for example, clinical research,” Vorobeychik said. “Secondary analysis of clinical data could be valuable. Someone could use it and show that there’s a particular drug that happens to be associated with preventing cancer. That is ambiguously a good thing that you could potentially prevent by having very strict data regulations.”

As an individual, we can opt out of spam email, Vorobeychik said, but this assumes compliance on the part of the sender. But from a social perspective, what should be regulated and how?

“You may be OK with Facebook using your data, but you may be a lot less OK with Facebook selling your data to a health insurance provider who can subsequently use it to indirectly discriminate against you in some way,” he said. “We have no idea if this is happening, because people are not transparent about what they are selling and to whom.”

83%

of enterprise workloads will be living in the cloud by 2020*

** Forbes 2018*

41%

will be on public cloud platforms offered by companies such as Amazon, Google, IBM and Microsoft*

THE FUTURE

In November, an Amazon Echo smart speaker was called as a witness to a double homicide in New Hampshire. A state judge ordered Amazon to turn over the device’s recordings, but Amazon has not yet determined whether it will comply. In a separate murder case in Arkansas in 2015, Amazon initially objected to police’s request for Amazon Echo recordings but eventually conceded.

Cases such as this one raise even more questions about the future of big data, privacy, security, policy and ethics. One question still unanswered is who owns our data — does it belong to each individual, or does it belong to the holder? Sometimes the details are in the company’s privacy agreements.

“Once your data is uploaded to a cloud, often the data is owned by whoever runs it,” Zhang said. “Oftentimes it’s not transparent to us, so transparency is also a key item in privacy. But if we are able to achieve transparency, which leads to broader share of data to accomplish higher society good, then there is this economic value drive that may be able to far offset the drop out of implementing the system.”

Das said the world is becoming more of an algorithmic decision-making society, as evidenced by China’s dystopian Social Credit System, a mass surveillance network monitoring its 1.4 billion citizens and using it to assign individual trust scores to people and businesses. The system’s 200 million closed-circuit cameras are connected to a facial-recognition system as well as financial, legal and medical records to make decisions about a person’s or business’ social credit.

> **“Once your data is uploaded to a cloud, often the data is owned by whoever runs it. Oftentimes it’s not transparent to us, so transparency is also a key item in privacy.”**
>
> — NING ZHANG, ASSISTANT PROFESSOR

Ultimately, making the most of big data will require balance.

“There is a sense in which we can try to understand how to make better policy by looking at existing data to see how current policy works and think there are counterfactuals about how policy would’ve worked on the goals that we’re trying to achieve otherwise,” Das said. “The question becomes how do we balance this with privacy, security and fairness. I’m bullish on the possibility for data to achieve good outcomes, but I’m a bit worried about the unfettered nature of it, especially when you’ve got powerful players who could really benefit by doing things that perhaps we as a society don’t want to see happen.”

Jessica Wagenseil

Changing the approach

Wagenseil uses mechanics to identify heart disease

RON KLEIN

Written by **JUDY H. WATTS**

Arterial stiffness. Hypertension. Atherosclerosis. Diabetes. These stubborn diseases are as potentially lethal as they are rampant. They disrupt the body's systems, including the life-supporting arteries that circulate blood. In the presence of disease or genetic mutations, the coronary arteries struggle to adapt, altering the exquisite biomechanical interplay meant to ensure efficient performance for a lifetime.

Through her basic research on cardiovascular mechanics, often conducted collaboratively with colleagues in the McKelvey School of Engineering and at the School of Medicine, Jessica Wagenseil is constructing an intricate knowledge system. Experiment by experiment, scientific paper by paper (more than 40 have been published to date), Wagenseil is assembling insights into how changes in the different mechanical properties of the large arteries, such as stiffness, are related to disease, and how arteries develop and remodel to provide optimal performance. Her work on these frontiers will very likely point to new and more effective treatments for cardiovascular disease.

One of Wagenseil's discoveries related to elastin has overturned longstanding medical thinking.

Wagenseil earned a bachelor's of science in bioengineering from the University of California, San Diego.

Wagenseil earned a doctorate of science in biomedical engineering from Washington University in St. Louis

Wagenseil is involved with Girls on the Run in the St. Louis community and is an avid runner — rain or shine.

Wagenseil joined the Mechanical Engineering & Materials Science (MEMS) faculty as an associate professor in 2013. Ten years earlier, Robert P. Mecham, the Alumni Endowed Professor of Cell Biology and Physiology and professor of medicine, of pediatrics and of biomedical engineering, sat on her dissertation committee in part because he worked on vascular biology. Afterward, he invited Wagenseil to be a postdoctoral researcher in his lab.

"I thought it would be a great idea for her to help us learn some engineering," he says, "and in the meantime, we'd provide biological models for her to learn some vascular biology."

Along the way, Wagenseil became interested in the body's ubiquitous stretchy protein elastin, which is reversibly elastic and, along with collagen and more than 40 other proteins, makes up the artery wall.

One of Wagenseil's discoveries related to elastin has overturned longstanding medical thinking. For decades, professionals believed that hypertension and stiffness in artery walls worsen atherosclerosis by creating additional plaque buildup, which can lead to heart attack, heart disease or stroke. But in a National Institutes of Health-supported 36-week study of mice, which were fed the typical high-fat Western diet, Wagenseil showed that while high blood pressure and artery stiffness often co-exist with plaque, they do not directly cause it. Instead, damaged elastin in the form of fragments in the artery wall appears to be the risk factor for plaque accumulation.

"Without elastin fragmentation, hypertension and arterial stiffness have no effect on plaque buildup," Wagenseil says.

Published in the journal *Atherosclerosis*, Wagenseil's findings could change the scope of how heart disease — still the world's leading cause of death for both women and men — is identified and treated.

In addition, Wagenseil and Mecham are investigating vessel stiffness, hypertension and remodeling of the vessel wall.

BROCK RUSSELL

Watch the Wagenseil lab video: engineering.wustl.edu/magazine

COURTESY PHOTO

Jessica (center) in 2003 with her mentors Frank Yin, MD, PhD, former chair of the Department of Biomedical Engineering, and Ruth Okomoto, senior research associate in the Department of Mechanical Engineering & Materials Science

"We're interested in what's happening in the artery wall, what proteins are being laid down, and how and whether we can interfere with the process to prevent stiffening and the associated hypertension," Wagenseil says. Related questions include how cells know how much elastin to make, where to put it and when to start and stop.

Mecham says his collaboration with Wagenseil provides insights that would be unattainable without including the complexities of mechanical forces in his investigations.

"The interesting intersection between my background in cell biology and Jessica's background in mechanics represents an interface that can be difficult for some researchers from entirely different disciplines to achieve," he says.

Wagenseil also investigates arterial development with funding from the National Science Foundation. Using models of genetic diseases, she studies the processes that give large arteries their unique mechanical properties, including how cells lay down elastin in a formidably complicated assembly process during the early months of life. For example, she recently published a paper with Larry Taber, senior professor of biomedical engineering, showing that when blood flow in a developing chicken embryo is reduced, cells sense the change and alter the way they make the artery wall, laying down less elastin than they would otherwise. Wagenseil is seeking funding for further developmental studies despite reduced federal funding for basic research that has persisted for more than a decade.

All of Wagenseil's ambitious basic research is crucial to her future discoveries. It may be transformative for the undergraduate and graduate researchers brimming with ideas and enthusiasm in professors' labs and important for students in their classes and seminars. And through an outreach program Wagenseil runs with her former mentor, MEMS Senior Research Associate Ruth Okomoto, her new knowledge even reaches children in middle school and may spark a lasting interest.

Dual Degree students

make it TWO

While earning a bachelor's degree is an accomplishment in itself, earning one in three years and a second one in an engineering field in two or three additional years is even more challenging. But in the McKelvey School of Engineering, more than 250 students are doing just that — and three-fourths of them choose to earn a one-year master's degree, as well, ultimately earning three degrees in six years.

Written by **BETH MILLER** *Photos by* **DEVON HILL**

"I love that I spent three years getting a math degree, and now I get to do what I've been wanting to do since the beginning and use my math degree to have a deeper understanding of mechanical engineering."
— Taylor

TAYLOR TULEJA

Second year at WashU

BS, Mathematics, Hawaii Pacific University, Honolulu

BS, Mechanical Engineering; MS, Aerospace Engineering, WashU

Hometown:
Palos Verdes, California

Activities: President, WU Design-Build-Fly; WUTA; teaching assistant in fluid mechanics course; externship at Spartan Light Metal Products; summer internship at Brookhaven National Laboratory.

Career plans:
Get a doctorate

CYRUS "KK" KIRWA

Second year at WashU

BS, Chemistry, Drury University, Springfield, Missouri

BS, Chemical Engineering; MEng, Energy, Environmental & Chemical Engineering, WashU

Hometown:
Nakuru, Kenya

Activities:
Track and Field, Drury University

"The resources that are available to the students played a key role; in terms of research, internships and co-ops. Students are put in a position where they can achieve their goals and become successful."
— KK

252
current dual degree students

38
states represented

74
schools represented

1,800
alumni in 45 years

DUAL DEGREE PROGRAM

These students have taken advantage of the 45-year-old Dual Degree program, in which students attend a liberal arts college or university for three to four years earning a bachelor's degree, then come to Washington University in St. Louis to earn a second bachelor's degree in engineering. The program — one of a handful in the U.S. — is growing increasingly popular each year. For the class entering in fall 2018, there were a record-breaking 121 new Dual Degree students. The previous record was 89 in one year, said Ronald Laue, assistant dean and coordinator for the program.

"These students are risk takers and more willing to step outside of their comfort zone. They want to grab every bit of it for the short amount of time that they are here."

Academically, they are also on par with Engineering students who began as freshmen.

Currently, McKelvey Engineering at WashU is affiliated with 100 liberal arts schools nationwide, but since the program's beginning in the early 1970s, students have come to the program from 175 different affiliated schools. More students have entered the program from Nebraska Wesleyan University and Grinnell College in Iowa than from any other schools.

Laue said the Dual Degree students assimilate more quickly into the WashU community because they already have at least three years of college experience.

"This group brings a wonderful perspective to our engineering community as a whole," he said. "At WashU, yes, we have a great location, we have great facilities and we have so many resources coupled with the outstanding academic reputation. But in the end, it's really the people who make for a great community, and the Dual Degree students add so much value to all of our daily experiences, and we appreciate them for that."

First year at WashU

OLUWAKEMI (PRECIOUS) FANIYI

"I love the fact that you get to experience college twice in two different ways. We get to experience the small liberal arts education but also a larger university. I also like that WashU offers so many research opportunities that the liberal arts schools don't offer."
— Precious

BS, Biology, minors in applied mathematics and sculpture, Jacksonville University, Jacksonville, Florida,

BS, Biomedical Engineering, minor in electrical engineering, WashU

Hometown:
Rochester, Minnesota

Activities:
Working in the Center for Cellular Imaging lab at the School of Medicine; president of the National Society of Professional Engineers at Jacksonville

Career plans:
Get a doctorate and work in a medical research lab

Second year at WashU

JOHN FORDICE

"I'd make the same decision again. It has benefitted me in so many ways. It's a value-trade, having the skills to get a job that I enjoy rather than being in a chemistry lab for the rest of my life. I would make the same value trade-off every time."
— John

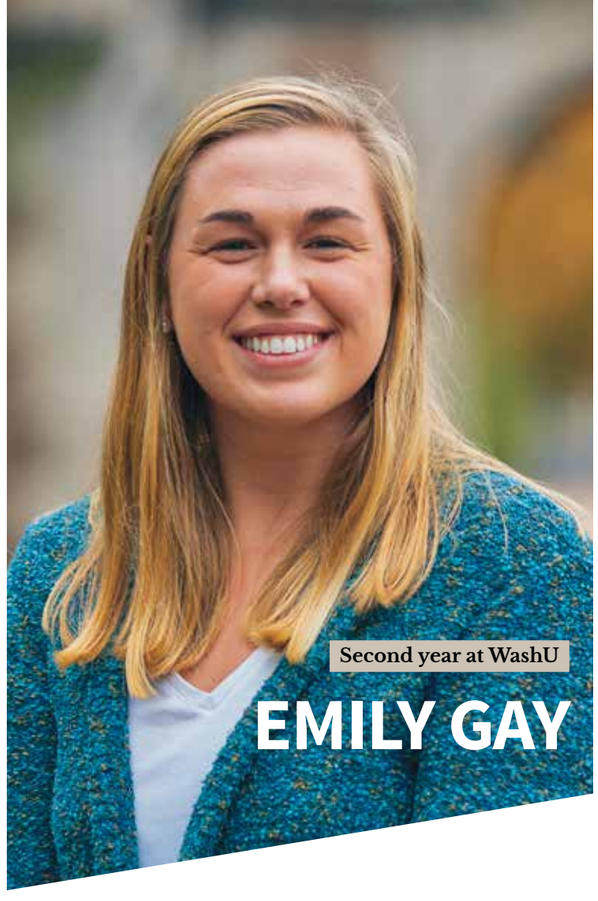
BS, Chemistry, Pacific Lutheran University, Tacoma, Washington

BS, Systems Science & Engineering, WashU

Hometown:
Tacoma, Washington

Activities:
Internships at Tesla and Smartsheet

Career plans:
Find a job in New York City after graduating in December 2018



Second year at WashU

EMILY GAY

"The Dual Degree program is a pretty small group of students, and we all support one another. Any second- or third-year is always willing to take time to give advice to a first-year no matter what is going on in his/her life. It is so nice to have a group of people who are in the same situation as you and want you to be successful."
— Emily

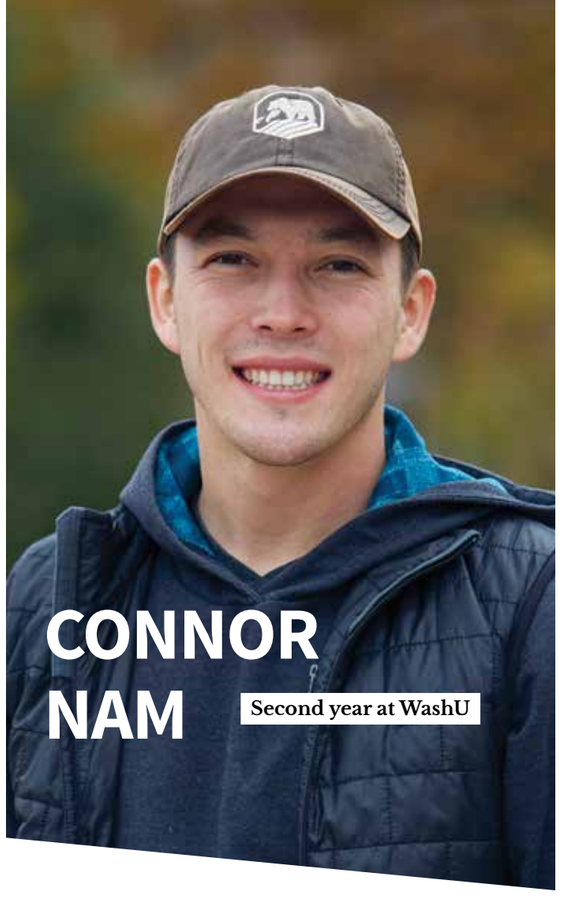
BS, Chemistry, Sewanee: The University of the South, Sewanee, Tennessee

BS, Chemical Engineering, WashU

Hometown:
Richmond, Virginia

Activities:
Leadership Society of Women and Engineering; one summer internship at Tredegar Corp. and three summers at WestRock Corp. in Richmond, Virginia, in research and development; Varsity swimming at Sewanee

Career plans:
Run plant engineer, Dow Chemical Co. in Plaquemine, Louisiana



CONNOR NAM

Second year at WashU

"WashU offers a unique combination of attributes, including a top-notch education, exposure to top companies, a strong support system and built-in community through the Dual Degree Program. These qualities were my top priorities as I evaluated my goals both for my career and my continued educational experience."
— Connor

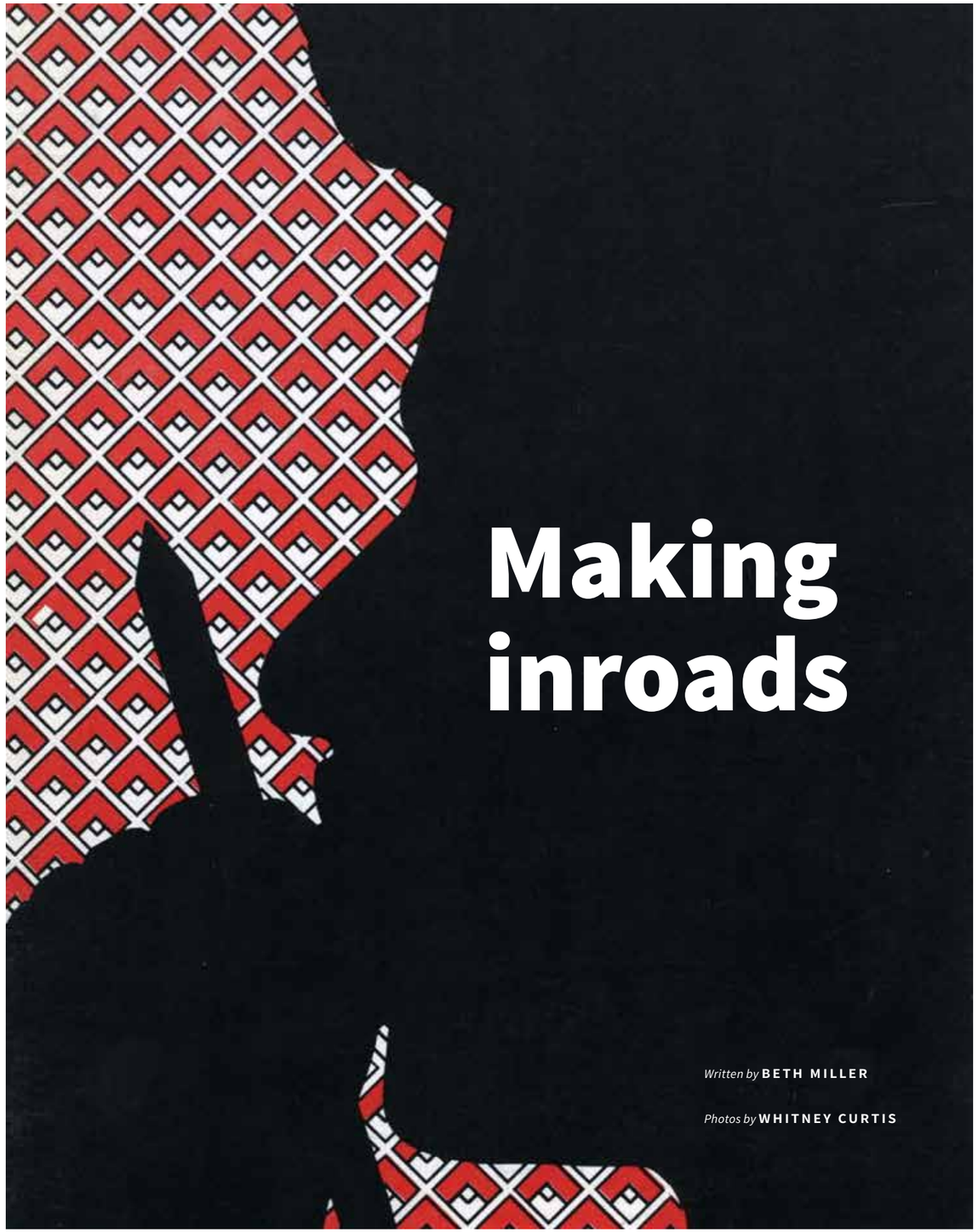
BA, Natural Science with minors in physics and computer science, Pepperdine University, Malibu, California

BS/MS, Electrical Engineering, Graduate Certificate in Data Mining and Machine Learning, WashU

Hometown:
Scottsdale, Arizona

Activities:
Summer internship at SpaceX; two summer internships at NASA Glenn Research Center

Career plans:
Work at SpaceX



Making inroads

Written by **BETH MILLER**

Photos by **WHITNEY CURTIS**

While engineering is a challenging discipline for anyone, some of the earliest black students in the McKelvey School of Engineering — both male and female — often experienced an unlevel playing field. For some of the female students, having to fight harder for their education while overcoming obstacles of racism and an unwelcome environment strengthened their resolve to earn their degrees, which led them to successful careers and prepared them to face hostile work environments.

The following five women were among the earliest black engineering students, and each has a similar story of developing a fighting spirit to earn her degree. While there were some resources for black Engineering students in the early 1970s, black students said they often felt excluded. The Black Student Union's Black Student Guide indicated there would be "apathetic and hostile environments," but encouraged black students not to lose sight of their purpose: getting a good education.

Although Washington University began recruiting black students as early as 1963, it did not require students to indicate their race or ethnicity until 1979, so it is unclear when the earliest female black engineering students graduated. The earliest female engineering graduate on record is Gracie Mae Sanders, who earned a degree in applied math & computer science in 1970.

From left: Kathy Miller Mapp, Sandra Massey Townsend, Nancy Spears Hamilton, Hazel Donald and Kim Jefferson Simmons

Cover of the WashU Black Student Union's Black Student Guide from the 1970s.

Kim Jefferson came to WashU in 1974 at the urging of her father. She quickly realized she was the only black student in her classes and fitting in would not be easy.

"I didn't know any students in my engineering classes, and they were not interested in bringing me into their circle," said Jefferson, now Simmons, who earned a degree in systems science & mathematics in 1978.

Simmons said she felt that black students were overlooked — she saw an adviser only once in four years — but what she learned from her experience at WashU was invaluable.

"It made you a better fighter because you had to fend for yourself," she said.

Fending for oneself was a common theme among

"I worked for my degree. No one gave me a pass, and no one was easy on me, so I wear it proudly."

— SANDRA MASSEY TOWNSEND

these women. Sandra Massey, now Sandra Townsend. came to WashU in 1974 after graduating from Sumner High School in St. Louis. At the end of her first year, her adviser expressed surprise at how well she did in her math and chemistry classes and suggested she change her major from pre-med to chemical engineering. But when she tried to enroll for her third year, she was prevented from registering and getting financial aid: An administrator had placed a note in her file predicting that based on her background, she would not make it past her second year and not to allocate financial aid for her.

"That was devastating — it was a life-changing event," she said. "I gathered my report cards and everything I had to prove I had not failed a course. There wasn't anyone to go to for help."

Townsend stayed the course and was vice president of the Engineering Council her senior year before earning a bachelor's in chemical engineering in 1978.

Finding a community

Coming to WashU as a married dual-degree student from Carleton College and having attended predominantly white schools since fifth grade, Hazel Donald's experience was somewhat different. The Society of Black Engineers (SOBE) was started in the mid-1970s to meet the need for community and support among black students in Engineering, which she found was lacking.

"You did feel an anomaly because you were," Donald said. "But because I was married and older and had already had a good experience at Carleton, it helped me not worry about it as much. I had a built-in support group in my husband, who also was a dual degree Engineering student. If I had come fresh from high school in Boston, I don't think that I would have chosen engineering because it wasn't so welcoming — in fact, it was downright hostile."

Townsend, Simmons and Donald met — and became lifelong friends and godparents to each other's children — through SOBE, which was later folded into what became the National Society of Black Engineers (NSBE), a nationwide group of black engineering societies that has a vibrant WashU chapter. SOBE was instrumental during their time at WashU, Townsend said.

"If we didn't have SOBE, there was no way I could have stayed," Townsend said. "There wasn't a place for us that felt comfortable to socialize or to get into study groups. You didn't feel welcome to do that. SOBE gave us that place to go and help us to navigate through everything."

Katherine Miller, now Mapp, came to WashU in 1969 from Carver High School in Memphis, Tennessee, and found her own support system in applied math & computer science. Her engineering study partner was Lewis Price, another black student.

"An electrical engineering professor used to tell us that with our background, there was no way we would make it out of WashU School of Engineering," Mapp said. "I think Lewis and I took that as fuel for the fire to show them that we were going to graduate."

"It was important for me to be successful, not only for me, but also for my family. I was the first one in my immediate family to graduate from college."

— NANCY SPEARS HAMILTON

Nancy Spears, now Hamilton, who came to WashU from predominantly white Kirkwood High School, said her adjustment to WashU was likely easier for her than for other black students.

"My biggest issue was the black students, because I felt different and misunderstood," she said.

But that didn't get in the way of her purpose: to earn a degree in applied math & computer science.

Successful careers

All of these women — and many of their peers — persevered through their WashU experience during a turbulent time in the nation and the world and implementation of affirmative action policies designed to end discrimination.

Hamilton graduated in 1974 with more than a dozen job offers and went to work in information systems management at Southwestern Bell Telephone Co., now AT&T, retiring in 2003 as a chief of staff in industry markets.

Mapp graduated in May 1973 and went to work at Ralston Purina working with mainframe computers. She retired from Nestlé Purina 41 years later, and remains active with WashU's Black Alumni Council and returns for Thurtene Carnival annually.

Townsend held several positions, including 19 years at Monsanto as a chemical engineer in the plant and progressed to several management positions in manufacturing, at IBM as a systems engineer, as a business consultant for the city of St. Louis and participated as owner/operator of a McDonald's franchise with her husband. She has owned a The UPS Store franchise for 14 years.

Donald graduated in 1977 with a degree in systems science & mathematics from WashU and a degree in mathematics from Carleton College, then returned to WashU to earn a master's in teaching in 1991 and taught math in local private schools.

Simmons graduated in 1978 with 14 job offers. She joined Southwestern Bell, where she worked for 35 years, and owned a Massage Envy franchise for 10 years.

"All things being said, we are where we are today because we had a good education," Simmons said. "We earned a degree from WashU, which was impressive to a lot of companies."

10.5%
University-wide black students in Fall 2018

3.75%
Percentage of black graduates in Engineering in the 1980s

4.36%
Percentage of black graduates in Engineering in the 2010s

NSBE was founded in 1975 with the mission "to increase the number of culturally responsible Black Engineers who excel academically, succeed professionally and positively impact the community."

Kim Jefferson Simmons

Graduated in 1978 with a BS in systems science & mathematics

Had more than 14 job offers and worked at Southwestern Bell Telephone Co. for 35 years

Hazel Donald

Graduated in 1977 with a BS in systems science & mathematics and in 1991 with an MA in teaching

Taught math in local private schools

Sandra Massey Townsend

Graduated in 1978 with a BS in chemical engineering

Spent 19 years at Monsanto as a chemical engineer

Nancy Spears Hamilton

Graduated in 1974 with a BS in applied math & computer science

Had more than a dozen job offers and spent her career at Southwestern Bell Telephone Co.

Kathy Miller Mapp

Graduated in 1973 with a BS in applied math & computer science

Worked on mainframe computers at Ralston Purina (now Nestlé Purina) for 41 years

School celebrates alumni for service and achievements

The 2018 Alumni Achievement Awards were held March 31 at the Saint Louis Art Museum. From left: Vincent Belusko, Cedric Yu, Michele Liebman, Jan Holloway, Nathalie de Vos Burchart, Steve Lowy

WHITNEY CURTIS

Young Alumni Award

Nathalie de Vos Burchart

Nathalie de Vos Burchart began her career at ExxonMobil as a crude oil distillation process contact engineer. In 2006, she co-founded BioUrja Trading LLC, now a globally recognized physical commodity trading firm that also supplies petroleum products, crude oil and natural gas. Since 2009, she has invested in residential real estate through her current company, Heathwood Enterprises Ltd. She earned a bachelor of science degree in chemical engineering in 2004 from WashU and an MBA from the University of Texas at Austin.

Alumni Achievement Award

Vincent Belusko

Vincent Belusko's practice at Morrison & Foerster focuses on patent litigation, trademark, copyright and related matters. He is unbeaten in more than 25 intellectual property cases during the past five years. He is admitted to practice in all California district courts, the U.S. Courts of Appeals, the U.S. Supreme Court, and before the U.S. Patent and Trademark Office. Belusko earned a bachelor of science degree in civil engineering from WashU in 1978 and a juris doctor from George Washington University Law School.

Steve Lowy

Since 1994, Steve Lowy has been chairman of Envision LLC, a computer services firm targeting Fortune 500 companies. In 1999, Lowy bought Quatrix, also an information technology consulting firm. Under his leadership, Envision has more than tripled sales and opened two new offices with more than 250 employees. From 1970 to 1994, he was president of the family's floor covering business, Lowy Enterprises Inc. Lowy earned bachelor's and master's degrees in chemical engineering from WashU in 1968 and 1970, respectively.

Cedric Yu

Cedric Yu is the Carl M. Mansfield, MD, Professor in Radiation Oncology at the University of Maryland School of Medicine and the co-founder and CEO of Xcision Medical Systems LLC. He is the co-inventor of Xcision's GammaPod, a high-precision, image-guided radiation therapy system designed to treat early-stage breast cancer. He earned an electrical engineering degree from Tianjin University in China, then earned a master's and doctorate in electrical engineering from WashU in 1985 and 1989, respectively.

Dean's Award

The McKelvey School of Engineering established Women & Engineering as a means for engineering alumnae to support each other, mentor female students and support STEM outreach to female students of all ages. Jan Holloway and Michele Liebman established the first Women & Engineering Challenge Fund to inspire other alumni and friends to support diversity, encourage a strong community to enhance the experience of female students during their time on campus and provide additional opportunities for their development and growth.

Jan Holloway

As senior vice president, chief of staff and community relations of Monsanto Co., Holloway oversees the multinational company's community relations activities and business services organization and manages the office of the chairman and CEO. She has been named among the *St. Louis Business Journal's* 25 Most Influential Women in Business and the YWCA Leader of Distinction. She earned a bachelor of science degree from Augusta College and a master of science degree in applied mathematics and computer science from WashU in 1983.

Michele Liebman

Liebman was named principal at Edward Jones in 1994, and her role expanded in the firm's intranet and client reporting. She led the effort to evaluate, select and implement the St. Louis headquarters' first office automation software, satellite vendor and integrated usability lab techniques. When she retired in 2014, she was responsible for the firm's banking operations. Liebman earned a bachelor's in technology and information management from WashU in 1986 and an MBA from Southern Illinois University at Edwardsville.

LEADING TOGETHER: 2009-2018

Campaign impact report

"Remarkable students learning from and working with world-class faculty in state-of-the-art facilities. It's who we are. And none of this is possible without you."

Thank you for believing in us, for supporting us and for making this unprecedented success a reality. From solving fundamental problems of the world today to preparing students for the world tomorrow, we lead together with you and continue to be inspired by you.

— Dean Aaron Bobick

Campaign: Engineering impact

119
new annual scholarships established

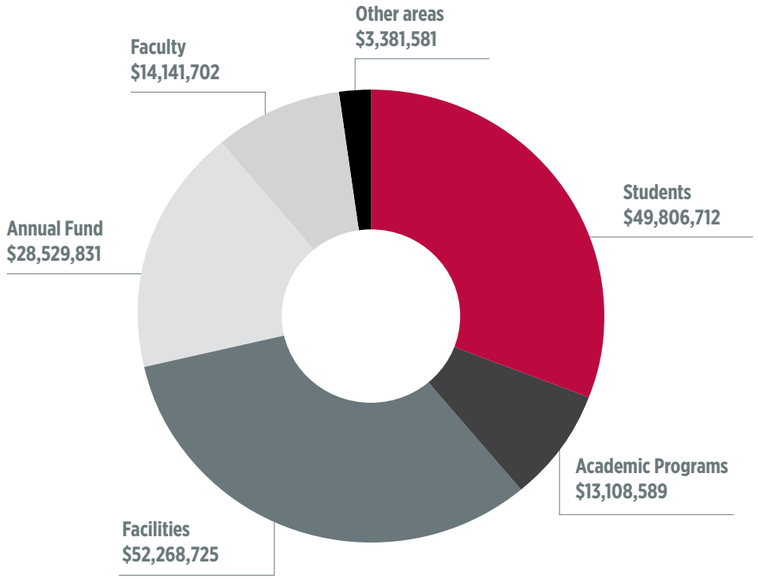
105
new endowed scholarships established

32
new academic programs created

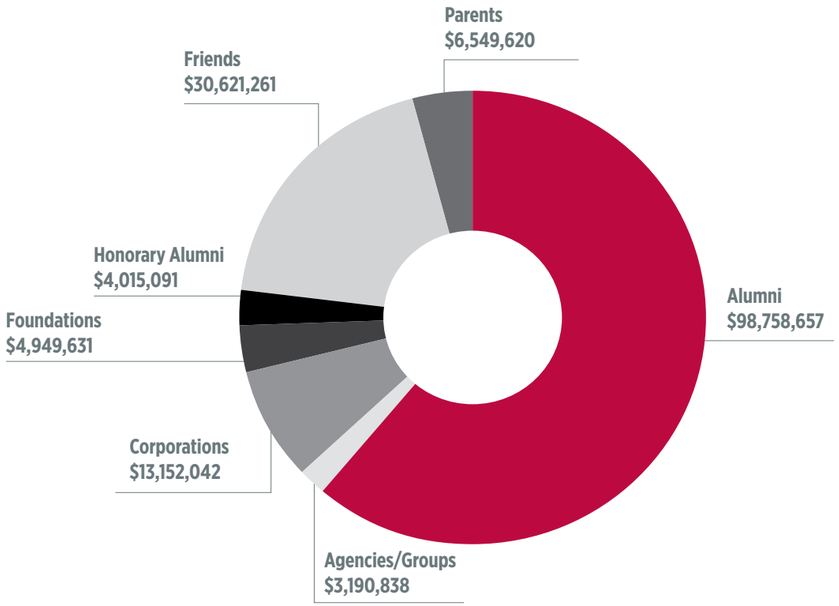
4
professorships created

4
new buildings

What do the gifts support?



Gifts by source



By the numbers

$161.2M
total amount raised for Engineering

14,101
total donors to Engineering

$67.8M
raised for endowed and annual student scholarships

55.5%
increase in Eliot Society membership

$67M
added to the Engineering endowment

3,409
days in the *Leading Together* Campaign

JHUAPL/ED WHITMAN

Melissa Holtmeyer

Written by **BETH MILLER**

In the five years since she left Washington University in St. Louis, Melissa Holtmeyer has applied the skills she acquired earning three degrees from the McKelvey School of Engineering not in a research lab or classroom, but in the halls of the U.S. government.

Holtmeyer, who earned bachelor's and master's degrees in mechanical engineering in 2006 and 2007, respectively, and a doctorate in chemical engineering in 2012, has been working in the Washington, D.C., area in a variety of scientific advisory roles that draw on her expertise in both mechanical and environmental engineering, as well as her networking and communication skills.

Her doctoral work, which focused on fundamental flame theory and emissions trends of biomass in air and oxygen-enriched combustion environments, along with grants she received from the U.S. Environmental Protection Agency, helped spark her interest in the bigger picture beyond fundamental energy research. Since 2016, she has worked for the Johns Hopkins University Applied Physics Laboratory (APL) doing both technical laboratory research and military operations analysis projects. She is currently on detail to the U.S. Navy as the study and analysis portfolio lead for the Chief of Naval Operations (CNO), the highest-ranking 4-star admiral in the U.S. Navy.

"Working for CNO is a great honor, especially at this point in my career, and he challenges both my technical and analytical skills with his questions," she said. "When at APL, I work at the intersection of technology development and military operations where I must understand the ins and outs of the technical details and the operations in which they will be used."

For Holtmeyer, the role blends her technical skill and her work in engineering policy, which she began in 2013 as an American Association for the Advancement of Science (AAAS) Congressional Science & Engineering Fellow in the U.S. Senate assigned to Sen. Bernie Sanders' office. In the prestigious one-year fellowship, Holtmeyer helped to craft legislation underpinned by scientific facts, managed Sanders' Senate committee activity and vote recommendations, and wrote floor speeches for Sanders.

Following her year in Sanders' office, Holtmeyer was selected for another AAAS fellowship as a U.S. Department of Defense (DoD) Science & Technology Policy Fellow for two years.

"I was a science adviser looking at how the use of energy and fuels impacts military operations," she said.

"I was able to do policy interpretation as well as getting into the technical details, such as how the military consumes energy, what types does it need, how much fuel is on a battlefield."

It was a natural step, then, for her to move to APL, where Holtmeyer uses her technical skills as well as softer skills. She credits her doctoral adviser, Richard Axelbaum, the Stifel & Quinette Jens Professor of Environmental Engineering Science, for allowing her to explore some opportunities that boosted those soft skills, including being a student speaker at the dedication of Brauer Hall and a graduate student representative to the university's Board of Trustees.

"Beyond the traditional opportunities presenting my research at technical conferences, those were my first tastes of communicating to senior leaders and getting a feel for what it would take to do some of these high-visibility, higher-level positions," she said. "If I had not had the ability to communicate effectively or to network or to be able to talk to senior leaders, I would not have had these opportunities in the Senate, the DoD or Navy."

Holtmeyer said the one-year fellowship in the Senate changed her career path.

"I was on this trajectory where I was in pure science in grad school and wanted to try something different, so I went to pure policy in the U.S. Senate," Holtmeyer said. "At the DoD, it was a little more technical and less policy. Now at APL, I have the right balance for me of policy and analysis and back to technical research. I've built a portfolio that combines that, and I can do that all at the same place."

Kyle Nicholson is a junior from Minneapolis majoring in biomedical engineering.

Appreciation

Written by **KYLE NICHOLSON**

COURTESY PHOTOS

To create a lasting impact, there must be a well-developed understanding of the problem at hand and appreciation for the potential outcomes. For example, when Washington University in St. Louis matched me with a generous donor and granted me a scholarship, the university appreciated my potential as a student and empowered me to create change. To pay that generosity forward and to appreciate my own opportunities, I have dedicated much of my time at school to serving others.

Engineers Without Borders has given me the opportunity to use the resources I have at Washington University to positively impact whole communities around the world. Through my work with Engineers Without Borders, I have been able to appreciate not only my own opportunities, but also how a similar appreciation can contribute to strong engineering projects.

Through multiple community partnerships, it has become clear to me that time invested in appreciating the insights of community leaders and detailed consideration of specific project parameters lead to the most thoughtful solutions. Recently, I returned from Uganda where I was able to network with a variety of organizations, government officials and community members. Developing these relationships early on will provide our new partnership incredible strength and an appreciation for strong local leadership. These connections will allow us to place more emphasis on specific local concerns and opinions, creating more sustainable and empowering change for our community partners.

How can we as engineers continue to appreciate our partners and the problems we are working to solve?

Welcome to our new faculty members



Biomedical Engineering:

Princess Imoukhuede, associate professor

Abhinav Jha, assistant professor

Jai Rudra, assistant professor



Computer Science & Engineering:

Yevgeniy Vorobeychik, associate professor

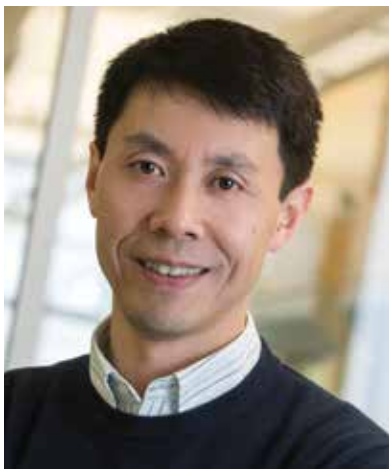
Miaomiao Zhang, assistant professor

Ning Zhang, assistant professor


Electrical & Systems Engineering

Neal Patwari, professor (joint appointment in Computer Science & Engineering)

Bruno Sinopoli, professor and department chair


Energy, Environmental & Chemical Engineering

Fanqiong Ling, assistant professor

Jian Wang, professor

Mechanical Engineering & Materials Science:

Jianjun Guan, professor