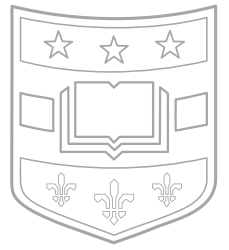


# ENGINEERING Momentum

Across Disciplines. Across the World® // FALL 2015



## Water: Vital for life

## Snapshot //

1983 — Engineering Day  
in Urbauer Hall

Recognize yourself or  
someone else in this photo?  
Let us know if you do at  
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FALL 2015

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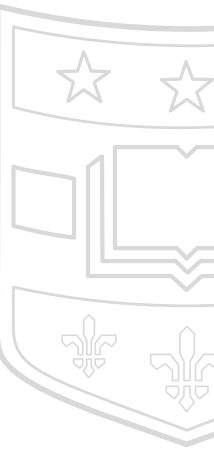
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Dear friends,

Since becoming Dean a little more than 100 days ago, I have had the privilege to interact with hundreds of tremendous students, faculty, staff, alumni, parents, industrial partners and others. As I have these meetings each day, I develop even more excitement about what is possible for our School of Engineering & Applied Science.

I am often asked what attracted me to this position, having previously been on faculty at universities with much larger engineering enterprises than WashU. Though it sounds cliché, it was the clear focus on excellence that the administration articulated regarding the growth of Engineering & Applied Science, along with the talent already present. WashU is a university with a variety of world-class academic units, and I was convinced that there is a deep passion for and commitment to helping the entire Engineering & Applied Science endeavor — undergraduate education, graduate training and research impact — achieve a world-class status. Our goal should be nothing short of producing both the people *and the knowledge and innovations* that change the world.

I also am sometimes asked if I have been surprised by anything I have seen since my arrival, and I say two aspects of our new life were unanticipated. First, St. Louis is so much more engaging than what Denise and I learned from our research while living in Stockholm earlier this year (you cannot easily “pop over” from Stockholm to St. Louis). We live across the street from the university, and surrounding WashU are dozens of restaurants and an amazing, deep music and theater scene. The other nice surprise is the people – both at the university and in the community – who are incredibly supportive and eager to advance our school. From the remarkable undergraduate students and enthusiastic alumni to the dedicated faculty and staff and the collaborative partners across WashU, everyone is committed to work together as we strengthen the quality, visibility and impact of the engineering school.

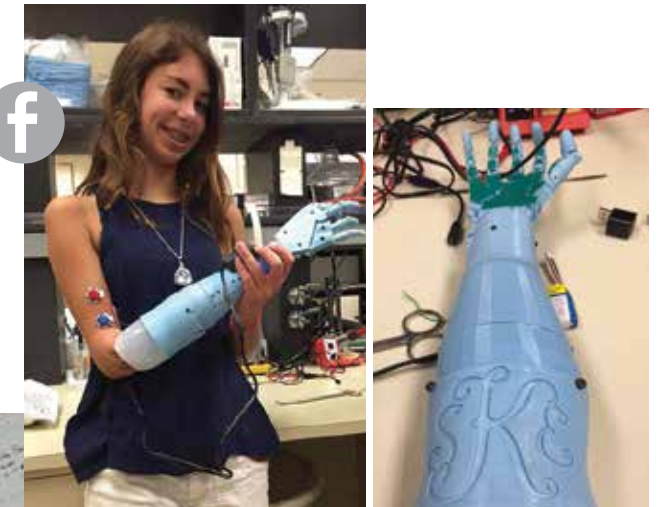
Of course, we all owe a great amount of gratitude to Ralph Quatrano for his steadfast leadership during the past five years and to Chancellor Wrighton, Provost Thorp, other WashU leaders, and the school’s National Council, all who have provided tremendous guidance and support to strategically position the engineering school. It is now up to all of us to achieve the success for which we are poised.

As I travel the country and world, I look forward to meeting as many of you as possible, sharing with you our exciting plans and successes, listening to your ideas and experiences, and working with you to propel our school to excellence.

Sincerely,

Aaron F. Bobick  
Dean & James M. McKelvey Professor  
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# SOCIAL MEDIA BUZZ #WashUengineers



Sydney received a robotic 3D-printed prosthetic arm  
Results of #WashUengineers collaborating with Washington University School of Medicine and Shriners Hospitals for Children - St. Louis.



“The WashU Summer Engineering Fellowship allowed us to explore various research fields, get an inside look into industry with the chief engineer at Boeing and hear from professors in different fields about the benefits of graduate school.” — Deko Ricketts



Sparo Labs co-founders and WashU alums Andrew Brimer and Abby Cohen presented at the White House Demo Day hosted by President Obama.  
Read more on pg. 25



WashU is honored to once again be selected as host of a presidential debate. #WashUdebate2016

## #Ilooklikeanengineer



*One of the world's most precious resources is essential for public health, food supply and the economy.*



*"Water is the most basic of all resources. Civilizations grew or withered depending on its availability."*

— DR. NATHAN W. SNYDER

Written by **BETH MILLER**

**M**ost of us take for granted that when we turn on a faucet in our homes or businesses that clean, fresh, drinkable water will be available in a seemingly endless supply. But in the last several years, clean water has become almost a luxury in parts of the U.S. due to drought and changes in climate, while worldwide, there is too much water in some places and not enough in others.

One of every six people in the world does not have access to clean water, making this shortage responsible for more deaths worldwide than war, according to the National Academy of Engineering (NAE). Lack of clean water has a significant effect on public health, food supply, manufacturing and the economy. That's why providing access to clean water is one of the NAE's 14 Grand Challenges for engineering in the 21st century.

In the past few years, several areas of the U.S. have experienced threats to their water supply. Most recently, after residents of Flint, Mich., complained of the odor and color of their drinking water, officials determined that the water was contaminated with lead that exceeded the U.S. Environmental Protection Agency's limit of 15 parts per billion. In West Virginia in 2014, a chemical used to clean coal leaked from a storage facility into the Elk River, which served as the water supply for more than 300,000 residents.

In addition to water quality, water supply is in peril. In the U.S., more than 33 million people in Arizona, California, Colorado, New Mexico, Nevada, Utah and Wyoming share portions of the Colorado River for their water supply, of which the majority goes to agricultural use. However, population growth in these states and changes in climate have led to demand for water exceeding supply, leading to severe drought conditions



WHITNEY CURTIS

*Daniel Giammar, PhD, with doctoral student Wei Xiong in his lab, where he studies chemical reactions affecting the fate and transport of heavy metals and other contaminants in engineered aquatic systems.*



**NASA scientists have estimated it would take 11 trillion gallons of water to recover from the drought in California.**

In addition, the plan calls for strengthening government and community planning and response, such as improving water use efficiency and increasing water storage to manage changes in water supply, as well as using drought-resistant seeds to help farmers manage changes in climate.

## Engineering's role

Engineers in the School of Engineering & Applied Science are working to meet some of the challenges in the President's plan as well as the NAE's Grand Challenge. By addressing the issues from a variety of angles, Washington University's efforts are playing a major role in solving the world's water crisis.

In the Department of Energy, Environmental & Chemical Engineering, the Engineered Aquatic Processes group includes John Fortner, PhD, the I-CARES Career Development Assistant Professor; Daniel Giammar, PhD, the Walter E. Browne Professor of Environmental

in California since 2011. As one of many steps to alleviate the crisis, Californians passed a \$7.5 billion water bond measure in 2014 that included \$2.7 billion for increased water storage.

In June 2013, President Barack Obama rolled out his Climate Action Plan that proposed conserving water resources, managing drought and drought-related risks and preparing for future floods. In

Engineering; and Young-Shin Jun, PhD, the Harold D. Jolley Career Development Associate Professor. The trio creates a world-class group of researchers tackling water issues from unique angles.

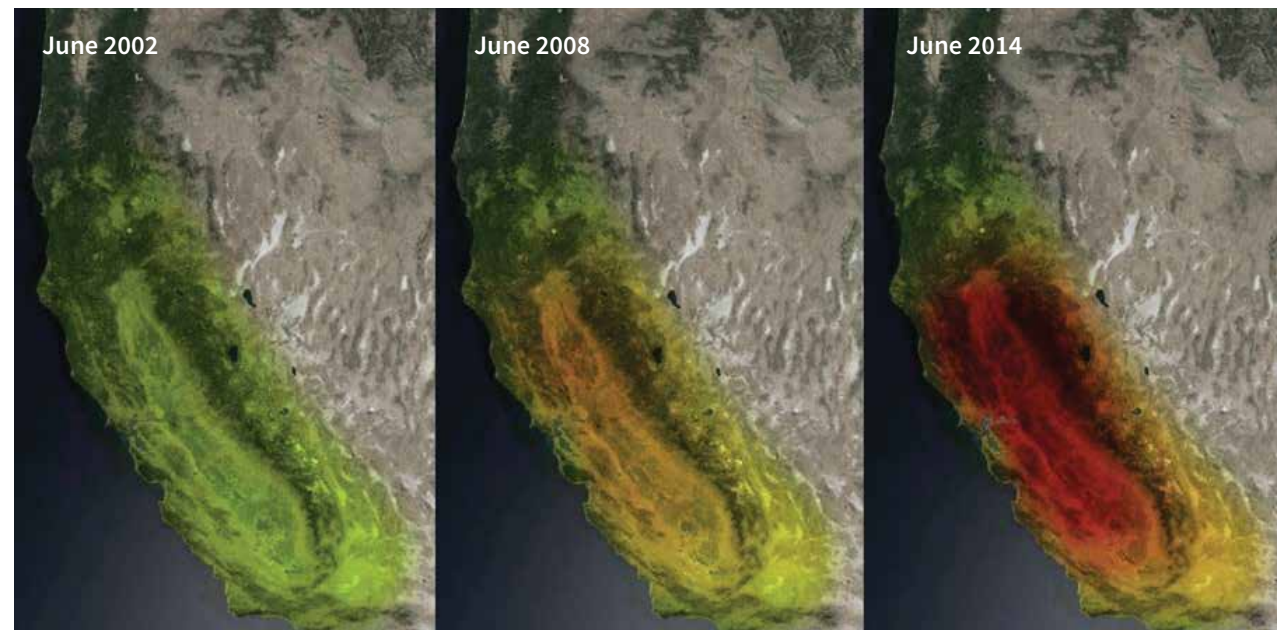
Jun studies natural and engineered aquatic processes, including the impact of human behavior on water quality and supply. Currently, she and her research team are studying managed aquifer recharge (MAR), one important technical solution available to address water needs in areas where supplies are low.

"We are using more and more water, and, somehow, we have to refill the aquifers," Jun says. "By injecting reclaimed water from water treatment systems into depleted aquifers, we can keep them filled."

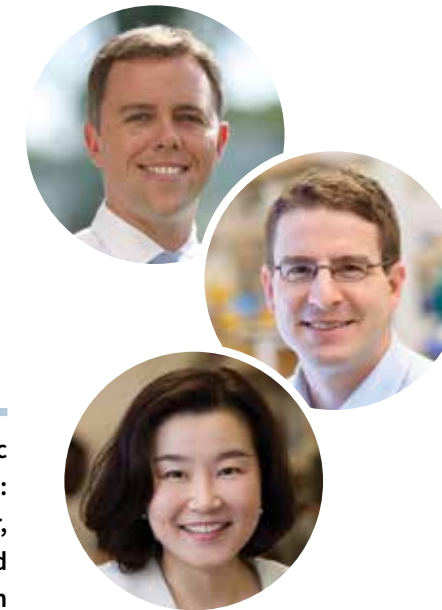
Jun's group also examines whether there are any adverse effects on the water quality from replenishing groundwater aquifers. Results from her work will help determine how engineers should pretreat reclaimed water from wastewater treatment plants to minimize these adverse effects, providing a basis for developing more sustainable MAR operations. In addition, knowledge obtained from the study can be applied to other environmental systems, including areas with arsenic-contaminated surface or groundwater. Her group's recent publication on MAR was recognized as the 2014 Top Environmental Science Paper from *Environmental Science & Technology*.

Orange County, Calif., has been using MAR to replace some of the water that is pumped from nearly 400 wells in the area. In the last decade, the county's water district had the foresight to complete a groundwater replenishment system that purifies wastewater for recharge year-round. This has become particularly important because water from its traditional sources,

California's cumulative water storage changes from NASA GRACE (2002-2014)



**Engineered Aquatic Processes group:**  
**John Fortner,**  
**Daniel Giammar and**  
**Young-Shin Jun**



including the Colorado River, has become scarcer in the last few years.

Jun's group also investigates reverse osmosis membrane modifications to use during the desalination of seawater or brackish water to generate fresh water.

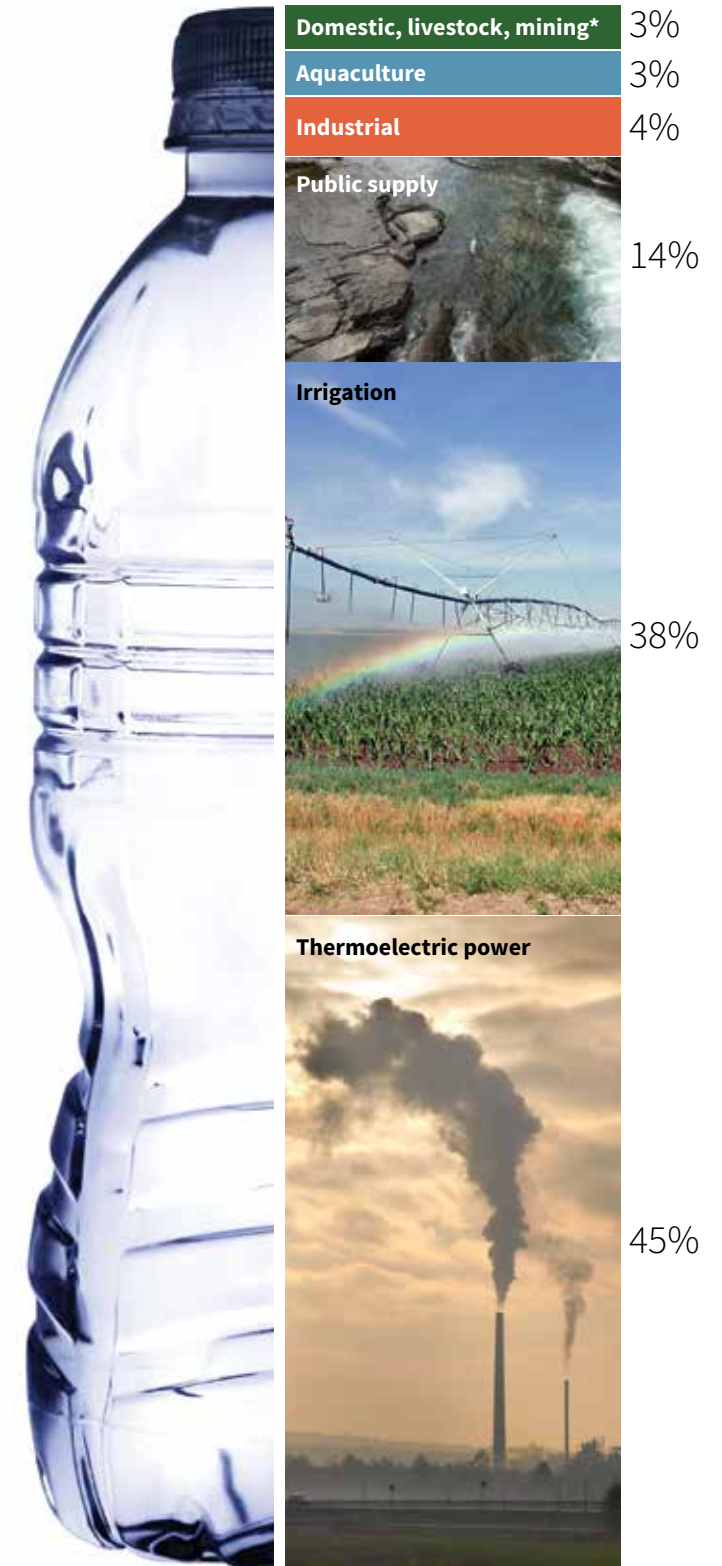
Giammar focuses his research on chemical reactions affecting the fate and transport of heavy metals, radionuclides and other inorganic contaminants in natural and engineered aquatic systems. He is particularly interested in reactions at solid-water interfaces that are relevant to drinking water treatment.

Giammar is teaming with Jeffrey Catalano, PhD, associate professor in the Department of Earth & Planetary Sciences, to study the performance and mechanisms of iron electrocoagulation on two projects: one funded by the National Science Foundation (NSF) to use the technique to remove hexavalent chromium from drinking water, and one funded by the university's Consortium for Clean Coal Utilization (CCCU) to remove selenium from wastewaters from coal use. Previously, he used the same technique to remove arsenic from drinking water in collaborative work with the Indian Institute of Technology Bombay.

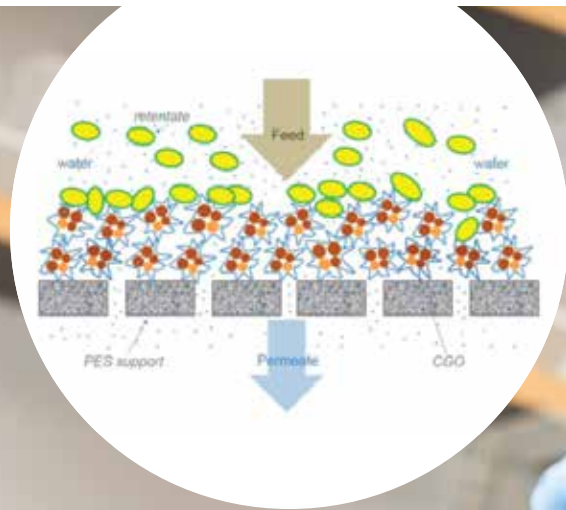
"They had taken field measurements, but hadn't taken them into the lab, so we brought their data into our lab," Giammar says.

"It was a merger of fundamental chemical investigation with a very applied problem in a setting where water quality is incredibly important."

Total U.S. water use (estimated, 2010)



\*each category represents 1%  
Data source: U.S. Geological Survey



Jiewei Wu, a doctoral student in John Fortner's lab, works to develop advanced materials to remove contaminants from water.

RON KLEIN

Fortner's research focuses on the environmental implications and applications of advanced materials. With Pratim Biswas, PhD, the Lucy & Stanley Lopata Professor and chair of Energy, Environmental & Chemical Engineering, he has developed a one-of-a-kind multifunctional membrane, or microfilter, with crumpled graphene oxide-based nanocomposites, which are highly water-permeable, photoreactive and antimicrobial.

"These nanocomposites are similar to a basket full of crumpled paper — they are inherently porous," Fortner says. "At the nanoscale, water can move through it better than most commercial membranes used now."

In 2014, Fortner and Giammar began a collaboration to use a novel technology using nanoparticles to remove

metal and metalloid contaminants, including arsenic, uranium and chromium, from drinking water. They are engineering nanoparticles that will adhere to the grains of sand in a traditional sand-based water filter. As contaminated water flows through the filter, the engineered particles can adsorb dissolved pollutants, thus treating the water. Once the nanosorbents are used to capacity, they can be selectively removed from the sand grains and collected with a magnet for waste disposal. Fresh nanoparticles can then be added to the sand to regenerate the filter.

Fortner and Giammar also teamed with Maxine Lipeles from the School of Law to study the energy-water nexus with funding from the university's McDonnell

In addition, Fortner's lab makes other nanoparticles with different compositions and surface coatings. One nanoparticle Fortner developed binds uranium in water at the highest level ever reported for an engineered sorbent.



**Demand for natural gas is expected to increase up to 2 percent annually for the next 25 years.**

Academy Global Energy and Environment Partnership (MAGEEP). This interdisciplinary project focused the emerging energy-water nexus related to enhanced natural gas extraction and geothermal (energy-harvesting) use. Both processes are expected to play increasingly important roles in the energy resources of the U.S., India and Turkey.

WashU also is tackling water and related issues through funding from the International Center for Advanced Renewable Energy and Sustainability (I-CARES), which awards grants for interdisciplinary research on energy, environment and sustainability.

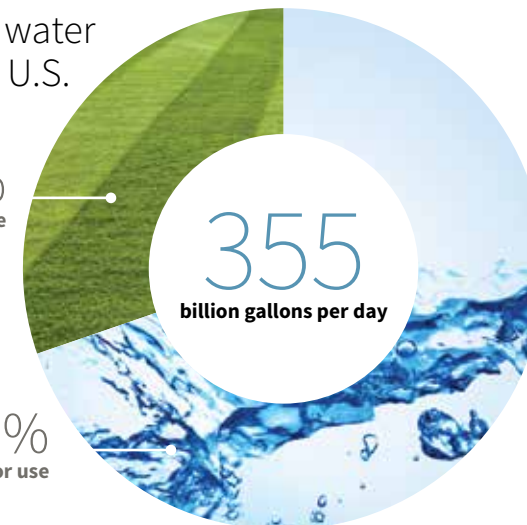
Jun has I-CARES support to work with Srikanth Singamaneni, PhD, associate professor of mechanical engineering & materials science, to develop novel, multifunctional membranes for safer, efficient and renewable-energy-driven water treatment using gold nanostars. Taking advantage of the photothermal capability of these nanostructures, Jun and Singamaneni are working together to create a new membrane that would reduce mineral scale formation and organic accumulation, while also preventing microbial buildup.

"Using these photothermal gold nanostars and light, we can kill microorganisms on a membrane," Jun says. "The membrane will use low-energy near infrared LEDs to activate the bactericidal capability. When the light shines on the gold nanostars, they convert light into heat energy by electron oscillation and relaxation. The temperature will be high enough to kill microorganisms and greatly reduce biofilm accumulation. We can also modify the membrane to repel the inorganic and organic compounds simultaneously. Currently, we are searching for more economically sustainable and earth-abundant materials to power this development."

Domestic water use in the U.S.

30% outdoor use

70% indoor use



Data source: EPA.gov and usgs.gov



Fortner is working on an I-CARES-funded project with Parag Banerjee, PhD, assistant professor of mechanical engineering & materials science, to create next-generation, magnetic, photocatalytic nanocomposites for use in water treatment plants. Giammar was a co-investigator on an I-CARES funded project with Zorimar Riviera-Núñez, PhD, and Lora Iannotti, PhD, both assistant professors in the Brown School, to evaluate the environmental contaminants that affect water quality in Haiti. Giammar tested water samples from sources of water in several neighborhoods in Cap-Haïtien to determine the contaminants in the water.

**40 percent of people in Haiti don't have access to clean drinking water and only 20 percent have access to sanitation facilities.**

## The future

While engineers and scientists do their part to ensure the world has access to clean water, Jun says everyone is responsible.

"We'll never be able to solve the problem unless we adjust our desire to use a lot of water, but our lives are fundamentally reliant on water," she says.

**"It's everyone's responsibility to think about what we can do better."**

Fortner says solving the water issues isn't a question of technology, but of political will and financing.

"The west of America is very dry, but parts of the Northwest are actually rainforest, so it's about how to manage and allocate and buffer, because climate change will change rainfall and snow patterns, and thus change our 'water' reality."

# Attracted by light

Written by TONY FITZPATRICK

In the small city of Hong Jiang, Hunan Province, China, Lan Yang's hometown, the Washington University School of Engineering professor is an inspiring role model for students, especially young girls.

Yang, PhD, the Edward H. and Florence G. Skinner Professor in the Department of Electrical & Systems Engineering, has blazed a remarkably swift career path in photonics and nanoparticles where her results have turned physics notions atop their venerable heads. On sabbatical in 2014, Yang gave four lectures in one activity-jammed week in Hong Jiang. The turnout included her elementary school teacher, now over 90 years old, and her high school principal. The audience was mostly teachers, parents and students. Two lectures in particular were intended for students.

Her message: "If you have the talent, let nothing stop you," she says. "The stereotype that girls aren't good at science and math still remains in China. This is puzzling to girl students, as the differences between individuals are larger than gender differences. I was gratified by the turnouts, but most impressed with the questions I got from girl students."

**"I resolved that I wanted to do work that influences others and impacts the world, and I thought that light is a wonderful thing that enables many important discoveries."**

— LAN YANG, PHD



Members of the Yang lab

RON KLEIN

The seed that she might one day become a math teacher was planted by a caring middle school teacher who, seeing Yang's talent and intellectual hunger, bought her mathematics books written by professors at the University of Science and Technology of China, a top technical institution, where she would matriculate in the 1990s as the first student from her hometown to go there in decades.

As a teen, Yang was undaunted. In the Chinese educational system at the time, students had two choices after finishing junior high: They took entrance exams to determine whether they would advance to high school and eventually college, or to a three-year professional school that guaranteed a profession and a government job. Yang ranked first in the professional school exam, making her a shoo-in for entrance, and second in the high school test. Her choice was obvious, but her

mother lobbied for her to go the safer, professional route.

But Yang dug in her heels. Virtually on the eve of setting off for a professional school in a large city of Hunan Province, Yang went on a hunger strike. It lasted one day, but made the point to her parents. When Yang's mother, Youmei Yang, realized the college dream meant so much to her daughter, she went to the head of the local education bureau and asked if the decision could be reversed and to change Yang's application for professional school to an application for high school, and she was told no. Yang's mother wept in the office. Who should come upon her but Wenxiang Zhong, the local high school principal and an old friend of Yang's father, Rongchun Li. Zhong was at the local education bureau for business and reassured Yang's mother that her daughter was such an outstanding student that she would undoubtedly thrive

in college. Yang's father also reached out to his friends seeking help and advice. The hunger strike was thwarted when Yang's parents insisted that the family visit the principal so he could assure them that Yang would be admitted to high school.

Eventually, Yang enrolled in a special class for gifted youth at the University of Science and Technology of China, earning a bachelor's degree in materials science and a master's in solid state physics, and was admitted to the fabled technology giant, California Institute of Technology (Caltech), where she first saw the light.

"I was searching for a focus for my doctoral work when light resonated with me," she says. "I resolved that I wanted to do work that influences others and impacts the world, and I thought that light is a wonderful thing that enables many important discoveries."

Yang changed her degree from materials science to applied physics.

At Caltech, she used a variation of the sol gel method to create a device to make microlasers on a silicon wafer. Toward the end of her doctoral work, she began to observe a recurring phenomenon in her microlasers: A single resonance can split in two if something on the resonator can scatter light. After she founded the nano/microphtonics lab at Washington University, this observation was integral to Yang's development with collaborators of a new sensor that can detect and count nanoparticles at sizes as small as 10 nanometers, one at a time, opening up intriguing possibilities in biosensing, pollution control, cancer detection and pharmaceuticals.

In 2014, Yang and her colleagues showed that laser systems can actually gain in energy when loss is introduced to the system. Energy loss in optical systems, such as lasers, is a chief hindrance to their performance and efficiency, and it occurs all the time.

### Counterintuitive and paradoxical, the results of three experiments showed that, once the lasing starts, output power becomes higher and higher when more loss is introduced.

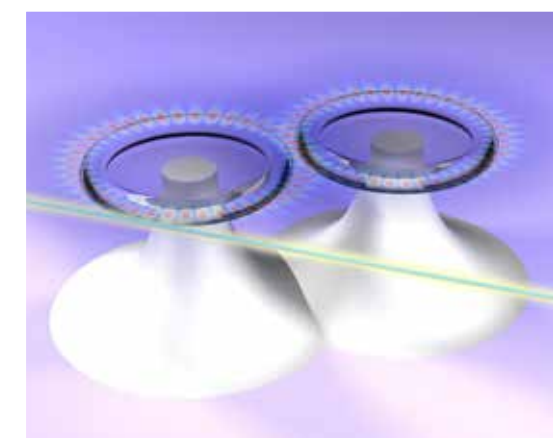
"This turns the conventional textbook understanding of lasers upside down," says her Washington University collaborator Sahin Kaya Ozdemir, PhD, a research associate professor in Yang's lab.

In the near future, Yang intends to integrate electronics with photonics. She plans to collaborate more with medical school researchers, for example, to trace the drug release profile of a single nanoparticle, which could be useful in disease detection or remediation.

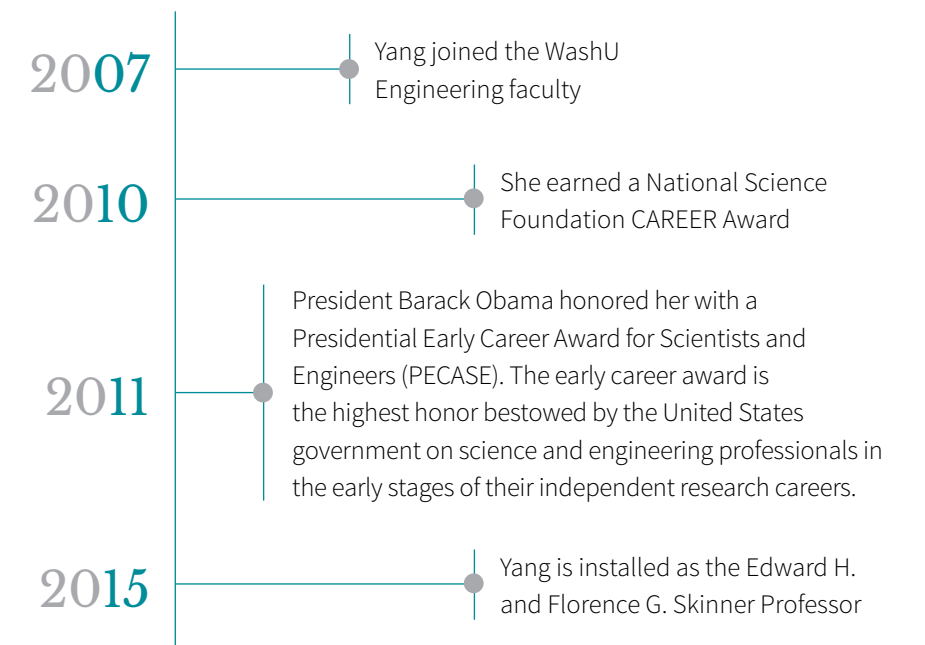
"We hope to integrate light with electronics to form some hybrid structures to achieve functionalities that cannot be achieved by electronics or photonics alone," she says.



RAY MARKLIN



Yang, the Edward H. and Florence G. Skinner Professor, and her husband, Chenyang Lu, PhD, Fullgraf Professor of Computer Science & Engineering, were installed with their new titles in a ceremony March 16, 2015, on the Washington University campus. The couple has three daughters, Sophia, 9, Olivia, 5, and Stella, 3. Also pictured are Yang's parents, Rongchun Li and Youmei Yang.





# BREAKING down BARRIERS

Written by **BETH MILLER**

Materials scientists have a hand in nearly everything we use, from shatterproof smartphone cases to recyclable plastic bottles to coatings that make skis and snowboards glide through the snow to lifesaving medical devices.

Unlike a classic science or engineering field, materials science is an interdisciplinary field that requires expertise in chemistry, physics and biology, allowing engineers to look at a problem from a variety of perspectives. These engineers look at the structure of materials, their properties and performance. They test materials in different ways to see if any of those qualities change under different stressors, such as temperature, pressure and impact.

The School of Engineering & Applied Science and the Graduate School of Arts & Sciences recognized the importance of training these scientists and engineers to meet the increasing demand for advanced materials when it launched a unique Materials Science & Engineering doctoral program within the Institute of Materials Science & Engineering (IMSE) in 2013. Within the program, students are working collaboratively on a range of advanced materials created for the next generation of products that will improve productivity through better and more sustainable semiconductor devices and improve medicine and health care through using nanoparticles to create better biomaterials. The program emphasizes interaction among students and laboratories as well as breaking through departmental barriers by allowing students to rotate through various disciplines to find their niche.

IMSE was born from the Materials Genome Initiative, launched by the White House in 2011 to accelerate materials innovation and development in the United States. Kenneth Kelton, PhD, the Arthur Holly Compton Professor of Arts & Sciences in the Department of Physics, and Katharine Flores, PhD, professor of mechanical engineering & materials science in Engineering, are co-directors of IMSE.

"IMSE would have never started without Ken Kelton," Flores says. "He was the right person to start this institute. He knew all the players and knew what needed to be done and was really sensitive to making sure it was an Arts & Sciences and Engineering collaborative activity. He's done a great job."

Flores says when admitting students, the team is careful to ensure that each student will have a place in a lab that matches their interest area.

"The students who have found their places in groups and students who have come in with materials undergraduate or master's degrees have been placed in chemistry and physics groups or other groups, so we have made that transition and broken down that barrier, which is the most important thing for the interdisciplinarity of the program," Flores says.



DEVON HILL

**Sirimuvva Tadepalli, a fourth-year IMSE doctoral student, is working on the interface between nanoparticles and proteins in the lab of Srikanth Singamaneni, PhD, associate professor of materials science. Tadepalli says she appreciates the size of the program, which now has 14 students.**

"Because there are so many resources and not as many students, there is one-on-one interaction," says Tadepalli, who earned a bachelor's degree in metallurgy from the National Institute of Technology in Warangal, India. "All of the professors know you, and they are more approachable, giving you a different perspective which is very important for interdisciplinary research."

As an undergraduate, Kranjc was working at the Air Force Research lab in Dayton developing composites for aircraft that would be resistant to lightning strikes. In Flores' lab, she studies the micromechanical properties of metallic glass.

Kelly Kranjc, who is in the final year of the program, is the secretary for the graduate student group ProSPER (Promoting Science Policy, Education, and Research) and has become an advocate for science education through the group Material Advantage, a national organization for students in materials science.

Kranjc has made two visits to Washington, D.C., to meet with Congressional staffers about federal funding for science and engineering. "I feel like that's something that I can contribute to — trying to get the word out that what we're doing is important and needs funding and trying to be a liaison between the scientists and Congress," says Kranjc, who earned a bachelor's degree in chemical engineering from the University of Dayton.

**Kelly Kranjc works in Flores' lab and came with Flores from the Ohio State University, where Kranjc had already completed two years of study.**



DEVON HILL

**Yvonne Afriyie, a native of Ghana, studied chemistry and math at Newman University in Kansas. Afriyie knew she wanted to continue her education, building on her chemistry background. Now in her second year at WashU, Afriyie took advantage of the program's rotation offering and is now working in the lab of Sophia Hayes, PhD, professor of chemistry, characterizing semiconductor thin film materials using solid-state nuclear magnetic resonance imaging.**



DEVON HILL

"In IMSE I've been exposed to different areas than I would have if I were only in chemistry," Afriyie says. "I've taken classes in engineering, physics and chemistry, which would have otherwise not been needed unless it complemented or enhanced my understanding in my area of specialization. But there are several core requirements in IMSE that broaden our knowledge and show us different ways of thinking about the same thing."



WHITNEY CURTIS

# yes, it's possible!

Written by MICHAEL FITZGERALD

**J**oandy, a recent high school graduate, runs Fixkicks, a shoe restoring and customizing business that he dreamed up and launched as part of The Possible Project, a five-year old program that is the brainchild of School of Engineering & Applied Science alumnus Mark Levin and his wife, Becky. The Levins set up the program to help underprivileged kids in Cambridge, Mass., learn entrepreneurship skills. Fixkicks is special for Levin because his father ran shoe stores in St. Louis, and he met Becky when she started working at one of them. Levin's bio includes the phrase "If the shoe looks cool, wear it."

Mark Levin is wearing bright orange running shoes the day we meet. He's already blazed a trail, becoming a highly successful biotech entrepreneur and financier, notably spending 12 years as CEO of Millennium Pharmaceuticals, a biotech company that develops cancer treatments (Millennium was purchased by Takeda in 2008), then co-founding Third Rock Ventures, a successful biotech venture capital firm. In 2008, he felt it was time to strategize a different venture, a philanthropic effort to teach entrepreneurship to low-income kids.

He had had this ambition since not long after graduating from Washington University in St. Louis with a bachelor's and master's in chemical engineering in 1973 and 1974, respectively. Levin remains very involved with the School of Engineering & Applied Science as a member of the school's National Council. He received an Alumni Achievement Award from the school in 2011 and the Washington University Founders Day Distinguished Alumni Award in 2002.

In the late 1970s, he and Becky were living in San Francisco's Haight-Ashbury district. Levin noticed a lot of disengaged high school kids hanging around a bakery they frequented, seemingly with nothing to do.

"I saw all these kids, and I thought, maybe entrepreneurship might help these kids learn resilience, grit and, maybe most important, 'I can do this.'"

— MARK LEVIN



These young entrepreneurs, of whom 75 percent are from families that live below the poverty line, also get support for college applications. Those who go through the program have a high college acceptance rate compared to the national average.

“I saw all these kids, and I thought, maybe entrepreneurship might help these kids learn resilience, grit and, maybe most important, ‘I can do this,’” he says.

Levin thought his own life had been changed by watching his father, and then running his own business, a doughnut shop he operated with Becky that ultimately failed, but taught him great lessons.

“Becky and I talked about renting some space on Haight Street and having some businesses that kids can work in,” he says.

But they were both building their careers, and there wasn’t time. There wouldn’t be time for several decades.

When the time came, they spent two years planning what would become The Possible Project, which offers kids a three-year program in entrepreneurship, set up after school, complete with pitch competitions. Levin thought about just donating money to an existing program, but, he says, “We really wanted to do it ourselves — we wanted to be part of it.”

Both of them had been entrepreneurs — Becky Levin is founder of Levin & Co., an executive search firm — and were passionate about the skills kids could learn from turning their ideas into businesses.

They picked Cambridge, a suburb across the Charles River from Boston, because the co-founders of The Possible Project would walk by housing projects on their way to work and wanted to do something that would help kids living there. Now, The Possible Project works with the three Cambridge public high schools, bringing 10th-12th graders into their pleasant, open offices on the 3rd floor of a building not far from Harvard Square.

“The longevity of the program is key,” Becky Levin says.

Research suggested that three- to six-month after-school programs didn’t change much in the lives of the children who took them.

The program is free, subsidized by the Levins and other donors. In fact, high schoolers who come to the

program get a stipend, starting at the equivalent of \$10 a day. The stipend gives the kids a reason not to go work at a fast-food restaurant or other low-skilled jobs. Instead, kids take classes, meet with mentors, and work on their own businesses or on projects like The Possible Project’s e-commerce store. Alternatively, they can spend time at the makerspace which opened in 2014 with support from Biogen, a Cambridge-based biopharmaceutical firm, and the Cambridge Housing Authority. They also can choose to work on a project it has with Lovepop, a Cambridge startup that makes three-dimensional greeting cards.

Mark Levin continues to serve as a mentor. He says he sometimes catches himself being critical of his budding entrepreneurs, and then he reminds himself what he was like at their age.

“When I was 16 years old, I never talked to anybody,” he says. “I don’t think I would’ve done this after school.”

A natural introvert, Mark Levin says it took him years of working in his father’s shoe stores before he would come out from behind the cash register to help customers try on shoes.

Becky Levin is now The Possible Project’s executive director, and dinner conversation often revolves around what’s happening there. Mark Levin serves as the main strategist and is on a number of its management committees. The Possible Project is expanding into Boston, where it hopes to have 500 kids a year involved in its after-school program. He’s also talked with Aaron Bobick, PhD, dean of the School of Engineering & Applied Science, about doing a version of The Possible Project outside of Boston.

*“If the shoe looks cool, wear it.”*



CAITLIN CUNNINGHAM

Jacey Buel, director of entrepreneurship education (left), and Becky Levin (center) with Joandy, a first-year intern, who started at The Possible Project during his sophomore year in high school. Now graduated from high school, Joandy runs Fixkicks, a shoe restoring and customizing business.



Bouchra (left), a high-school junior and co-creator of Reverie Apparel, which sells homemade jewelry marketed through Instagram, with her friend and classmate Zahyeh, creator of Jammin, which sells homemade jam.

CAITLIN CUNNINGHAM

# ACHIEVING MORE

*What the gift to build Brauer Hall has done in five years*



DAVID RUIZ

**32** FACULTY OFFICES

**4** DRY LABS

**21** WET LABS



**BRAUER HALL ENABLED NEW RESEARCH IN**

- » Solar energy
- » Clean water
- » Clean air
- » Energy alternatives
- » Biofuels
- » Cleaner coal
- » Sensing technology
- » Cancer
- » Huntington's Disease
- » Biological systems engineering
- » Nanotechnology
- » Materials
- » Water supply



GROUND BREAKING 10.29.08



04.20.09



04.21.10

COURTESY OF CLAYCO

In 2008, Stephen F. and Camilla T. Brauer made a generous commitment to the School of Engineering & Applied Science to build a second building in the then-new Engineering complex on the northeast corner of the Danforth Campus. The 150,875 square-foot, three-story building was dedicated Oct. 1, 2010, as the Stephen F. and Camilla T. Brauer Hall, housing the Department of Energy, Environmental & Chemical Engineering (EECE) and part of the Department of Biomedical Engineering (BME). Stephen Brauer is president of Hunter Engineering. His involvement with Washington University began in 1987 when he joined Engineering's National Council. He was elected to the university's Board of Trustees in 1991 and is currently vice chair. Camilla Brauer is a cultural and civic leader and community volunteer.



Camilla T. and Stephen F. Brauer

**BY THE NUMBERS**

**2,360**

students who have taken classes in Brauer Hall

**\$31.1 M**

total research expenditures by faculty in Brauer Hall from FY2011-FY2015 (to date)

**28%**

more efficient than a standard building and LEED Gold certified

**BRAUER HALL ENABLED FACULTY GROWTH**

**30%**

increase in EECE faculty

**25%**

increase in BME faculty

Visit [engineering.wustl.edu/magazine](http://engineering.wustl.edu/magazine) to see more photos and read more about how Brauer Hall has benefited faculty research.



COURTESY PHOTO

## Engineering alum nominated for ESPY Award

Kendall Gretsch, who earned a bachelor's degree in biomedical engineering in 2014, was nominated for ESPN's 23rd annual ESPY Awards.

Gretsch, a world-class triathlete who now lives in Madison, Wis., was nominated for the Best Female Athlete with a Disability. Gretsch has been undefeated in every event she's competed in since May 2014.

The ESPY awards highlight the best of the best in sports.

While a senior at WashU, Gretsch was part of a student team that developed a robotic prosthetic arm for a teenage girl who had lost part of her arm in an accident (see page 3). Using a 3-D printer, the three students created a robotic prosthetic arm out of pink plastic for a total cost of \$200, a fraction of the price of standard prosthetics, which start at \$6,000.

## WashU alum crucial to successful mission to Pluto

Early July 14, NASA's New Horizons spacecraft swept past Pluto, ending a 3-billion mile trip that began in 2006.

Two people key to the achievement are:

Brian Bauer (EN SI '05), an alumnus of Parkway Central and Washington University, was in charge of the probe's autopilot software. He works in the Applied Physics Laboratory at Johns Hopkins University.

William McKinnon, PhD, a planetary science professor at Washington University, specializes in solar system geology and geophysics. He serves as the mission's deputy lead scientist.

"It's just a huge day around here, and everyone is enjoying it. Nobody wants it to end," said Bauer, who explained that his job was that of "autonomy lead."



NASA/APL/SWRI

## Applied Particle Technology wins \$50,000 Arch Grant

Arch Grants, which provides equity-free cash awards and free support services to startups willing to headquarter their businesses in St. Louis, announced its 2015 cohort June 18. Among the 11 award winners was Applied Particle Technology.

Applied Particle Technology (APT) provides air treatment systems in environments that require high efficiency removal of tiny particles. The innovative system, which operates without a media filter, can also inactivate pathogens and remove toxic fumes or odors. APT's technology could be used on commercial airplanes, in hospital clean rooms and in other areas where the highest standards of air quality must be maintained.

Pratim Biswas, PhD, the Lucy & Stanley Lopata Professor and chair of the Department of Energy, Environmental & Chemical Engineering, along with doctoral students Jiaxi Fang and Tandeep Chadha, founded APT in 2014. Their adviser, Emre Toker, is managing director of the Washington University Skandalaris Center for Interdisciplinary Innovation and Entrepreneurship.



WHITNEY CURTIS

The class of 2019 welcomed 273 freshmen to WashU Engineering in addition to 380 new master's and 63 new PhD students.

## Doctoral student wins \$100,000 in healthcare technology competition



DAVID SONG

Xinyu (David) Song, a doctoral student in Biomedical Engineering, took second place and won \$100,000 in the CIMIT Student Healthcare Technology competition.

Earlier this year, he won \$10,000 to continue developing his project as one of 10 finalists for the final prizes of \$150,000, \$100,000 and \$50,000.

Song works in the lab of Dennis Barbour, MD, PhD, associate professor of biomedical engineering, studying how to streamline the diagnosis of auditory disorders.

Song's project involves providing an automated, user-friendly hearing test to primary-care physicians, who are likely the first to notice symptoms of hearing loss in their patients. By enabling hearing loss screening to be conducted in primary-care facilities, patients with hearing disorders can be identified more easily and can then be referred to audiologists for more detailed testing and treatment.

## Alumni entrepreneurs invited to first-ever White House Demo Day

Sparo Labs, a digital health startup based in downtown St. Louis, was invited to participate in the first-ever White House Demo Day hosted by President Barack Obama Aug. 4. Co-Founders Andrew Brimer (EN '13) and Abby Cohen (EN '13) traveled to Washington, D.C., for the event and were proud to represent the burgeoning St. Louis startup community.

The first-ever White House Demo Day celebrated the important role entrepreneurship plays in America's economy. Unlike a private-sector Demo Day, where entrepreneurs and startups pitch their ideas to funders, these select innovators from around the country "demoed" their individual stories.

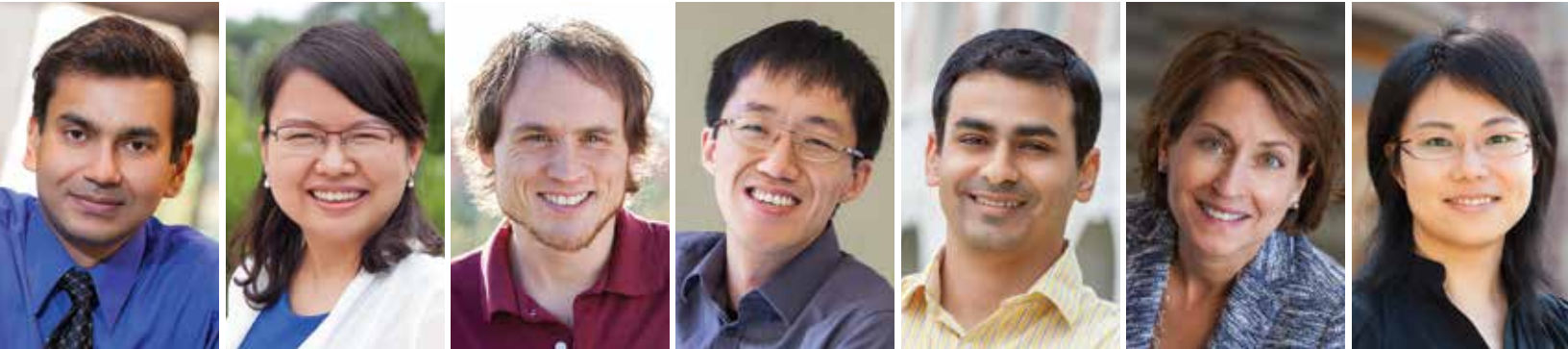
The Demo Day event showcased the need to give more entrepreneurs from all walks of life a chance to turn their ideas into indispensable products and services and included new announcements that support inclusive entrepreneurship.

Sparo Labs exhibited their product — Wing™ — at the Demo Day. Wing helps patients control their asthma or other respiratory condition using a powerful app and pocket-sized sensor that measures their lungs. Wing ends the fear and uncertainty of asthma by empowering users to better understand, track and proactively manage their condition.



SPARO LABS

# New faculty join School of Engineering & Applied Science



## Shantanu Chakrabarty, PhD

- » Professor in the Department of Computer Science & Engineering
- » PhD, Johns Hopkins University
- » Chakrabarty is a renowned expert in floating-gate circuits and systems for energy scavenging and self-powering applications. He received the prestigious CAREER award from the National Science Foundation in 2010 and the Innovator of the Year award from MSU Technologies in 2012.

## Hong Chen, PhD

- » Assistant Professor in the Department of Biomedical Engineering and of radiation oncology at the School of Medicine
- » PhD, biomedical engineering, University of Washington
- » Chen's research focuses on physical acoustics, therapeutic ultrasound and ultrasound imaging. She plans to set up an ultrasound-based, image-guided therapy laboratory to translate basic research advances in medical ultrasound into medical devices that can impact patient care.

## Roman Garnett, DPhil

- » Assistant Professor in the Department of Computer Science & Engineering
- » DPhil, engineering science, University of Oxford
- » Garnett's research interest is developing new Bayesian machine-learning techniques for sequential decision-making under

uncertainty. He is interested in active learning, especially with atypical objectives, Bayesian optimization, intelligent approaches to approximate Bayesian inference and Bayesian quadrature.

## Matthew Lew, PhD

- » Assistant Professor in the Department of Electrical & Systems Engineering
- » PhD, electrical engineering, Stanford University
- » Lew's research interest is in developing optical tools for biology and medicine. While at Stanford, Lew designed microscopes and developed computational tools for three-dimensional super-resolution fluorescence imaging. In addition, he simultaneously measured the orientation and 3-D position of single molecules for the first time.

## Rohan Mishra, PhD

- » Assistant Professor in the Department of Mechanical Engineering & Materials Science
- » PhD, materials science and engineering, The Ohio State University
- » Mishra plans to identify and develop a quantitative measure of structure-property correlations in materials, such as epitaxial thin films and materials with reduced dimensionality, using a synergistic combination of scanning transmission electron microscopy and atomic-scale theory, to create rational design of materials with properties tailored for electronic, magnetic, optical and energy applications.

## Lori Setton, PhD

- » Lucy and Stanley Lopata Distinguished Professor of Biomedical Engineering; Professor of orthopaedic surgery at the School of Medicine
- » PhD, mechanical engineering and biomechanics, Columbia University
- » Setton's research focuses on the role of mechanical factors in the degeneration and repair of soft tissues of the musculoskeletal system, including the intervertebral disc, articular cartilage and meniscus. In the lab, her work focuses on engineering and evaluating materials for tissue regeneration and drug delivery. She combines engineering and biology to determine the role of mechanical factors to promote and control healing of cartilage.

## Silvia (Xuan) Zhang, PhD

- » Assistant Professor in the Department of Electrical & Systems Engineering
- » PhD, electrical and computer engineering, Cornell University
- » Her research interests are in efficient and reliable System-on-Chip (SoC) for miniaturized autonomous robotics, failure-resilient and harsh environment-capable embedded cyber-physical systems, tools and automation for workload-aware, data-centric, energy-efficient computing and circuit interfaces with nano- and micro-electro-mechanical systems devices for biomedical applications.



## Inspiring future STEM leaders

The gym at University City High School buzzed with the energy and anticipation of a pep rally. However, the teams present came not for a battle of brawn but of brains.

For Washington University undergraduate Mani Raman, the scene at U. City's First LEGO League (FLL) Fall Warm-Up was a familiar one. Raman served as an expert at the presentation help desk at the Warm-Up along with four of her peers from WashU's School of Engineering & Applied Science.

Raman said that being at the event brought her full circle. "I did FTC, the high school division of LEGO Robotics, for four years," Raman said. "Our team did a lot of outreach to (the middle school division) FLL. We refereed events like this, ran help desks and many other things."

Raman and her fellow WashU students, Zoe Cohen, Liu Mengxuan, Peter Li and Henry Moyerman, volunteered with FLL after hearing about it through the Institute for School Partnership (ISP).

The ISP helps connect volunteer needs in K-12 schools to the people and resources at WashU through a program

called K-12 Connections. Through this program, WashU students studying in the fields of science, technology, engineering and math (STEM) can help inspire younger students to do the same by volunteering at events like the FLL Warm-Up.

Computer Science graduate student Henry Moyerman said that he too participated in LEGO events when he was growing up.

"Even just having the students present their ideas to us and having us ask them questions can help them think through their designs," Moyerman said.

The Warm-Up allowed students to test their LEGO robotic designs and practice presenting their ideas to others. Students perfected their designs before competing in the first qualifier at Brittany Woods Middle School Nov. 7-8.

All of the students' work will culminate at the FIRST Championship in St. Louis in the spring of 2016.

"FLL is a great program and gives students a lot of confidence," Raman said. "It is what got me interested in engineering in the first place... It was life changing for me."

*Written by Gennafer Barajas*

## Borbely named head of professional education for engineering



EDWARD BORBELY

Edward Borbely has been appointed associate dean and executive director of professional education in the School of Engineering & Applied Science. Borbely previously was director of the

Integrative Systems and Design Division (ISD) at the University of Michigan.

"Ed brings more than 30 years of successful experience in building and implementing interdisciplinary professional education programs, and this extensive knowledge will help SEAS transform how we meet the training and professional development needs of individuals and industries," Aaron Bobick, PhD, dean of the School of Engineering & Applied Science, said. "Ed will collaborate with the faculty and with other WashU schools to enhance existing programs and to create unique educational opportunities, including online courses," Bobick said.

Borbely had been at Michigan since 1994, first as the founding director of the Center for Professional Development, then Interdisciplinary and Professional Programs, and most recently as director of ISD, an interdisciplinary division that brings together faculty from engineering, art and design, business, medicine, public policy and the sciences. During the past 21 years, he led the development of programs on campus, online and at locations worldwide that have attracted more than 100,000 students, including programs in health care, energy systems engineering, design science, and systems engineering and design.

## Chakrabarty receives CAREER Award from National Science Foundation



RAJAN CHAKRABARTY

Properties of Biomass Burning Aerosols.”

Rajan Chakrabarty, PhD, assistant professor of energy, environmental & chemical engineering in the School of Engineering & Applied Science, has been awarded a five-year, \$691,180 Faculty Early Career Development Award (CAREER) from the National Science Foundation. His project is titled “From Cradle to Grave: Radiative

CAREER 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. Chakrabarty is the 25th faculty member in the School of Engineering & Applied Science to receive the award.

With the funding, Chakrabarty will study the optical and microphysical properties of aerosols emitted from burning of wildland fuels prevalent in the United States.

As part of the project, Chakrabarty will work with teachers from high schools in the St. Louis area whose students are from groups underrepresented in science, technology, engineering and math (STEM) fields. He will hold intensive teacher-training workshops to cover key scientific concepts from climate change science and climate modeling exercises using the National Aeronautics and Space Administration (NASA) Education Global Climate Model.



## WashU computer scientists part of \$8M big data research grant

Two computer scientists from Washington University are on a research team that will use big data to accelerate breeding and the commercial release of sorghum crops that can be used as a renewable energy source.

Robert Pless, PhD, professor of computer science, and Roman Garnett, PhD, assistant professor of computer science, will join a team of 10 university, government and industry collaborators working on the four-year, \$8 million project, headed by the Donald Danforth Plant Science Center and funded by the U.S. Department of Energy’s ARPA-E TERRA program.

With about \$900,000 of the total funding, Pless will develop 3-D models of the crops, including their shapes, volumes and properties, such as leaf curvature, that may indicate drought stress in field conditions, and Garnett will develop algorithms that make the most effective use of statistical estimates of the final biomass of the crops from sensor data as early in the growing season as possible to speed the breeding process.

## Setton elected president of The Biomedical Engineering Society



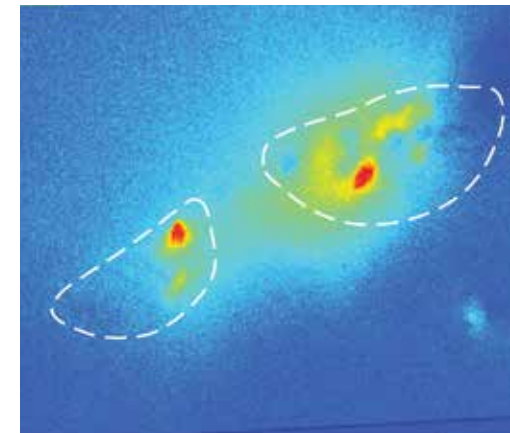
LORI SETTON

Lori Setton, PhD, professor of biomedical engineering at Washington University in St. Louis, has been elected president of The Biomedical Engineering Society (BMES), a professional society for biomedical engineering and bioengineering.

Setton, the Lucy and Stanley Lopata Distinguished Professor of Biomedical Engineering and professor of orthopaedic surgery at the School of Medicine, joined WashU in 2015 from Duke University, where she was the William Bevan Professor of Biomedical Engineering and Bass Fellow and associate professor of orthopaedic surgery. She is a fellow of BMES and of the American Institute for Medical and Biological Engineering and earned a Presidential Early Career Award for Scientists and Engineers (PECASE) in 1997, as well as several awards for excellence in mentoring.

Setton and the society’s other newly elected leadership members plan to improve industry involvement in the society and encourage a more diverse membership. She will begin her role as president at the society’s 2016 annual meeting in Minneapolis.

## Raman seeks to replicate sense of smell with NSF CAREER Award



A biomedical engineer is aspiring to develop an artificial or electronic nose that has potential applications in a number of domains, including medical diagnosis and homeland security.

But instead of starting from scratch to discover how the sense of smell works in the brain, Baranidharan Raman, PhD, assistant professor of biomedical engineering, is looking to nature for clues. His lab is using relatively simple models of olfaction — fruit flies and locusts — to study their design and computing principles.

Raman has been awarded a five-year, \$600,000 Faculty Early Career Development Award (CAREER) from the National Science Foundation to understand information processing principles in biological sense of smell, or olfaction, and to develop bio-inspired signal processing algorithms for artificial olfaction. His project is titled “Neural Dynamics, Olfactory Coding and Behavior.”

Raman will use the genetic tool kit available in fruit flies to investigate how neural activity in individual sensory neurons in their antennae is translated into behavior. The larger locust model will be used to examine activity of ensembles of neurons in the insect brain and how they encode information about an odor.

Written by Tony Fitzpatrick



## WashU engineer developing methods to model, analyze brain networks

ShiNung Ching, PhD, assistant professor of electrical & systems engineering in the School of Engineering & Applied Science, will use a three-year, \$374,643 grant from the National Science Foundation to develop and analyze mathematical models of brain networks. Specifically, Ching will use these models to investigate how particular features of brain networks may enable processing of information, such as sounds and visual cues from the environment.

“We’re developing new instantiations of engineering theory to study biological networks and understand how biology has engineered the brain to perform its functions,” Ching said. “In much the same way that we would analyze a mechanical system, such as an airplane or a power grid, we’re using these formal engineering methods to study networks in the brain.”

While man-made systems are relatively straightforward, the brain has unparalleled complexity, Ching said, making such work a challenge. To address this challenge, he plans to take what is known about the brain’s anatomy and develop mathematical descriptions of neurons and networks. From there, he can extract key features to develop simpler models for analysis.

## Agarwal receives Honorary Fellowship from Royal Aeronautical Society



RAMESH AGARWAL

Ramesh Agarwal, PhD, will receive an Honorary Fellowship from the Royal Aeronautical Society, the highest distinction for global aerospace achievement.

Agarwal, the William Palm Professor of Engineering in the School of Engineering & Applied Science, will be given the award in recognition of his “outstanding leadership in aerospace education and research and for advancing the improvement and development of a wide range of flying aerospace vehicles through ingenious application of computational fluid dynamics.”

He will receive the award in December at the society’s Wilbur and Orville Wright Lecture in London.



## Computer programming may get easier with new WashU research



KUNAL AGRAWAL ANGELINA LEE

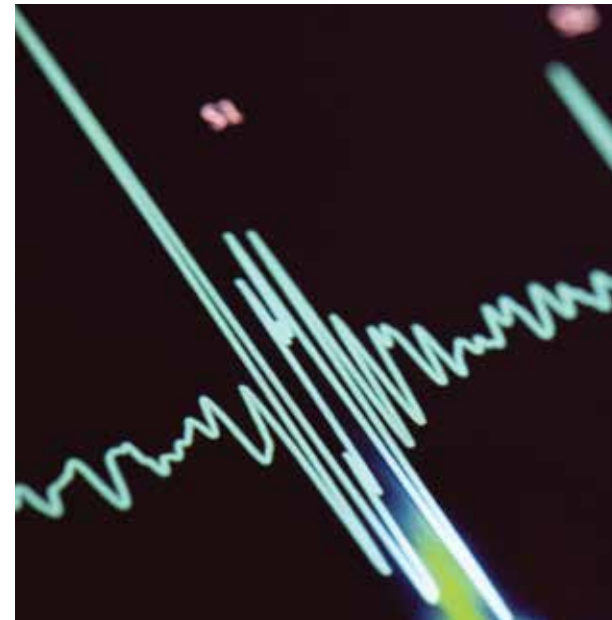
I-Ting Angelina Lee, PhD, assistant professor, and Kunal Agrawal, PhD, associate professor, both in computer science, will work to make it easier for programmers to create high-performance parallel programs with a three-year, \$449,947 grant from the National Science Foundation.

The team is targeting parallel programs, or those designed to use multiple cores simultaneously. Parallel programs can potentially process larger amounts of data in the same time, or perform the same computation in a shorter amount of time compared to serial programs.

They will focus on improving the locality of parallel programs, which can greatly impact the performance of programs. A program with good locality uses the computer's cache efficiently. The cache is a small piece of memory that stores data that can be quickly accessed. Because a cache has limited capacity, and a programmer cannot control what data is kept in a cache, maintaining good locality can be challenging, Lee says.

## New drugs to treat deadly heart condition aim of \$3.1 million study

Jianmin Cui, PhD, professor of biomedical engineering, is taking an innovative approach to finding new drug candidates to treat Long QT syndrome with a four-year, \$3.1 million grant from the National Heart, Lung, and Blood Institute of the National Institutes of Health. This work will build on Cui's ongoing research into the molecular bases behind the causes of Long QT syndrome, arrhythmia, or irregular heartbeat, and other cardiac disorders.



Long QT syndrome, which causes arrhythmia, can be inherited or acquired after use of certain medications and is caused by specific mutations in genes that produce ion channels, which provide the current for the heart's electrical activity. Although there are several types of ion channels in the heart, a change in one or more of them may lead to arrhythmia.

## WashU working to improve technology to treat Parkinson's, other disorders



JR-SHIN LI

develop a framework for optimal control of the dynamics in the brain's networks through neurostimulation. With better control, clinicians could more directly target the neuronal network, both by location and with precise timing, allowing

for better understanding of brain function and potentially better treatment.

Currently, the technology is used to activate or deactivate the entire neural network, rather than individual neurons, and without regard to timing or patterns of activity. Li will use his expertise in formal systems theory, computational neuroscience and developing mathematical formulations to create frameworks for better control of the neurons.

With co-principal investigator ShiNung Ching, PhD, assistant professor of electrical & systems engineering, Li will release software developed through the research under an open-source license. They also will establish an independent study course titled "Neural Control and Engineering with Clinical Applications." In addition, the team will work with the university's Institute for School Partnership to offer summer workshops on systems theory, mathematics and neuroscience to local K-12 students.



DEVON HILL

## Biswas receives prestigious award for environmental chemical engineering

Pratim Biswas, PhD, has been selected to receive the 2015 Lawrence K. Cecil Award in Environmental Chemical Engineering from the American Institute of Chemical Engineers (AIChE).

The award, one of the most prestigious given by AIChE, is given by the institute's Environmental Division in recognition of an individual's outstanding chemical engineering contribution and achievement in preserving or improving the environment. The recipient must be an AIChE member, have 15 years of chemical engineering experience in the environmental field and demonstrate leadership in research, teaching, engineering or regulatory activities in either the public or private sector.

Biswas, the Lucy and Stanley Lopata Professor and chair of the Department of Energy, Environmental & Chemical Engineering, is an internationally renowned aerosol scientist. Among his many contributions to the field include understanding the formation of combustion aerosols, which has been successfully applied to prevent the emissions of inadvertently produced particles and for the controlled production of nanoparticles for energy and environmental technologies.

## Sakiyama-Elbert named Vice Dean for Research



SHELLY SAKIYAMA-ELBERT

Shelly Sakiyama-Elbert, PhD, the Joseph & Florence Farrow Professor of Biomedical Engineering, was appointed vice dean for research in the School of Engineering & Applied Science. Known for her groundbreaking work to develop biomaterials for drug delivery and cell transplantation for the treatment of peripheral nerve and spinal cord injury, Sakiyama-Elbert is the co-director of the Center of Regenerative Medicine and is a member of the Hope Center for Neurological Disorders and the Institute of Materials Science & Engineering. She also has appointments in the Department of Energy, Environmental & Chemical Engineering, the Division of Biology & Biomedical Sciences, and the Division of Plastic & Reconstructive Surgery.

In addition to her research and teaching, Sakiyama-Elbert was the associate chair for graduate studies in the Department of Biomedical Engineering and was a Faculty Fellow in the Office of the Provost, where she worked to encourage interdisciplinary collaboration, strengthen diversity and increase faculty leadership opportunities. She also graduated from the Executive Leadership in Academic Technology and Engineering (ELATE) program, a national professional development program designed for women in academic STEM fields.

She earned bachelor's degrees in chemical engineering and biology from the Massachusetts Institute of Technology and earned master's and doctoral degrees in chemical engineering from the California Institute of Technology. Sakiyama-Elbert joined the faculty at WashU in 2000.

Sakiyama-Elbert has written five book chapters and more than 70 articles in peer-reviewed journals, and she holds eight U.S. patents with additional patents pending. Sakiyama-Elbert has received numerous awards, including the WashU Distinguished Faculty award, and she was elected a fellow of the Biomedical Engineering Society in 2013.

## Genin receives highest academic honor from Chinese government



Guy M. Genin, PhD, professor of mechanical engineering, has been named a Yangtze River Scholar by the Ministry of Education of the People's Republic of China.

The prestigious award is the highest award issued to an individual in higher education by the country's Ministry of Education. In addition to China's top scholars, the ministry also selects several international recipients each year. Only a handful of people who were not born in China have ever been honored with the award.

The award is for Genin's "fundamental contributions to and international scholarly leadership in the study of interfaces in physiology."

## Wang to receive prize from international photoacoustic group



LIHONG WANG

Lihong Wang, PhD, an internationally renowned expert in photoacoustic imaging, received the 2015 Senior Prize of the International Photoacoustic and Photothermal Association.

The prize was established to recognize outstanding researchers who have been instrumental in the development and evolution of photoacoustic, photothermal and related techniques and applications that have a major impact on diverse scientific and engineering communities.

Wang, the Gene K. Beare Distinguished Professor of Biomedical Engineering, was honored for his groundbreaking work and leadership in biomedical photoacoustic imaging. Wang is or has been principal investigator on more than 40 research grants with a cumulative budget of more than \$50 million.

The prize is the most recent award Wang has received. In the past several years, he has received the National Institutes of Health's (NIH) BRAIN Initiative, the NIH FIRST, the National Science Foundation's CAREER, the NIH Director's Pioneer, and NIH Director's Transformative Research awards. He also received The Optical Society (OSA) C.E.K. Mees Medal, the Institute of Electrical & Electronics Engineers (IEEE) Technical Achievement Award, IEEE Biomedical Engineering Award and SPIE Britton Chance Biomedical Optics Award. In addition, he received an honorary doctorate from Lund University in Sweden.

## WashU engineer uses marine crustacean model to improve imaging

Viktor Gruev, PhD, associate professor of computer science & engineering, has received a one-year, \$299,857 grant from the Air Force Office of Scientific Research (AFOSR) to develop a bio-inspired, low-noise spectral-polarization imaging system. This instrument's capabilities are based on the vision of the mantis shrimp, an aggressive marine crustacean that has among the most sophisticated vision of all animals.

The mantis shrimp, or stomatopod, has 20 different photoreceptor types, or functional input channels: 12 channels for color spanning, six for linear polarization and two for circular polarization. Gruev has been working to recreate this unique vision to create more efficient design of sensors, imaging devices and analyzers. His lab has



already developed the first bio-inspired polarization camera and the first bio-inspired color-polarization imaging sensor modeled after the mantis shrimp visual system. Polarization is the alignment of light waves through space and time.

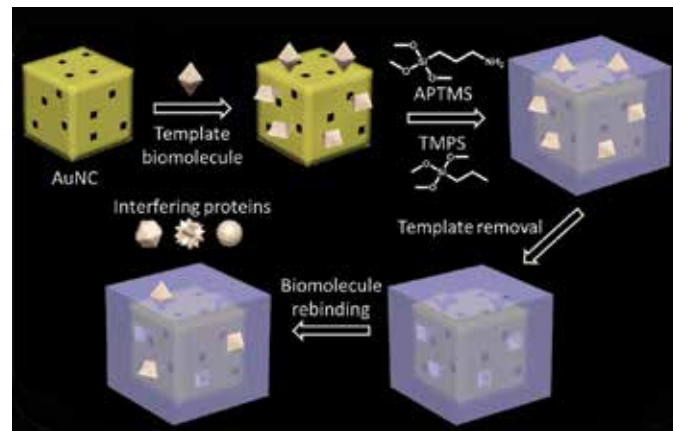
With the new funding from the AFOSR, Gruev plans to create a new imaging system that overcomes the shortcomings of the existing system, including noise and lack of speed.

## Artificial antibodies on gold nanocages may lead to speedier detection of kidney injury

Srikanth Singamaneni, PhD, associate professor of materials science, has received a two-year, \$411,246 grant from the National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health to design and produce biosensors based on gold nanocages and artificial antibodies to detect certain proteins in urine and blood plasma.

The rapid, point-of-care method could be used in intensive care units or emergency rooms to quickly detect acute kidney injury, a sudden deterioration in kidney function, and lead to earlier diagnosis and treatment. Current detection methods require expensive tests that must be done in hospital-based labs and are not ideal for settings with limited resources.

The gold nanocages with artificial antibodies would be designed to detect three protein biomarkers that have been considered for early diagnosis and prognosis of acute kidney injury: neutrophil gelatinase-associated lipocalin (NGAL), kidney injury molecule 1 (KIM-1) and fatty acid binding protein 1 (FABP1).



# power

*Water is the driving force of all nature.*

— LEONARDO DA VINCI

Water is so very simple — two parts hydrogen, one part oxygen — yet has enormous power in the world. It is strong enough to generate energy, but also to destroy the earth in floods and hurricanes. It is even powerful when scarce — it's what the parched earth craves in times of drought and what dry throats desire in intense heat. It is even powerful enough to start wars: Those who don't have it want it badly enough to fight for it.

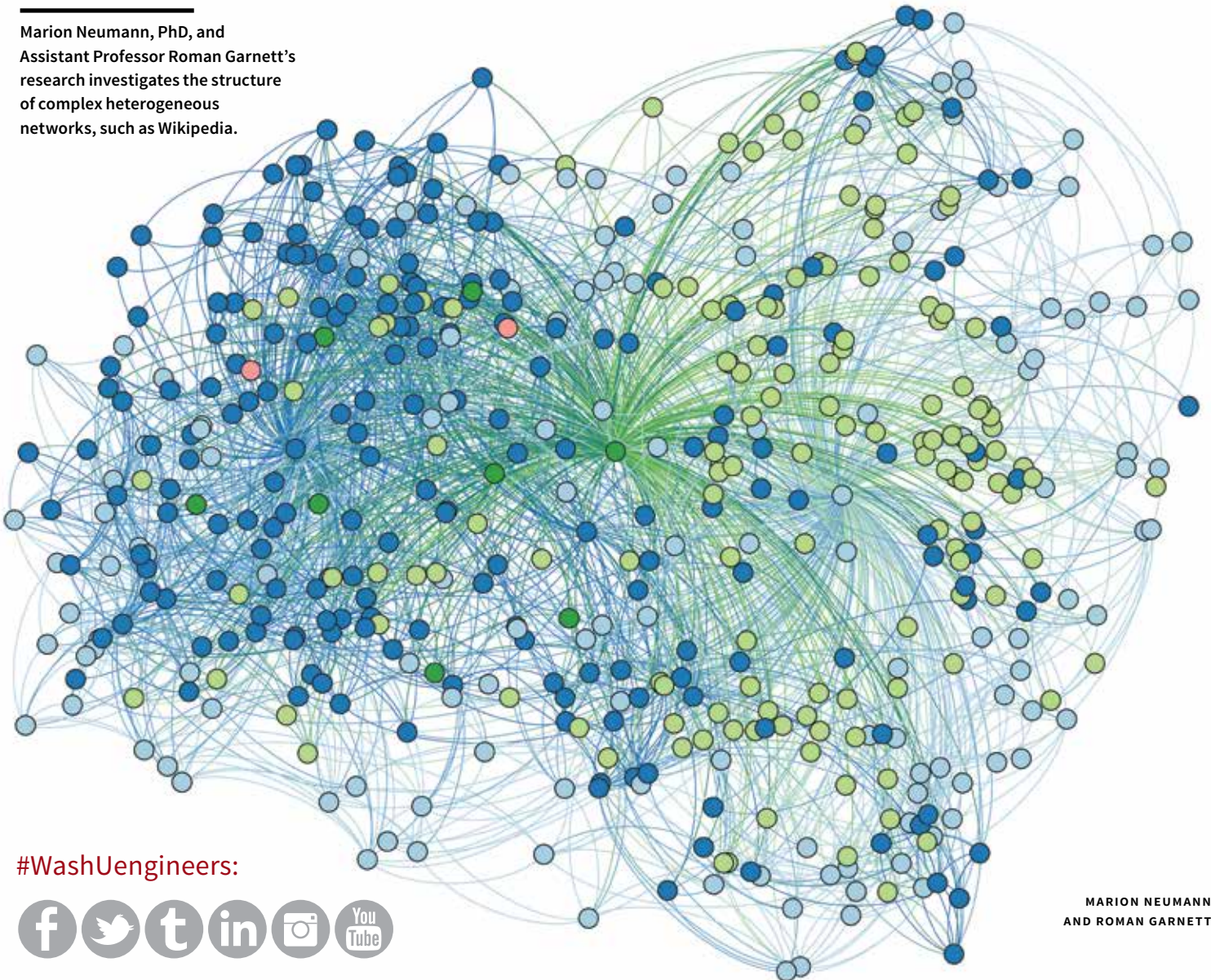
As powerful as it is, water also is weak, in that it is disappearing rapidly around the world. Changes in climate and increases in population and demand have led to vast shortages in California in the United States, South America, Europe, Southeast Asia, India and Africa. People in the Andean countries in South America depend on melted glacier water for fresh water, but because glaciers are melting so quickly, that water source is expected to evaporate by 2020.

Environmental engineers in the School of Engineering & Applied Science understand the power of water and focus their research on finding new ways to remedy shortages as well as water that is unsafe to drink. By creating new materials to clean water as well as looking for solutions to find new sources for water, these engineers are poised to solve this issue that affects every person on the planet.

$$p = mv$$

## Snapshot //

Marion Neumann, PhD, and Assistant Professor Roman Garnett's research investigates the structure of complex heterogeneous networks, such as Wikipedia.



#WashUengineers:



MARION NEUMANN  
AND ROMAN GARNETT