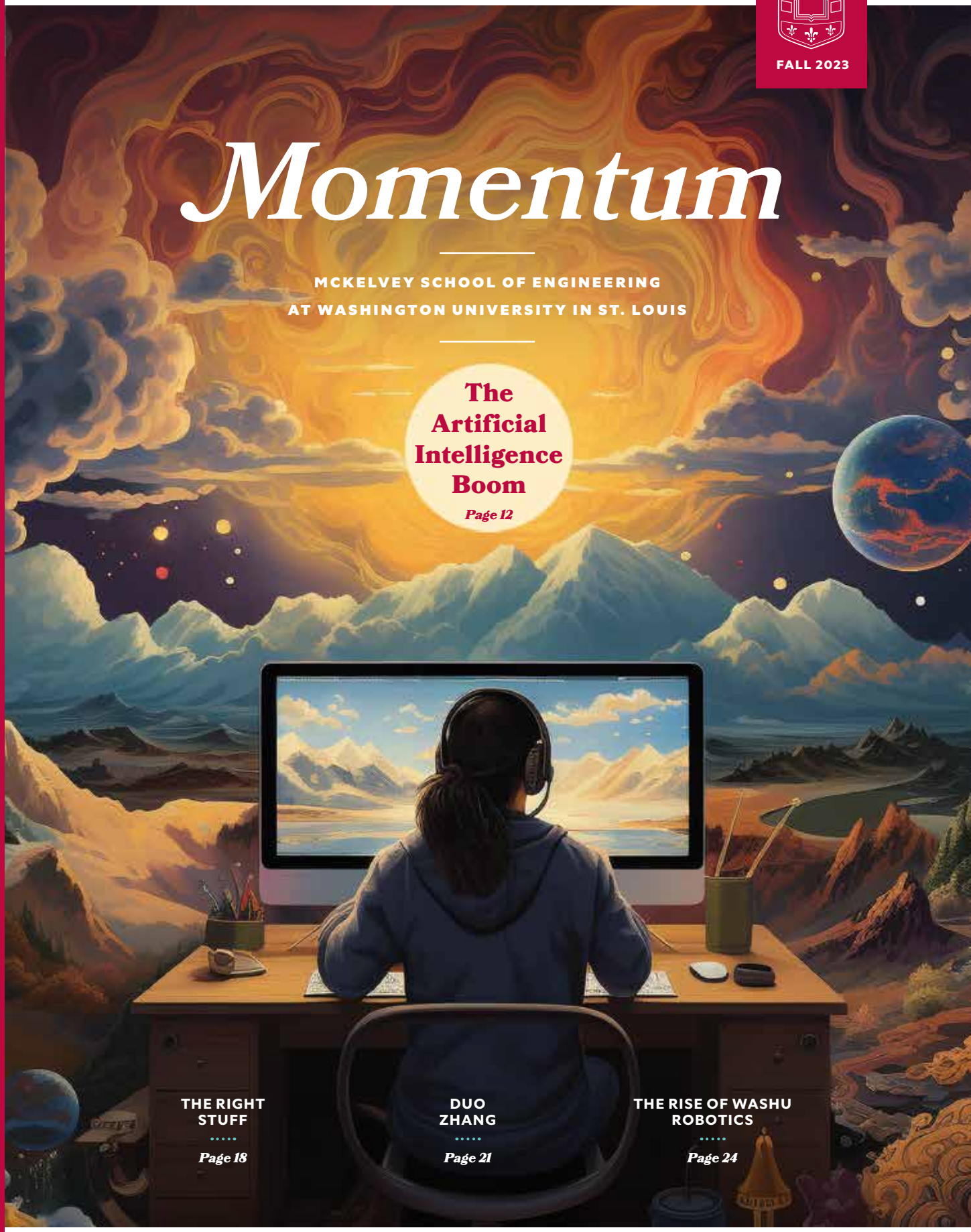
FALL 2023

Momentum

MCKELVEY SCHOOL OF ENGINEERING
AT WASHINGTON UNIVERSITY IN ST. LOUIS



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Momentum

FALL 2023

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DOUGLAS GARFIELD

WASHU PHOTO

“While maintaining a focus on excellence, the new driver of our aspirations is impact and relevance, and thus the title *From Excellence to Impact*.”

In 2016-17, the then-named School of Engineering & Applied Science conducted a strategic planning exercise that resulted in the *Leadership through Excellence* plan. Through a broad community engagement, we identified a series of steps we needed to take to support our pursuit of true excellence in both education and research. The goal was to establish a uniformly strong foundation upon which we could build ever stronger programs and launch new initiatives.

The resulting growth that the *Leadership through Excellence* plan enabled is truly inspiring: new undergraduate programs including partnerships with the Sam Fox School of Design & Visual Arts, Arts & Sciences, and the Olin Business School; expanding our PhD numbers from 380 to more than 550; and increasing our tenure-track faculty count by 25% but growing our research awards by more than 100% from $25 million in 2015 to $57 million in fiscal year 2023. Our faculty and students are simply achieving more. And, because of the vision and trust of Jim and Anna McKelvey, we now have a new name.

In 2023, the McKelvey School of Engineering finds itself operating from a position of much greater strength than in 2016, but also in quite a different context. First, the world itself has changed. The new challenges range from the scientific and technological – e.g., climate change impact is no longer a hypothetical, and artificial intelligence (AI) is integrated in numerous aspects of our society – to the social and cultural, including polarized politics and growing social-economic-racial divides. Second, our own region of St. Louis has evolved, with an emergence of new industrial sectors including geospatial, cybersecurity and advanced manufacturing. And finally, and perhaps most significantly for McKelvey Engineering, Washington University has adopted a strongly targeted strategic plan, *Here and Next,* that identifies aspirational and investment priorities for the entire university.

This new context along with the strongly established foundation within the school calls for the next iteration of strategic planning. While maintaining a focus on excellence, the new driver of our aspirations is impact and relevance, and thus the title *From Excellence to Impact.* In this issue of *Momentum,* there is a brief story about this new plan, which in turn contains links to more full descriptions. I note that this new plan aligns with the university’s strategies in several ways. First, *Here and Next* has a significant focus on the environment. Indeed, as mentioned in the *School News* section, the university has established a new Center for the Environment that will be led by our own Dan Giammar; McKelvey Engineering will play a leading role in the universitywide efforts.

Another aspect of the university’s plan is digital transformation, and core to that effort is the rise of artificial intelligence. Unsurprisingly, AI is also central to the McKelvey Engineering plan. Our cover story describes some of our research into not only new AI methods but also how to leverage AI in other research disciplines such as materials science; these efforts are well underway. But our plan also embraces AI in education, both in pedagogy – *how* we teach – and in curriculum – *what* we teach. Going forward, all McKelvey graduates must be not only AI literate but AI competent.

Before closing, I want to note the new format of the magazine. Just as engineering evolves, so do communication and publishing. The new visual style along with the inclusion of active QR links results in a more modern publication. I like to think of it as greater forward *Momentum.*

Aaron F. Bobick
Dean & James M. McKelvey Professor

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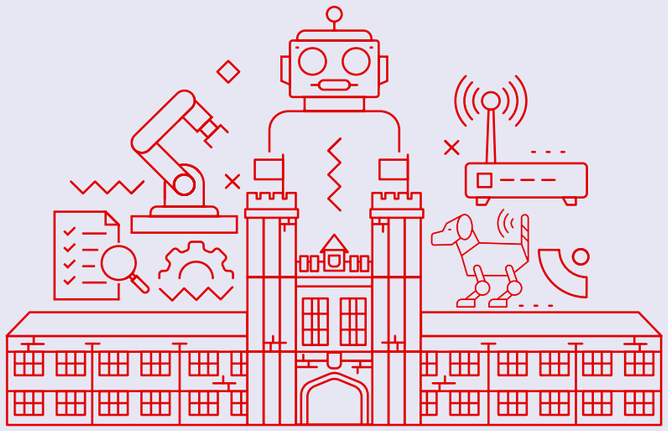

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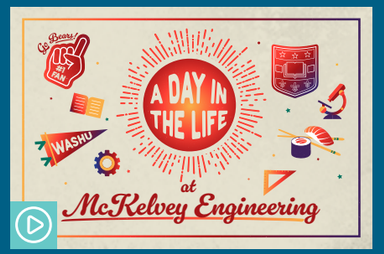
In every issue

$57 million

TOTAL IN RESEARCH AWARDS MCKELVEY FACULTY RECEIVED IN FISCAL YEAR 2023



WATCH: Check out the videos to see a glimpse of a day in the life of an Engineering student.

Congratulations to Kaushik Dutta and Guinter Damé Vogg!

Dutta and Vogg are McKelvey Engineering students who were elected as new student representatives of the WashU Board of Trustees for the 2023-24 academic year. Dutta is a fourth-year PhD student in the imaging science program. Vogg is a senior from Encruzilhada do Sul, Brazil, who is majoring in chemical engineering. We are so proud that two of the four student representatives are WashU Engineers!

Class of 2027

MORE THAN **39%** IDENTIFY AS FEMALE

29% ARE UNDERREPRESENTED STUDENTS OF COLOR

28% OF INCOMING STUDENTS ARE PELL GRANT-ELIGIBLE

&

19% ARE FIRST-GENERATION COLLEGE STUDENTS

95 NEW DUAL DEGREE STUDENTS PURSUING EITHER 3/2 OR 3/3 OPTIONS

EDITOR'S NOTE

In the Summer of 2022, we surveyed our readers on what you liked about *Engineering Momentum*, what you didn't like and what you wanted to see included in the magazine. You said you wanted to see more research news; to continue receiving the print issue; and to increase alumni engagement. We listened to those requests, and this issue is our first with a new design and other changes. Let us know what you think of the new look by emailing millerbe@wustl.edu.

McKelvey Engineering has been getting a lot of attention in the past few months. Several of our faculty members have been featured in national media outlets for their innovative research, and our Marketing & Communications team was recently recognized with two awards from the University & College Designers Association: one for the illustrations for the Center for Women's Health Engineering cover story in the Winter 2023 issue, and one for a video titled "How far can your PhD stipend go?"

We hope you enjoy the Fall 2023 issue! Look for QR codes throughout the magazine to access videos and additional content online.

Beth Miller, *Editor*

Meet the Class of 2023 valedictorians

Front row, from left: Edward Chandler, Samm Kaiser, Jacob Wheelock, Evelyn Song, Louis Kotler and Caleb Liu. Second row, from left: Amay Kejriwal, Kyle Montgomery, Jacob Sandler, Ulysses Atkeson, Jeremy Kunen, Evan Zhong and Asher Baraban. Third row, from left: Robert Fuchs, Bochun Mei and Joseph Melkonian

The McKelvey School of Engineering celebrates the 20 students recognized as valedictorians of the Class of 2023. Students were named valedictorian for earning a 4.0 cumulative GPA with no repeated courses.

"To be a valedictorian is to be recognized as the highest-ranking student in terms of grade point average within a graduating class," said Chris Kroeger, associate dean for undergraduate student services in McKelvey Engineering. "To reach this level requires tremendous focus, dedication and persistence. These students thrived at WashU despite having to deal with COVID-19, and I'm very proud of them."

The large cohort of valedictorians is in part the result of the university community adjusting to changes brought on by social distancing and other public health policies during the COVID-19 pandemic.

Vahey lab hosts K-12 educator for curriculum development

When Kirstin Blase learned about a summer position in the lab of Michael Vahey, assistant professor of biomedical engineering, she was excited by the opportunity to return to research.

Blase, a chemistry teacher at Villa Duchesne, had previously worked in the Division of Radiological Sciences in the Mallinckrodt Institute of Radiology at WashU's School of Medicine, where she researched radioactive compounds used in positron emission tomography (PET) imaging.

"As a scientist, I loved being in the lab and doing research," Blase said. "As a teacher, the idea of observing real-world research and incorporating it into my classroom sounded like fun."

The position, funded by Vahey's recent award from the National Science Foundation's Faculty Early Career Development (CAREER) Program, allows a local K-12 educator to spend time in the lab developing curriculum inspired by the team's work with fluorescent microscopy.

Center for the Environment to launch in 2024

Washington University in St. Louis' *Here and Next* strategic vision has launched the Center for the Environment, designed to build on and further advance the environmental research at the university.

Daniel Giammar, the Walter E. Browne Professor of Environmental Engineering at the McKelvey School of Engineering, will serve as inaugural director of the new center, scheduled to launch in 2024. It will serve as a cross-cutting collaboration hub, encouraging partners, faculty and students to advance research projects in areas including climate change, air quality, food insecurity, clean-water access, biodiversity loss and infectious diseases.

"The center can be a catalyst for attracting new students and faculty to WashU who will enrich our ecosystem of environmental research," Giammar said.

The International Center for Energy, Environment and Sustainability (InCEES) and the Washington University Climate Change Program (WUCCP) will be folded into the Center for the Environment, and their contributions will become part of WashU's greater effort to elevate research and implementation in critical environmental domains.

Women & Engineering to launch revamped mentoring program

The Women & Engineering Center at the McKelvey School of Engineering has expanded its mentorship program to engage a larger audience and provide students with more opportunities to learn from Washington University in St. Louis alumni. The center will launch the new offerings this fall.

The revamped program will introduce alternative forms of mentorship, such as peer mentoring, which will allow the center to better respond to students' specific needs and concerns.

"While the formal mentorship between students and alumnae has proven to be a powerful experience, we believe there are additional ways to foster growth and support," said Christine Dearmont, director of the Women & Engineering Center. "By incorporating peer mentoring and other expanded approaches, we can empower students through a wider range of perspectives, expose them to diverse expertise and facilitate connections among their peers."

The expanded program options will also allow WashU alumni who cannot commit to mentoring for a full academic year to take part in one-day mentorship opportunities.

Melissa Holtmeyer Terlaje, center, is a three-time graduate of WashU who mentored junior and senior students during the center's first topic-mentoring session in May. The expanded mentoring program will include more frequent small-group mentoring sessions.

The expanded program options are:

- **WE Pairs.** The current WE Pairs program, formally known as BearPairs, matches students in the Women & Engineering Leadership Society with accomplished WashU alumni for one-on-one mentoring throughout the academic year.
- **Theme mentoring.** Students and a panel of mentors will convene around a specific theme, such as career preparation or research. Students will learn from the diverse perspectives of mentors and leave with advice and a call to action.
- **Topic mentoring.** Individual mentors will present on their areas of expertise, such as the latest breakthroughs in different fields of engineering, careers outside of research or their leadership experiences. After each short session, participants will break out into discussion groups.
- **Peer mentoring.** Students will be matched with another student and discuss guided conversation topics.

Students win Rice360 global health tech design competition

From left: Trinh Woolridge, Samantha Olson and Savannah Chatman

Fistula Fighters, a team of three McKelvey School of Engineering students, won first place at the Rice360 Institute for Global Health Technologies' annual Global Health Technologies Design Competition. Team members Trinh Woolridge, a senior majoring in biomedical engineering, and Savannah Chatman and Samantha Olson, both Dual Degree students in the Department of Biomedical Engineering, competed against 27 teams to take home the $500 top prize.

The competition recognizes designs for low-cost technologies that address global health challenges in resource-limited settings.

The team developed a wearable device for those experiencing urinary incontinence due to vesicovaginal fistulas, which are abnormal openings between the bladder and vagina that result from prolonged and obstructed labor. The device is a biker-style short with a built-in urine collection cup and bag, enabling users to seamlessly perform everyday tasks and avoid the stigma associated with incontinence.

Throughout the project, the group worked with mentors Christine O'Brien, assistant professor of biomedical engineering; Lewis Wall, professor of sociocultural anthropology in Arts & Sciences and of obstetrics & gynecology at the School of Medicine; and Tracy Spitznagle, professor of physical therapy in the School of Medicine.

McKelvey Engineering-led team receives $3.6 million grant to combat plastic waste

Plastics transformed engineering in the past century, but they also transformed the environment in ways that will take millennia to repair. Washington University is leading a new effort to address the grand challenge of developing the next generation of high-performance, sustainably sourced and biodegradable plastics that advance engineering while protecting the environment.

"The task is urgent," said Marcus Foston, associate professor of energy, environmental & chemical engineering and lead investigator of the multi-institutional project. "We are on track to have more plastic than fish in the oceans by 2050, and we need to bring people together to develop the innovations and work force that will reverse this trend while expanding the performance of engineered polymers."

Foston and his interdisciplinary team have received a five-year, $3.6 million Growing Convergence Research (GCR) grant from the National Science Foundation (NSF) to develop a new class of biologically synthesized, protein-based and biodegradable materials that harness motifs from nature to replace traditional petroleum-derived plastics. The team, which includes researchers from WashU, Northwestern University, Iowa State University and University of South Florida, brings together a convergence of cross-disciplinary expertise to evolve the plastics economy by developing a platform for the discovery of synthetic biological materials with desired properties, guided by artificial intelligence, biomimetics and the science of the product adoption.

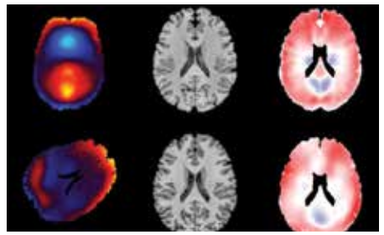
Data from wearables could be a boon to mental health diagnosis

Depression and anxiety are among the most common mental health disorders in the United States, but more than half of people struggling with the conditions are not diagnosed and treated. Hoping to find simple ways to detect such disorders, mental health professionals are considering the role of popular wearable fitness monitors in providing data that could alert wearers to potential health risks.

While the long-term feasibility of detecting such disorders with wearable technology is an open question in a large and diverse population, a team of researchers at Washington University in St. Louis showed that there is reason for optimism. They developed a deep-learning model called WearNet, in which they studied 10 variables collected by the Fitbit activity tracker. Variables included everything from total daily steps and calorie burn rates, to average heart rate and sedentary minutes. The researchers compiled Fitbit data for individuals more than 60 days.

The team presented its findings May 10 at the ACM/IEEE Conference on Internet of Things Design and Implementation. The paper was awarded the Best Paper Award for IoT Data Analytics at the conference.

Brain movement measured for clues to prevent, reduce traumatic brain injury



When the human head experiences any kind of movement — from nodding yes or no to heading a soccer ball or being jolted in a car crash — the brain moves inside the skull, leading to deformation of the tissue. Such deformations are key to understanding traumatic brain injury but are challenging to study since the brain is hidden inside the skull.

Philip V. Bayly, the Lee Hunter Distinguished Professor and chair of the Department of Mechanical Engineering & Materials Science, and Jordan D. Escarcega, a mechanical engineering doctoral student in Bayly's lab, led a multi-institutional team to compare how the human brain deforms in response to movement using two types of magnetic resonance imaging (MRI). Their work is published in the August 2023 issue of the *ASME Journal of Biomechanical Engineering*.

Induction of a torpor-like state with ultrasound

WATCH: AN ILLUSTRATIVE VIEW OF THE ULTRASOUND-INDUCED ARTIFICIAL TORPOR.

Some mammals and birds have a clever way to preserve energy and heat by going into torpor, during which their body temperature and metabolic rate drop to allow them to survive potentially fatal conditions in the environment, such as extreme cold or lack of food. While a similar condition was proposed for scientists making flights to space in the 1960s or for patients with life-threatening health conditions, safely inducing such a state remains elusive.

Hong Chen, associate professor of biomedical engineering in the McKelvey School of Engineering and of neurosurgery at the School of Medicine, and a multidisciplinary team induced a torpor-like state in mice by using ultrasound to stimulate the hypothalamus preoptic area in the brain, which helps to regulate body temperature and metabolism. In addition to the mouse, which naturally goes into torpor, Chen and her team induced torpor in a rat, which does not. Their findings, published May 25, 2023, in *Nature Metabolism*, show the first noninvasive and safe method to induce a torpor-like state by targeting the central nervous system.

Chen and her team, including Yaoheng (Mack) Yang, a postdoctoral research associate, created a wearable ultrasound transducer to stimulate the neurons in the hypothalamus preoptic area. When stimulated, the mice showed a drop in body temperature of about 3 degrees C for about one hour. In addition, the mice's metabolism showed a change from using both carbohydrates and fat for energy to only fat, a key feature of torpor, and their heart rates fell by about 47%, all while at room temperature.

NSF CAREER AWARDS

Making every photon count

In imaging applications used for everything from astronomy to medical imaging, scientists aim to extract maximum information from each tiny bit of light they capture. However, current approaches lose information during data processing, necessitating new imaging methods to make each photon count.

Abhinav Jha, assistant professor of biomedical engineering and of radiology at Mallinckrodt Institute of Radiology in the School of Medicine, will develop one such method with a five-year, $500,000 CAREER Award from the National Science Foundation.

Molecular activity of the immune system to get a closer look

The COVID-19 pandemic brought immune systems into new light as researchers worldwide worked quickly to learn about the virus and develop effective vaccines. However, much remains unknown about how proteins in the immune system assemble and engage in response to a viral invasion.

Michael Vahey, assistant professor of biomedical engineering in the McKelvey School of Engineering, has received a five-year, $606,563 CAREER award from the National Science Foundation to establish the factors that drive the assembly of viral immune complexes and study how they interact with immune cell receptors.

Building availability assurance in safety-critical cyber-physical systems

For safety-critical, real-time cyber-physical systems, from critical energy infrastructure that provides the daily necessity to pacemaker implants that save lives, staying correct and responsive in the presence of cyberattacks is essential.

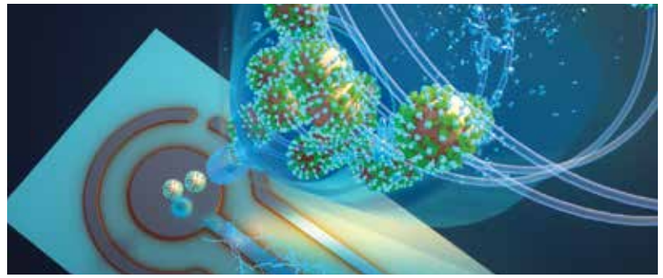
Ning Zhang, assistant professor of computer science & engineering and an expert in cyberphysical system security, plans to address threats to the availability of these systems with a five-year, nearly $521,000 CAREER Award from the National Science Foundation.

Portable, low-cost tech tracks uterine contractions

Keeping track of pregnancy requires a dizzying array of gargantuan and expensive machines. An MRI machine is the size of a room and can cost up to $1 million. But the care such equipment provides is a critical part of prenatal care, especially for dealing with complications like preterm birth. To get this care, pregnant people frequently need to visit a hospital, a significant burden for underserved and disadvantaged communities.

In a paper published May 19 in early access online in *IEEE Transactions on Biomedical Circuits and Systems*, a collaboration of researchers at Washington University St. Louis described a more accessible route to care: a portable uterine-contraction tracker, a cheap-to-make, flexible electrode patch.

The paper builds on previous work from Washington University researchers. In 2019, Yong Wang, associate professor of obstetrics and gynecology at the School of Medicine, published a paper describing the creation of noninvasive electromyometrial imaging (EMMI). This method monitors electrical signals generated by uterine contractions and can detect unusual and preterm contraction patterns. Shantanu Chakrabartty, the Clifford W. Murphy Professor, and Chuan Wang, associate professor of electrical & systems engineering, led an effort to shrink down that technique invented by Wang, who was also a collaborator on this new work. Weilun Li, a doctoral student in Chakrabartty's lab, is the first author on the paper.



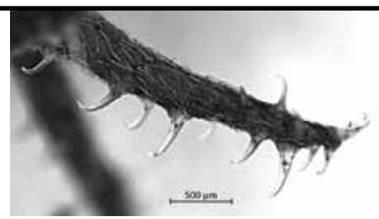
Air monitor can detect COVID-19 virus variants in about 5 minutes

Now that the emergency phase of the COVID-19 pandemic has ended, scientists are looking at ways to surveil indoor environments in real time for viruses. By combining recent advances in aerosol sampling technology and an ultrasensitive biosensing technique, researchers at WashU have created a real-time monitor that can detect any of the SARS-CoV-2 virus variants in a room in about 5 minutes.

The inexpensive, proof-of-concept device could be used in hospitals and health care facilities, schools and public places to help detect CoV-2 and potentially monitor for other respiratory virus aerosols, such as influenza and respiratory syncytial virus (RSV). Results of their work on the monitor, which they say is the most sensitive detector available, are published in *Nature Communications* July 10, 2023.

The interdisciplinary team of researchers from the McKelvey School of Engineering and the School of Medicine consists of Rajan Chakrabarty, the Harold D. Jolley Career Development Associate Professor of Energy, Environmental & Chemical Engineering in McKelvey Engineering; Joseph Puthussery, a postdoctoral research associate in Chakrabarty's lab; John Cirrito, professor of neurology; and Carla Yuede, associate professor of psychiatry, both at the School of Medicine.

Hitchhiker plants inspire improved techniques for reattaching tendon to bone



Tendon-to-bone reattachment is required in many surgical procedures, perhaps most commonly in repairing torn rotator cuff tendons in the shoulder, a condition that will affect more than 30% of the population over 60. Current suturing methods fail to distribute stress evenly, leading to failure rates as high as 94% due to ineffective attachment and re-tearing of sutures.

A team of researchers led by Guy Genin, the Harold and Kathleen Faught Professor of Mechanical Engineering, has developed a new approach to suturing based on the mechanics and spacing of a hitchhiker plant's attachment system. Their strategies show promise for balancing forces across sutures, reducing the stress on healing tendons and potentially doubling repair strength over current suturing schemes.

The findings were published March 1 in *Proceedings of the Royal Society A*.

Analyzing generative AI's copyright crisis

The recent explosion of artificial intelligence tools such as ChatGPT and Copilot have supercharged the assistance available to programmers. However, AI assistants may strip out comments embedded in code to convey copyright and attribution guidelines, leaving human coders none the wiser yet still on the hook legally for intellectual property infringement.

To combat this problem, computer science & engineering researchers in the McKelvey School of Engineering have developed CodeIPPrompt, the first automated testing platform to evaluate how much language models generate IP-violating code. The team includes Ning Zhang and Chenguang Wang, both assistant professors; Yevgeniy Vorobeychik, professor; Zhiyuan Yu, a graduate student in Zhang's lab and first author on the paper; and Chaowei Xiao, assistant professor of computer science at Arizona State University.

"We developed this tool to help people understand that if they're using these large language models to help write code, there's a good chance they might generate IP infringing content," Zhang said. "As users, we have a responsibility to use AI ethically. That's influenced by how we understand AI technology and the content it produces."

Though CodeIPPrompt can't say for sure if AI-generated code constitutes an IP violation — Zhang notes that issue is ultimately a legal question that will play out in the courts as cases are brought against the users of AI tools for copyright infringement — it can give users a risk score that indicates how similar generated code is to copyright protected content. Zhang anticipates that the tool will help guide the ongoing development of AI and point to potential mitigation strategies and other protections against IP violations in the future.

New imaging technology may reduce surgeries for rectal cancer patients

Colorectal cancer is the third most common cause of cancer death in the United States among men and women, and the incidence among people under age 50 has risen to one in five new diagnoses, according to the American Cancer Society. While treatment allows some patients to avoid surgery, existing technology makes it difficult to determine whether the cancer has been successfully treated with no residual cancers.

Quing Zhu, a biomedical engineer, and Matthew Mutch, MD, a colorectal surgeon at the School of Medicine, and their collaborators have been working together to address this problem by developing a new imaging technology combining photoacoustic microscopy, ultrasound and deep learning to better determine whether a rectal cancer patient is successfully treated with radiation and chemotherapy and can be safely followed-up with nonsurgical imaging monitoring. With a four-year, $1.75 million grant from the National Institutes of Health, the team led by Zhu and Mutch will pursue development of this new technology that would help physicians to accurately identify a treated rectal tumor bed with residual cancers that need surgery or normalized rectal tissue without need for surgery.

New pathway discovered for RNA degradation in iron-rich environments

RNA, an essential biomolecule for life, has been used in environmental applications including monitoring microbial communities, developing pesticides, and quantifying the abundance of pathogenic viruses, such as SARS-CoV-2, in water and wastewater systems. Understanding how quickly RNA breaks down in given conditions is critical to harnessing the molecule in these and other emerging technologies.

According to a new study by researchers working with Kimberly Parker, assistant professor of energy, environmental & chemical engineering, RNA can undergo rapid hydrolysis when adsorbed into iron oxide minerals. This discovery unveils a previously unknown abiotic pathway for RNA degradation and sheds light on biogeochemical processes and environmental system dynamics. The results were published May 22 in *Environmental Science & Technology*.

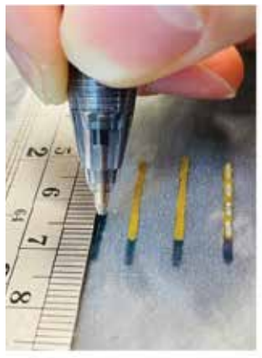
Fanning the flames: Wildfires emit potent climate-warming organic particles

In a new study published Aug. 7 in *Nature Geoscience*, researchers led by Rajan Chakrabarty, the Harold D. Jolley Career Development Associate Professor of Energy, Environmental & Chemical Engineering found that wildfires are causing a much greater warming effect than has been accounted for by climate scientists. The work, which focuses on the role of "dark brown carbon" — an abundant but previously unknown class of particles emitted as part of wildfire smoke — highlights an urgent need to revise climate models and update approaches for the changing environment.

Cellular obstacle course

No one wants to hit a wall, or even a seemingly minor obstacle that might completely derail their forward progress. The same goes for cells. A recent study by mechanical engineers found that migrating cells are susceptible to physical disruptions in their environment, losing speed and direction when they encounter obstructions, just like runners navigating an obstacle course.

Researchers working with Amit Pathak, associate professor of mechanical engineering & materials science, have revealed key insights into the role that physical disruptions in cellular environments play in collective cell migration. Though scientists already knew cells could sense stiffness and confinement in their environments, the team's study published July 24, 2023 in *Molecular Biology of the Cell* shows that surface obstructions can also alter cell response.



Perovskite light emitters and detectors with the stroke of a pen

Researchers working with Chuan Wang, associate professor of electrical & systems engineering, have developed ink pens that allow individuals to handwrite flexible, stretchable optoelectronic devices on everyday materials including paper, textiles, rubber, plastics and 3D objects. Flexible optoelectronics for emitting and detecting light, which are already found in everyday objects like smartphones and fitness trackers, can bend, fold and flex while maintaining functionality.

In a paper published Aug. 7 in *Nature Photonics*, the team reports its simple and versatile fabrication approach to allow anyone to make a custom light-emitting diode (LED) or photodetector without the need for any specialized training or bulky equipment. The new handheld fabrication technology builds on earlier work by Wang and first author Junyi Zhao, a doctoral candidate in Wang's lab, in which they demonstrated a novel way to fabricate stretchable LEDs with a simple inkjet printer.

Gates Foundation awards McKelvey Engineering $5 million for food production initiative

Feng Jiao, who is internationally renowned for carbon dioxide conversion and electrolysis, has received a nearly $5 million, two-year grant from the Novo Nordisk Foundation and the Bill & Melinda Gates Foundation to create a novel technology that could transform food insecurity in low-and middle-income countries by overcoming limited resources such as arable land. This grant is part of a newly established Acetate Consortium. The two foundations share a mission to improve lives worldwide, including increasing access to foods and drugs.

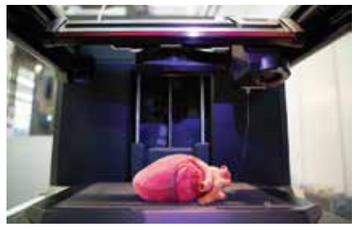
Jiao plans to create a new method to manufacture acetate using carbon dioxide as the sole carbon source, efficiently and sustainably to then transform the carbon dioxide-derived acetate into high-value proteins for foods and drugs. The method is based on an electro-biological hybrid approach, which can overcome limits of photosynthesis, such as inefficient capture of solar energy and poor conversion of carbon dioxide.

Good smells, bad smells: It's all in the insect brain

Everyone has scents that naturally appeal to them, such as vanilla or coffee, and scents that don't appeal. What makes some smells appealing and others not?

Barani Raman, a professor of biomedical engineering, and Rishabh Chandak, who earned bachelor's, master's and doctoral degrees in biomedical engineering in 2016, 2021 and 2022, respectively, studied the behavior of the locusts and how the neurons in their brains responded to appealing and unappealing odors to learn more about how the brain encodes for preferences and how it learns. The study provides insights into how our ability to learn is constrained by what an organism finds appealing or unappealing, and the timing of the reward. Results of their research were published in *Nature Communications* Aug. 5, 2023.

New approach to defend 3D printed medical devices from cyberattack



No longer the stuff of science fiction, personalized medical devices, ranging from hearing aids to surgical instruments, are already being created using 3D printing, with more advanced products like customized artificial organs on the horizon. Though these advances promise benefits to patients worldwide, they also open new pathways for cybercriminals to exploit.

Ning Zhang, assistant professor of computer science & engineering in the McKelvey School of Engineering, and his team are working to get ahead of potential cyberattacks with XCheck, a tool they developed to detect hidden defects in 3D printed patient-specific devices.

"The future is personalized medicine, and the consequences of attack are potentially very big," Zhang said. "This technology is in its infancy, so we aren't seeing a lot of attacks yet, but it's good to think about how to defend against them in advance before harm to real patients occurs."

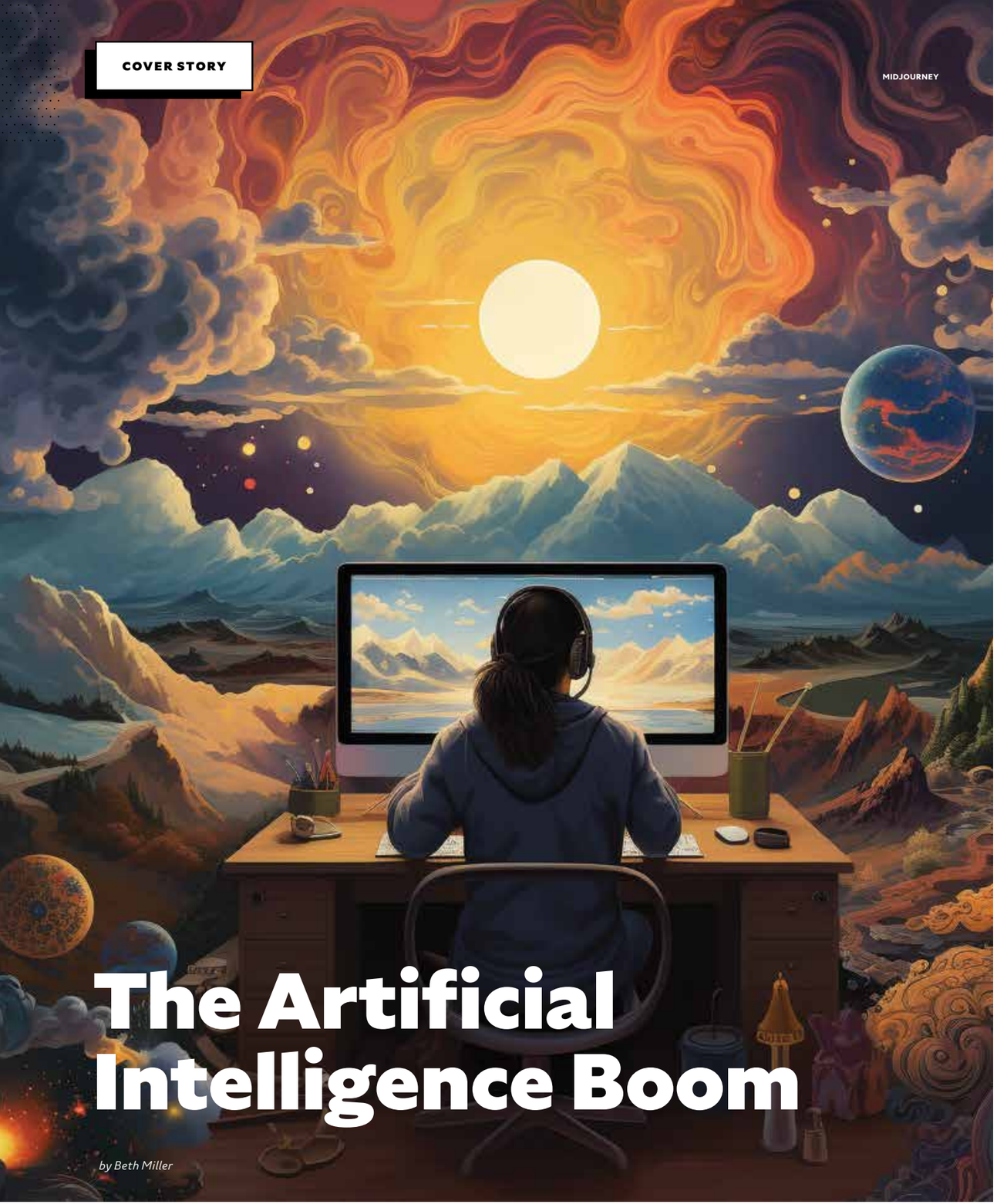
The process to manufacture patient-specific devices often requires medical professionals to send designs to specialized printing facilities, which fabricate the device. Similar to ransomware attacks where cybercriminals hold information hostage until payment is made, bad actors could tamper with the designs or printing process to introduce malicious defects that only they know how to address.

XCheck is unique in that it protects against such attacks by evaluating the final product via CT scan, rather than trying to secure every stage of the manufacturing process, which could be a complex and costly — if not outright impossible — endeavor.

"XCheck automatically compares the CT scans of a printed device to its original design to detect deviations that might be invisible to medical practitioners," explained Zhiyuan Yu, the lead author of the paper and a graduate student in Zhang's lab. "The CT scan can reveal surface discrepancies, but, more importantly, it also lets us see hidden flaws."

XCheck measures the volume of the device to make sure there aren't any internal defects, like hollowed-out portions that shouldn't be there. It can also use data provided by the CT scan to verify the correct material has been used to fabricate the device.

Because XCheck uses existing equipment and will be made widely available by Zhang's team, Zhang would like to see the tool employed widely in medicine and in other applications as a general tool for quality assurance in a future he says will be increasingly cyberphysical.



The Artificial Intelligence Boom

by Beth Miller

Image created using Midjourney, a generative AI program that creates images based on text prompts. Text prompt for this image: Colorful illustration of a student at a computer using Midjourney to create a beautiful image. All illustrations in this story were a partnership between human and artificial intelligence.

The rapid rollout of new forms of artificial intelligence has led to widespread adoption, but also a lot of questions: Is this a benefit or a cause for concern?

A new world in artificial intelligence (AI) opened in the past year when OpenAI released ChatGPT, a large language model that scours the Internet for words in response to a question. Since then, similar programs and new technologies continue to be released while their developers call for government regulation and a six-month moratorium to slow things down, leaving many uncertain if the advances are beneficial or cause for concern.

We're told that artificial intelligence will make our lives easier. Siri, Apple's virtual assistant launched in 2010, is used daily by hundreds of millions of Apple users to get directions, check weather and dozens of other tasks. ChatGPT, which is based on machine learning, is said to turn out eloquent prose, and generative art programs can create stunning, realistic images in seconds. But we're also told that about 80% of the U.S. workforce could have at least 10% of their work tasks affected in some way by the introduction of large language models, according to a March 2023 study by OpenAI, OpenResearch and the University of Pennsylvania.

'AI will not replace you, but the person using AI will.'

"What happens in the age of AI is going to supercharge humans and automate processes even more than before," said Gaurav Garg, who earned bachelor's and master's degrees from the engineering school in 1988 and 1990, respectively, and is founding partner of Wing Venture Capital, a member of the McKelvey Engineering National Council and of the university's Board of Trustees. "The world is going to shrink even further, and the ability to work remotely with AI will remove all cultural language accent barriers so we will be in a truly global labor marketplace."

And while we start to grasp one new development, things change almost daily.

"The AI I know today might be different from the AI I know tomorrow. How do we cope with that?" asked Ning Zhang, assistant professor of computer science & engineering. "I don't think any of us has the answer right now."

Artificial intelligence researchers in the McKelvey School of Engineering are watching this dizzying array of developments with interest as they both study these new technologies and incorporate them in their own research. Although McKelvey Engineering faculty study many areas and aspects of artificial intelligence, this story will focus only on a few areas as well as how the school is integrating AI into the curriculum.

"What happens in the age of AI is going to supercharge humans and automate processes even more than before."

– GAURAV GARG

MIDJOURNEY

AI and medicine

McKelvey Engineering faculty have had longstanding collaborations with faculty at the School of Medicine to improve diagnostics and ultimately, patient care. Integrating artificial intelligence into medicine has the potential to hasten precision medicine as well as introduce time-saving methods that will allow health care providers to spend more time with patients.

Yixin Chen, professor of computer science & engineering, has been involved in a variety of projects in this field, including helping to develop an Anesthesia Control Tower. Like an air traffic control tower, the Anesthesia Control Tower uses machine learning to detect unforeseen events in anesthetized patients' health before they become emergencies, such as rapidly dropping blood pressure or an allergic reaction. Chen is now leading a team of computer science faculty and students to develop and improve machine learning models for a Telemedicine Control Tower that can reveal patterns in patient data.

MIDJOURNEY

"These patterns can help clinicians identify patients who might benefit from extra attention, facilitating earlier diagnosis of medical problems and earlier initiation of treatments," Chen said. "These patterns might also help clinicians deliver targeted, more personalized care by allowing them to identify which medications or other interventions are most likely to benefit a particular patient."

Chenyang Lu, the Fullgraf Professor in the Department of Computer Science & Engineering, also has multiple collaborations with faculty from the School of Medicine that have been used to predict physician burnout, surgical outcomes and outcomes of treatment for mental health disorders. Most recently, he and collaborators developed a deep-learning model called WearNet, in which they studied variables collected by the Fitbit activity tracker, including total daily steps, average heart rate and sedentary minutes. WearNet did a better job at detecting depression and anxiety than state-of-the-art machine learning models and produced individual-level predictions of mental health outcomes.

Data from wearables, which are used by about 25% of the U.S. population, could act as an automated screening tool for depression or anxiety in people who may be reluctant to visit a physician or a psychiatrist, Lu said.

Lu said the way physicians and nurses work will change as AI assistants are incorporated into their workflows.

"Our health care professionals need to use AI effectively as powerful assistants in their daily work," he said. "As often stated, AI will not replace doctors, but doctors who use AI will replace those who do not. If we do it right, we will have a much more efficient, effective and affordable health care system through the integration of AI."

Both Chen and Lu stress that there is a potential downside to AI integration.

"AI/machine learning learns from the past, including both the things we have historically done well and the things we have done less well," Chen said. "We all know the American health care system has produced very different health outcomes for individuals from different racial, ethnic and other backgrounds, and we must be mindful about how AI/machine learning tools are designed and implemented to prevent these inequities from being perpetuated or even magnified."

"AI may also generate misinformation and biased advice," Lu said. "We need to provide safeguards against any potential harm while incorporating AI into medicine."

> "As often stated, AI will not replace doctors, but doctors who use AI will replace those who do not. If we do it right, we will have a much more efficient, effective and affordable health care system through the integration of AI."
>
> – CHENYANG LU

WATCH: Learn more about AI and medicine

Cyberphysical systems and safety

The world isn't replacing human intelligence with artificial intelligence but augmenting it through statistical methods that leverage the availability of large amounts of data, said Bruno Sinopoli, the Das Family Distinguished Professor and chair of the Preston M. Green Department of Electrical & Systems Engineering.

"This is drastically changing science and engineering because this data was previously not available," he said. "With this data, we can now address questions that could not be answered by previous methods, which had limitations in modeling very complex engineered systems. At the same time, we have to face a number of challenges associated with the uncertainty introduced by data-driven models," Sinopoli said.

Safety is of ultimate concern in cyberphysical systems such as self-driving vehicles, drones, robotic surgical systems and smart grids. They must be able to withstand malicious activities by adversaries trying to create misinformation and chaos. For example, an autonomous car needs to be robust enough to withstand attacks that may cause a crash. Machine learning is often used to discern malicious behavior from normal behavior, said Yevgeniy Vorobeychik, associate professor of computer science & engineering.

Vorobeychik studies the integration of AI in autonomy and how to do it robustly with a complementary set of approaches, including verifying the properties of the system and making sure that it is safe and can withstand adversarial perturbations. He said it is hard to know when a system is secure.

"You don't ever know until people have earnestly tried to attack, and it's failed," he said. "You can never say the system is secure in an absolute sense, but you can make sure it is secure with respect to a specific threat model of what can go wrong."

Vorobeychik, Sinopoli and Zhang are all members of the Center for Trustworthy AI in Cyberphysical Systems at Washington University, under which faculty conduct a broad scope of research to study the safety and security of AI-driven cyberphysical systems.

"AI is a powerful tool that we need to master, and just like any other tool, there will be good and bad aspects," Zhang said.

Zhang showed his students an example of the bad aspects where his computer thought that a photo of a Golden Retriever was a bowl of guacamole. Four pixels in the photo of the Golden Retriever were altered simply by changing the percentage of three colors in the pixels.

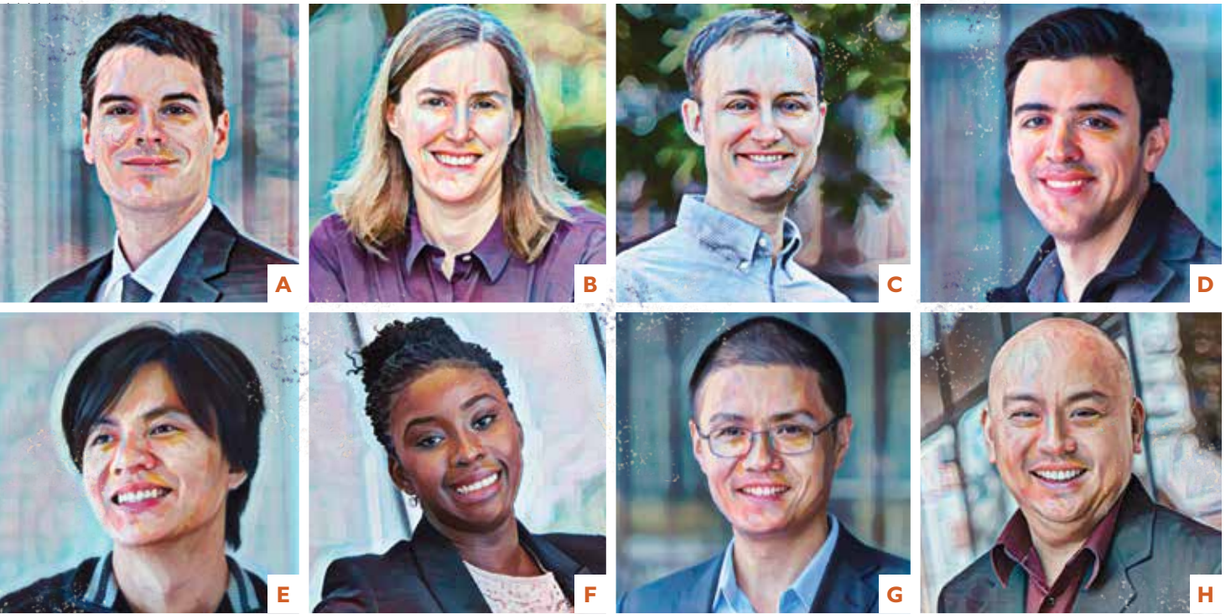
"These are the pixels that an attacker would modify such that the image looks perfectly ok to a human but looks different to the machine," Zhang said. "Now imagine if this were the adversarial example submitted to a missile locking system or a self-driving car."

Zhang said he and Vorobeychik are working to address the robustness of cyberphysical systems as well as the resiliency to leverage the machine learning in the cyberphysical systems.

"One thing that motivates me to study this is that I see AI is going to make fundamental changes in all sectors," Zhang said. "While the AI developers are pushing the performance of AI to the next level, how do we make sure that lead is actually deployed in the real world and that we're safe?"

MIDJOURNEY

> "While the AI developers are pushing the performance of AI to the next level, how do we make sure that lead is actually deployed in the real world and that we're safe?"
>
> – NING ZHANG



Many faculty in the McKelvey School of Engineering focus their research on artificial intelligence and look at it from various angles. In addition, degree programs in which artificial intelligence and machine learning are the focus are already in place. A new minor in biomedical data science, offered through the Department of Biomedical Engineering, had 28 students at the end of the Spring 2023 semester: one third were majoring in biomedical engineering, and the rest had a major outside of biomedical engineering.

A sampling of faculty research in AI:

A Andrew Clark

Andrew Clark is interested in introducing new game- and control-theoretic models that describe the impact of cyberattacks and other disturbances on physical infrastructures.

B Katharine Flores

Katharine Flores is incorporating artificial intelligence-based algorithms to identify which metal alloys are best to form metallic glasses with funding from the National Science Foundation.

C Nathan Jacobs

Nathan Jacobs' research centers on developing learning-based algorithms and systems for extracting information from large-scale image collections. He has applied this expertise in many application domains, with a particular focus on geospatial and medical applications.

D Yiannis Kantaros

Yiannis Kantaros' research focuses on developing scientific principles for improving the safety, robustness, efficiency and versatility of autonomous robot teams.

E Jr-Shin Li

Jr-Shin Li's lab combines artificial intelligence with systems theory to develop a more efficient way to detect and accurately identify an epileptic seizure in real-time.

F Alvitta Ottley

Alvitta Ottley's lab is developing tools to analyze and understand social data, including crime data, social media posts and home listings. Additionally, they use research methods from the social sciences to inform how to present the right data in the right way to the viewer.

G Chenguang Wang

Chenguang Wang's work focuses on fundamental natural language processing research including deep learning models, large language models, knowledge graphs, and language generation.

H William Yeoh

William Yeoh and his collaborators recently received a $3 million grant from the National Science Foundation to advance AI in computational, environmental and social sciences.

AI and education

In addition to research, McKelvey Engineering faculty are adapting curriculum so that students become AI-informed and AI-aware.

"We can't be afraid to address these new technologies because the implications are coming regardless, so we'd better have as many tools as possible," said Aaron Bobick, dean and the James M. McKelvey Professor, who is a pioneer in action recognition by computer vision. "We need an AI-informed citizenry. One key to a rational future is to have everyone understand as much as possible about these systems, and that's why I'm willing to commit to all McKelvey Engineering students being AI aware."

To get there, McKelvey Engineering faculty are looking at how best to integrate AI into the curriculum. In fact, tackling the emerging challenges and evolving opportunities related to artificial intelligence and AI-assisted systems is an initiative in new strategic plan being implemented in the school and joins the university's goal of a "digital transformation."

"We are looking at how we contextualize artificial intelligence and machine learning as an experience for all," said Jay Turner, vice dean for education and the James McKelvey Professor of Engineering Education. "When the curriculum is ideal, there are always two points: one is how we leverage technology to improve teaching in the student experience, and the other is teaching the skill sets that students need to have for a career in which this will be part of their daily life. We want to prepare them to have a mindset that as these tools evolve and become more available, they will be opportunistic in how they can use that to their level."

Academia also has a role to play in AI integration.

"Academia has a unique responsibility to be transparent about its methods and data used to train algorithms," said Alvitta Ottley, assistant professor of computer science & engineering. "More often than not, academia performs government-funded work with an increasing requirement for open access. It can also provide opportunities for society to provide feedback on AI systems and participate in the design of algorithms."

"We can't be afraid to address these new technologies because the implications are coming regardless, so we'd better have as many tools as possible."

– AARON BOBICK

MIDJOURNEY

The Right Stuff

Katharine Flores brings dedication, leadership and expertise to the McKelvey School of Engineering's materials science program.

by Danielle Lacey

JERRY NAUNHEIM

Metallic glass. The concept sounds like a contradiction to most lay people, but for Katharine Flores, Christopher I. Byrnes Professor and director of the Institute of Materials Science & Engineering (IMSE) at Washington University in St. Louis, the unique material was the well-timed breakthrough that set her on her path as a leader and scholar.

Flores, who earned a bachelor's degree in mechanical engineering from the School of Engineering in 1995, was first drawn to materials research during a co-op experience with McDonnell-Douglas Corp.

"I was fascinated by how you select a material for an application and how important that is to the final design," Flores said. "You're designing something from the atomic level up."

She would go on to earn master's and doctoral degrees in materials science and engineering from Stanford University. During this time, metallic glass would make its comeback in the materials space. Originally invented in the 1960s, metallic glass is a metallic material that has a disordered atomic structure. Most metals typically have a crystalline structure — that is, one that is highly organized.

"The atoms will sit like eggs in an egg carton," Flores said. "When we say 'glass,' everybody immediately thinks of window glass because silicates, which are what windows are made of, have an atomic structure that is very complex and difficult to organize in that orderly egg carton arrangement."

Metallic glass underwent a renaissance in the '80s and '90s when researchers discovered new alloy materials that could be cooled more slowly while maintaining that disorganized structure. That allowed them to produce thicker and more practical products, such as sports equipment and electronics casings.

"We were able to make things that were millimeters or even centimeters in scale," Flores said. "That's something big enough to make structural things out of. I'm interested in the behavior of load-bearing materials, and my thesis was on understanding the fracture and fatigue behavior of these metallic glasses."

BUILDING A NEW PROGRAM

Flores' first faculty position was with the Department of Materials Science and Engineering at The Ohio State University. She would remain there for 10 years before a fortuitous meeting with Kenneth Kelton, professor of physics in Arts & Sciences at WashU, who also researches metallic glass, at a professional conference.

"In his presentation, the WashU seal was on his opening slide," Flores said. "I was surprised because I didn't usually see materials people from WashU. It was a weird confluence of coincidences that WashU was starting to do something serious in the materials domain when I ran into Ken."

> **"It's a competitive and interesting discipline with applications that span all of the other engineering disciplines and would draw students with an interest in fundamental and applied science."**

They kept in touch for years before Kelton asked Flores to come to WashU to present a seminar and to provide guidance on the development of the university's new materials science and engineering division.

"At that point in my career, I was thinking about what I wanted to do next," Flores said. "Our meetings led to a conversation about the new unit, and I knew it would be a way of moving my career forward, giving back to WashU and bringing an area I was really excited about to a new level of prominence at the university."

In 2012, Flores joined the School of Engineering as a professor of mechanical engineering & materials science and associate director of the new IMSE. Under her leadership, the institute launched its doctoral degree program in materials science and engineering in 2013, and since then, more than two dozen students have graduated from the program.

"The university wanted the institute to grow a doctoral program in a sustainable way," Flores said. "I came in with the right level of visibility in materials science, brought an awareness of what a typical program would look like and what WashU needed to position itself to gain that level of recognition and visibility to our own."

Flores briefly brought that same visibility to the Department of Energy, Environmental & Chemical Engineering when she served as interim department chair from November 2020 to May 2022.

"The motivation for that experience was to build the relationship between EECE and the materials sciences," she said. "I got to appreciate environmental engineering and aerosols research and its connection to materials in a way I hadn't until that point."

From left: Sam Perkins, a student in the Thermal Management REU program from Bradley University, works with Flores on the Optomec MR-7 Laser Engineered Net Shaping (LENS) system, which is a direct laser deposition system for 3D printing metals.

THE NEXT STEP

Flores has ambitions beyond the doctoral program for the institute, including attracting external funding to form a national research center.

"The Materials Research Science and Engineering Center program at the National Science Foundation has a call for proposals that comes around every three years, and I've pushed us to submit something every time," she said. "I've also worked hard to bring together groups around other materials-focused opportunities. The IMSE holds regular seminars, workshops and brown-bag discussions to engage people throughout the university."

Flores said she'd also like for the school to eventually offer an undergraduate degree in materials science and engineering. Currently, the school only offers a minor, which she helped develop, through the Department of Mechanical Engineering & Materials Science, of which she is associate chair.

"It's a competitive and interesting discipline with applications that span all of the other engineering disciplines and would draw students with an interest in fundamental and applied science," Flores said. "In my undergraduate classes, I tell them my goal is to get them to think about materials other than steel and concrete when they build something. If I can get people to go beyond stuff everyone's already been making, then I call that a win." M

The WashU shield is made from a titanium alloy and was 3D printed using the LENS.

WATCH:
Learn more about Flores' lab

Flores was installed as the Christopher I. Byrnes Professor in Fall 2022. Her husband, Jim, who earned a bachelor's degree in chemistry from WashU in 1993; son James, and daughter Jennifer joined the celebration.

Duo Zhang

by Danielle Lacey

Duo Zhang, an alumnus of the McKelvey School of Engineering and a soldier in the U.S. Army, earned a master's degree in chemical engineering in 2021 despite his studies being interrupted by multiple deployments and the COVID-19 pandemic.

He's now a chemical engineer and contracting officer representative for the Army's National Training Center at Fort Irwin in San Bernardino County, California. We spoke to Zhang about his experiences and how they helped him to be a better soldier.

Q: Why did you decide to continue your education?

A: The Army encourages all soldiers to go back to school and will pay their tuition. I enlisted as a nuclear, biological, radiological and nuclear specialist and knew I wanted to learn more so I could better serve the Army. I've always wanted to go to WashU, and this was my opportunity.

I decided to study engineering because it was a new concept for me. Mathematics and computer science are concepts we use in engineering that I didn't deal with as a chemistry major.

Q: What was it like returning to the classroom?

A: I started in the spring semester of 2019 before I was deployed, which was tough because I had just started getting used to being a new student. Plus, as a chemistry major with no engineering background, it was hard for me to catch up that first semester. I had been out of school for so long.

It was very different being back in the classroom. In the Army, we're expected to listen to orders. We do the job and report back. There are also certain procedures we always have to follow. In the classroom, the professors will ask a question and we're expected to give feedback. We can say what we think.

Q: Were there any resources that helped you to adjust to life back on campus?

A: Professors Yinjie Tang and Fuzhong Zhang, both professors of energy, environmental & chemical engineering, were patient in helping me. I would go to their office hours, and they'd tell me what I should know before I came to their lectures. Professor Tang also introduced me to Garrett Roell. He was a fourth-year doctoral student who became my mentor. He would help me in the labs and would also let me shadow him during his work.

The WashU Office of Military & Veteran Services sent my team and me seven care boxes during our Operation Spartan Shield deployment in the Middle East. These boxes included food, toiletries and two WashU T-shirts. I was touched by that.

Q: Can you describe some of the projects you've worked on since earning your master's degree?

A: Fort Irwin is in the Mojave Desert. The Army wants to keep working in this zone, but they can't without a source of clean water. Before they used recycled water, but now there is an irrigation system that handles potable water, non-potable water, green water and more.

When I got here, the colonel in charge of the garrison asked me to put together a report on what improvements could be made to the water system. The data that was provided to me to review was from the 1980s. I worked with contractors and environmental officers to update the fort's data and improve the models they were used in. Last summer, the secretary of the Army came to Fort Irwin and reviewed the report. She approved it, and we got $12 million to make the updates. I was prepared for this project by what I learned in Professor Young-Shin Jun's class.

Q: You're a chemist, a soldier and an engineer. How have these different experiences helped to get you where you are now?

A: WashU gave me the knowledge and skills to serve, while the Army gave me a job and the opportunity to improve. The Army also taught me values such as integrity, loyalty and discipline that helped me to not give up on difficult papers or projects in the classroom. M


JERRY NAUNHEIM

Multitasking master

Myrna Harbison marks **45 growth-filled years** in the Department of Computer Science & Engineering

by Beth Miller

IN 1978, computers were beginning to use the 5.25-inch floppy disk, Microsoft Corp. released the BASIC programming language, and Washington University in St. Louis was celebrating its 125th anniversary.

While much has changed in computing and at Washington University in the past 45 years, one thing hasn't changed — Myrna Harbison's presence in the Department of Computer Science & Engineering. That year, Harbison joined the small staff in the department, then located in Bryan Hall, as a department secretary. Now the longtime assistant to the chair, she has assisted four department chairs, beginning with the late Jerome Cox, who became the founding chair of Computer Science in 1975.

Computer science has evolved exponentially since the late 1970s, when Harbison and her coworkers used electric typewriters for their work and students processed data by feeding punch cards into a machine, and Harbison has helped shepherd the department through that. She deftly oversaw everything from organizing large conferences to overseeing department moves twice: from Bryan Hall to Jolley Hall in 2016, and into the newly-opened sleek McKelvey Hall in early 2021.

"As Computer Science grew, there was talk of the department moving into a brand new building, but little did we know the benefactor would be one of our own alums, Jim McKelvey, which made the move into this building more meaningful," Harbison said.

When McKelvey Jr. was an undergraduate, Harbison recalls, enrollment was small enough that she knew most of the students. While the department's rapid growth makes that more difficult today, she said it has been wonderful to see the increase in students and faculty each year.

"There's not really a typical day here at WashU, and that's a good thing," she said. "It's like Forrest Gump said, 'Life is like a box of chocolates. You never know what you're going to get.' It's one of the most challenging aspects of working here, but also one of the things that makes it interesting enough to want to keep doing it."

For the past 10 years, Harbison has been assistant to Roch Guérin, the Harold B. & Adelaide G. Welge Professor of Computer Science and chair, who said her presence has helped shape the department's collegial structure that everyone enjoys.

"Besides being the repository for the department's institutional memory, i.e., the go-to person for any question related to processes and traditions in the department, one of her unique qualities has been in making everyone feel that helping them is the most important thing to her," Guérin said. "No matter how mundane the task, she handles it as if it is the most important thing in the world, and she keeps at it, often above and beyond the call of duty, so that you never have to worry about whether it will get done and be done well. I would not have survived my job as chair were it not for her constant efforts."

Harbison said her longevity at WashU is surprising even to her. Washington University is only the second place Harbison has worked in her adult life, but it has become her home.

"If you had asked me then if I'd still be here 45 years later, I probably would have said, 'No, are you kidding?'" she said. "But Dean Bobick said recently that universities are continually renewing themselves, which is what I've always felt and one of the reasons I've been here this long. Every fall we get an influx of new people who bring with them new ideas and challenges, and it's this change and renewal that can make it possible for staff members to enjoy staying at WashU."

Having achieved such a large milestone, Harbison said it's now time to move on to other things and will retire at the end 2023 with 45 years of great memories. *M*

> **"Besides being the repository for the department's institutional memory, i.e., the go-to person for any question related to processes and traditions in the department, one of her unique qualities has been in making everyone feel that helping them is the most important thing to her ... "**
>
> **— ROCH GUÉRIN**
> *Department Chair, Computer Science & Engineering*

McKelvey Engineering Awards

APRIL 30, 2023


SID HASTINGS

From left: Andrew Schiermeier, Mariah Weyland Gratz, Andre Audi, Dave Rosetti, Jan Avent, Craig Kaufman, Parag Mallick and Aaron Bobick

Andre Audi, *BS, civil engineering, MS in structural design, 1984*

Craig Kaufman, *BS, MS, civil engineering, 1986 and 1987, respectively*

Andrew Schiermeier, *BS, mechanical engineering, 1991*

Mariah Weyland Gratz, *BS in biomedical engineering, 2002*

Engineering Entrepreneurship Award – **Parag Mallick**, *BS, computer science, 1997*

Dean's Award – **Dave Rossetti**, *BS, applied mathematics and computer science, 1974* and **Jan Avent**

WATCH: SEE INTERVIEWS WITH EACH OF THE MCKELVEY ENGINEERING AWARDEES.

Emerging Leader Awards

APRIL 14, 2023

Frank Bergh, *BS, electrical engineering, 2008*

Craig Goergen, *BS, biomedical engineering, 2005*

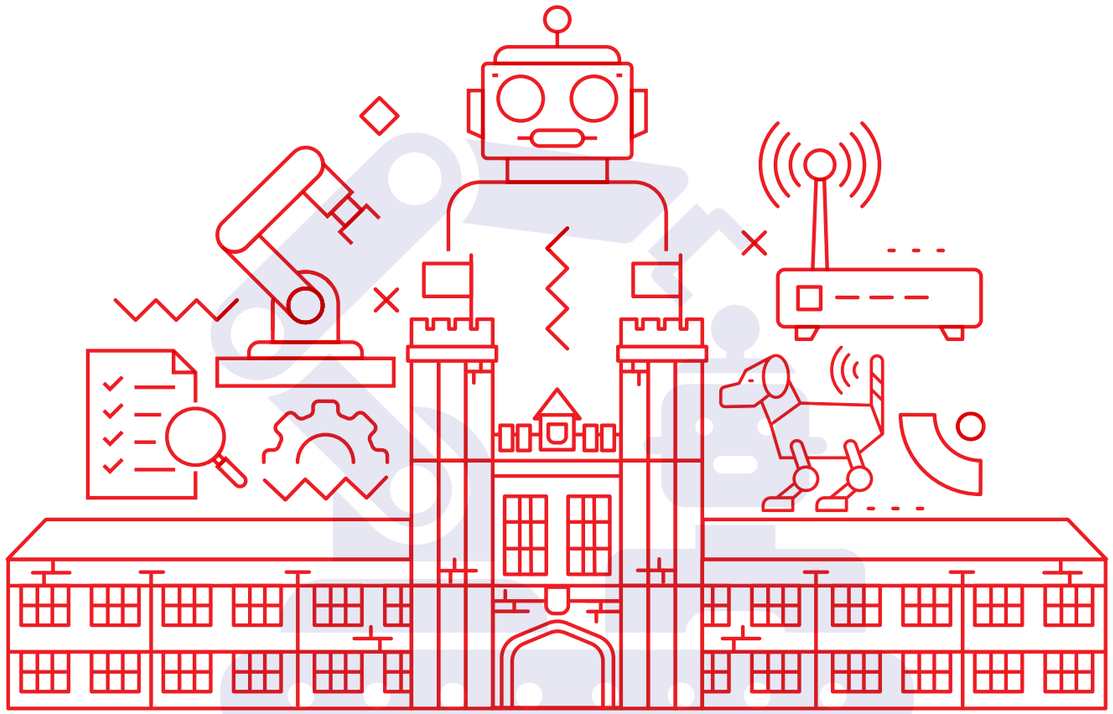
Kate Nevin, *BS, MS, mechanical engineering, 2009*

Fiona Turett, *BS, mechanical engineering, 2009*

WATCH: SEE INTERVIEWS WITH EACH OF THE EMERGING LEADERS AWARDEES.


SID HASTINGS

From left: Chris Kroeger, Craig Goergen, Kate Nevin, Frank Bergh, Fiona Turett and Aaron Bobick



Engineering the future: The rise of WashU Robotics

by Shawn Ballard

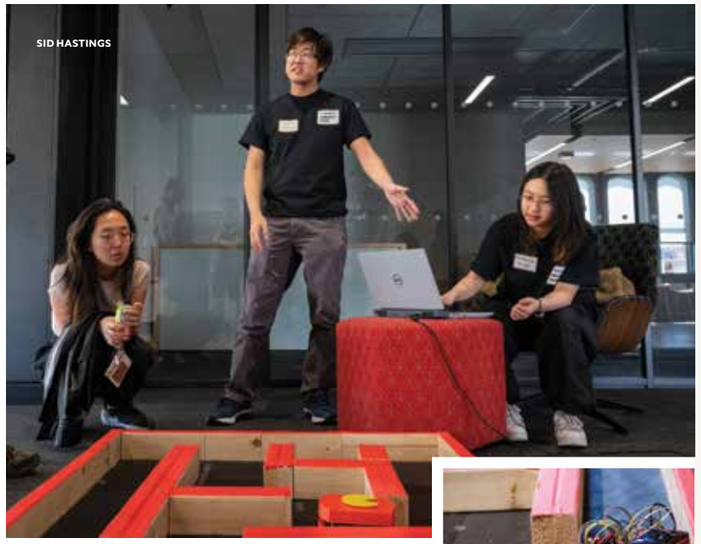
WashU Robotics Club founders Liana Tilton and Jack Nanez reflect on the community they've built in just under two years and look ahead to what's next

Every Saturday, in the basement of James M. McKelvey, Sr. Hall, an eclectic group of innovative students gather, drawn together by their shared love of robotics. Meetings of the WashU Robotics Club buzz with activity, alive with the challenges of hands-on problem solving and the thrills of effort rewarded.

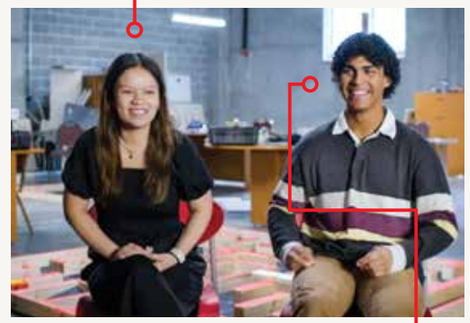
Since its founding in January 2022, the club has grown from 13 members with three robots to 270 total members, with 60 active members working on six complex projects, including a robotic dog, flying drone, virtual reality/augmented reality headset, robotic arm, flexible wearables, and PacBot navigator. Founding president Liana Tilton and vice president Jack Nanez lead an expanded 11-member executive board with the support of faculty adviser Yiannis Kantaros, assistant professor of electrical & systems engineering, and mentor Louis Woodhams, senior lecturer of mechanical engineering & materials science.

"When we founded WashU Robotics, we wanted the club to be different from other engineering design clubs," said Tilton, a senior majoring in electrical engineering with a minor in robotics. "Instead of focusing on one project per year or choosing a competition team in the fall, we have multiple projects going on year-round."

WashU Robotics' open door requires a careful balance of introductory opportunities for newcomers alongside competitive projects that can go head-to-head with more established robotics teams. And their efforts are already paying off. WashU Robotics earned an honorable mention at the Harvard PacBot competition last spring against engineering teams from MIT and Princeton University in the task of having a from-scratch autonomous robot navigate a physical Pac-Man field.



▲ *Joshua Cheng and Kathleen Weng (right) describe the autonomous PacBot robot they designed to navigate a physical Pac-Man field. WashU Robotics earned an honorable mention at the Harvard PacBot competition last spring.*



LIANA TILTON
Class of 2024

Hometown:
Guilford, Connecticut

Major:
Electrical engineering

Minor:
Robotics

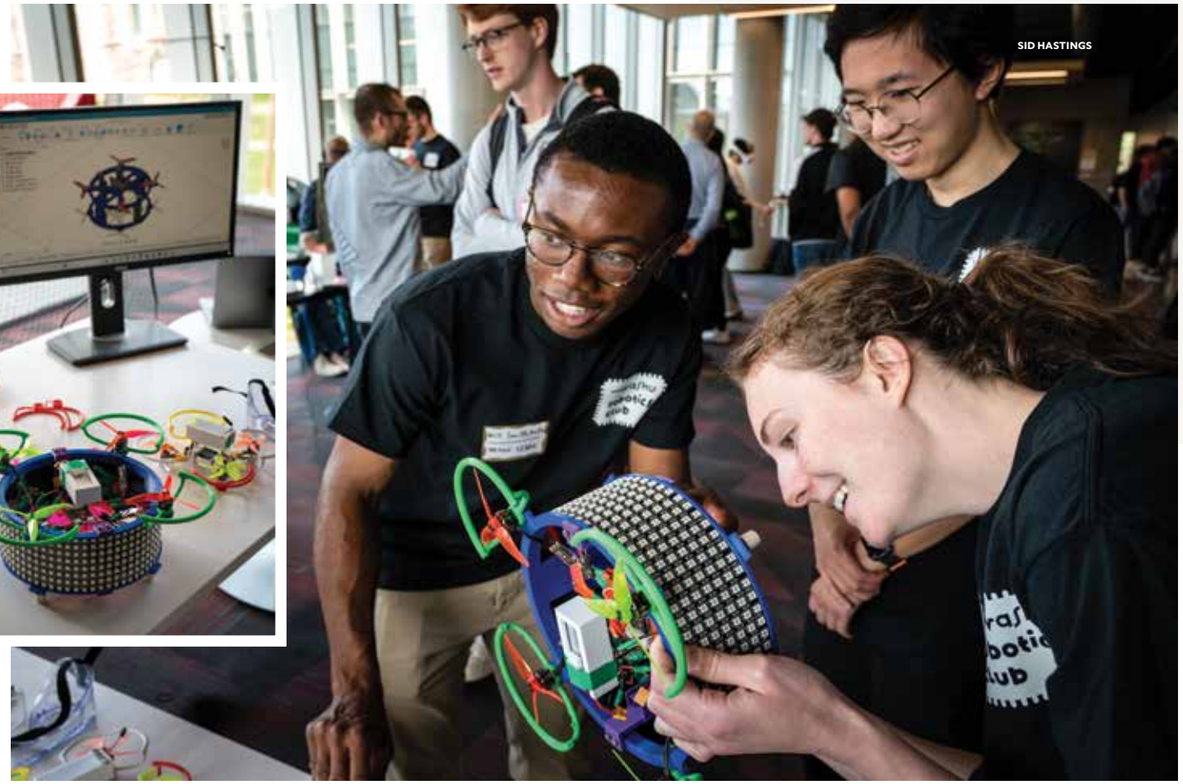
JACK NANEZ
Class of 2024

Hometown:
Wilton, Connecticut

Major:
Mechanical engineering

"Instead of focusing on one project per year or choosing a competition team in the fall, we have multiple projects going on year-round."

– LIANA TILTON



The Robotics Club's drone team prepares the drone for flight. (From left) Will Smith, Thomas Lang, and Sophie Fendler.

Membership also continues to rise, infusing a remarkable diversity of talent into WashU Robotics. The club includes students from all undergraduate schools at WashU, all majors in the McKelvey School of Engineering and all levels, from first-year to doctoral students.

"No matter how much we grow, we always want to consider our accessibility," said Nanez, a senior majoring in mechanical engineering. "Whatever experience you have in robotics, there's always more to learn, so lots of teaching happens at club meetings. Older members help new members; teams lend support to other teams, helping with tools, designing and coding.

"We don't want to lose that dynamic — those interactions that make the club and the community so fun — even as we look ahead to doing more big competitions," Nanez added.

The club's focus on building community as much as crafting cool robots is baked into its foundation. A fortuitous pairing in circuits lab connected Tilton and Nanez, who quickly discovered a shared interest in robotics. Tilton said her participation in the FIRST Robotics Competition in elementary and high school, combined with her growing interest in robotics research, is what drew her to McKelvey Engineering. However, when she arrived at WashU, Tilton was shocked to discover there was no robotics club. Like any respectable WashU engineer, Tilton identified this problem and set out to solve it.

"I've always had an interest in entrepreneurship and a desire to try and start something," Tilton recalled. "After talking with Jack and others in my classes who also loved doing robotics in high school, I believed we could build something special. And McKelvey gave me that opportunity to create something new."

Nanez said forming the club was about more than the technical side of robotics.

"The community aspect of having people who are interested in the same things is what makes the club so awesome," he said. "Pulling late nights working on robots or hanging out on the weekend finishing a project together have been some of my favorite experiences at WashU."

> **"The club's rapid growth is a testament to the unwavering interest and enthusiasm for robotics at WashU."**
>
> **– YIANNIS KANTAROS**
> *Faculty Adviser*

As WashU Robotics continues to grow, with funding from the National Havoc Robot League and McKelvey Engineering, more opportunities for club members to do what they love are on the horizon. The team's very first robot, Pupper, an adorable robotic dog, has gotten an AI upgrade and is learning to fetch and perform other tasks. A beefier, smarter robotic arm is in the works to enable the team to participate in more competitions and give members hands-on experience with technology that will be critical in next-generation surgical applications. And Flashbird, a flying, flashing drone the team built from scratch, will soon be equipped with more bells, whistles and ways to say "Hello, WashU!" in flight.

"I am continually amazed by the remarkable leadership skills demonstrated by club members and their unwavering passion for innovation and collaboration," Kantaros said. "This is evidenced by the rapid progress they achieve in their collaborative projects, the external funding they secure, their established connections with the industry, and their exceptional capacity to inspire and motivate their peers.

"The club's rapid growth is a testament to the unwavering interest and enthusiasm for robotics at WashU," Kantaros added. "It is a privilege to witness this incredible journey, and I eagerly look forward to further empowering the club's members and supporting their aspirations. *M*

Pupper, the robotic dog, is learning how to fetch and perform other tasks.

(From left) Matthew Giardinelli and Daniel Melka explain the glove.

WATCH: Learn more about WashU Robotics Club

STEVE DOLAN

Sanitation advocate

Lilia Abron has devoted her career to solving the world's most pressing water problems.

by Shawn Ballard

"Everybody deserves to go to the bathroom and have a pleasant experience. All humans have bodily functions for eliminating waste, but for most the experience is not pleasant, and the available toilet options are likely unsanitary and not environmentally safe," said Lilia Abron, president and CEO of PEER Consultants PC.

"The situation in some areas of South Africa is so bad that people are going back to the bucket system, literally lining a bucket with a plastic grocery bag and using that as a toilet," she said. "When they finish, they take the bag out of the bucket, tie it up and toss it over in the next yard or out in the street. When I see that practice, I can practically see cholera and other infectious diseases transmitted through fecal matter flying in the air. Something must be done."

Abron, the first Black woman in the U.S. to earn a doctorate in chemical engineering, is globally recognized as a leader in environmental and sanitary engineering. Her mission to address sanitation challenges, particularly those faced by marginalized communities, was born from her realization that these challenges are universal.

"When it comes to solving basic human problems, I find there's nothing new under the sun," she said. "Sitting at WashU as a student in 1966, I learned about a town in Kansas that had run out of drinking water in its reservoir and had to take water from the wastewater plant to the drinking water treatment plant. Environmental engineers did what they had to do to solve the problem and keep people healthy."

Though clever innovations in engineering regularly make the impossible possible, popular support can be harder to come by. Especially when it comes to excrement.

"We can be our own worst enemies," Abron noted. "People see solutions like that and say 'ugh, we're drinking poop water.' I really hate that description. Water is water is water. We clean it up and use it again, over and over again. Engineers have the skills to address pressing issues in infrastructure, but too often we get held up by negative public sentiment or other entrenched systems that harm the public good."

Born and raised in the heart of Memphis, Tennessee, Abron's early interest in science led her to study chemistry at LeMoyne College, then to earn a master's degree in environmental engineering from Washington University in St. Louis in 1968 and a doctorate in chemical engineering from the University of Iowa in 1972. In 1978, Abron established PEER Consultants, an environmental engineering firm focused on providing sustainable, cost-effective solutions to environmental and sanitation problems. Today, the company is a leader in addressing problems of the human environment, with an emphasis on environmental injustice and improving the quality of life for communities worldwide.

Abron's advice for building a thriving and sustainable sanitation economy? You must have community engagement, but first you must convince the women.

COURTESY PHOTO

Lilia Abron and her colleague John Corliss, senior vice president of PEER Consultants PC, standing in front of a solar array designed and installed by PEER at a wastewater treatment plant in Connecticut.

> **"Engineers have the skills to address pressing issues in infrastructure, but too often we get held up by negative public sentiment or other entrenched systems that harm the public good."**
>
> **– LILIA ABRON**

"You can't build a house, and you certainly can't build a community, without buy-in from women," Abron said. "Women are often the ones running the show, running the whole household, so first you have to make mama happy if you want to build something that actually works."

Abron is a longtime member of the International Women's Forum, an international group of women at the top of their fields who promote efforts by women around the world.

"Being part of the global discourse led by women to support women is especially important right now around issues of climate change and sustainability," she said.

Abron pointed to the interconnections between water delivery, sanitation, housing, hygiene and economic development and how all are impacted by climate change.

For decades PEER has been building sustainable communities in South Africa, even in areas that aren't on the electric grid, but environmental changes have brought new pressures.

"In South Africa, we're dealing with potable water, sanitation, energy and housing issues because there are so many people coming from the countryside for jobs or to escape issues caused by climate change," Abron said. "Towns are just overrun; they don't have the infrastructure to support this daily influx of hundreds of people."

> **"You can't build a house, and you certainly can't build a community, without buy-in from women."**

Even when she's focused on immediate sanitation issues such as avoiding bucket toilets and infectious disease outbreaks, Abron's goal isn't merely to solve the pressing crisis. By setting up public ablution facilities that run on green energy, PEER improves public health while improving infrastructural foundations for additional developments, including energy efficient housing and other facilities. These projects in turn activate the local economy by hiring local tradespeople who are invested in and benefit from the work being done.

This transformative work isn't only happening half a world away. Abron has long observed the same issues in the U.S., notably in rural areas. Her latest focus is on the Alabama Black Belt Region, where lack of access to water, sanitation and hygiene suffers many of the same problems as in South Africa with the same underlying racial inequities.

"Historically, this area was home to many Black enslaved people. Today, we have social inequity alongside infrastructural and waste management issues," Abron said. "We need social activists and engineers to work together to solve this combined problem, and that's exactly what we're doing. By jumpstarting the sanitation economy, we're expanding health to wellness, putting in the infrastructure needed to attract businesses and services that support a thriving community."

Abron describes herself as a bit of a dreamer. But when a dreamer is also an engineer at the top of her game, dreams have a remarkable way of becoming reality.

"If woman can imagine it, woman can do it," she says.

Lilia Abron (center) with two of her sons, Ernest Robinson (left) and David Robinson (right)

Lilia Abron and Dr. Cecil Lue-Hung, who recruited Abron to WashU in 1966 and has been a valued mentor to her ever since, at the 2019 National Academy of Engineering conference in Washington, D.C.

DUAL DEGREE PROGRAM celebrates 50 years

by Danielle Lacey

The program has welcomed more than 2,600 students since its creation in 1973.

IN THE FALL OF 1973, the Dual Degree Program, then known as the Three-Two Plan, at the engineering school welcomed its first student. Fifty years later, the program is seeing record enrollment and graduating more than 100 students a year.

Washington University in St. Louis was among the first in the country to offer such a program, which allows students to earn a bachelor's degree in another field from select affiliated liberal arts institutions in three years, then a bachelor's degree in engineering at WashU in two years.

It was the school's namesake who brought the program to campus after observing a similar initiative at another university.

"James McKelvey Sr. was a key person in the early seventies in getting the program going," said Ron Laue, senior associate dean of the Dual Degree Program. "He felt the communication and critical thinking skills students received at liberal arts schools would make them excellent engineering candidates."

Harold Brown, former associate dean at the engineering school, was also instrumental in the program's development and early recruiting efforts. The school awards 10 Harold P. Brown Engineering Fellowships to deserving Dual Degree students each academic year.

"Offering a financially supported pathway for students to enter engineering school helps McKelvey Engineering diversify its population, our partner schools attract STEM-oriented applicants and our graduates prepare for a wide range of opportunities," said Scott Crawford, assistant dean of the Dual Degree Program.

Program staff rely on the close relationships they build with faculty at more than 100 affiliated institutions across the country, and much of their recruitment is done by word of mouth.

"What makes our program unique is that the people who recruit our students work with them as their advisers," said Kate Whitaker, program coordinator of the Dual Degree Program. "We can say we worked with each and every student from application to graduation."

Dual Degree students tend to form strong cohorts due to their shared experiences as older undergraduate students attending a new university. As a result, they tend to have higher rates of retention compared to traditional first-year students; 90% of Dual Degree students remain in McKelvey Engineering compared with 85% of traditional first-year students.

"I appreciate working with Dual Degree students because they are engaged and ready to take advantage of all the resources WashU has to offer from day one," Laue said. Since its establishment, more than 2,300 students have graduated from the Dual Degree Program at McKelvey Engineering. Alumni of the program include Chiamaka Asinugo, lecturer in the Department of Mechanical Engineering & Materials Science; Lance Cage, executive vice president of Alberici Constructors Inc.; Steve Sands, managing director, vice chairman of investment banking and chairman of the Global Healthcare Group at Lazard; Libby Allman, vice president operations, TVH; and Arnold Donald, former president, CEO and chief climate officer of Carnival Corp. & plc.

Looking ahead, program staff say goals for the program include increasing the program's visibility at a national level, continuing to grow enrollment and diversifying the Dual Degree student body.

A gathering to celebrate the program's 50th anniversary is being planned for Spring 2024.

2023 Dual Degree Group

CLIMBING TO THE NEXT LEVEL:

From Excellence *to* Impact

McKelvey School of Engineering launches forward-thinking strategic plan

> **We want our students to be as prepared as they can be for not only their first job, but for continuing education and their entire careers."**
>
> – CHAO ZHOU

The McKelvey School of Engineering is embarking on a comprehensive and future-looking strategic plan to guide it into 2030. Steering committee co-chairs Katharine Flores, the Christopher I. Byrnes Professor in the Department of Mechanical Engineering & Materials Science, and Chao Zhou, professor of biomedical engineering, are leading a team of faculty and staff who have crafted a plan to improve education, research and innovation, and work environment and culture that will encompass faculty, students, staff, postdoctoral researchers and the St. Louis community.

"This long-term vision builds on the previous school strategic plan of 2017 and is informed by the university's *Here and Next* strategic plan, with an emphasis on particular research domains, digital transformation and community," said Aaron Bobick, dean and the James M. McKelvey Professor. "Deliberate implementation of our previous plan resulted in our ability to execute our education and research missions effectively, as evidenced by our recent growth and successes. With these new, global-context-aware initiatives, McKelvey Engineering is poised to advance significantly by 2030."

"This road map guides priorities and action plans that build on the strong foundation while adding adaptations to the post-pandemic environment," said Flores, also the director of the Institute of Materials Science & Engineering. "It allows the school to continue existing collaborations with other schools within the university while creating space for new opportunities."

The school has identified four strategic priorities to help achieve its vision over the next seven years: to generate scholarship that transcends engineering disciplines; to engage students with experiential and industry-based learning activities; to drive innovation, industrial impact and entrepreneurship; and to cultivate healthy and inclusive environments for employees.

> **Deliberate implementation of our previous plan resulted in our ability to execute our education and research missions effectively, as evidenced by our recent growth and successes. With these new, global-context-aware initiatives, McKelvey Engineering is poised to advance significantly by 2030."** – AARON BOBICK

The plan includes nine signature initiatives:

1. Conduct environmental and climate solutions research
2. Conduct research at the intersection of engineering and medicine
3. Research to develop the bioeconomy and biomanufacturing research and innovation
4. Embed engineering artificial intelligence (AI) into research
5. Integrate AI in teaching and learning
6. Ensure experiential learning in all academic programs
7. Emphasize industry impact, partnerships and entrepreneurship
8. Implement an equity, diversity and inclusion (EDI) action plan
9. Invest in our people

Among the goals for education is providing a cross-disciplinary engineering curriculum to prepare students to be leaders in their chosen engineering field, whether it be research and academia or in industry. In addition, the committee is discussing new disciplines and degree programs to further set the school apart among its peers.

"For McKelvey to continue providing an elite engineering education and remain competitive in higher education, we must deliver an exquisite student experience that strikes a better balance between demanding curricula and well-rounded, experiential learning opportunities," Zhou said. "We want our students to be as prepared as they can be for not only their first job, but for continuing education and their entire careers."

While McKelvey Engineering has long been a leader in research, a new goal is to make it a nationally recognized leader in a few key initiatives as well as in translational artificial intelligence and data-driven research. In addition, a schoolwide innovation and entrepreneurship strategy would position the school as a research partner for startup companies and industry and as an economic driver for the St. Louis region. Other goals include positioning McKelvey Engineering as a destination employer for researchers at the top of their fields and providing support to faculty members early in their careers.

The committee's workplace and culture goals envision faculty and staff benefitting from an investment in onboarding, learning and development and career progression opportunities as well as opportunities to be creative and collaborative. Another goal is to create a work environment in which equity, diversity and inclusion principles are ingrained within the culture, and to ensure that accountability, transparency and inclusion are a part of all decisions made within the school.

Ten new faculty join McKelvey Engineering

A Cory Berkland, professor

» PhD, chemical and biomolecular engineering, University of Illinois at Urbana-Champaign, 2003

Cory Berkland joins the faculty Nov. 1 from The University of Kansas as the Mark and Becky Levin Professor. Berkland's research merges engineering and biological sciences to develop novel therapeutics and biomaterials. His lab designs molecules and materials to treat disease using tools such as biomolecular engineering, polymer science and material design. His research areas include cancer immunotherapy, antigen-specific immunotherapies, biosensors and targeted drug delivery, among others.

B Yifan Dai, assistant professor

» PhD, chemical and biomolecular engineering, Case Western Reserve University, 2020

Yifan Dai joined the faculty July 1 from Duke University, where he was most recently a postdoctoral fellow in biomedical engineering. His research focuses on exploring and studying the physical chemistry of biology to understand how chemical functions are encoded in biological soft matter and developing fundamental capabilities for synthetic biology to design smart medicine capable of sensing and responding to cellular states to improve human well-being.

C Jiaxin Huang, assistant professor

» PhD, computer science, University of Illinois at Urbana-Champaign, 2023

Jiaxin Huang joins the McKelvey School of Engineering from University of Illinois at Urbana-Champaign, where she earned a doctorate in computer science. She was a recipient of the highly competitive two-year Microsoft Research PhD fellowship in 2021. Her research primarily focuses on leveraging large language models to enable label-efficient knowledge acquisition and utilization. She develops novel approaches from constructing fundamental knowledge representations for concepts, entities and documents, to improving complex reasoning process for language models.

D Umar Iqbal, assistant professor

» PhD, University of Iowa, computer science, 2021

Umar Iqbal joins McKelvey Engineering from the University of Washington, where he has been a postdoctoral scholar since 2021. His research interests are in privacy, security, technology policy and internet measurements. His research takes a data-driven approach to improve user privacy and security on the internet. He is particularly interested in building defenses against prevalent threats on the internet, preemptively anticipating and mitigating threats in emerging technologies, and exploring defenses that leverage law and policy. He joined the faculty Sept. 1, 2023.

E Chongjie Zhang, associate professor

» PhD, computer science, University of Massachusetts Amherst, 2011

Chongjie Zhang joined the faculty Sept. 1 from Tsinghua University, where he has been an assistant professor at the Institute for Interdisciplinary Information Sciences since 2017. In addition, Zhang is the co-founder and chief scientist for Zealen Ltd., a company that uses artificial intelligence to revolutionize clean energy production. Zhang's research focuses on deep reinforcement learning, multi-agent systems and human-AI interaction. His work explores how intelligent agents can learn to make decisions and effectively collaborate with other agents or humans to achieve goals beyond individual capabilities. He has numerous peer-reviewed publications in top venues.

F Christopher Cooper, assistant professor

» PhD, chemical engineering, Stanford University, 2023

Christopher Cooper will join the faculty in Fall 2024 after completing postdoctoral research at the National Institute of Standards and Technology (NIST), where he will study novel methods for polymer upcycling. His doctoral research at Stanford focused on synthesizing dynamic polymers with distinct molecular designs and reversible bonds to create novel stretchable materials that integrate into wearable or implantable electronic devices. His research at WashU will focus on using these dynamic polymers to create responsive soft materials for applications in energy storage, sustainability and human health.

G Feng Jiao, professor

» PhD, chemistry, University of St. Andrews, United Kingdom, 2008

Feng Jiao joins McKelvey School of Engineering as the Evera and William Stuckenberg Professor from the University of Delaware, where he was most recently professor and graduate program director in the Department of Chemical and Biomolecular Engineering and director of the Center for Catalytic Science & Technology. Jiao was hired as part of the environmental research initiative in *Here and Next*, the university's strategic plan initiative.

Jiao's research focuses on developing cutting-edge electrochemical technologies that address pressing global issues in energy storage, chemical manufacturing and food production. His lab focuses on advancing electrochemical systems for carbon utilization by pursuing high-performance CO_2 and CO electrolysis, surpassing the efficiency of conventional fossil-based systems and exploring innovative synthesis methods for nanostructured materials tailored for energy applications, with the goal to mitigate global climate change by delivering clean, sustainable and eco-friendly energy and chemical solutions.

H Kurt Russell, lecturer

» PhD, chemical engineering, Purdue University, 2023

Kurt Russell joined the faculty July 1 from Purdue University, where he has been a doctoral student in chemical engineering. His research is in characterizing catalysts in various applications, including X-ray absorption spectroscopy and X-ray diffraction at Argonne and Brookhaven National Labs. He also has conducted research into the effects of combining dehydrogenation catalysts with zeolites on the reactivity and product distribution of olefin reactions.

I Xudong Chen, associate professor

» PhD, electrical engineering, Harvard University, 2014

Xudong Chen joined the faculty Aug. 1, 2023, from the University of Colorado, Boulder, where he was an assistant professor in the Department of Electrical, Computer and Energy Engineering since 2016. He also is an affiliate faculty member in the Department of Applied Mathematics.

His research interests are in control theory, stochastic processes, optimization, graph theory, and their applications in modeling, analysis, control and estimation of complex systems as well as in the mathematical frameworks of ensemble control, which has applications in quantum spin systems, biological systems, unmanned aerial vehicles and robotics.

J Ben Wormleighton, lecturer

» PhD, University of California, Berkeley

Ben Wormleighton joined the McKelvey Engineering faculty as a lecturer in August 2023 from the College of Arts & Sciences, where he has been the William Chauvenet Postdoctoral Lecturer in the Department of Mathematics and Statistics since August 2020.

His research interests are centered on building formative practices in STEM education and in studying geometric problems largely arising from theoretical physics.

PROFESSORSHIPS

(since March 2023)

Ian Bogost named Barbara and David Thomas Distinguished Professor
A scholar, critic and award-winning game designer, Bogost is the author or co-author of 10 books and a contributing editor at *The Atlantic*, where he writes about science, technology, design and culture.

Jr-Shin Li named Newton R. and Sarah Louisa Glasgow Wilson Professor of Engineering
Li's research focuses on the areas of control, dynamical systems, optimization, learning and data science. He is interested in studying large-scale complex systems arising from emerging applications.

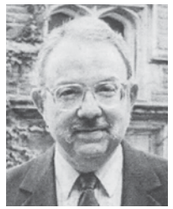
Randall Martin named Raymond R. Tucker Distinguished Professor
Martin, a world-renowned expert in atmospheric composition, uses satellite observations, global models and in situ measurements to improve understanding about the processes controlling air quality, climate and biogeochemical cycling.

Srikanth Singamaneni named Lilyan & E. Lisle Hughes Professor
Singamaneni is widely acknowledged as one of the pioneers in the design, synthesis and applications of plasmonic nanostructures and organic/inorganic hybrids, as well as in the biomedical applications of these materials.

Quing Zhu named Edwin H. Murty Professor of Engineering
Zhu's passion is in women's health — specifically, to advance cancer diagnosis and treatment prediction. Her research interests focus on multi-modality photoacoustic, diffuse optical tomography, ultrasound, optical coherence tomography, and structured light imaging techniques.

IN MEMORIAM

Robert Morgan, former professor of engineering, 89



Robert Morgan, who was a professor at Washington University in St. Louis for more than 30 years, died Monday, June 26, 2023, in Falls Church, Virginia. He was 89.

Morgan joined the Washington University faculty in 1968 as a visiting associate professor and retired from the university in 1999 as a professor. He was a part-time lecturer until 2002. He worked to build new research and educational activities on the social applications of technology, which led to him becoming the founding chair of the Department of Technology and Human Affairs and ultimately the first Elvera and William Stuckenberg Professor of Technology and Human Affairs, a title he held until his retirement.

In addition to his work at Washington University, he was a science public policy fellow at the Brookings Institution; chairman of the advisory subcommittee of the Technology Transfer Program at the National Aeronautics and Space Administration (NASA); a member of the national advisory board program on ethics and values in science and technical at the National Science Foundation (NSF); a member of the commission on research grants at the National Research Council; a Sigma Xi national lecturer; a visiting senior analyst at the Office of Technology Assessment of the U.S. Congress; and a fellow at the National Academy of Engineering.

William Pickard, former senior professor, 90

William Pickard, a senior professor in the Preston M. Green Department of Electrical & Systems Engineering in the McKelvey School of Engineering, died Thursday, March 9, 2023, in Portland, Oregon, after a short illness. He was 90.

Pickard joined the faculty at Washington University in the early 1960s and spent the majority of his career as a professor in what was then the Department of Electrical Engineering, teaching and conducting research in high voltage engineering, electrobiology, the biological effects of electromagnetic fields, and biological transport and systems biology. He received a distinguished faculty award from the Engineering school's Class of 1973.

Later in his career, he focused on the theory and practice of massive energy storage for reliable, dispatchable energy. Specifically, he looked at exploring likely trajectories that the fossil fuels follow on their way to exhaustion; sharing the importance of preparing now for that exhaustion; evaluating the sustainability of future renewable energy sources; and discerning the potential realism of proposed energy storage technologies.

Awards & Honors

Setton receives faculty achievement award

Lori Setton, the Lucy & Stanley Lopata Distinguished Professor of Biomedical Engineering, will receive the Arthur Holly Compton Faculty Achievement Award. Setton is a renowned researcher on the role of mechanical factors in the degeneration and repair of soft tissues of the musculoskeletal system. Her collaborative research is pioneering new ways of providing relief to those with pain from osteoarthritis or lumbar disc degeneration.

Yang elected senior member of National Academy of Inventors

Lan Yang, the Edwin H. & Florence G. Skinner Professor in the Preston M. Green Department of Electrical & Systems Engineering, has been elected a senior member of the National Academy of Inventors (NAI). A leader in the field of nanophotonics, her research focuses on silicon-chip-based, ultra-high-quality micro-resonators and their applications for sensing, lasing, nonlinear optics, environmental monitoring, biomedical research and communication.

Singamaneni and Wagenseil named American Institute for Medical and Biological Engineering Fellows 2023

As the Lilyan & E. Lisle Hughes Professor in Mechanical Engineering & Materials Science, Srikanth Singamaneni's research includes plasmonic engineering in nanomedicine, including in vitro biosensing for point-of-care diagnostics and in resource-limited settings, molecular bioimaging and nanotherapeutics. Singamaneni was nominated for innovative developments in plasmonic nanostructures and metal-organic frameworks and for their application to biosensing, bioimaging, nanotherapeutics and biopreservation.

Jessica Wagenseil, professor of mechanical engineering & materials science and the vice dean for faculty advancement, studies cardiovascular mechanics, specifically focusing on cardiovascular development, extracellular matrix and microstructural modeling. Her work is important for determining clinical interventions for elastin-related diseases and for designing better protocols for building tissue engineered blood vessels.

DEFINITION:

undertaken or carried on without outside control.

by Katharine Flores

When people hear this word, they often think of "autonomous driving," the exciting and somewhat scary idea of letting AI take the wheel and direct a car to its destination while passengers relax and focus on other things. However, there are many other domains where letting AI control the decision-making process can be advantageous and may produce better results than relying on a human-driven process, without the obvious safety risks of self-driving cars. One of these domains is engineering design, particularly the design of new materials.

A common misconception is that materials are immutable black boxes, and that only a limited palette is available for any given application. In reality, the 118 elements on the periodic table can be combined in countless ways to make materials, some with functionalities we have yet to imagine. Thousands of years of human history have only scratched the surface of what is possible. Just in the world of metals, there are *hundreds of billions* of alloys waiting to be explored. AI, incorporating physics-based models as well as human intuition, offers the opportunity to not only make predictions about which new materials we should pursue in this vast design space, but to autonomously select, produce, validate and optimize a material with the complex set of properties required for an application, much more efficiently than humans have done alone.

The role of engineers will necessarily evolve as autonomous design becomes a reality. Nonetheless, our primary tasks will continue to be envisioning the future we want to create and asking the right questions to get us there. AI may take the wheel, but we will still set the destination.

AI may take the wheel, but we will still set the destination.

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James McKelvey School of Engineering

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SID HASTINGS

Joseph Melkonian and Neha Damaraju were the student speakers at the May 14, 2023 McKelvey School of Engineering Recognition Ceremony, held at the Field House. Melkonian earned a bachelor's degree in computer science, and Damaraju earned a bachelor's degree in biomedical engineering.