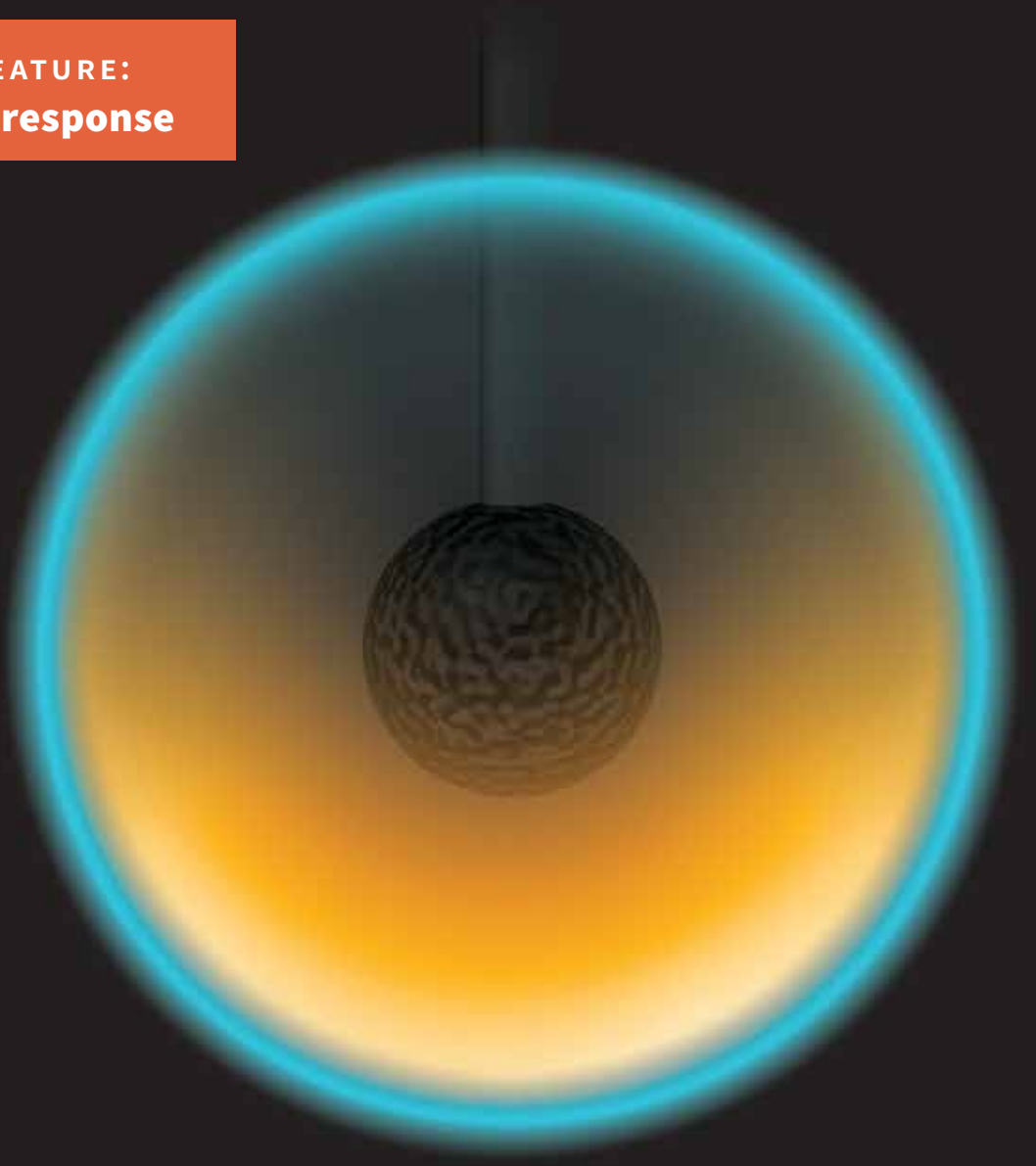
MCKELVEY ENGINEERING
Momentum
Across Disciplines. Across the World® // **SPRING 2020**

SPECIAL FEATURE:
COVID-19 response



Our mission:
To explore

Washington University in St. Louis

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The path back //

"We know the path to recovery will be long and challenging. There are no quick fixes here and we'll need to rely on the same ingenuity that allowed us to respond quickly at the onset of this crisis — as well as guidance from our infectious disease experts and all available data — to inform our way back. We will tackle this next phase with the same determination that has served us well to this point. At the same time, we realize that the steps we take next are about much more than the university itself. We're one piece of the regional and national solution, and we're committed to doing our part to think, lead and do whatever is required to contribute to the greater good. We really are all in this together, and this is our moment to unite as a community to find our way back from this unprecedented situation."

— CHANCELLOR ANDREW D. MARTIN

WASHU PHOTO

EDITOR'S NOTE

We hope you enjoy this magazine, which we had nearly completed when the COVID-19 pandemic changed the world. We quickly pivoted and replaced some content with new stories to directly address the school's response to the pandemic while keeping others, such as the feature on the Society for Hispanic Professional Engineers. We will continue to address issues of diversity, equity and inclusion within McKelvey Engineering as we work together to find solutions toward racial justice.

From the dean //

Aaron F. Bobick

Dean & James M. McKelvey Professor
afb@wustl.edu

A Moment in History

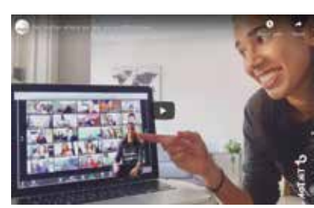
There are rare moments in our lives that we know will be marked in history. For me, the earliest was the assassination of JFK, though as a preschooler, all I understood as I watched the funeral procession on TV was that every adult in my world was shaken. Some such moments are positive – Armstrong stepping onto the moon — and some tragic, like 9/11.

The COVID-19 pandemic is another such moment. For WashU, what began as concern over international travel in February became a crisis by early March, with the decision to not have students return to campus after spring break. We had 10 days to go from no courses online to having all classes online. And, with the decision to not have faculty on campus, we had two weeks to leverage any on-campus facility for producing necessary materials. This included performing and video-recording labs in such a way that the students understood what was being done and why (and even how things occasionally break!), and then pushing the data out to students as if they had collected it, then asking them to do the analysis. At the end of the semester, we surveyed the students about their experiences, and the overwhelming response was that the faculty rose to the occasion: satisfaction with the quality of the instructor after going online was as strong as it was prior to spring break.

McKelvey responded in other ways as well. As you will read in this issue, faculty researchers quickly pivoted to address challenges including understanding basic mechanisms of virus attachment; creating rapid, highly-sensitive and accurate biosensor for detecting antibodies; and simulating how infection-causing droplets behave in the environment. Faculty and staff coordinated a Maker Task Force to produce personal protection equipment for our colleagues at the medical school and BJC HealthCare facilities, as well as prototyping an emergency ventilator that could be manufactured locally at scale if needed. And the business of McKelvey continued as well. Working remotely, our staff ensured that students had one-on-one advising meetings; grades were managed; grants were processed; payroll was made; all of our operations continued.

I want to take the opportunity of this note to publicly thank the faculty and staff of McKelvey Engineering for their incredible efforts. As alumni, you should all be proud of the work they did in the face of this unprecedented situation. During the next weeks and months, you will hear how WashU will continue to re-open gradually, how the fall semester will be conducted, and what we expect the near-term and lingering implications of this pandemic will be. Whatever those challenges may be, I know that our faculty, staff and students will respond with strength and grace.

I hope everyone and their families stay healthy as we navigate this moment in history together.



No matter where we are, We are McKelvey!

During this challenging time, it's amazing to see how our school and community have come together. Watch a short video: engineering.wustl.edu

In this issue //

SPRING 2020

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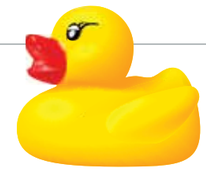
THE BUZZ

We are McKelvey!



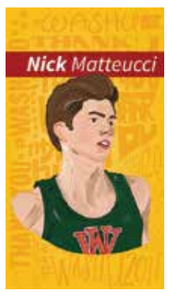
BME debugging ducks

Each year our biomedical engineering students are provided #debugging ducks as a fun problem-solving tool. And while the students may have had to leave them behind, the ducks have found a new purpose with our BME faculty.

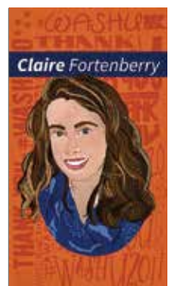
Surprise Zoom from the Chancellor!

Junior Zach Eisner (top right) was awarded the prestigious Truman Scholarship, the premier graduate fellowship in the United States for those pursuing careers as public service leaders. Eisner will receive $30,000 for graduate study. Chancellor Andrew D. Martin surprised the two WashU winners on a Zoom call.

Thank you #WashU20!



Thank you, Nick Matteucci, for being a leader on the track and in the locker room. A nine-time NCAA All-American, Matteucci led WashU's cross-country and indoor track teams to their best finishes in Bear history and set a school record in the 1,500-meter run in outdoor track and field. "As a runner, there's always another race, another personal record to chase," said Matteucci, who is earning a bachelor's degree in chemical engineering and will pursue a PhD in the same discipline. "If that's all that matters, you will never be satisfied. The joy, for me, comes from putting it all out there for my teammates."



Thank you, Claire Fortenberry, for doing your part to improve the air we breathe. Fortenberry is set to graduate with a PhD in energy, environmental & chemical engineering. For six years, she has worked in Brent Williams' Atmospheric Chemistry and Technology Lab, where she has built equipment to measure indoor and outdoor air quality. After graduation, Fortenberry plans to begin work at the NASA Glenn Research Center in Cleveland, where she will study a different type of atmosphere: space.

"Let's be clear — this is not online education in the conventional sense but rather emergency remote instruction. Our faculty demonstrated commitment, resiliency and creativity to execute this transition."

— Jay Turner,
Vice Dean for Education & Professor

Classes online by March 23

239 instructors

&

203 unique courses

10 days

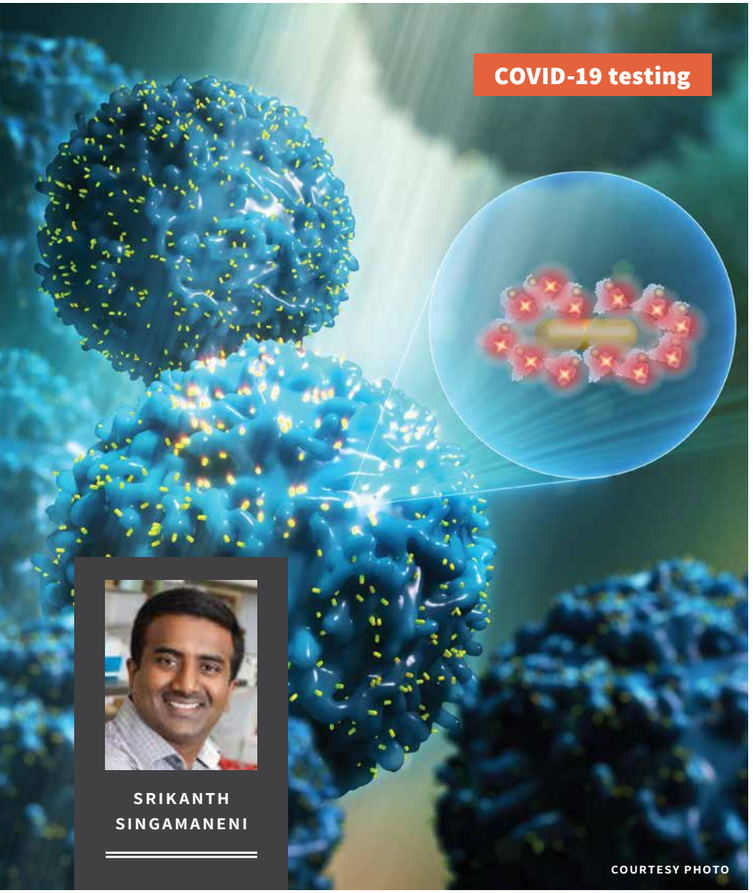
» Including labs and design courses

» No campus access after two weeks

» Chat moderators and other personnel support

Fall 2020

The first day of fall semester classes for engineering will be Monday, Sept. 14.



Federal funding for rapid COVID-19 test goes to McKelvey Engineering researchers

Engineers at the McKelvey School of Engineering at Washington University in St. Louis have received federal funding for a rapid COVID-19 test using a newly developed technology.

Srikanth Singamaneni, professor of mechanical engineering & materials science, and his team have developed a rapid, highly sensitive and accurate biosensor based on an ultrabright fluorescent nanoprobe, which has the potential to be broadly deployed.

Called plasmonic-fluor, the ultrabright fluorescent nanoprobe can also help in resource-limited conditions because it requires fewer complex instruments to read the results. The National Science Foundation has awarded Singamaneni and his team a $100,008 grant toward developing a COVID-19 test using plasmonic-fluor.

Singamaneni hypothesizes the plasmonic-fluor-based biosensor will be 100 times more sensitive compared with the conventional SARS-CoV-2 antibody detection method. Increased sensitivity would allow clinicians and researchers to more easily find positive cases and lessen the chance of false negatives.

The study was published in the April 20 issue of *Nature Biomedical Engineering.*

Written by Brandie Jefferson

COVID-19 WashU/BJC Maker Task Force

Demand for personal protective equipment

The task force is working to supplement BJC Supply Chain's efforts to ensure that clinicians and patients have the necessary medical supplies for the expected COVID-19 surge. To help meet the increasing need for personal protective equipment for health care workers on the front lines of the coronavirus pandemic, staff at McKelvey School of Engineering at Washington University in St. Louis are making use of the state-of-the-art facilities in the Spartan Light Metals Makerspace to create face shields for those treating patients at BJC HealthCare.

face shields

950

face shields have been delivered to BJC (as of April 24, 2020)

ventilators

2nd

generation emergency ventilator prototypes

gowns

clinician-approved prototype and identification of local company to sew

250K

isolation gowns

ST. LOUIS POST-DISPATCH


ROBERT COHEN

Dennis Mell, an electrical and systems engineering professor at Washington University and chief technology officer at Custom Technologies, talks with his team as he tests a prototype ventilator attached to a calibration machine at Custom Technologies in Brentwood.

COVID-19 in the media

Eclectic St. Louis team of doctors, engineers and machinists answers call for emergency ventilators

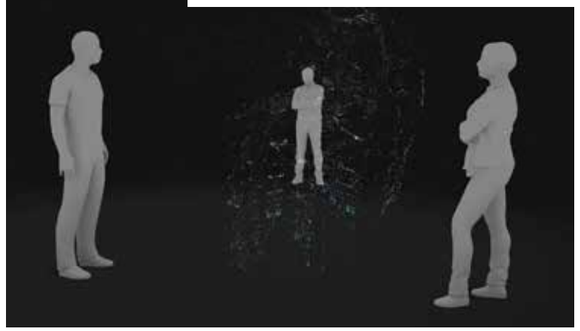
On March 23, a formal push was made for emergency ventilators designed and built by experts in the St. Louis region who had ready access to parts. An eclectic team of engineers, scientists, doctors and machinists answered the call to action and delivered their first prototype for clinical simulation on Wednesday.

Finishing touches on three more were underway, with the promise that another 100 could be made soon, if needed.

The small team is working together for the first time. Powered by a cumulative pile of advanced degrees and willingness to help.

Philip Bayly, chair of mechanical engineering & materials science at Washington University, who has a hand in the ventilator project, said there are similar efforts going on around the country. "We are definitely not trying to reinvent the wheel," said Bayly. "We are making a slightly different version because of the people and the materials that we have available to us."

The New York Times



COVID-19 in the media

This 3D Simulation Shows Why Social Distancing Is So Important

Pratim Biswas, professor and department cchair

An infected person talking for 5 minutes in a poorly ventilated space can produce as many viral droplets as one infectious cough. "If there are 10 people in there, it's going to build up."

Model predicts economic, public health repercussions of lifting quarantine before COVID-19 vaccine

Modeling & policy


ARYE NEHORAI

New interdisciplinary research carried out by an electrical & systems engineer, a biomedical engineer and a health care economist from the Olin Business School outlines the effects on the economy and health outcomes of three distinct quarantine scenarios.

Their model indicates that, of the scenarios they consider, keeping a strict self-quarantine policy for seniors until the number of new infections is drastically reduced, while gradually loosening the policy for the rest of the population, will lead to the best economic and health outcomes.

One key result is the model's prediction of the way in which different scenarios affect the number of people hospitalized. In two scenarios, the maximum number of simultaneous hospitalizations is about 189,000. In one, however, about 4.4 million people would need to be hospitalized at once.

Their work is published on MedRxiv and is currently under review.

Written by Brandie Jefferson

COVID-19 & aerosols

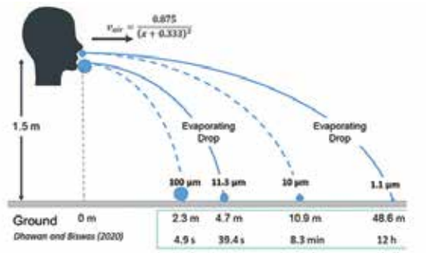
Aerosol researchers at McKelvey School of Engineering tackle novel coronavirus

Researchers in McKelvey Engineering are at the forefront of aerosol science. With ongoing research from as high as 250 miles above earth at the International Space Station, down to remote marine environments, the Center of Aerosol Science and Engineering (CASE) has expertise from the broadest scale to the molecular level.

Right now, that's the kind of range in expertise needed to tackle COVID-19, the disease caused by the SARS-Cov-2 virus. WashU experts are putting their expertise to work.

Written by Brandie Jefferson

Airborne transmission



AAQRL researchers in the lab of Pratim Biswas are working to better understand the infectivity of SARS-CoV-2 and aerosolization of antiviral agents (studies on self-assembly and denaturing). This important fundamental study will aid in the development of aerosol delivery methodologies for antiviral drugs and targeting them at the appropriate location to be effective. The work is being done by Hao Zhou, a doctoral student.

Health care demand

Rajan Chakrabarty has used computer modeling to determine how social distancing relates to health care demand, both hospital beds and ICU beds based on different scenarios.

Assuming the United States does not plan social distancing forever, he said, "One thing we have found out based on our data sets is that you really have to be careful not to extend intermittent social distancing through a longer period than a 5-to-1 distancing/no-distancing period. Beyond this ratio, the benefit of social distancing diminishes to a negligible level."

Long-term air quality

Jay Turner and his team have been conducting long-term air quality measurements in a Louisville, Kentucky, neighborhood and will continue these measurements and the corresponding sample analyses in the lab during the COVID-19 pandemic, getting data on changes to air quality and exposures.

Pradeep Prathibha, a doctoral student in Turner's lab, is analyzing samples from their 60-site neighborhood-scale sampling network.

Particles in masks

Brent Williams is guiding one of two groups researching how well face masks can filter out particles, such as viruses and small droplets. Research teams are investigating low-tech solutions for the public; different materials for masks that compare to the highly efficient N95 masks; and the stability and performance of those N95 masks with extended use. They are collaborating with the School of Medicine and the Sam Fox School of Design & Visual Arts on mask design and fit.


The New York Times

New Research Links Air Pollution to Higher Coronavirus Death Rates

Mortality rates

Randall Martin and his group are applying satellite remote sensing to assess how air pollution is changing around the world in response to COVID-19. He also is collaborating with colleagues to understand how air pollution affects COVID-19 mortality rates.

Data from his group were included in a national study published April 5 by Harvard University on long-term exposure to air pollution and COVID-19 mortality in the United States.

The study, featured in *The New York Times*, found that an increase of only 1 microgram per cubic meter in PM2.5 — fine particulate matter that can embed in the respiratory tract — is associated with a 15% increase in the COVID-19 death rate.

Pollution reduction

Jian Wang and members of his lab are looking at reduction in the emissions of aerosol particles and their precursors while businesses are closed during the pandemic.

"We are going to take a look at the measurements at a surface station in the Azores, which is thousands of kilometers 'downwind' of North America," he said. "We are interested in finding out if the 'shut down' leads to a decrease of aerosol concentration in remote marine environment and the effects of aerosol on marine clouds."

St.LouisPublicRadio | npr

COVID-19 in the media

St. Louis engineers put homemade mask materials to the test, as N95 supply dwindles

Brent Williams, associate professor

"These little particles — just a few hundred nanometers in size — will follow the airflow around the fiber and through the material. There's this critical gap that's really hard to filter out, and we think the virus could be surviving in that particle size range."

Students answer the call to design solutions

After learning about a COVID-19 virtual design competition, hosted by Johns Hopkins Center for Bioengineering Innovation and Design, WashU students felt compelled to take part. Teams were asked to find solutions for problems created by the novel coronavirus.

Thao Cao, a senior majoring in biomedical engineering, and her team came up with a sanitation station that would reduce the spread of the virus through health care providers' clothes. Her team members included Helena Hurbon, a senior majoring in biomedical engineering; Diana Griffin, a junior majoring in biomedical engineering; Emily Jayne, a master's student studying public health; and Rosie Dutt, a doctoral student studying imaging science.

Written by Danielle Lacey

BME faculty characterizing interactions between COVID-19 spike proteins, receptors

Virus behavior

Michael Vahey, assistant professor, and Rohit Pappu, the Edwin H. Murty Professor of Engineering, have joined forces to characterize how particles of SARS-CoV-2, the novel coronavirus circulating worldwide, interact with the human version of angiotensin converting enzyme 2 (ACE-2), the host cell receptor responsible for SARS-CoV-2 infection. Through a series of experiments and simulation, they will obtain quantitative assessments of how the virus particles attach to the receptors via their spike proteins and how long they stay attached. In addition, they will measure the number of ACE-2 receptors the virus particle interacts with on the surface of a cell. Their work is funded by a one-year, $200,000 grant from the National Science Foundation for work specifically related to COVID-19.

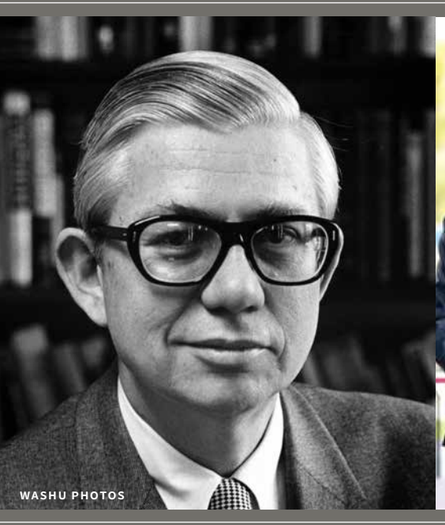
Vahey and Pappu are also working with Srikanth Singamaneni, professor of mechanical engineering & materials science, to leverage the results from their studies to functionalize model surfaces using peptides derived from the human ACE-2 receptor. The goal is to develop peptide-based sensors that can be used to detect SARS-CoV-2 on surfaces. Vahey, Singamaneni and Pappu work jointly under the auspices of the Center for Science & Engineering of Living Systems (CSELS), an interdisciplinary center funded by the McKelvey School of Engineering. Pappu is the director of CSELS, and Singamaneni and Vahey are members of CSELS.

MICHAEL VAHEY

ROHIT PAPPU

IN MEMORIAM

James M. McKelvey Sr., longtime dean, 94



WASHU PHOTOS

McKelvey was instrumental in transforming the school, renamed the James McKelvey School of Engineering in January 2019, from a regional program to a nationally recognized research institution throughout his tenure as dean.

James M. McKelvey Sr., dean of the School of Engineering at Washington University in St. Louis from 1964 to 1991, died Wednesday, Nov. 13, 2019, in Bethesda, Maryland. He was 94.

The former dean grew up in University City, Missouri. After earning an undergraduate degree in chemical engineering from the University of Missouri-Rolla in 1945, he returned to St. Louis, earning a master's in chemical engineering in 1947 and a doctorate in chemical engineering in 1950, both from Washington University.

"James McKelvey Sr. left a remarkable and unprecedented imprint on both our McKelvey School of Engineering and on our entire university community," said Andrew D. Martin, chancellor of Washington University. "He represented the very best of Washington University, and I'm extremely grateful for the opportunities I had this past year to spend time with him and learn about the many contributions he has made. I have no doubt his legacy will endure, not only through the buildings and programs that bear his name, but through the family members, colleagues and friends who continue to honor James Sr. with their leadership and service."

After his doctoral studies, McKelvey joined DuPont, where he researched polymer processing and became a pioneer in the field. In 1954, he joined the faculty of Johns Hopkins University, and, in 1957, he returned to Washington University as an associate professor of chemical engineering. In 1960, he became a full professor, and in 1962, he was named department chair. Two years later, McKelvey Sr. became the seventh dean of the university's engineering school, a position he held for 27 years.

During his tenure as dean, McKelvey led the school to prominence in engineering research, education and innovation. He launched the Engineers' Scholarship Program, the Dual Degree Program and the Cooperative Education Program. Under his visionary leadership, three new buildings — Bryan, Lopata and Jolley Halls — were constructed. The school's endowment grew more than tenfold, from $4 million to nearly $52 million, and research expenditures grew substantially. Although he officially retired in 1996, McKelvey continued teaching in the chemical engineering department through the 2007-2008 academic year.

> **"James McKelvey Sr. left a remarkable and unprecedented imprint on both our McKelvey School of Engineering and on our entire university community. He represented the very best of Washington University."**
>
> — CHANCELLOR ANDREW D. MARTIN

"Since I arrived at WashU, I have not only held the title of dean, but also have had the honor of holding the James M. McKelvey Professor of Engineering," said Aaron F. Bobick, dean of the McKelvey School of Engineering and the James M. McKelvey Professor. "Today I am particularly reminded of the challenge and opportunity that I and all of us in Engineering have to continue to build upon Jim's legacy of the pursuit of excellence in research and education."

In 2016, McKelvey Sr.'s son, entrepreneur James M. McKelvey Jr., gave a lead gift to the university to construct James M. McKelvey, Sr. Hall, to be completed in 2020.

Earlier this year, McKelvey Jr. shared what he admired about his father.

"My father is a living example of patience and humility," McKelvey Jr. said. "When I ask for advice, he does not pontificate. But watching him, I just absorb the spirit of someone who is always charitable and kind and modest but also very accomplished. And that's a great role model, and I learn from him every time."

Washington University has honored McKelvey Sr. with the William Greenleaf Eliot Society's Search Award and with an undergraduate research award established in his name. His contributions have also been recognized throughout the years by the school, which has bestowed upon him its Alumni Achievement Award, Distinguished Faculty Award and Dean's Award. In 2003, John F. McDonnell and the JSM Charitable Trust established the James M. McKelvey Professorship in his honor.

Undergraduate students interested in research benefit from the James M. McKelvey Undergraduate Research Scholars program, which provides selected students with an award to conduct research with any Washington University faculty member in engineering, medicine or the sciences. These scholars also take advantage of special programming, including both cultural and academic activities.

McKelvey Sr. is survived by his wife and Washington University alumna Judith McKelvey, MD; son and alumnus James McKelvey Jr., and his wife, Anna McKelvey; son and alumnus Robert McKelvey, and his wife and alumna Stacey McKelvey, MD; stepdaughter Elizabeth Goldberg, and her husband and alumnus, Eric Goldberg; stepson Edward Forgotson, and his wife, Jennifer Craig Forgotson; brother Robert McKelvey, and his wife, Peggy; brother Charles Forbes, and wife, Marilyn; friend Donald Mosby; grandchildren Ian, Morgan, James, Lucy and Margaret, and stepgrandchildren Juliet and Jerome.

Help with the push of a button

It's a simple question: How can institutions provide help for people considering suicide?

For Evin Jaff, a first-year student majoring in biomedical engineering in the McKelvey School of Engineering, the solution arrived the way many things do nowadays: through Amazon.

After losing a friend to suicide in his sophomore year of high school, he wanted to design a solution that could help prevent future deaths. He'd noticed within his own community that teens had a need for proper mental health resources but weren't taking advantage of offered services. Inspired by Amazon's Dash button technology, Jaff developed a product that connects at-risk individuals with the resources they need with the push of a button.

And while his original motivation was suicide prevention, he soon realized that his device could help many more.

"I came in with a very specific idea of suicide prevention, because that's hit closest to me," Jaff said. "But when I thought it through, I realized it's really just about getting help. People need help for a lot of different reasons, and you can have a button that does that all in one."

The device uses an API provided by Twilio, a cloud communications service, to connect callers with a resource hotline. Currently, the button acts as an intermediary; when callers press the button, it uses what Jaff calls "server magic" to call their phone from the hotline, similar to teleconferencing services. Once the two calls are live, the service unites them.

Until recently, connecting callers directly to a hotline in the absence of Wi-Fi was one of Jaff's biggest challenges; but the product has attracted interest from industry leaders and he was encouraged to continue working on the project. He recently started developing a version of his framework on an updated prototype of an AT&T-produced button, which works through more reliable cellular service. He's pushing to have a version of the button with an integrated microphone.

"That's the most exciting development ahead," he said. "Having the microphone would allow the button to be its own cell phone, making access to a crisis hotline extremely convenient."

Written by Danielle Lacey

Career Spotlight attracts more than 900 students, 54 companies

In September 2019, McKelvey School of Engineering held its first annual Career Spotlight, a niche recruiting event designed to connect industry with WashU engineering students and faculty. Fifty-four companies and more than 900 undergraduate and graduate students attended the event where they made connections about internships and full-time opportunities in industry and to learn more about the broad scope of career paths available to engineers. Companies that attended ranged from startups to Fortune 500 companies and included Google, Capital One, Mastercard, Johnson & Johnson, Procter & Gamble, Pfizer, General Motors, ExxonMobil, AT&T, Anheuser-Busch and Eastman. The event was held the day before the Fall 2019 Internship and Job Career Fair sponsored by the university's Career Center. The event will be held again in Fall 2020.

Student cybersecurity team posts two wins in one weekend

The McKelvey School of Engineering's cybersecurity team won first prize at two cybersecurity competitions Nov. 15-17, 2019. The team took part in a capture-the-flag challenge during STLCyberCon Nov. 15 and the two-day Gateway Higher Education Cybersecurity Consortium (GHECC) CyberCup competition, held at COLLAB in the Cortex Innovation Community Nov. 15-17.

Division of Computational and Data Sciences marries AI, social science

A new PhD program at Washington University in St. Louis is looking at developing additional tools for use in social services and other areas dealing with human and social behavior: computer programs that can use this wealth of data to help humans better understand problems in the social sciences.

This is the inaugural year of the Division of Computational and Data Sciences (DCDS), one of a few of its kind in the country, which focuses on turning the computational lens on social sciences. The program has four tracks: computational methodologies, social work and public health, political science, and psychological and brain sciences.

Students come from either a computer science or social science background, but have a team of mentors from different disciplines and graduate as experts in a transdisciplinary field, creating something brand new.

It's not that the disciplines haven't worked together in the past, said Sanmay Das, associate professor in the Department of Computer Science & Engineering and head of the computational methodologies track. It's not unusual for him to be approached by a social scientist asking the help of machine learning to solve a problem that involves a lot of data.

"But what really gets me excited," Das said, "is when a social scientist's problem enables exciting conversations between the disciplines, leading to the discovery of a new problem that transcends traditional disciplinary boundaries."

DCDS sits at that nexus of social science and computer science, where an interesting question in the former leads to an equally interesting question in the latter.

Das and Patrick Fowler, associate professor in the Brown School and head of the social work and public health track, have recently received two grants for projects that illustrate the potential power and complexity of marrying the disciplines.

Written by Brandie Jefferson

WeBelong! workshop aims to help women thrive in computer science

WeBelong! is the beginning of a new tradition at Washington University in St. Louis. The Department of Computer Science & Engineering in the McKelvey School of Engineering funded and helped organize the event for women new to WashU or to computer science who were interested in learning more about the department, getting to know upper-class women and faculty and finding friends who share their interests and experiences.

Martin, Pappu, Yang among most highly cited researchers worldwide

Randall Martin, Rohit Pappu and Lan Yang have been named among the most highly cited researchers in the sciences by the Institute for Scientific Information.

Martin, professor of energy, environmental & chemical engineering; Pappu, professor of biomedical engineering; and Yang, professor of electrical & systems engineering, were among 55 faculty from Washington University named to the list, which recognizes researchers worldwide who have demonstrated significant and broad influence reflected in their publication of multiple papers, highly cited by their peers over the course of the last decade. These papers rank in the top 1% by citations for these fields and year in Web of Science.

Washington University ranks seventh in the world for its number of highly cited researchers. For 2019, 6,216 researchers made the overall list.

WashU BME graduate program named No. 12 nationwide

The graduate program within the Department of Biomedical Engineering at the McKelvey School of Engineering was ranked No. 12 in the nation, up from No. 14, by U.S. News & World Report in March 2020.

U.S. News ranks programs based on reputation among peer institutions, quality of the program's students and faculty research activity.

"We're honored by this recognition of our graduate research and educational programs," said Lori Setton, the Lucy & Stanley Lopata Distinguished Professor of Biomedical Engineering and department chair. "We have a large and strong graduate student body that partners across the university and region to advance engineering research and scholarship, while building a community that values collaboration, entrepreneurship and diversity."

Sinopoli named Das Family Distinguished Professor

(From left): Dean Aaron Bobick, Santanu Das, Bruno Sinopoli, Marion Crain.

Bruno Sinopoli has been named the Das Family Distinguished Professor in Electrical Engineering in the McKelvey School of Engineering at Washington University in St. Louis. He was installed Jan. 16, 2020.

Sinopoli is professor and chair of the Preston M. Green Department of Electrical & Systems Engineering. He is a renowned expert in cyber-physical systems and control systems. His research focuses on robust and resilient design of cyber-physical systems, networked and distributed control systems, distributed interference in networks, smart infrastructures, wireless sensor and actuator networks, adaptive video streaming applications and energy systems. He also has an interest in social engineering issues, including investigating the mechanisms of influence of people on each other. He seeks to understand these mechanisms and to further this understanding in ways that can be beneficial to humanity.

"The Das family has been staunch supporters of the McKelvey School of Engineering for many years, and we are extremely grateful for their loyalty," said Andrew D. Martin, chancellor. "With their shared interests in different applications of electrical engineering, Bruno Sinopoli is a natural choice for the Das Family Distinguished Professorship in Electrical Engineering."

Assembly Series

NASA's David McBride fills Whitaker Auditorium

David McBride (right), director of NASA's Armstrong Flight Research Center, spoke on the future of aerospace engineering, including the next generation of NASA X-planes, the Artemis program and the role of government in the age of private space and aircraft flight. More than 250 people attended the event, which was sponsored by the WashU student chapter of the American Institute of Aeronautics and Astronautics (AIAA) and the St. Louis Chapter of AIAA; the Design/Build/Fly team, and the Department of Mechanical Engineering & Materials Science.

New partnership brings together WashU, IIT Bombay to study air pollution

On Dec. 16, 2019, researchers from the McKelvey School of Engineering joined peers at the Indian Institute of Technology Bombay (IITB) to celebrate the opening of the Aerosol and Air Quality Research Shared Facility in Mumbai, along with the launch of a new, joint master's degree program.

"This will provide an opportunity for students at IITB to engage in cutting-edge research that is very relevant, guided by world leading faculty members from the two institutions," said Pratim Biswas, the Lucy and Stanley Lopata Professor in the McKelvey School of Engineering. Biswas is also a member of the National Academy of Engineering (NAE) and assistant vice chancellor for international programs at Washington University.

"The work will be relevant to both India and the U.S.," he said.

The new research facility will join the Surface Particulate Matter Network (SPARTAN), a global particulate matter network, which connects satellite mapping and particulate matter sensor deployment.

It will also bring to the Mumbai campus high-tech instrumentation for fundamental research in aerosol science and engineering, as well as new equipment for on-the-ground air quality monitoring and characterization.

Not only is the joint nature of the degree unique — with students earning a single degree from both universities — but it is the the only such aerosol science program in engineering offered to students in India.

Written by Brandie Jefferson

IN MEMORIAM

William Kwang-Yeh Tao, alumnus and longtime supporter, 102

William K.Y. Tao, a 1950 alumnus of the McKelvey School of Engineering at Washington University in St. Louis and a longtime supporter of the school, the university and the St. Louis area, died Tuesday, Dec. 17, 2019, in Franklin, Tennessee. He was 102.

The son of a well-known engineer, Bill, as he was known to most, came to St. Louis from China in 1947 to earn a master's degree in mechanical engineering from Washington University. From that time, he made significant contributions to the Engineering school, including establishing the university's first annual named scholarship program in 1974 for the Engineering school. Sixty-seven students have received scholarships from one of the five scholarships that Tao and his wife, Anne, established. Today, all of the university's schools have named scholarship programs.

After earning a master's degree, he became a full-time instructor in Engineering. He continued as an affiliate professor after starting his own engineering consulting business, William Tao & Associates Inc., in 1956. He also was an affiliate professor at the Sam Fox School of Design & Visual Arts.

Recognized internationally as a leader in engineering systems design, Tao was responsible for many innovative, energy-effective concepts and applications. He was known as an "engineer's engineer" who was always on the edge of technology in energy systems, mechanical and electrical design, according to longtime associates. His company built among the largest and most sophisticated buildings worldwide, including the Southwestern Bell Telephone Co. Headquarters building in St. Louis, McDonnell Douglas Data Center, General American Life and Edison Brothers headquarters, Anheuser-Busch, parts of St. Louis Lambert International Airport and the Gateway Arch; the Taipei World Trade Center and 85-story 85 Sky Tower in Taiwan and the 97th U.S. Army Hospital in Frankfurt, Germany, and many buildings for Washington University. During his tenure heading the firm, his company completed systems designs for 45 million square feet of buildings with a construction value exceeding $5 billion, according to news reports. After his retirement in 1989, Tao continued to serve as a management adviser and building systems consultant to selected clients.

"Bill was not only a consummate engineer and successful businessman, but also a tireless and innovative supporter of Washington University and its Engineering school in particular," said Aaron Bobick, dean of the McKelvey School of Engineering and the James M. McKelvey Professor.

A trustee emeritus, Tao formerly served on the National Council for McKelvey Engineering and was its first chair in the 1980s. He also was a critical member of the WU International Advisory Council for Asia. He received a Distinguished Alumni Award in 1971, an Engineering Alumni Achievement Award in 1982, the William Greenleaf Eliot Society Annual Search Award in 1990, and the Engineering Dean's Award in 1994. In addition, he received an honorary Doctor of Science degree from the university in 1997. On his business trips in Asia, he often acted as unofficial liaison to university alumni.

In addition to his work as an engineer, Tao was considered among the top tennis players in the St. Louis area. He played tennis in more than 25 countries as part of a goodwill tennis program. Even in his 80s, he played tennis three times a week and was learning to play golf. He even continued playing tennis until age 95. He provided a gift to the university for the Tao Tennis Center and helped gather support to build the pavilion at the Dwight Davis Tennis Center in Forest Park.

Often referred to as a civic treasure, Tao served on numerous boards and committees and received many additional honors for his professional achievements, humanitarian work and community service. He supported the International Institute of St. Louis, University of Missouri-St. Louis, Saint Louis University, the Missouri Botanical Garden, Goodwill Industries and the Missouri Historical Society. He founded the Organization of Chinese-Americans in St. Louis and established a leadership award program for St. Louis-area high-school students interested in Chinese culture who showed leadership potential. He helped chair or orchestrate fundraising efforts for the Chinese Garden at the Missouri Botanical Garden, the new building campaign for the International Institute where the IISTL created the Tao Refugee Fund in honor. He was also deeply involved with Washington University's Athletic Department.

Anne Tao, university benefactor, 98

Anne Tao, a respected businesswoman, philanthropist, community leader and Washington University in St. Louis benefactor, died Tuesday, Jan. 21, 2020, in Franklin, Tenn. She was 98.

She worked with her husband, the late William Tao, a 1950 alumnus of the McKelvey School of Engineering and emeritus trustee, as business manager and partner in the internationally renowned engineering firm William Tao & Associates.

NSF CAREER Award

Zhang's CAREER Award could reshape how to build computers for data-intensive era

The human brain is a remarkable inspiration for computer science and artificial intelligence. A systems architect in the McKelvey School of Engineering seeks to make information processing in future computing systems and mobile devices more efficient — both in speed and energy — by modeling it after the brain's neural network.

Xuan "Silvia" Zhang, assistant professor of electrical & systems engineering, plans to improve computer performance while saving energy with a five-year, $500,000 CAREER Award from the National Science Foundation. The awards support junior faculty who model the role of teacher-scholar through outstanding research, excellent education and the integration of education and research within the context of the mission of their organization. One-third of current McKelvey Engineering faculty have received the award.

Computers take in analog signals, or waves, and convert them to digital signals, the binary numbers made up of zeros and ones.

"A lot of the signals the computer gets from sensors are analog in nature, so to perform digital computation, you have to do this conversion step," she said. "It wastes a lot of energy and also results in a huge number of sometimes redundant digital bits. As it turns out, saving and moving these digital bits around when they become very large is the most inefficient thing in the computer."

Zhang, who studies computer architecture and integrated circuit design and automation, seeks to apply mathematical formulation from the brain's neural network to the design of computer chips using a technique called neural approximation.

Written by Beth Miller

Personalized treatment for arrhythmia to get closer look

Jonathan Silva, associate professor of biomedical engineering, will study the efficacy of the drug mexiletine on patients with arrhythmia with a five-year, $3.17 million grant from the National Institutes of Health's National Heart, Lung, and Blood Institute. The grant builds on years of work Silva has done both computationally in his lab and experimentally with collaborators.

The standard of care for patients with ventricular arrhythmia is an implanted cardiac defibrillator and treatment with the drug amiodarone, which works well on many patients but can have toxic side effects such as thyroid dysfunction, pulmonary and liver toxicity and glaucoma with long-term use. Another drug, mexiletine, is designed to block extra current that travels through the sodium channel in the heart and causes fatal heart rhythms. However, the drug is not effective for every patient, though researchers are not clear why. Silva has been seeking answers, most recently developing the first computational model that showed the molecular groundwork for mexiletine's effectiveness in some patients but not others.

Written by Beth Miller

Guan inducted into American Institute for Medical and Biological Engineering

Jianjun Guan, professor of mechanical engineering & materials science, has been inducted into the American Institute for Medical and Biological Engineering (AIMBE) College of Fellows.

Guan was elected by peers and members of the College of Fellows for "leading contributions in developing elastomers, smart hydrogels and cell and drug delivery systems for cardiovascular and musculoskeletal tissue regeneration."

Jun selected to receive 2020 James M. Lee Memorial Award

Young-Shin Jun, professor of energy, environmental & chemical engineering, was selected to receive the 2020 James M. Lee Memorial Award from the U.S. chapter of the Korean Institute of Chemical Engineers (KIChE).

The award recognizes Korean and Korean-American scientists and engineers who have demonstrated exceptional leadership at the frontiers of scientific knowledge in the field of chemical engineering. Jun, who joined Washington University in St. Louis in 2008, studies environmental nanochemistry to solve global problems in energy and water.

'Surfing attack' hacks Siri, Google with ultrasonic waves

Attacks on cell phones aren't new, and researchers have previously shown that ultrasonic waves can be used to deliver a single command through the air.

However, new research from Washington University expands the scope of vulnerability that ultrasonic waves pose to cellphone security. These waves, the researchers found, can propagate through many solid surfaces to activate voice recognition systems and — with the addition of some cheap hardware — the person initiating the attack can also hear the phone's response.

The results were presented Feb. 24 at the Network and Distributed System Security Symposium in San Diego.

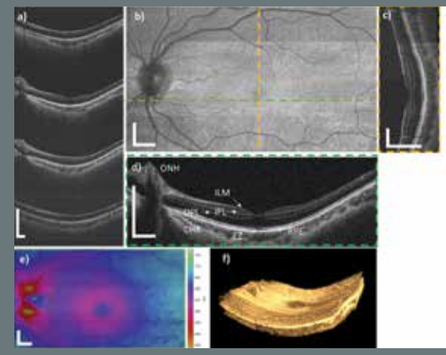
"We want to raise awareness of such a threat," said Ning Zhang, assistant professor of computer science & engineering. "I want everybody in the public to know this."

Zhang and his co-authors were able to send "voice" commands to cellphones as they sat inconspicuously on a table, next to the owner. With the addition of a stealthily placed microphone, the researchers were able to communicate back and forth with the phone, ultimately controlling it from afar.

Ultrasonic waves are sound waves in a frequency that is higher than humans can hear. Cellphone microphones, however, can and do record these higher frequencies. "If you know how to play with the signals, you can get the phone such that when it interprets the incoming sound waves, it will think that you are saying a command," Zhang said.

Written by Brandie Jefferson

New technology offers faster, broader 3D imaging of retinas, feasibility study shows



Each year, more than 30 million people have their eyes scanned using optical coherence tomography (OCT) to detect for diseases of the retina, such as age-related macular degeneration and diabetic retinopathy. While OCT takes excellent images, it is very sensitive to any movement — even breathing — by the patient, and is limited to a specific region of the eye. A team of biomedical engineers in the McKelvey School of Engineering has performed a clinical feasibility study on a new technique that is at least 10 times faster than existing OCT scanners, which creates fewer opportunities for errors from patient movement and allows for earlier detection and treatment of eye diseases.

Chao Zhou, associate professor of biomedical engineering, led a team in testing a light-splitting technique known as space-division multiplexing (SDM) that takes four high-definition OCT images simultaneously with a single detector. Working with ophthalmologists at the Scheie Eye Institute at the Penn Presbyterian Medical Center at the University of Pennsylvania, Zhou and doctoral student Jason Jerwick tested the technique on 10 patients ages 18-80 with retinal disease and were able to acquire images in a wider field than an existing OCT scanner in less than 1 second. The results of the feasibility study were published in *Photonics Research* April 1.

Written by Beth Miller

Wagenseil to receive Iozzo Award from American Society of Matrix Biology

Jessica Wagenseil, associate professor of mechanical engineering & materials science, has been selected to receive the Renato Iozzo Award for Outstanding Research in Matrix Biology from the American Society of Matrix Biology at its Biennial meeting in November.

The award is given to a mid-career investigator, five to 15 years from his or her first faculty or equivalent appointment for work that distinguishes the qualifications of the awardee from the recipients of the junior and senior investigator awards.

Forward osmosis could be alternative wastewater treatment method

Zhen (Jason) He, professor of energy, environmental & chemical engineering and Matthew Ferby, a doctoral student in his lab, analyzed the feasibility of using forward osmosis as an alternative wastewater treatment method in a paper published in and featured on the cover of *Environmental Science Water Research & Technology* March 5, 2020.

Forward osmosis uses natural osmotic pressure created by a concentrated solution such as fertilizer, salts or sugar solutions as the power to extract high-quality water from wastewater with a membrane as an effective barrier to prevent contaminants from entering the extracted water. However, first they must reduce reverse solute flux, an overlooked process in which the concentrated solute flows back through the membrane into the treated wastewater. Negative effects of reverse solute flux include decrease in water flow, increase in operational costs due to loss of solutes, and accumulation of salts.

All's fair in artificial intelligence?

A team of computer scientists from the Department of Computer Science & Engineering is working with researchers from the Brown School and the School of Law to develop a framework for algorithms that can make decisions with fair outcomes. The game-theory based framework, to be called FairGame, will include an auditor that can determine potential fairness violations.

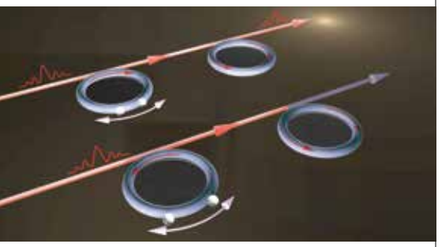
"The ultimate goal is to make sure that whatever algorithms we design make decisions that are fair according to some specified criteria when these decisions are consequential for individuals," said Yevgeniy Vorobeychik, associate professor of computer science & engineering and principal investigator in the project, which is funded by a three-year, $444,145 grant from the National Science Foundation.

To do this, the researchers must first assess whether something is fair.

"We want to be as agnostic as possible to how we know our policymakers would define fairness in the particular situation and want to make sure that the algorithm is fair with respect to those criteria," Vorobeychik said. "Second, we want to use this generic approach for verifying or certifying fairness. If you design an algorithm, you have to account for the fact that someone is going to see if there are any issues with the way you're making decisions in terms of being unfair to people and ensuring that your decisions don't inadvertently discriminate against individuals or groups."

Written by Beth Miller

Tuning optical resonators gives researchers control over transparency



Researchers have devised a fully contained optical resonator system that can be used to turn transparency on and off, allowing for a measure of control that has implications across a wide variety of applications.

The group published the results of the research, conducted in the lab of Lan Yang, the Edwin H. & Florence G. Skinner Professor in the Preston M. Green Department of Electrical & Systems Engineering, in a paper titled Electromagnetically Induced Transparency at a Chiral Exceptional Point in the Jan. 13 issue of *Nature Physics.*

An optical resonator system is analogous to an electronic resonant circuit but uses photons instead of electrons. Resonators come in different shapes, but they all involve reflective material that captures light for a period of time as it bounces back and forth between or around its surface. These components are found in anything from lasers to high precision measuring devices.

Written by Beth Miller

Weisensee to develop heat transfer switch for NASA with early career award

Patricia Weisensee, a mechanical engineer and materials scientist, plans to develop a liquid-metal-based heat switch that automatically turns on or off based on the external temperature with a three-year, $600,000 Early Career Award from NASA. The award is given annually to six to eight tenure-track assistant professors who demonstrate proof-of-concept of the proposed technology.

Unlike existing passive heat switches, which can be bulky, unable to be scaled or have moderate switching ratios, Weisensee's proposed switch is lightweight, compact and actuated passively by temperature, all things that NASA is seeking for its manned and unmanned space vehicles.

New method for measuring RNAi pesticide in soil

These RNAi pesticides, which work by interfering with the functioning of RNA crop-killing pests, are genetically engineered into agricultural crops, giving the plants their own defense against pests. Until recently, there was no method to measure the amount of the pesticide present in the dynamic environment of agricultural soil.

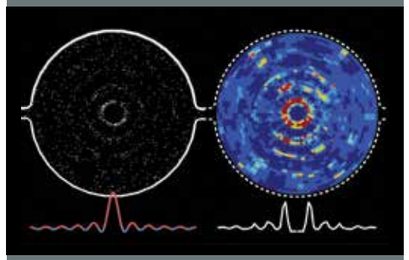
Researchers at the McKelvey School of Engineering published their technique for measuring just how much of RNAi pesticide is present in a few grams of soil. Their research was published in the April 21 edition of E*nvironmental Science & Technology.*

Kimberly Parker, assistant professor of energy, environmental & chemical engineering, led the research that culminated in the paper. To understand how these RNAi pesticides behave in the real-world, Parker said, "We needed to be able to determine what happens to them in the environment."

Written by Brandie Jefferson

NSF CAREER Award

Algae cells offer in-depth look at waves, acoustics and vibrations



Engineers often create devices to study forces, motion or other behaviors found in nature. J. Mark Meacham, a mechanical engineer in the McKelvey School of Engineering at Washington University in St. Louis, is doing it in reverse — he's using algae cells to study the devices he creates in his lab.

Meacham, assistant professor of mechanical engineering & materials science, received a five-year, $500,000 CAREER Award from the National Science Foundation to assess how well the acoustic microfluidic devices he develops work by using active, swimming algae cells as measurement probes.

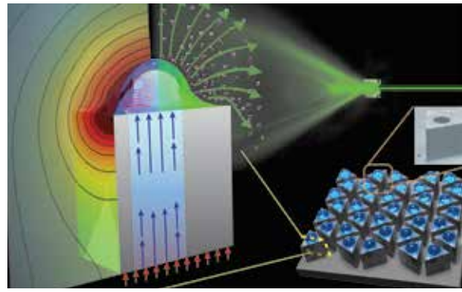
Acoustofluidics combines acoustics, or sound, with fluid mechanics. Meacham will build on existing work to develop a new technique to characterize the acoustic pressure field in his microscale acoustofluidic devices.

"Research-scale demonstrations of these acoustic microfluidic technologies have shown a lot of promise for the biological and biomedical sciences, but they're not yet common in clinical and industrial environments, partly because their operation is inconsistent," Meacham said. "While computer models can be used to improve designs, devices often don't perform as expected. It's hard to assess and compare real-world performance of different devices experimentally, so that's where we come in."

Written by Beth Miller

NSF CAREER Award

Agonafer receives NSF CAREER Award to explore limits of evaporative cooling for electronic devices



Damena Agonafer, assistant professor of mechanical engineering & materials science, received a five-year, $500,000 CAREER Award from the National Science Foundation to identify different modes of heat transfer during the evaporation process of nonsymmetrical microdroplets that sit atop micropillar structures on a cooling platform. CAREER awards support junior faculty who model the role of teacher-scholar through outstanding research, excellence in education and the integration of education and research within the context of the mission of their organization. One-third of current McKelvey Engineering faculty have received the award.

Agonafer's hollow micropillar structures, designed to dissipate heat in electronics, hold droplets of liquid on the surface. The bioinspired structure is based on a millennia-old insect called a springtail that can breathe through its skin, even buried in soil, through sharp edges on its surface. Like on the springtail, each droplet on the micropillar has sharp edges that form an energy barrier that keeps the liquid from spilling over. Agonafer has been working on the microstructure since he was a postdoctoral researcher at Stanford University and has determined the optimal size and shape of the droplet in previous studies.

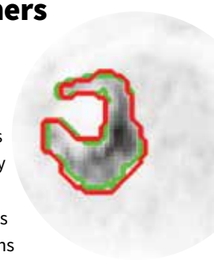
Written by Beth Miller

Jerry Cox inducted to National Academy of Inventors

Jerome R. Cox Jr., senior professor emeritus in computer science & engineering is a new fellow of the National Academy of Inventors, the highest professional distinction accorded solely to academic inventors. The distinction recognizes their prolific and innovative work and their contributions, which have had tangible, positive impacts on society.

Cox has been at Washington University since 1955, starting as an assistant professor after having earned bachelor's, master's and doctoral degrees in electrical engineering at Massachusetts Institute of Technology. In April 1964, he founded the Biomedical Computing Laboratory, whose goal was the introduction of small computers to biomedical research.

Physics, AI help researchers to better define tumor boundaries in imaging



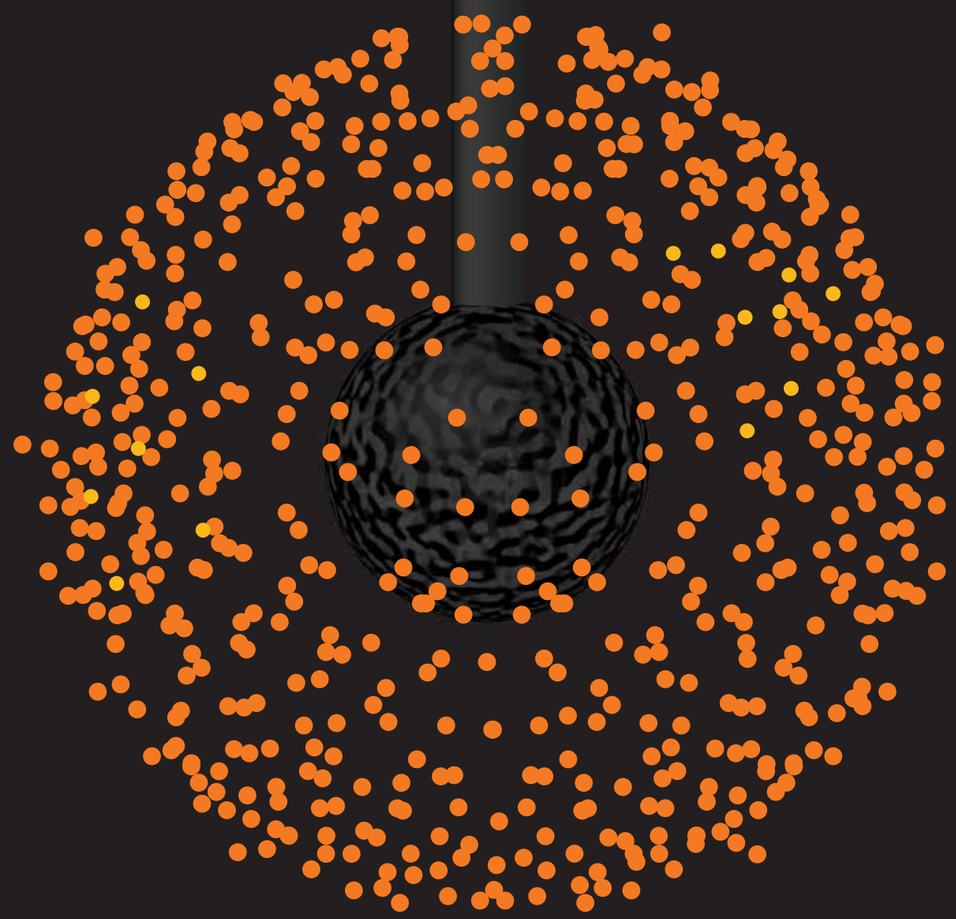
A team of researchers at several institutions worldwide, including Washington University in St. Louis, has developed a framework to more precisely determine tumor boundaries in positron emission tomography (PET) scans using physics and artificial intelligence (AI).

Abhinav Jha, assistant professor of biomedical engineering, and collaborators at Johns Hopkins University, Jordan University of Science and Technology, Memorial Sloan Kettering Cancer Center and the University of British Columbia combined their expertise in physics, imaging and machine learning to improve delineation of lung tumors in PET scans. Results are published online in *Physics in Medicine & Biology.*

"In the clinic, there is a need for methods to delineate the tumor boundary for PET-based radiotherapy planning," said Jha, who also is an assistant professor of radiology at WashU's School of Medicine. "Tumor delineation is also needed, and in radiomics where we extract features from the image and use these features to see if the patient has a better chance of responding to treatment or has a better chance of surviving."

Written by Beth Miller

Written by **BETH MILLER**



Our mission: **To explore**

ILLUSTRATION BY WILLIAM FEHR

McKelvey Engineers contribute to mission-critical NASA research

With SpaceX's launch of McKelvey School of Engineering alumnus and NASA Chief Astronaut Robert Behnken to the International Space Station May 30, another rover set to explore Mars, and creation of the U.S. Space Force, returning to space has once again become a national priority. McKelvey Engineering has been a growing part of NASA's efforts. From designing a flame that produces less soot to measuring harmful particles in the atmosphere, McKelvey Engineering is playing a critical role in NASA's research and development.

Researchers throughout Washington University in St. Louis have been instrumental in NASA's success for decades. Ray Arvidson, the James S. McDonnell Distinguished University Professor, is the deputy project scientist for NASA's Mars Exploration Rover mission and a member of the two other Mars mission science teams. A team from the Department of Physics has traveled to Antarctica for several winters on a NASA-funded mission to launch the Super Trans-Iron Galactic Element Recorder, or SuperTIGER, to measure cosmic rays.

Within McKelvey Engineering, much of the research for NASA is in aerosols and atmospheric chemistry, areas in which faculty are internationally renowned for their leadership and groundbreaking discoveries.

Randall Martin, professor of energy, environmental & chemical engineering, leads several projects that provide NASA with insight into fine particulate matter, PM2.5, in the air. He is part of a large Multi-Angle Imager for Aerosols (MAIA) mission team led by NASA's Jet Propulsion Laboratory at the California Institute of Technology that is preparing to use the MAIA satellite after launch in 2022 to take observations and measurements of ground levels of PM2.5 composition around the world.

"A goal from the combination of the satellite and the ground-based measurements is to develop algorithms to enable inferring ground-level particle type everywhere the satellite observes," Martin said.

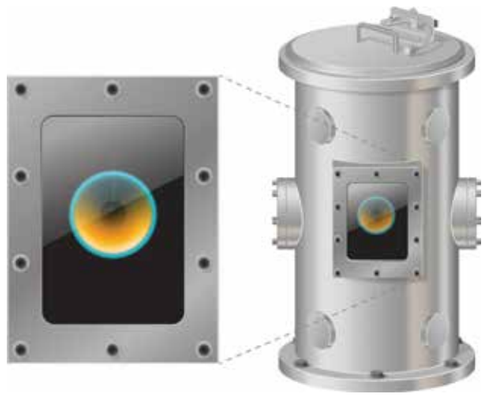
Martin has been conducting research with NASA for more than 25 years, beginning with a summer internship while an undergraduate student. A decade later, he received his first grant to conduct research for NASA while completing a postdoctoral fellowship at the Harvard-Smithsonian Center for Astrophysics. Since then, he has continued working with NASA on various projects with both immediate and long-term applicability, including as co-model scientist for a leading global atmospheric model called GEOS-Chem and a member of multiple science teams for satellite instruments.

"We're working to develop models that are used by scientists around the world, both to address current research questions and for longer-term advances," he said. "For example, some of our current research has been enabled by work that I and others did 20 years ago while pursuing my PhD. At that time, we were starting a chemical transport model, GEOS-Chem, which is now flourishing. And I'm sure that activities that we're doing today will be useful 20 years from now.

"There's a long-term benefit that accrues, and that's exciting about working with NASA," he said. "That

Randall Martin (center) has been conducting research for NASA for more than two decades. He develops models from data on fine particulate matter in the air.

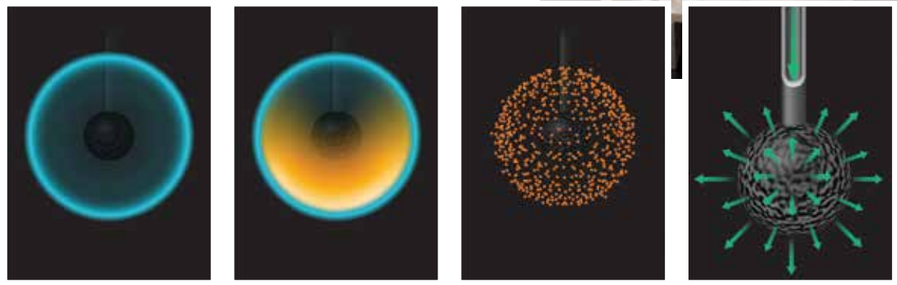
WHITNEY CURTIS



ILLUSTRATIONS BY WILLIAM FEHR

This type of chamber was used for earlier ground-based Flame Design experiments.

WHITNEY CURTIS



Top right: Phillip Irace, a doctoral student in energy, environmental & chemical engineering who works in Richard Axelbaum's lab, with a chamber that was operated at low pressure to simulate low-gravity flames and conduct proof-of-concept experiments before going into space, i.e., on board the International Space Station. A similar chamber was used in NASA's 2.2s drop tower to conduct earth-based microgravity experiments.

longevity is also exciting about science in general, that what you're working on has permanence that is sustained going forward, and that's stimulating."

NASA has long had an influence in our daily lives by producing some common products, such as LEDs, infrared ear thermometers and portable cordless vacuums. Now, they are helping a McKelvey Engineering professor study the behavior of a simple flame.

Richard Axelbaum, the Stifel & Quinette Jens Professor of Environmental Engineering Science, is working with NASA and its International Space Station to observe flame behavior in space with a greater goal of understanding combustion and fire. The project seeks to understand how soot, a major pollutant, forms and how it can be controlled.

What he and his team have observed so far is that a candle-like flame on the Space Station is very different from a flame typically seen on Earth, which is generally yellow-orange, teardrop-shaped and sometimes emits black smoke, or soot. In space, the flame is round with large visible soot particles, all surrounded with a blue halo. The difference? Gravity.

"Gravity is important to the flame itself and to the generation of particles within the flame," Axelbaum said. "Our goal is to understand the process of particle formation in flames so we can control and, if necessary, eliminate it."

Jian Wang, professor of energy, environmental & chemical engineering, spent 16 years at the U.S. Department of Energy's Brookhaven National Laboratory studying the ways in which aerosol particles affect clouds and how clouds affect aerosols. He and his lab have developed a novel instrument that is placed onboard aircraft to study how interactions between aerosols and clouds affect hydrological cycles.

"Our instrument measures the size of particles and how they add to the concentration of different-sized particles, because the particle size can determine how efficiently they influence climate," Wang said. "For example, particles reflect sunlight. This influences the energy budget of the earth because most of the energy is coming from the sun. If you have particles that reflect the sunlight back to space more efficiently than the earth's surface, it cools the climate, so it is very important that we know how many particles are in the air."

In the blink of an eye, Wang's instrument draws in particles from the air, sorts them by size, and takes video to quantify particle size and numbers. A traditional instrument takes a full minute to do the same.

"The faster we can do the measurements, the better we know how particles change with space and time," he says. "This is what makes our instrument very unique. We are the only group in the world who can do this."

Other faculty are doing or have done research with NASA in the past decade. Patricia Weisensee and Fuzhong Zhang each received NASA's three-year, $600,000 early-career award. Weisensee, assistant professor of mechanical engineering & materials science, received the award in fall 2019 to develop a liquid-metal-based heat switch that automatically turns on or off based on the external temperature. The switch could be used in electronic components of a spacecraft, which generate a tremendous amount of heat.

Zhang, the Francis Ahmann Career Development Associate Professor in energy, environmental & chemical engineering, received the award in 2015, with which he developed biosynthetic silk threads that perform as well as natural spider silk and could be used to replace petroleum-based synthetic fibers in future space missions.

Rajan Chakrabarty, assistant professor of energy, environmental & chemical engineering, used funding from NASA to study the environmental impact of cookstove emissions in India, where millions of households burn crop chaff or dung to prepare food each day. More than twice the emission levels were detected in samples from central India than in previous studies.

Ramesh Agarwal, the William Palm Professor of Engineering and professor of mechanical engineering & materials science, previously worked at NASA Ames Research Center. He is among a group of collaborators from Missouri University of Science & Technology and Lincoln University developing new turbulence models for aircraft and aerospace vehicles with a NASA grant.

University-NASA partnership

Axelbaum said research universities and NASA share a unique goal.

"The whole mission of NASA is to explore – to boldly go where no man has gone before," he said. "The university mission is, to some extent, to explore as well.

WHITNEY CURTIS

Jian Wang with his instrument that measures the size of particles in the air. He and his team use those measurements to determine the particles' influence on climate.

COURTESY PHOTOS

From top left: Jonathan Richter, Emme Wiederhold, Zarya DeSouza working as interns for NASA in Summer 2019.

“The university mission is, to some extent, to explore as well. We’re not building something to sell, but are trying to understand and explore things that weren’t known before, so they’re very complementary missions.”

— RICHARD AXELBAUM

We’re not building something to sell, but are trying to understand and explore things that weren’t known before, so they’re very complementary missions.”

Wang and Martin said university research complements the work that NASA does in its various research facilities nationwide.

“At the National Lab, we focused on really big projects that would be hard for a university to manage and is a different type of research,” Wang said. “The university is more nimble because it has more individual investigators who work with students and can change research direction very quickly in response to new discoveries, and even pursue new directions.”

“NASA has overall objectives for advancing scientific understanding through satellite observations and through technology development, and they directly undertake the central component of that objective,” Martin said. “Academia contributes by always questioning, especially with new students who are coming in with different perspectives, challenging assumptions, and trying to understand what they see. It’s definitely a partnership.”

Students

Those different perspectives held by both undergraduate and graduate students can lead to new instruments, new apps and new insight into a future career.

Ben Sumlin, a doctoral student in Chakrabarty’s lab, was one of only 54 students to win a prestigious three-year NASA Earth & Space Science Fellowship in 2018. He is building and deploying a state-of-the-art photoacoustic instrument for NASA’s Fire Influence on Regional to Global Environments Experiment - Air Quality study.

Five Engineering students have spent at least one summer working as interns at various NASA facilities nationwide: Emme Wiederhold, a senior majoring in computer science with minors in architecture and in design, will join NASA’s Jet Propulsion Laboratory full-time this year. Jonathan Richter, a junior majoring in mechanical engineering with a minor in aerospace, worked at NASA Armstrong Flight Research Center; Zarya DeSouza, a junior majoring in mechanical engineering, worked at NASA Ames Research Center; Anton Salem, a senior majoring in systems science & engineering, worked at NASA John H. Glenn Research Center; and Nathan Shreve, a junior majoring in electrical engineering with minors in computer science and managerial economics, worked at NASA Goddard Space Flight Center.

Ultimately, faculty and students have the same goal as NASA’s scientists.

“We all want to do great science,” Wang said. “If our instrument can have an application that contributes or helps lead to discoveries, we are happy to be a part of it.”

Alumni @ work

COURTESY PHOTOS

When you come here to work, you go through a lot of classes to learn the skills for the technical items, almost like getting a master’s degree. You have to know how to think like an engineer, have a basis to solve problems, communicate well, and work on teams, and the opportunities I had during college were helpful to lay that foundation for that.”

— KATIE BURLINGAME

Behnken (left) and Hurley (right)

St. Louis native and McKelvey Engineering alumnus Robert Behnken (left) and his crewmate, Doug Hurley, successfully launched the Demo-2 flight of SpaceX’s CrewDragon spacecraft, the first commercially built and operated U.S. spacecraft to transport humans into space, May 30, 2020. The two NASA astronauts worked with SpaceX to develop their new spacecraft systems, which transported crew to and from the International Space Station (ISS). After the first attempt at a launch was scrubbed due to weather, Behnken and Hurley arrived at the space station May 31.

Behnken is the joint operations commander for the Demo-2 mission and is responsible for activities such as rendezvous, docking and undocking, as well as Demo-2 activities while the spacecraft is docked to the space station.

Behnken, who earned bachelor’s degrees in physics and in mechanical engineering in 1992, both from the School of Engineering, is a flight test engineer, a colonel in the Air Force and joined the astronaut corps in 2000. He earned a master’s and a doctorate from the California Institute of Technology. He flew aboard space shuttle Endeavour twice, during which he performed six spacewalks totaling more than 37 hours and more than 708 hours in space.

Katie Burlingame (right), who earned a bachelor’s in mechanical engineering and a master’s degree in biomedical engineering from McKelvey Engineering in 2012, is a flight controller and instructor at NASA’s Johnson Space Center in Houston as support for the ISS. She and her group are responsible for the environmental and thermal controls on the space station, such as keeping water and air clean, responding to emergencies and regenerating waste products.

“We recycle sweat and urine into clean water, then use the clean water to generate oxygen.” Burlingame said. “We like to say we use yesterday’s coffee to make tomorrow’s coffee.”

As a contractor for Cimarron, Burlingame also does shifts on console in the Mission Control Center, where they operate the environmental control equipment on the space station. In addition, she helps to train new astronauts on space station systems, including crews assigned to space station missions.

When Burlingame was a senior at WashU, she was awarded a $10,000 scholarship from the Astronaut Scholarship Foundation. Starting her first year at WashU, she began working to build nanosatellites in the Aerospace Systems Lab. She was an Alexander S. Langsdorf Fellow, a McKelvey Undergraduate Research Scholar and a NASA MUST scholar, through which she did summer internships at NASA that solidified her interest.

“The activities that I did outside of classes and team projects that allowed me to work on engineering projects, work on creative solutions and work on integrating different people and systems and solving problems are things that transfer over to what I do now,” Burlingame said.

WHITNEY CURTIS

Photo Front row, from left to right: Valeria Pinedo Chipana, Landon Tafoya, Dylan Zubata and John Campoverde. Back row, from left to right: Michael Pichardo, Madison Larkin and Victor Kalil.

Understanding **Latinx diversity** and building a community

Written by **DANIELLE LACEY**

Michael Pichardo

Dylan Zubata

For Michael Pichardo and Dylan Zubata, establishing a chapter of the Society of Hispanic Professional Engineers (SHPE) at the McKelvey School of Engineering was more than just forming a new student organization — it was a way to form a community.

Pichardo and Zubata, both earned bachelor's degrees in systems science & engineering in 2020, founded the organization as first-year students at Washington University in St. Louis in 2016.

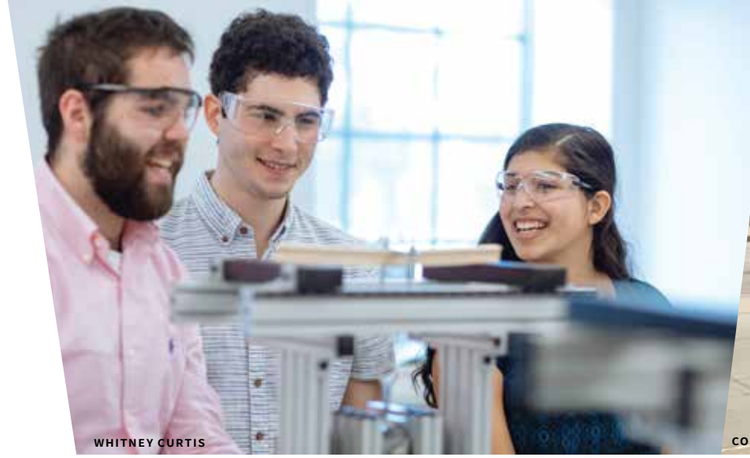
As high school students from Miami, they toured a few college campuses together before coming to WashU.

"When we both got here, the first thing we were looking for was this sense of community similar to that of back home," Zubata said. "Miami is a melting pot of Hispanics, but WashU and McKelvey Engineering have a small population of Hispanics."

With more than 80,000 Latinx undergraduate students studying engineering in the United States, McKelvey Engineering and SHPE asked the question: What can we do to recruit more Latinx students to WashU?

Latinx undergraduate students studying engineering in the United States

> Despite being treated as monolithic, Latinx students come together from a wide range of national origins, racial identities and languages. And understanding the multifaceted diversity of Latinx students is key to building an inclusive community.



WHITNEY CURTIS

COURTESY PHOTO

WashU students at the 2017 SHPE National Conference in Kansas City

A sense of identity

According to Pichardo, the answer to that question goes back to community. That's why he's excited SHPE and McKelvey Engineering are working together to build that community and to show it to prospective students.

"The school, the university's Office of Undergraduate Admissions and SHPE are engaging more prospective Hispanic engineering students through new communications and new events. We are telling them, 'Look, this is our community. You'll be successful here,'" he said. "I'm happy that this is happening because this is the single most important thing that's going to help students enroll after they're accepted."

Madison Larkin

Madison Larkin, a senior majoring in mechanical engineering and SHPE's president during the 2019-2020 academic year, cites visiting campus and learning more about organizations like SHPE as one of the reasons she decided to attend WashU.

"I visited WashU during an invitation weekend where I looked at the diversity, and I saw a lot of the Hispanic organizations," Larkin said. "As a Latinx student and as an individual, I want to be involved in my community."

But it is important to understand Latinx diversity when building this community.

Despite being treated as monolithic, Latinx students come together from a wide range of national origins, racial identities and languages. And understanding the multifaceted diversity of Latinx students is key to building an inclusive community.

Identifying potential members can be difficult because it's not always apparent who is or isn't Hispanic.

"A lot of it is self-identification," Larkin said. "Checking that box is the first obstacle in the college experience because some people may not feel like they are Latinx enough or Hispanic enough."

Larkin said much of that comes from people — Hispanic and non-Hispanic alike — with preconceived notions of what it looks like to be Hispanic.

"The non-Latinx community should know that you cannot tell from looking at someone," she added. "Don't question someone's heritage or background, and know that there are struggles — even if they are 'passing' as white or black — that are different from those who are not Latinx."

Building SHPE

Partnering with the school and university to recruit more Latinx students was a big win for SHPE and proof of how much the organization has grown in only a few years.

Attempts to establish SHPE in Engineering had been made previously, but a lack of funds prevented the chapter from taking off. Aware of the challenges, Pichardo and Zubata put together an ambitious fundraising plan. By reaching out to companies, they raised more than $8,000 in their first year.

"I think we've done a great job in such a short time," Pichardo said. "Deans [Chris] Ramsay, [Chris] Kroeger] and [Nick] Benassi have said that what we've accomplished has never been done, at least at the rate that we did, and that's something to be proud of."

Benassi, who is the senior associate dean of strategy, communications and external relations and also chief of staff at McKelvey Engineering, has worked to bring more visibility to SHPE and to secure additional funding for both the organization and the recruitment events. "Improving all aspects of diversity, equity and inclusion is a core value at McKelvey," Benassi said. "By helping Latinx student voices be heard and fostering a stronger community at WashU, we hope to create more respect for and a greater understanding of the strength and value of this and other communities that face ongoing inequity and discrimination."

The group's hard work has paid off. The number of Hispanic students enrolled in Engineering in the fall of 2020 has doubled compared to fall 2019. Not only are more Hispanic students applying, but, thanks to SHPE's outreach, more Hispanic students feel welcome on campus.

Looking forward

SHPE's leadership hopes to extend its relationships beyond campus by developing ties to the St. Louis community and businesses across the country.

"We want SHPE to be a springboard where students can reach out to top-tier companies at a faster rate," Zubata said. "If we bring Capital One to campus, it's more likely that a member will actually have a one-on-one conversation with a representative, as opposed to just applying online."

During the next academic year, SHPE will bring guest speakers to campus so students can gain first-hand insight from Hispanic and Latinx professionals and will provide professional development workshops for its members.

Their dream, however, is to create a strong alumni network that can serve as a resource for future students and professionals.

"These are the people who are going to go to bat for you for a job early on your career to support you and know where you're coming from," Pichardo said. "If we build our alumni network, it would make the process a lot easier for young Hispanic engineers."

SHPE
Leading Hispanics in STEM

You're invited

Founded in 1974, the national SHPE organization's mission is to empower Hispanic engineers, and membership is open to everyone.

"Every single time we've ever had an event, we emphasize that anyone can come," Zubata said. "You don't have to be Hispanic. You don't have to be an engineer. You could be neither."

One of the organization's biggest events of the year, "SHPE Under the SEAS" (playing off of the former School of Engineering & Applied Science name), offers all Engineering students an opportunity to meet with faculty and others in an informal environment.

"We want as many people in McKelvey and across the university to show up," Zubata said.

To learn more about how to get involved with SHPE, visit shpe.wustl.edu or email shpe@wustl.edu. Alumni, especially those who identify with the organization's mission, are encouraged to get in touch.

McKelvey Engineering alumni pitch in to COVID-19 effort

As the world adjusts to a new normal during the COVID-19 pandemic, many individuals are using their skills and talents to help, from sewing masks to holding food drives to running errands for elderly neighbors. McKelvey School of Engineering alumni are doing their part as well, both as part of their work and on their own time. We know there are many out there, but here are a few we learned about:

Written by **BETH MILLER**

Nathan Eberlin, MS, information management, 2009; MS, project management, 2010

Nathan Eberlin has been working with flattenthecurvestl.com's Face Shield Initiative printing face shields and ear savers for masks for the past several weeks. Over four weeks, he 3D-printed 115 face shield frames using eight rolls of filament. When he began, the process took eight hours per frame, but he reduced the time to four hours per frame using his two 3D printers.

Separately, Eberlin printed about 200 ear savers. He provided Alton Memorial Hospital in Alton, Illinois, where his mother works, 150 face shields from the initiative and 150 ear savers.

Overall, the Face Shield Initiative delivered more than 8,000 face shields provided to medical professionals. The initiative is winding down due to material shortage and commercial manufacturers now meeting demand to supply medical centers, however, the initiative will respond to new requests.

COURTESY PHOTOS

COURTESY PHOTOS

Nick Colarelli, MS, electrical engineering, 1986

Nick Colarelli, executive vice president at Hunter Engineering in St. Louis, is on a team at Hunter that is providing engineering and manufacturing resources to build Powered Air Purifying Respirators (PAPRs) for health care providers on the frontlines. Up to 30 percent of health care workers who wear N95 masks get infected with COVID-19.

Taking an idea from Jennifer Delaney, MD, an instructor in clinical medicine at Washington University School of Medicine, to build PAPRs from recycled CPAP machine motors, the Hunter Engineering team worked with the technical department of John Burroughs School to design and build a prototype with assistance from PASCO Systems, a local company that provides robotic automation and palletizing. The team is streamlining a manufacturing process to convert recycled CPAP machine motors into PAPRs. As of late April, Hunter had collected more than 300 donated CPAP machines to salvage the blower motors.

UVIC PHOTO SERVICES

Stephanie Willerth, MS, PhD, biomedical engineering, 2008

Stephanie Willerth is director of the biomedical engineering program at the University of Victoria in British Columbia, Canada. She and her team delivered 1,000 face shields to Island Health at no cost with plans to distribute 4,000 more in the coming weeks. The face shield's components are being produced in local businesses, research labs and even homes across the region, then are dropped off for Willerth's team to inspect, assemble and package. In addition, a machine in her lab that emits ultraviolet rays is used to sterilize the shields and their packaging before they are sent to Island Health.

"We've been linking with groups that are able to machine components and 3D print from all over the Island. It is definitely an amazing community effort," Willerth said.

In addition, Willerth is supervising a cohort of Engineering co-op students this summer who are all working on challenges related to COVID-19.

COURTESY PHOTOS

Michael Nasuta, BS, biomedical engineering, 2008

Michael Nasuta is a core team leader at Becton Dickinson (BD) in Baltimore. BD recently launched its fourth test to detect COVID-19 globally. The molecular test can detect viral RNA in two to three hours on the thousands of existing BD MAX instruments installed in laboratories worldwide. The company has employees working around the clock to manufacture the tests, he said.

"Everyone is focused on getting the product to market as soon as possible," Nasuta said.

Nasuta ensures that the company's instruments that analyze these tests run with minimal errors.

Nasuta said it generally takes a few years to get an FDA-approved test on the market, but BD has been able to bring four new tests to market in only a few months, which has provided test results to millions of patients.

"Governments, regulatory bodies and industry have moved mountains to make what has happened possible," he said. "The people who are in the trenches are very proud of the work we are doing that has impacted millions of people."

Bob Parks, BS, electrical engineering, 1973

Bob Parks has organized nearly 40 3D printer owners and volunteers in the Chicago area to create, package and distribute full-face protective shields. As of May 2, his "Noble Army" had provided more than 5,000 full-face protective COVID-19 face shields to hospitals, the Chicago Food Depository and other health care organizations in Cook County, in only one month of operation. Now, they are creating 200 face shields a day and have been recognized by the Cook County Sheriff's Office for their contributions.

Parks, who is retired, saw the need for more protective equipment through a neighbor who is a nurse in an intensive care unit. Using a design available online with his 3D printer, a plastic page protector, a three-hole punch and an elastic band, he created a prototype in about three hours. Her ICU supervisor was so impressed that he ordered 70 face shields as soon as he could get them.

Knowing he couldn't do it alone, Parks used social media and email to recruit helpers, and in under 24 hours, he had a group of volunteers running 20 3D printers to create the plastic headset, which they dropped off at Parks' home for sterilization and packaging with other needed parts for delivery. Since then, he and the group revised the design to eliminate the need for elastic, which is in short supply nationwide.

Parks wants to share what he's learned through the process with others who would like to mobilize their own "Noble Army." He and his wife, Susan, have documented procedures and built management tools, setting up a website with a manual on how to make all of this happen. He is available for guidance and wants to be in a position to guarantee the success of others and see growth in factories go viral.

"You have one shot on earth to try to make a difference on this scale," he said. "When this opportunity popped up, I was like a bulldog to the jugular — it is the one opportunity in my life to really make that sort of impact."

Parks invites those interested to contact him at ShieldCrowdFactory@gmail.com. His website is FaceShieldFactory.org.

COURTESY PHOTO

Bob and Susan Parks

Mona Stone, BS, biomedical engineering, 2005

Mona Stone, DDS, a maxillofacial surgeon in Dallas, is part of an organization providing personal protective equipment to health care workers in need. The group, Real Heroes Need Masks, donated 20,000 surgical masks in its first eight days and raised thousands of dollars in two weeks. Since then, it has donated 33,000 masks to 33 hospitals in Texas, New York, Illinois, Louisiana, New Jersey, California, Indiana and Georgia.

The group has worked with physicians to set up donation centers at outpatient clinics in more than 30 cities across the country where masks can be donated. At the end of April, the group was preparing to ship another 30,000 surgical masks to hospitals in Dallas, New Orleans and other cities where the need is great.

Stone has a friend and fellow surgeon who is getting an MBA at Indiana University and was participating in an idea sprint weekend for COVID-19 in March. Her friend asked Stone to join the team, which decided to coordinate purchasing FDA-certified surgical masks at a deep discount and distribute them to hospitals nationwide through a growing network of volunteers. Also on the team is WashU alumna Jun Yang, who earned a doctorate in finance from Olin Business School in 2004.

Stone said she and several other physicians used their social media accounts to spread the word about their campaign.

As a member of the medical profession, Stone saw firsthand the need for equipment and is proud to be a part of it.

"It means the world because I truly know that when you have proper protection against virus bacteria, we are able to save lives," she said. "I know that this has helped in reducing rates of transmission in the hospitals that have gotten these masks. Knowing that there are a lot of people out there going through this hard time, but they took the time to help shows that there's a lot of good people out there. That makes me happy and proud."

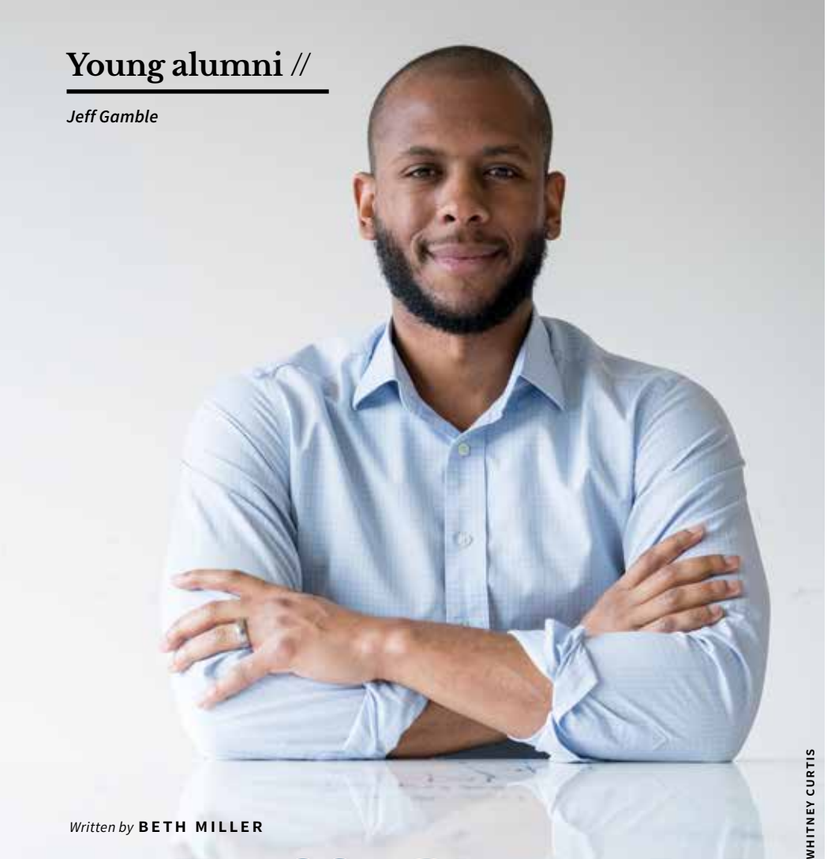
COURTESY PHOTOS

Scott Schienvar, BS, chemical engineering, 1994

Scott Schienvar, vice president of operations, professional productions division at L'Oreal Corp. in New York, and his team used an open-source design to create an intubation box designed to protect doctors from aerosolized particles during the intubation procedure. The lucite box is designed to pack, ship, assemble, clean up and store easily for use at hospitals nationwide.

Schienvar said he and his team first learned about this open source project on a website shared via a colleague in Taiwan. After trading emails for 12 hours, some of his coworkers made it to full production in 48 hours, he said.

Jeff Gamble



WHITNEY CURTIS

Written by **BETH MILLER**

Jeff Gamble

In the spring of 2016, then biomedical engineering doctoral student Jeff Gamble pitched a company at Sling Health's Demo Day against Danish Nagda, MD, then a resident at Washington University School of Medicine — and won. But Nagda didn't hold it against Gamble, and a year later, they teamed up to start a company designed to change the way virtual medicine operates.

Their timing couldn't have been better, as telehealth accelerated quickly into the mainstream as the coronavirus pandemic hit communities worldwide in March. But the majority of existing telehealth visits are simply physician-patient video conferences. What Gamble and Nagda are creating, robotic telehealth, allows physicians to perform physical exams using web-based software and a robot they created that can look in the eyes and ears and perform other tests by controlling the positioning of medical devices used in in-person exams. Those devices then transmit the data back to the physician in real time. The robot could be placed in pharmacies, senior living facilities or other community centers where health care is limited or where patients are unable to travel to see a physician in person.

"We are digitizing the interaction between the physician and the patient," Gamble said of his company, Rezilient, based in St. Louis' Central West End. "Because of this, we can transmit the actual skills of the provider to any location that has our robotic interface and increase access to specialist care." Automating documentation has become much less of a focus with COVID.

Before the pandemic reached the U.S., Gamble and Nagda were working with several private physician practices to implement the robot with their practices. But when the pandemic hit, these practices reached out to Gamble and Nagda to help them quickly implement basic video telehealth availability for their practices.

Gamble's interest in being part of a tech startup came as a doctoral student when he had an opportunity to work part-time for Neurolutions, a company founded by Dan Moran, professor of biomedical engineering, and Eric Leuthardt, MD, PhD, professor of neurological surgery at the School of Medicine and of biomedical engineering and mechanical engineering & materials science in McKelvey Engineering, and found his niche through that experience.

Gamble then focused the rest of his doctoral studies on a career in startups, then crossed paths with Nagda again when Nagda was doing a research rotation in the lab of Dennis Barbour, MD, PhD, professor of biomedical engineering, and the lab where Gamble was doing his doctoral research.

Gamble said the company is focusing on implementing and iterating with its first customers. In addition, he and Nagda, who earned a bachelor's in business administration from WashU in 2009, have been traveling frequently pitching their idea to investors. So far, they have raised $1.3 million from angel investors.

Although starting a tech company has its challenges, it's one that Gamble said he wouldn't trade.

"I've learned a lot about myself," he said. "Knowing when to change something is really challenging, and successfully changing it is really challenging."

Gamble knows firsthand that having someone as an advocate makes a difference.

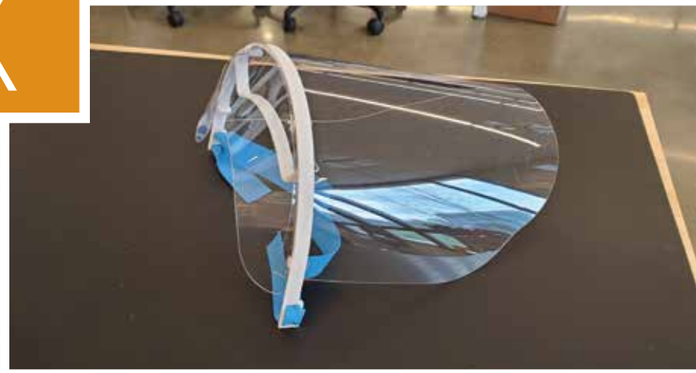
While a junior at Duke University, where he earned a bachelor's degree in biomedical engineering with a minor in neuroscience in 2011, Gamble did research with Warren Grill, professor of biomedical engineering at Duke, who has a neuroprosthetics lab. Gamble says Grill planted some of the seed for what he is doing now.

"He had multiple companies that he was working on, and he was the one who encouraged me to stay in engineering," Gamble said. "His taking me under his wing meant a lot at the time when I was questioning what I was doing. It's the time when you hope that there are people who are further ahead and are willing to reach back and say 'You should be doing this.' That can completely change the trajectory of your life."

Gamble said he feels similarly about his experience with Barbour, his doctoral mentor.

"At the time, I was the first in my family to ever pursue a PhD, so Dennis was extremely influential in guiding me through the ups and downs of a PhD and extremely supportive of my entrepreneurial endeavors once I realized that my calling was outside of the academic arena."

Clockwise from left: A workstation in the makerspace ready to assemble faceshields; a completed faceshield; Guertler (left) and Okamoto model the completed faceshields.



COURTESY PHOTOS

REMIX

Written by

CHARLOTTE GUERTLER AND RUTH OKAMOTO

Charlotte Guertler is staff research associate & Makerspace associate director, and Ruth Okamoto is Makerspace director and teaching professor, both in the Department of Mechanical Engineering & Materials Science.

On March 11 we learned our students would complete the spring semester online. A semester and a half after opening, the Spartan Light Metal Products Makerspace was silent. We began to plan for next fall — envisioning improvements and new projects. This was a quiet — and brief — interlude.

Within days, our inboxes filled with requests from the School of Medicine for personal protective equipment. Colleagues and students had seen designs for personal protective equipment posted online. Could we make them? Could we improve them? Our planning morphed to research on face shields, N95 masks, ventilators and more. What was most needed, and how could we help? Our efforts quickly merged into the COVID-19 Maker Task Force. Face shields were needed urgently, and we had the tools to produce them. Numerous designs were available online, but we needed to know if what we built met the needs of medical professionals.

Our Makerspace lights were back on. Each shield became a "remix"— taking the best of existing designs and modifying them. Each new set of 3D printed frames was ready within hours. Plastic shields were laser cut. Endless questions ensued — were the shields wide enough? Long enough? Could they be cleaned? Elastic ran out — could we use a tourniquet strap? Within days, we had several designs ready for clinicians to evaluate. Their feedback led to further remix and eventually a new shield. Then we turned from prototyping to production.

We borrowed additional 3D printers and turned the Makerspace into a mini-factory. We moved tables, cut material, cleaned 3D prints, washed, dried and assembled shields, all while observing social distancing.

Three weeks later, we and our task force partners had made and distributed 950 face shields. The equipment, flexibility and tools of the Makerspace made it possible — remixed for an unexpected and important new purpose.

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CHANGE SERVICE REQUESTED

#WashUengineers

$$p = mv$$

Snapshot //

Women & Engineering hosted an event for students at the MADE facility in St. Louis. Women engineers toured the facility and took part in activities such as screen-printing and welding.

COURTESY PHOTO