

FALL 2013

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Engineering Momentum

ACROSS DISCIPLINES. ACROSS THE WORLD.™

 Washington University in St. Louis

Engineering

MIND MATTERS

Brain research could one day alter the way we treat life-changing injuries and diseases

inside

- >> Jubel Hall Announced
- >> Young-Shin Jun
- >> Student Athletes
- >> Gaurav Garg





UNDERGRADUATE ORIENTATION

ENGINEERING
by the
NUMBERS
2013

281
Engineering
freshmen

1,345
Engineering
undergraduate
students

502
Engineering
masters students

377
Engineering
doctoral students

DAN GILL



2013 COMMENCEMENT



SUMMER WEEKEND EGG DROP



2013 SCHOLARSHIP DINNER



KEVIN LOWDER

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FALL 2013



Engineering

DEAN
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Charles A. Buescher Jr. (center) was honored with the 2013 Volunteer of the Year Award for his service to the school and community, with Mike Perlmutter (left), alumni advisory council president, and Dean Ralph Quatrano (right).



Dear friends,

2013 marks another banner year for our School of Engineering & Applied Science, as we made significant progress implementing our strategic plan.

- » We increased the size and improved the diversity of our faculty with 20 hires, or about one-quarter of our current faculty, across all departments since I became dean. We increased the number of women faculty members by 50 percent within the past two years, and women account for half of the faculty promotions during the past year. We also hired the first African-American male faculty member and the first two Hispanic faculty members. Read more about the newest faculty on page 32.
- » We made significant progress in building a sustainable infrastructure to enable cutting-edge research in energy and the environment, medicine and health and security. While many other schools face decreasing federal financial support, our faculty's research awards and expenditures continue to climb — an acknowledgement to their innovation. This magazine includes several examples of our faculty's world-changing research.
- » We continue to uphold the quality and selectivity of our undergraduate students. With applications increasing for the fourth year in a row, we received more applications and were the most selective than ever before. Just as important, one-third of accepted prospective students chose our engineering school over any other. Now with 1,345 undergraduate students, we have the largest, most diverse and academically talented undergraduate students we have ever had. Read about how our student athletes excel on and off the field on page 18.

- » We achieved ABET re-accreditation without any deficiencies — the first time in the school's history.
- » We announced a new building in our new engineering complex, thanks to the generous support of the Jubel family. Henry A. & Elvira H. Jubel Hall will become the new home for our Department of Mechanical Engineering & Materials Science. Read more about this exciting development on page 4.
- » Finally, we launched several new programs, such as the Master of Cyber Security Management with the Olin Business School and the Discovery Competition to promote entrepreneurial endeavors among our undergraduate students.

Of course, none of these achievements would be possible without the steadfast commitment and support from you and the entire school community. I am grateful for your contributions, and I hope you enjoy reading about our progress toward becoming one of the very best engineering schools in the world.

Sincerely,

Ralph Quatrano, PhD
Spencer T. Olin Professor & Dean
rsq@wustl.edu

social media buzz



POSTED OCT. 8, 2013

Student blogs: What I learned in the Fullbridge Program

by Brittany Edwards



"Overall, the experience of the Fullbridge Program was absolutely amazing. I was able to meet and network with so many interesting people, learn about business and better understand who I am and what I want for my future. This small step — partaking in this program — has made such a large impact on my life and my future."



POSTED AUG. 10, 2013

What was your favorite engineering course at WUSTL and why?

First and foremost was Transport Phenomena with Dr. Sparks (Chemical Engineering). A true genius of a man whom we got to share individual time with each Friday discussing relevant topics. A terrific learning experience.

Kevin Egan
Regional Sales Manager at Sprint

Dr. Khomami's transport class. Never experienced a 7-hour-long midterm examination!

Heather Benedict
Chemical Engineer

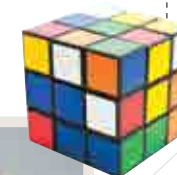
CoE 462 - senior design course for the computer engineering degree. I enjoyed it since it was practical and hands-on.

Chris Hackmann
Senior Software Development Engineer at Microsoft



POSTED OCT. 22, 2013

#1 popular post: EECE students and sponsors at the scholarship dinner



@WUSTLENGINEERS Oct. 14, 2013



Rubik's Cube Competition:

#WUSTL Provost @holdenWU vs. Rubik's Cube 6x6 World Champion Kevin Hays: Who won? VIDEO: <http://ow.ly/pOBKN>



Keep up to date with news and events engineering.wustl.edu



POSTED AUG. 26, 2013

Orientation Instagram Contest Winner

Evan Kerr, the winner
#wustleng2017

#wustlengineers

Mechanical Engineering & Materials Science to anchor

HENRY A. & ELVIRA H. JUBEL HALL



“America needs more young people who pursue engineering and other technical disciplines to help us compete globally. It is my hope that this new building will create enthusiasm and attract bright students who will serve as our leaders of tomorrow.”

— DON JUBEL

Written by **BETH MILLER**

When Henry A. Jubel came to the United States from Germany in the 1920s as a young boy, he likely never imagined that he would start what has become a multimillion-dollar international manufacturing company.

The aluminum die-casting company he founded in 1961, Spartan Aluminum Products in Sparta, Ill., has flourished and is now run by his son, Don Jubel, who is honoring his late parents with a gift from the Henry A. Jubel Foundation toward construction of the Henry A. and Elvira H. Jubel Hall for the School of Engineering & Applied Science at Washington University in St. Louis. It's a fitting tribute to a man who earned a bachelor's degree in mechanical engineering from Washington University in 1940 with the help of a scholarship and wages from cutting grass, translating books from German to English and from his mother, who cleaned homes.

Jubel Hall, the new home of the Department of Mechanical Engineering & Materials Science, will be located near the intersection of Brookings Drive and Hoyt Drive. As the newest building in the Engineering complex at the northeast corner of campus, it will contain classrooms, laboratories, faculty offices and gathering and study areas. The new space will allow the department to expand its faculty by up to 80 percent and provide the infrastructure to double its already robust research program. In addition, it will help meet the growing demands of a top-tier program in mechanical engineering, the school's second-largest major.

The gift is part of *Leading Together: The Campaign for Washington University*. A formal groundbreaking for the new building will be announced at a later date.

the
**JUBEL FAMILY
BUSINESS**

1961

*Spartan Aluminum Products is
founded in Sparta, Ill.*



2013

*Spartan Light Metal Products
has 700 employees in Illinois,
Missouri, Michigan and Tokyo.*

“Three generations of the Jubel family have now earned or are earning degrees from Washington University, and I'm sure Henry Jubel would be honored by this gift,” says Mark S. Wrighton, chancellor of Washington University in St. Louis. “Jubel Hall will be an excellent example of the foundation's mission to support young people seeking to improve their lives through higher education.”

More than \$150 million has already been invested in new and renovated Engineering space over the past 10 years, part of the school's master plan calling for a 700,000-square-foot engineering complex on the northeast corner of the Danforth Campus.

“The addition of Jubel Hall to Whitaker, Brauer and Green halls in the new engineering complex will enable us to attract and retain the best and brightest students and the most talented faculty, and it will provide them with the tools they need to do great work,” says Ralph S. Quatrano, PhD, dean of the School of Engineering & Applied Science and the Spencer T. and Ann W. Olin Professor. “A project such as Jubel Hall can only happen with the support and commitment of many people, and we are truly grateful to the Henry A. Jubel Foundation and the Jubel family for making this a reality.”

After graduating from Washington University, Henry Jubel took a position in 1941 with the Civil Service Ordnance Department, from which he received the highest civilian award and a cash bonus of \$1,000 for inventing a modification of a grenade launcher that fit onto the bayonet attachment of the M-1 rifle. After World War II, he went to work for Sterling Aluminum Products as a production engineer. Later, changes at Sterling led Mr. Jubel to purchase Sterling's aluminum die-cut machines to establish Spartan Aluminum Products. With just two

Henry A. Jubel while a student at Washington University



Elvira Jubel, Karen Jubel, Don Jubel, Henry Jubel



Sitting, from left: Don Jubel, Karen Jubel
Standing, from left: Lance Jubel, Melissa Jubel, Markwort, Herb Markwort, Lindsey Jubel

PHOTOS COURTESY OF THE JUBEL FAMILY

employees, Mr. Jubel did much of the work himself and worked long hours, sleeping in the plant on an Army cot for an entire year.

When he established Spartan, Mr. Jubel aspired to develop an environment where he could help create value for his customers and share success with his associates by treating them fairly and equitably. He believed that machinery and technology weren't going to build the company, but that employees with innovative ideas and strong work ethics would put Spartan at the forefront of the die-casting industry. Helping customers with their problems was his first dedication, his family says.

"America needs more young people who pursue engineering and other technical disciplines to help us compete globally," Don Jubel says. "It is my hope that this new building will create enthusiasm and attract bright students who will serve as our leaders of tomorrow."

During his life, Mr. Jubel won a variety of awards and honors, including an Alumni Achievement Award in 1997 from the School of Engineering & Applied Science.

Don Jubel, who earned a bachelor's degree in mechanical engineering from Washington University in 1973, is now chief executive of the company, today known as Spartan Light Metal Products, which has 700 employees in operations in Sparta, Ill.; Mexico, Hannibal and St. Louis, Mo.; Detroit; and Tokyo. A major supplier to the automotive industry, the company has annual sales of \$200 million.

While a student at Washington University, Don Jubel worked in the Sparta plant every summer to learn all aspects of the business. After graduating from Washington University, he earned an MBA from the University of Missouri-Columbia before joining the family business full time in 1975, commuting the one hour each way daily with his father to Sparta from their south St. Louis County home.

When Spartan became the first company in North America to offer commercial magnesium die-cast products, Don became the initial project engineer for the fast-growing business. The company continued to grow, becoming an industry leader in designing and manufacturing aluminum and magnesium custom die-casting products and assemblies.

Don became president in 1991 and chief executive officer in 1999 after Henry's death. Like his father, he received an Alumni Achievement Award from the School of Engineering & Applied Science in 2008. That same year, he received the school's John W. Kourik Volunteer of the Year Award. In addition, he received the Distinguished Alumni Award in 2010. He is an ex officio trustee as executive vice chair of the Alumni Board of Governors, serves on the school's National Council, as chair of its Eliot Society and as a member of the Patrons Committee. He also is a member and past president of the school's Alumni Advisory Council and cochaired the 35th Reunion of the Class of 1973.

The Jubel family has already given much back to Washington University. In 1998, Mr. Jubel established the Spartan Light Metal Products Inc. Scholarship, which endows four scholarships. Don and his wife, Karen, also sponsor two annual scholarships. The family also set up the Henry A. Jubel Foundation in 1998 to support young people seeking to improve their lives through higher education.

Don and Karen's daughter Lindsey earned undergraduate and master's degrees in mechanical engineering in 2009. Another daughter, Melissa, and her husband, Herb Markwort, are both enrolled in the Executive MBA program at Olin Business School. Herb Markwort earned bachelor's and master's degrees in civil engineering at WUSTL in 2005. Elvira Recker Jubel died in May 2013 and was a very loyal friend of the university.

ABOUT HENRY A. & ELVIRA H. JUBEL HALL

Space for laboratories, classrooms, faculty offices and study areas

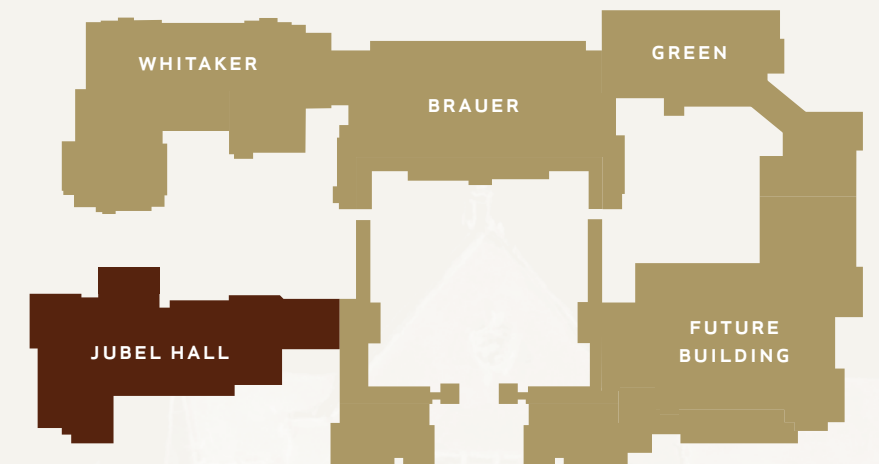
Home for the Department of Mechanical Engineering & Materials Science

Space for department to expand its faculty by 80 percent

Building will be designed for LEED certification program



LEED: The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ is a third-party certification program and the nationally accepted benchmark for the design, construction and operation of high-performance green buildings.



ALZHEIMER'S CONCUSSION SPINAL CORD INJURY HEARING LOSS PARKINSON'S MIND MATTERS

The human brain is one of the most powerful structures known to man. Not only is it important to health and disease, but also to learning, creativity and imagination, psychology, business and the arts. The brain makes life happen, and that's why the world's leading researchers are focusing more intently on unlocking its mysteries.

Written by **BETH MILLER**

This research is so important that President Barack Obama earmarked \$100 million in the Fiscal Year 2014 budget for the BRAIN (Brain Research Through Advancing Innovative Neurotechnologies) Initiative to help scientists and engineers find new ways to treat, cure and prevent brain disorders and injuries. In addition, the National Academy of Engineers has designated the reverse engineering of the brain as one of its Grand Challenges awaiting engineering solutions, and the European Brain Council declared 2014 the Year of the Brain.

Learning how the brain works has the potential to improve life, from restoring function to someone disabled by stroke or spinal cord injury to making Internet searches faster and more accurate. And this research is not limited to the School of Medicine. Many of these researchers are conducting pioneering work in medicine and health at Washington University in St. Louis' School of Engineering & Applied Science in mechanical and electrical engineering, biomedical engineering, computer science and computational biology.

The brain-computer interface

When Dan Moran, PhD, was growing up, he watched "The Six Million Dollar Man" and "The Bionic Woman," television shows that featured fictional characters injured in accidents, then given "bionic" surgical implants that gave them superhuman abilities they used to fight injustice. As a high school baseball player, Moran watched his friend slide into home plate headfirst and break his neck. This incident motivated Moran, now associate professor of biomedical engineering, to study electrical and biomedical engineering to find better ways to restore function for patients with spinal cord injuries such as his friend.

Moran works with Eric Leuthardt, MD, associate professor of neurological surgery and neurobiology at the School of Medicine and of biomedical engineering and mechanical engineering & materials science at the School of Engineering & Applied Science and director of the Center for Innovation in Neuroscience and Technology, who joined the project as a neurosurgery resident, and now works with humans who have electrodes placed on the brain's surface; and Kilian Weinberger, PhD, assistant professor of computer science & engineering. The team uses an interdisciplinary approach to restoring function to these patients by using a brain-computer interface, a communication method between the brain and an external device. The team has a \$2 million grant from the National Science Foundation to create brain-machine interface technology that allows direct control of external devices as if they were a natural extension of the body.

Engineering takes us from a research model to understanding an application that would otherwise not be possible.

— ERIC LEUTHARDT, MD

Moran has spent several years working with an animal model of a brain-computer interface, in which subjects learn to control images on a screen simply by thinking about moving them. The method has the potential to allow patients with spinal cord injury and without use of a limb to move the limb with their thoughts.

2014 — Year of the Brain



Above, top: A tiny computer chip implanted in the brain records brain activity. Bottom: Brain-controlled hand orthotics can help speed stroke recovery. Center: a robotic arm like this one can be controlled directly by the brain. Right: Dan Moran working with a student in his lab.

By implanting a 2-centimeter chip as thin as plastic wrap in the brain, Moran and his team can record brain activity to make sophisticated computer models.

“Normally, one side of the brain controls one hand, and the other side controls the other hand,” Moran says. “When someone has a stroke, he or she is affected on one side. With our special co-adaptive algorithm and decoding, we’re not limited to that, so we can have both hemispheres control both sides.”

Weinberger takes the data from the brain recordings and designs the algorithms that allow the movement to take place.

“When a person moves his hand to the right, the data in the brain recordings shows that,” Weinberger says. “If you give that information to the algorithm, eventually it starts picking up the patterns in the data and making predictions. Then the patient can just think about moving the hand, and the robotic hand will move.”

While this may sound like science fiction, it’s the perfect confluence of engineering and medicine.

“In the next five years, I see clinically approved brain-computer interfaces and consumer brain-computer interfaces that will be more widely used and applied,” Leuthardt says.

The mechanics behind it

WUSTL engineers study the brain’s various mechanical properties, such as shape, strength, flexibility, how it handles force and in what

direction physical waves travel. Philip Bayly, PhD, chair of the Department of Mechanical Engineering & Materials Science and the Lilyan and E. Lisle Hughes Professor of Mechanical Engineering, collaborates with others in Engineering and Medicine to take a closer look at the brain from a mechanical perspective.

The world is going to learn about the basic physics of brain injury, and also develop approaches to prevention and therapy, through computer simulation.

— PHILIP BAYLY, PHD

Earlier this year, Bayly received a five-year, \$2.25 million grant to better understand traumatic brain injuries in efforts to improve methods for prevention and treatment. The grant will allow Bayly and his research team to develop 3-D computer models of brain biomechanics that will give researchers and clinicians a better understanding about what happens to the brain during traumatic brain injury.

“It’s really hard to simulate the brain because it’s very complicated. The necessary ingredients for good simulations are the material properties,

the structure (how the materials are put together) and data for validation. That’s what we’re providing,” Bayly says.

The National Science Foundation also funds Bayly’s work, including a project with Joel Garbow, PhD, research associate professor of radiology at the School of Medicine, using non-invasive magnetic resonance elastography (MRE) to view and measure different properties of waves when they travel in different directions in the fibrous materials of the brain. What they determine could ultimately lead to new diagnostic tools for nerve and brain disorders and new insight into how artificial tissue degrades over time.

Larry Taber, PhD, the Dennis and Barbara Kessler Professor of Biomedical Engineering, collaborates with Bayly to study the shape of the brain using a combination of computational modeling and experiments. But instead of looking at the mature brain through imaging, Taber starts at the very beginning by looking at how the brain develops its shape.

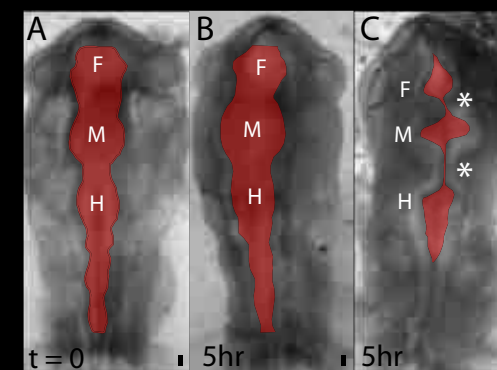
Taber, an aerospace engineer by training, studies how the neural tube, the embryo’s precursor to the central nervous system, which includes the brain and spinal cord, takes its shape using chicken embryos as a model. The way the chicken brain forms in its first few days is very similar to humans in the first trimester of development, Taber says.

“The embryo undergoes dramatic changes in geometry through the stretching and bending of

tissues,” Taber says. “The brain, the heart and other organs are created by tissues growing and being deformed by mechanical forces.”

Supported by a five-year \$1.6 million grant from the National Institutes of Health, Taber studies how organs develop in the embryo, how they acquire their characteristic shapes, what happens when things go wrong and how the tissues adapt to distress.

“We look at how embryonic tissue responds to changes in the mechanical environment,” he says. “There are certain responses that most embryonic tissues have. We found a similar response in the heart and brain to changes in loads, and we think there may be some fundamental principle there.”



Above: images of a very early chicken brain taking shape.

Listening well

People who wear hearing aids often complain about background noise interfering with their ability to hear, particularly in loud environments such as restaurants. As a result, people may stop wearing hearing aids or stop going out altogether.

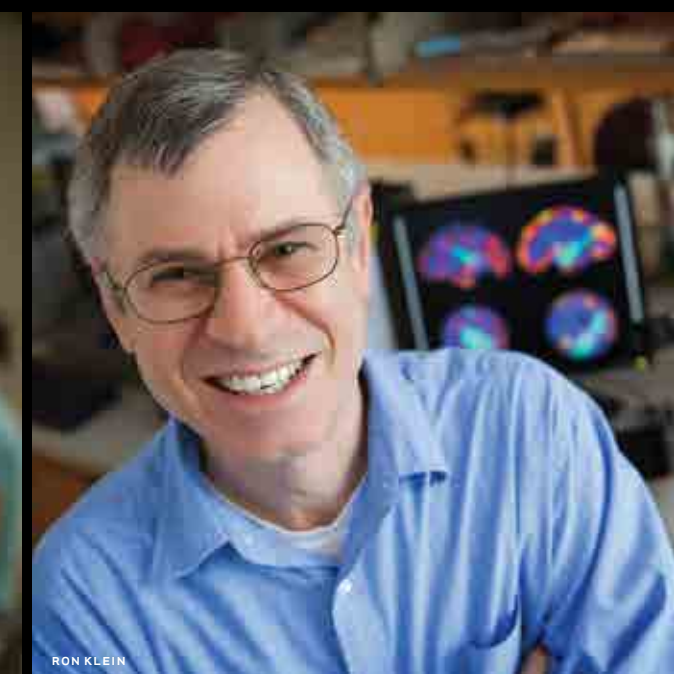
Dennis Barbour, MD, PhD, associate professor of biomedical engineering, has an idea that may help people learn to overcome the background noise — playing specially designed video games.

Barbour and Nancy Tye Murray, PhD, professor of otolaryngology and of audiology and

Below, left: Philip Bayly working with Ruth Okamoto, a senior research associate. Right: Larry Taber



DEVON HILL



RON KLEIN



Dennis Barbour

communication sciences at the School of Medicine, recently received a grant from the University Research Strategic Alliance to create video games designed to help with listening training. The therapy is part of a field called cognitive neurotherapeutics, in which the therapy targets the brain's neuroplasticity, or the ability for the nerve cells in the brain to compensate for injury and disease. Under the right circumstances, these nerve cells can adjust their activities in response to new situations or to changes in their environment.

"Our strategy is to develop games that are fun enough that people want to explore them," Barbour says.

Blending neural engineering, cognitive neurotherapeutics and software design, the project reaches into cognitive, computational, rehabilitation and auditory fields.

"We don't know how much the deficit in listening takes place in the brain compared to the ear," Barbour says. "We do know that about 30 million people in the United States have hearing loss, while close to 70 million have a listening disability. It's possible that listening is a skill that could be taught better with the right intervention."

Barbour says they think the video games will be more effective than traditional listening training, in which users hear the same words over and over.

The team has three games in development. One involves running in exotic locales around the world. The runner runs faster if he or she performs better in listening to the target words.



Eric Leuthardt

In the CINT's first three years, the group engaged 32 clinical and non-clinical inventors, resulting in nearly 50 ideas, 16 fellowships and 12 patents, more than half of which were licensed to industry.

Center for Innovation in Neuroscience & Technology (CINT)

The CINT, an interdisciplinary group based in the Department of Neurosurgery at the School of Medicine, has brought together leaders from the fields of medicine, engineering, law and business in an effort to remove classic barriers between these fields to allow a more open exchange of ideas and insights.

Led by Eric Leuthardt, MD, director of the CINT, nearly half of the center's faculty are from the School of Engineering & Applied Science.

Faculty in the CINT work to generate new ideas, study and validate them and translate them into technology that will help patients with neurologic disease, stroke, traumatic brain injury or spinal cord injury. Their research includes neuroprosthetics, motor and speech physiology, stroke rehabilitation and epilepsy, as well as clinical work with brain mapping and inoperable brain tumors.

Ultimately, the technologies that are born from the CINT will help solve medical problems with no current solution.

We train you to get better at listening by requiring you to listen to the dialogue to advance in the game and by giving strategies on how to listen well.

— DENNIS BARBOUR, MD, PHD

Another game makes the player a detective to solve a crime and involves interviews with suspects and witnesses. The third game involves having to talk to people at a cocktail party and pick up target words.

The video games will allow users to make choices as they go through the game. Based on the outcome, Barbour and Tye-Murray will track how well they do, which may uncover new principles of auditory training that researchers haven't yet discovered.

The biological systems approach

Alzheimer's disease is a tragic, progressive disease in which memory loss, confusion, disorientation, mood and behavior changes progressively get worse over time. It is the sixth leading cause of death in the United States. Parkinson's disease involves shaking or tremor, stiffness in the limbs, slow movements and balance and posture issues and is the 14th leading cause of death in the United States. And Huntington's disease is a genetically inherited neurodegenerative disorder that has many of the neuropathological features of Alzheimer's and Parkinson's disease.

Engineers at Washington University are looking at the connections between these three devastating neurodegenerative diseases using interdisciplinary approaches that involve collaborations between researchers within Engineering and clinical scientists at the School of Medicine. The Center for Biological Systems Engineering (CBSE) is an important catalyst for these collaborations. Research within the center focuses on modeling, predicting and designing functions of biological systems that result from integration of signals and responses of biomolecular and cellular networks.

Rohit Pappu, PhD, professor of biomedical engineering and director of the CBSE, delves into the biophysics and engineering of intrinsically disordered proteins, or proteins that lack a well-defined structure. These proteins often aggregate, or clump, leading to the death and disease of neurons, as in Alzheimer's disease.

Our overall mission is to bring quantitative tools to studying this process in vivo, in cells and, in the end, in the organism.

— JAN BIESCHKE, PHD

His research has yielded important insights regarding the molecular basis of Huntington's disease. Pappu and his team are working to understand the connection between genetic mutations in the protein huntingtin and cellular consequences of huntingtin aggregation. This work, funded by the National Institutes of Health, has highlighted the importance of sequence and cellular contexts as modulators of huntingtin aggregation. These insights result from a combination of state-of-the-art computational modeling and experiment methods that are used by Pappu and his team. Recently, Pappu and his team have started to leverage their expertise to understand how networks of interactions with other abundant proteins in cellular contexts help modulate the properties of proteins

involved in forming plaques seen in Alzheimer's disease. This is an area of growing synergy between Pappu and Jan Bieschke, PhD, assistant professor of biomedical engineering and a member of the CBSE.

In neurodegenerative diseases, a protein changes shape from a functional folded form into a different fold in the polypeptide chain, taking on an amyloid structure in which multiple copies of the same protein assemble into strong and stable fibers. But the process of making the fibers is very toxic to the cells, Bieschke says.

"In a brain with Alzheimer's disease, there are big clumps of plaque made up of these fibril protein structures," Bieschke says. "The challenge from the mechanistic perspective is understanding how that fibril formation process works, why it is toxic for the cells and what can be done about it, since there is no cure or treatment to slow the disease process."

Bieschke is looking for proof-of-principle experiments for new therapeutic strategies. So far, he's found two that derail the amyloid formation process, including one involving an antioxidant substance in green tea.

Given the strong collaborative effort at Washington University, progress in these areas is likely to happen, Bieschke says.

"You have this strong Alzheimer's disease clinical focus and you have the biophysics, biomedical engineering and the CBSE that try to vertically integrate computational basic modeling, analysis and experimental studies. This is a very productive and collaborative environment," Bieschke says.



Rohit Pappu

Below: Jan Bieschke (right) works with a student in his lab.



RON KLEIN

Young-Shin Jun

Meeting climate change head on

Written by **BETH MILLER**

Jun
정 | 순

Young
영 | 승

Shin
신 | 심

Korean | Chinese

In Korean culture, one's name is selected very carefully, as each has a special meaning. For Young-Shin Jun, PhD, the meaning behind her name — given to her by her grandfather — has formulated the philosophy she uses in life.

“Jun means complete, Young means forever and Shin means trust,” says Jun, associate professor of energy, environmental & chemical engineering in the School of Engineering & Applied Science. Her grandfather chose the name because a woman named Young-Shin was the first congresswoman in Korea. At the time, there were few women in leadership positions in that country, but Jun's grandfather wanted her to be a leader. And she's taken the name and the charge to heart.

“This is a big name for me, because I think that I should be a person who can trust completely forever,” she says. “I think about my name when I make decisions and ask myself if my decision betrays anyone's trust.”

IN THE LAB

Jun has many decisions to make as she has been adding to her roles in the Department of Energy, Environmental & Chemical Engineering since joining the faculty in 2008. Not only does she teach courses, she is principal investigator of the Environmental NanoChemistry Laboratory, where

she studies three main areas, all related to meeting the world's demands for clean water, air and energy: geologic carbon dioxide sequestration, the process of taking carbon dioxide from the atmosphere or flue gases and storing it deep underground to reduce the impact of burning fossil fuels on climate change; the process of how nanoparticles form and transform in natural and engineered aqueous systems; and managed aquifer recharge, a way to recycle stormwater or treated sewage effluent for non-potable and indirect potable reuse.

Maintaining a sustainable energy-water connection is the world's greatest environmental challenge, she says.

“My contribution to meeting this challenge is to advance our understanding of environmental interfacial reactions by providing *in situ*, real-time quantitative information from our unique experimental approaches,” Jun says.

Her lab is using a novel process to determine whether nanoparticle transformation in wastewater treatment will introduce more adverse effects on the quality of the effluent water from wastewater treatment systems, how these nanoparticles can be removed from the system or how they can be further used to better remove toxic contaminants. Already, her work in this area has provided new information on the

“My research can play a critical role in determining how to upscale environmental chemical systems to make a major impact on clean water and energy availability.”

— YOUNG-SHIN JUN, PHD



RON KLEIN



Take a virtual tour of Jun's lab: youtube.com/WUSTLEngineering



about Young-Shin Jun

Jun's lab bridges engineering and science as well as a variety of cultures and languages. Her graduate students come from the United States, Korea and China.

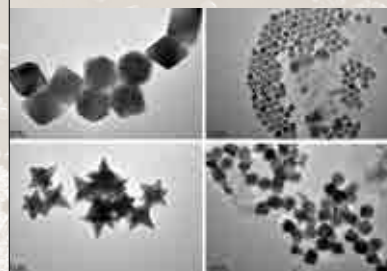
Front row, from left to right: Lijie Zhang, Jessica Ray, Young-Shin Jun, PhD, Xuyang Liu, PhD, Chelsea Neil

Back row, from left to right: Haesung Jung, Doyoon Kim, Yi Yang, PhD, Yujia Min, Qingyun Li



Since Jun spends most of her long workdays thinking about tiny nanoparticles and molecules, when she gets away with her husband, Jihun Ko, she likes to go big. National parks are her favorite places to visit, and she's visited all of them. "While I'm looking at nature, I don't need to think. I can just be there," she says.

Jun's sunny office in Brauer Hall is filled with large potted plants, including a rose bush she bought when she joined the faculty in 2008. She has saved and dried every rose that has blossomed on the plant.



- » More than \$2 million in research funding
- » Number of published articles: 38

» engineering.wustl.edu/faculty/jun

formation of nanoparticles and their reactions in natural and engineered water systems.

"Jun is an excellent colleague and is making contributions both to the scientific community and the department, school and university," says Pratim Biswas, PhD, chair of the Department of Energy, Environmental & Chemical Engineering and the Lucy & Stanley Lopata Professor. "She pursues her research endeavors in environmental nanochemistry with passion."

Jun has added roles in the department outside of research as well. In 2013, she became director of graduate studies for the department, as well as the McDonnell International Scholars Academy Ambassador to Seoul National University in her home city. She is faculty adviser to the university's chapter of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers, and she has been recognized nationally with such prestigious awards as the National Science Foundation CAREER Award in 2011 and the Ralph E. Powe Junior Faculty Enhancement Award in 2008. She is currently on the editorial board of *Environmental Science: Processes & Impacts*.

"As the graduate director of the department, Young-Shin diligently directs the doctoral program consisting of more than 95 students," Biswas says. "She is an excellent mentor to her doctoral students, and her drive, discipline and devotion to research is a great motivation to the students. At this early stage in her career, she has placed one of her PhD graduates as a faculty member."

FINDING HER NICHE

Encouraged by her parents to study hard, Jun knew from a very young age that she wanted to take a different path from her father and other family in business: She wanted to be a professor. In Korean high schools, students choose to study either literature or science, and often girls are steered toward literature.

"I said 'no' to literature," she says, emphatically. "I had good scores, and I wanted to go to engineering school. If someone tells me I can't do something, I'm going to do it."

Jun went to Ewha Womans University in Seoul, the world's largest educational institution

exclusively for women and the starting point for many of Korea's female leaders. The timing couldn't have been better — Ewha launched its engineering program, and Jun is one of the first undergraduate students from Ewha's engineering school. She also earned a master's degree at Ewha.

"It was challenging, but challenge gives us opportunities," she says. "I learn more during challenges than when things run smoothly."

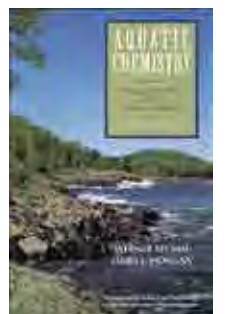
As a child, Jun loved to play in a creek near her home, catching fish and playing in the water. Years later, she returned to the creek to find it filled with waste and devoid of fish.

"That motivated me to do something about it," she says. "In my PhD application, I wrote about it and said I wanted the next generation to be able to play in creeks and touch things the way I did."

While a graduate student, Jun took a water chemistry course, and when she read the textbook, it was love at first sight.

"I love water chemistry, but I wanted to expand it because my ultimate and lifetime goal is to develop water chemistry together with nanochemistry and nanotechnology."

"This book, 'Aquatic Chemistry' by Stumm and Morgan, is the bible for an environmental engineer," she says, while gently holding the book she keeps at an arm's reach in her office. "When I read this book, I realized that I really wanted to do aquatic chemistry. That's the reason I went for my PhD."



Jun chose a doctoral program at Harvard University, coincidentally where the late Werner Stumm, PhD, and James J. Morgan, DSc, started their research lab in the 1960s. Her research adviser, Scot Martin, PhD, the Gordon McKay Professor of Environmental Chemistry, wanted to build up the water chemistry area, and Jun was the perfect person to make that happen.

"I really look hard to find a way I can contribute," she says. "The passion and motivation are the strongest justification of why I'm doing this. If you have passion, it helps to keep you moving forward."

STUDENT ATHLETES

EXCEL ON, OFF THE FIELD

Written by **BETH MILLER**

Students in Washington University's School of Engineering & Applied Science are known for having a rigorous curriculum and for working very hard. But many of these students also make time to play — on one of the university's athletic teams.

Engineering is the most predominant major among the 2013 Washington University football team and the cross-country and track & field teams. And these future engineers aren't simply filling a place on the roster — Engineering students regularly receive national recognition for their athletic and academic accomplishments.

Two Engineering students, Lucy Cheadle, a junior majoring in chemical engineering with minors in environmental engineering and energy engineering, and Anna Etherington, a senior majoring in systems engineering with a minor in operations and supply chain management through the Olin Business School, were selected for the 2013 Capital One Academic All-America Division III Men's and Women's Track & Field/ Cross-country Teams.

In July, both Cheadle and Etherington were named to the fifth annual University Athletic Association (UAA) President's Council Scholar-Athlete Team.

While these student athletes have different majors within Engineering and play different sports, they have a lot in common — determination, outstanding scholarship, a passion for their sports and the ability to manage a difficult curriculum along with practices, games, meets and travel.

Colin Webb, a senior majoring in mechanical engineering, is a captain of the football team and plays the H-back position. During the season, practice is 3.5 hours a day most weekdays, with games and travel on Saturdays. Despite this schedule, Webb also is a co-course director for Engineering 120, Freshman Seminar, with Christopher Coon, another member of the football team. He also is in a fraternity and directs the intramural officials.

"We are strongly encouraged to plan a class schedule and work on things outside of football practice. The coaches understand we came here for the education, and that's our future. They take the stance that education and school always come first."

— Colin Webb

Webb says it's not always easy to manage his course load and football.

"I've gotten good at being organized," he says. "I have a big calendar in my room, and I write everything down so I can stay on top of assignments. It's really about not procrastinating or wasting time and being disciplined. I go to class, go to practice, eat dinner and do homework."

Webb says there are several other mechanical engineering majors on the team, and they all work together. That support system has helped make the often grueling schedule much easier for Webb.



14

hours of practice and team meetings each week with Mondays off



Colin Webb



Anna Etherington

4.05
meters, Etherington's personal best

WUSTL PHOTO

DEVON HILL



21:01

Cheadle's personal best in 6K

"I always say that it's easier for me when I'm doing both. It forces me to manage my time well, be efficient, plan ahead, prioritize sleep and take care of my body, rather than staying up late studying for exams."

— Lucy Cheadle

Lucy Cheadle



WUSTL PHOTO

"From the outside it looks like a lot, but it's routine now," he says. Etherington says managing her course load and pole vaulting takes a lot of "forward thinking." "It's all about time management to a T," she says. "I know that in the fall I'm still busy, because we still have practice, but no competitions, so I take more or harder classes in the fall than I do in the spring," she says. "But in the spring, I know I'm going to have practice every day from 4 to 6 p.m., so I plan my homework schedule around that." Despite staying in the hotel to study when the team travels to meets and not being able to participate in clubs in the spring, Etherington says she's not sacrificing anything. "I just have a different experience," she

says. "All it takes is communication — talk to the professor, and talk to the coach. Anything can be worked out — it just takes communication among everybody." Chris Lowery, who has been playing baseball since he was 9 years old, is now a captain and third baseman on Washington University's baseball team. Because his spring semester is busy with weekday practices and games, he takes 20 credit hours in the fall and 16 in the spring. "I can push myself education-wise in the fall because I only have school," says Lowery, a junior majoring in mechanical engineering. "When the spring comes around, I'm still very swamped, but it's half baseball, half school. Year-round, it's always busy and always demanding, but I'm able to balance it out."

During the baseball season, Lowery has three-hour practices on weekdays, so he begins homework at 7 p.m. On spring weekends, the team has games and often double-headers, and the bus trips to and from games aren't conducive to good study time. "It just takes a lot of planning," he says. "People keep telling me college is all about planning. A sport just multiplies that in infinite. I can't see

Chris Lowery



WUSTL PHOTO

anything else being more demanding than a sport and a Wash U education." Athletes say they aren't getting special treatment from coaches for being engineering majors, either. "The coaches are supportive, but they don't separate engineering from other schools," Lowery says. "They know that Wash U is very demanding and are very understanding. They know we are student athletes first." Because Cheadle competes nearly year-round — cross-country in the fall, then track & field in the winter and spring — she isn't able to load more courses in a semester off from competing as those in other sports do. But that's how she works best, she says.

Why Washington University

Cheadle says she chose Washington University because of the balance between school and running. "I thought Wash U was a happy medium," she says. "I could be a very competitive athlete, but school always came first. Running is important to me, but I'm not going to do it competitively after college. We do it because we really love it and have a passion for the sport."

And that passion goes a long way, says Jeff Stiles, head coach for cross-country and track & field. "Lucy loves to run, and Anna loves to pole vault," he says. "The coaching staff can't take any credit for that. We recognize that they are two elite young women who are brilliant and motivated in the classroom and in track and cross-country. They are fostering the desire to do it, not just for themselves, but for the benefit of the team."

Steve Duncan, head coach of the baseball team, says Lowery is one of the leaders of the team. "Chris is one of my favorite players I've ever coached," Duncan says. "He gets it — he's not only a good student, but a good teammate, is very coachable, has a great sense of humor, works hard, is driven, and if anything, he puts too much pressure on himself. He is a joy to coach and is universally well-liked on the team."

Larry Kindbom, head coach of the football team for 24 years, says Webb is an outstanding example of a scholar athlete.

"Our Engineering students not only thrive academically and athletically, but they can do other things, like community service or serving on advisory committees. This is the type of school that you can be a part of. That's what makes Wash U a special place."

— Jeff Stiles, Cross-country and Track & Field head coach

"Colin represents the guys who have come before him and the guys who will come after him in their ability to excel in the engineering field and to get involved with activities on campus beyond football," Kindbom says. "Colin does all those things and does them well. He is a leader in a school where leaders abound. That's what makes him not just special, but you look at him and say, 'Wow.'"

Stiles says Etherington and Cheadle are the "full package." "They could have gone Division 1, but they chose Division 3 because Wash U is right for them. They love what Wash U has to offer them and wanted to be in this environment."

Washington University caters to students who want to be athletes and engineers, Kindbom says. "I've proctored exams on the road for many years, and many of those were engineering," he says. "That doesn't happen at other schools."

"We have to be flexible," Duncan says. "That's the nature of being a student athlete at Wash U — academics come first," Duncan says. "One of the cool things about Wash U is that there is really no question why these students are here. Baseball is a huge part of the college experience, but it's not their No. 1 focus."

The football program offers an informal mentoring program among its players who are engineering majors beginning their freshman year, Kindbom says. Upperclassmen serve as mentors to new students to help them get adjusted.

"We know that our players are here for their academics, but we also want to play for a national championship," Kindbom says. "We let them know we value their engineering education, and we value that they want to play at a national championship level."



123

Engineering students are currently playing on university athletic teams



2:1

two hours of practice and one hour in the gym for a typical workout

“THE GREATEST PLEASURE OF BEING A VC IS WATCHING PEOPLE YOUNGER, FAR SMARTER AND MORE MOTIVATED THAN ME GROW UP, DEFY THE ODDS AND BUILD LONG-TERM, STAND-ALONE BUSINESSES.”

the man behind the magic

GAURAV GARG

Written by **BETH MILLER**

Every time you wish the Internet were faster or want to save something “in the cloud,” there is a Washington University in St. Louis Engineering alumnus working to make that happen.

Gaurav Garg, who earned bachelor’s degrees in computer science and electrical engineering in 1988 and a master’s degree in electrical engineering in 1990, is the driving force behind early-stage, Silicon Valley startups looking to transform the way we use the cloud, mobile devices and big data.

Garg and business partner Peter Wagner recently launched Wing Ventures, a new venture capital firm designed to build business technology companies. Starting with a \$160 million fund, Wing focuses exclusively on early-stage companies with the potential to define new categories in cloud computing, mobile and big data and to provide entrepreneurs with the financial and strategic backing to build successful companies. Wing plans to invest about \$8 million to \$10 million over the life of each of its portfolio companies.

CHARLES BARRY



GARG HELPED BUILD THESE COMPANIES IN SILICON VALLEY

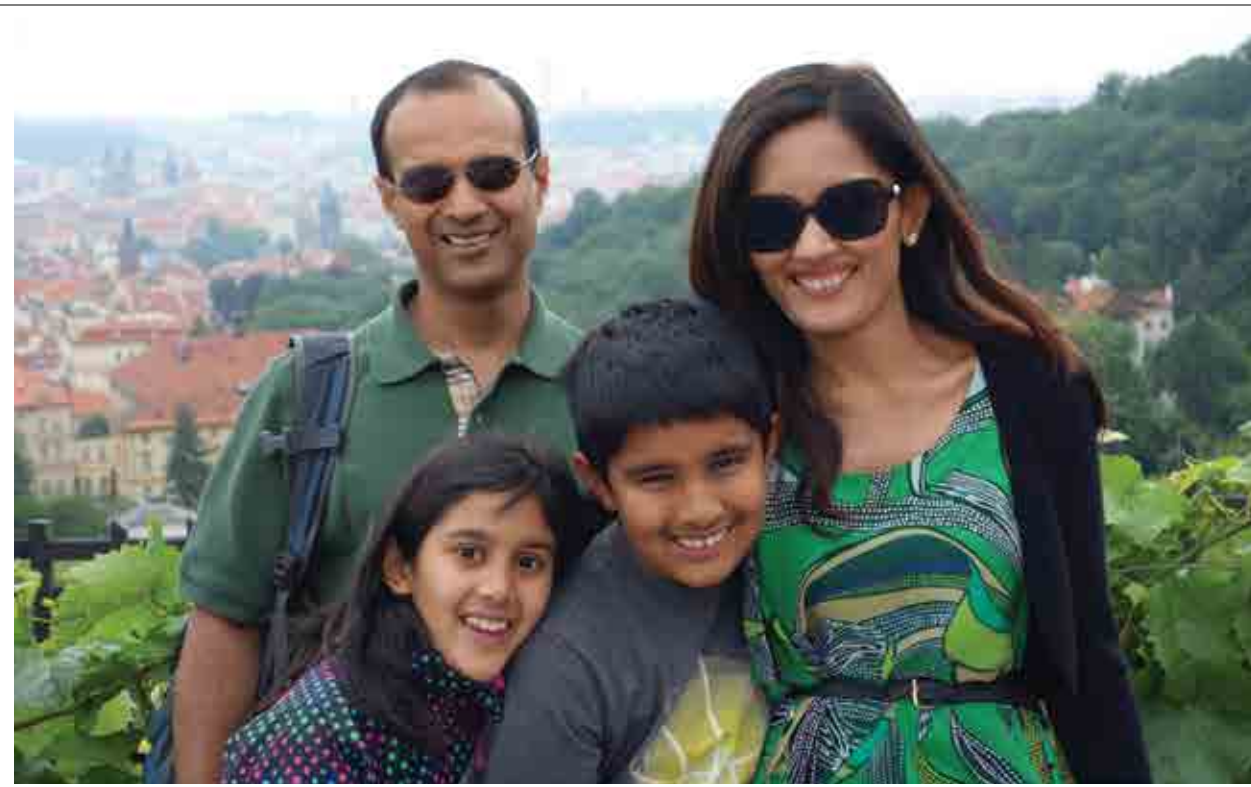
But Garg is doing much more for these companies than writing a check. He is passionate about being a true friend and mentor to the entrepreneurs and sharing first-hand knowledge from his own experience with launching a highly successful technology startup, Redback Networks, in 1996. Redback, which makes edge routing technology to help carriers deliver broadband, telephone, TV and mobility services over Internet-based infrastructures, grew to \$500 million in annual revenue and 1,300 employees in four years from inception. Gaurav was in the trenches, acting as CFO, chief recruiter, customer service, engineering and product management and doing whatever was needed. The company went public in 1999.

By mid-2000, Garg realized that his heart was in building companies from scratch into significant businesses. As a result, in 2001, Garg joined Sequoia Capital, a prominent Silicon Valley venture capital firm and Redback's first investor.

"It was the best place to learn the art and science of venture capital, while doing what I loved — backing seed-stage, early-stage and growth-stage emerging technology companies," he says.

Garg worked with Sequoia for 10 years, investing in and working with startup companies, typically with one or two founders. He helped build multiple successful companies, including Netscaler, which was acquired by Citrix; Aruba Networks; Ruckus Wireless, which went public in November 2012 and has a \$1.5 billion market capitalization, or the total value of the issued shares; FireEye, which went public Sept. 20 and has a \$5 billion market capitalization; RingCentral, which went public Sept. 27, with a market cap of \$1.1 billion. MobileIron, Jasper Wireless and Jawbone are all on a trajectory to go public as well.

Garg's excitement is evident as he recalls when the founder of FireEye, Ashar Aziz, first approached him with an idea. Garg says he was immediately interested, but it took the two of them a few months to create the right presentation for venture capital funders. And the founders of Ruckus Wireless camped out in



When he's not meeting with companies, Garg spends time with his wife, Komal Shah, and two children, ages 9 and 11. Over the summer, the family took a bicycling trip in Europe, riding part of the way from Prague to Vienna. On the way back to California, they stopped in Iceland.

his family room to set up their first Wi-Fi router.

It takes about five to seven years to learn the venture capital business, Garg says, but the business brings big rewards.

"You start out with these foggy, uncertain and impossibly fragile entities with promising ideas and watch them evolve over time," Garg says. "It's the founders who are driven, smart, agile and somewhat fanatical, who persuade all sorts of communities to take chances on them with their careers, money, reputations and time."

It takes a certain type of person to be an entrepreneur or venture capitalist.

"It takes patience and equanimity, and above all, faith in the company," Garg says.

It can take six to nine years of hard work and long hours for the companies in which Garg invests his time, knowledge and money to come to maturity and prepare for an initial public offering.

"I don't think of this as a job," he says. "It's such a privilege to watch these companies grow from two or three people to become what they have, in many cases public companies with revenue of more than half a billion dollars, and work with them over the years. You learn a lot, and it's very humbling."

Washington University was a new

experience for Garg. About six weeks after he started classes as a freshman, he felt exhilaration and panic at the same time. Coming from India, the pace expected of a college student in the United States was a bit of a shock.

"The level of teaching and quality of instruction and professors was off the charts," Garg says. "It was an absolute privilege and totally exhilarating."

Although Garg has three degrees in engineering, he says he also received an excellent education in economics at WUSTL.

"All of the economics classes I took were spectacular because they really opened my world beyond engineering," he says.

"Having breadth of learning today is incredibly useful to me in my job, where you have to look at everything from every angle. I've become better at figuring out first-order issues and variables lurking in the background."

"Working with early-stage companies is not a great business model," Garg says. "There are easier ways to make money. All of us in the early-stage venture business do this because we enjoy it and love our craft."

"MY ENGINEERING BACKGROUND TAUGHT ME TO THINK IN AN ORGANIZED WAY AND TO RELATE TO TECHNICAL PROBLEMS."



alumni achievement award recipients 2013

>> Watch a short video of each awardee: engineering.wustl.edu/alumniawards



Dr. T. Alan Hurwitz



The Honorable Zachary Lemnios



Mr. James V. Leonard



Dr. W. E. Moerner



Captain Joel Groves



Dr. Frank Yin

ALUMNI ACHIEVEMENT AWARD

Dr. T. Alan Hurwitz

As president of Gallaudet University in Washington, D.C., T. Alan Hurwitz is at the forefront of higher education for the deaf in the United States. Hurwitz's leadership in the education of the deaf, specifically in higher education, and in advocating for the rights of deaf individuals throughout the nation and the world has elevated the deaf community and society.

Hurwitz spent 40 years at the National Technical Institute for the Deaf (NTID) at the Rochester Institute of Technology. Hurwitz began at NTID as an educational specialist and held a variety of management positions, including president and chief executive officer. At the same time, he earned a doctorate in education from the University of Rochester. Since January 2010, Hurwitz has led a 1,600-student population at Gallaudet University, the world's only liberal arts university, where programs are designed to accommodate students who are deaf or hard of hearing. To many of these students, Hurwitz is a role model.

The Honorable Zachary Lemnios

Zachary Lemnios earned a master's degree in electrical engineering from Washington University in St. Louis in 1979 and is an internationally recognized leader in advanced technologies for national security.

He recently took the helm as vice president for research strategy at IBM, where he is responsible for outlining the research strategy across IBM's 12 global labs, transitioning innovative research concepts to products and leading the IBM Global Technology Outlook.

Previously, Lemnios served three terms in the U.S. Department of Defense. He was confirmed as the Honorable Assistant Secretary of Defense (Research & Engineering) by the U.S. Senate. In this position, Lemnios was the chief technology officer for the Department of Defense and shaped the department's

technical strategy to support the President's national security objectives and the Secretary's priorities. He launched a variety of department and international initiatives, including large data analytics, decision support, engineering education and electronic warfare concepts as future capabilities for the nation.

Mr. James V. Leonard

In September 2012, James V. Leonard, senior technical fellow at Boeing Defense Space & Security, celebrated 50 years with the company. Over the course of his career, he opened the door to integrating the Harpoon missile on the F-16 fighter by developing the Harpoon University Launch Adapter Unit. He also designed and patented new technology that has kept the Harpoon relevant and ready for the warfighter.

Leonard is widely respected in the aerospace electronics industry as an expert in aircraft weapons systems integration in military aircraft. He is one of only 62 technical leaders at Boeing out of 59,000 scientists and engineers. His contributions in the field of weapon systems integration have had a significant technological and economic impact in the military weapons industry and have played a vital role in national security.

Dr. W. E. Moerner

W. E. Moerner, PhD, is chair of the Department of Chemistry at Stanford University, where he also is the Harry S. Mosher Professor in Chemistry and Professor, by courtesy, of Applied Physics. His research focuses on physical chemistry, chemical physics, single-molecule biophysics, super-resolution imaging and nanoparticle trapping.

Moerner created a new field of science — single-molecule spectroscopy and imaging — by being the first to perform optical detection and spectroscopy of a single molecule in condensed matter in 1989. This discovery is widely seen as one of the most important developments in biophysical chemistry, physical/analytical chemistry and chemical physics on the nanoscopic scale during the past two decades.

The ability to optically observe individual nanometer-sized molecules is now having a broad interdisciplinary impact, from biophysical and cellular studies of proteins, enzymes, DNA and RNA, to physical/analytical chemistry of rare analytes, to spectroscopy of defects in solids, to materials science of amorphous materials and to single-photon sources of quantum mechanical light.

YOUNG ALUMNI AWARD

Captain Joel Groves

U.S. Army Captain Joel Groves has boldly represented his country in three tours of Afghanistan and Iraq since earning a bachelor's degree in mechanical engineering in 2006 on a four-year Army ROTC scholarship.

As a lieutenant, Groves attended U.S. Army Ranger School, won the 2008 Best Sapper Competition and deployed to Iraq to lead a Route Clearance Platoon. His team proved to be the best in Iraq, finding more improvised explosive devices (IEDs) than any other unit in 2009. As a result, Groves was selected among candidates nationwide to receive the U.S. Army Forces Command 2009 Outstanding Engineer Platoon Leader Award.

DEAN'S AWARD

Dr. Frank Yin

Frank Yin, MD, PhD, is past chair of the Department of Biomedical Engineering at Washington University in St. Louis. Although he stepped down as chair in June, he will remain the Stephen F. & Camilla T. Brauer Distinguished Professor of Biomedical Engineering.

Yin came to Washington University in St. Louis from the Johns Hopkins University School of Medicine in 1997 to lead the budding biomedical engineering department. During his 15-plus-year tenure, he handpicked 18 of the now 20 world-class faculty members who make up the department, which has become one of the fastest-growing and most successful departments at the university.

Carter heads international education & research in Engineering

Dedric A. Carter, PhD, has been named associate dean for international education & research and professor of the practice in the School of Engineering & Applied Science at Washington University.



In the newly created role, Carter is ambassador-at-large for the McDonnell International Scholars Academy and is developing international research partnerships with McDonnell Academy partners; developing graduate, professional certificate and summer programs for international students; and working with corporate partners to provide undergraduate and graduate practice opportunities abroad. He also provides support for entrepreneurship programs in the school, and as professor of the practice, teaches a course emphasizing the role of scientists and engineers in policy formation.

Carter joined Engineering July 1 from the National Science Foundation (NSF), where he was a senior adviser to the director for strategic initiatives. In this role, he was a co-creator and a senior leader of the NSF Innovation Corps (I-Corps), a program that prepares scientists and engineers to extend their focus beyond the laboratory to broaden the impact of select NSF-funded research.

Engineering students get summer lessons outside the classroom

School of Engineering undergraduate students spent their summers continuing to learn about engineering, though outside of the traditional classroom.

Victor Irony, Jake Lyonfields, Emily Storey and Anshu Tirumali worked as interns in Facilities Engineering at the School of Medicine to further the university's goal of becoming more sustainable and reducing energy use in the school's many research labs.

The four interns went to research labs at the medical school to collect information about equipment and to record model and serial numbers, amperage, wattage and other information. They created a database for the information they gathered to see how many pieces of each type of equipment exist and to calculate the energy used. In total, they counted and took data from 2,300 pieces of lab equipment. The team looked at electricity costs, operations and maintenance, initial costs and how they all worked together to see which were the best.

Seeing it in practice

Students in the School of Engineering & Applied Science learn more than how to be an engineer: They also learn to be leaders in a global society.

Sixteen WUSTL students went to Brisbane, Australia, for the International Experience program. The International



Left: Students working in the School of Medicine; Below: Students in Brisbane, Australia



Experience visits a different country each summer, in collaboration with McDonnell Global Energy and Environment Partnership partner universities, providing students with opportunities to learn how other countries handle energy and environmental challenges. The trip included lectures at the University of Queensland and visits to area labs.

In late May, Frank Yin, MD, PhD, professor of biomedical engineering, took a group of five rising seniors majoring in biomedical engineering on a two-week trip to Hong Kong and China to fit and make custom orthotics for young children with cerebral palsy in rural China.

» engineering.wustl.edu/summer2013

WU racing reaches goals at Michigan competition

The 22-member team placed 43rd overall out of 120 teams that entered the competition, held in May at the Michigan International Speedway. It also placed 15th overall for the car's fuel economy.

» engineering.wustl.edu/TBD



From left: Nick DiVincenzo, Sarah Jeu, Jeremy Veis, Michelle Lee, Nick Reim

ENCOUNCIL 100th ANNIVERSARY

PHOTOS BY RAY MARKLIN



Joy and Glen Stuckel



Kevin Cheung, Pratik Sachdeva, Tylon Wong

The EnCouncil, a student organization focused on representing the student body to the administration and bringing students together through social events, marked its 100th anniversary Sept. 20-21 at Washington University in St. Louis. Alumni, faculty and current students celebrated the anniversary through a variety of events, including a happy hour, St. Louis Blues hockey game, brunch, a State of the School presentation and an anniversary banquet. View more photos: facebook.com/WUSTLEngineering



Gage Crawford, Megan Tetlow, Tilo Buerger



The Osgood Family



Rafael Ribeiro Martins, Cassia Ortolani

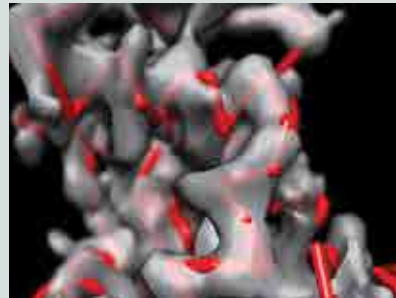


Cindy Pellisser, Ed Snyder



Frank and Cindy Radetic

Ju to study shape analysis with NSF grant



Tao Ju, PhD, associate professor of computer science & engineering, has received a three-year, \$242,020 grant from the National Science Foundation. With the funding, Ju and his collaborators seek to develop mathematical foundations and computational algorithms for a new class of shape descriptors. These descriptors will be able to characterize higher-level shape information than those currently studied and will assist in applications, including shape segmentation, model retrieval and analysis of biomedical images. In addition, the team will develop and distribute online software that implements the new algorithms.

» engineering.wustl.edu/shapeanalysis

Wang, Anastasio to adapt imaging technology for lab use with NIH grant



Sophisticated imaging techniques such as CT scans and MRIs help doctors spot a host of medical problems, ranging from cancer to torn ligaments. Although miniaturized systems based on these

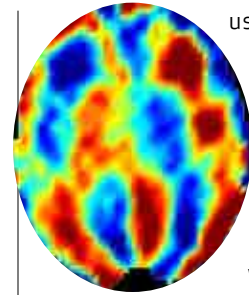
methods exist for the laboratory bench, they're not sensitive enough to give both an image of living tissue and reveal what's going on in living tissue. Engineers Lihong Wang, PhD, the Gene K. Beare Distinguished Professor of Biomedical Engineering, and Mark Anastasio, PhD, professor and interim chair of Biomedical Engineering, intend to meet those challenges by adapting a unique imaging technology their team is developing.

Wang and Anastasio recently received a four-year award from the National Institutes of Health for nearly \$2.5 million to modify a high-speed imaging method called photoacoustic computed tomography, or PACT, for use in research studies. The team will enhance PACT technology by combining laser light and sound waves. Light alone can detect structures in living tissue. But imaging methods using light alone can lose sensitivity. Adding sound waves tells researchers what's happening in whole animals in real time.

» engineering.wustl.edu/labimaging

Bayly to study biomechanics with two NSF grants

Philip Bayly, PhD, the Lilyan and E. Lisle Hughes Professor of Mechanical Engineering and chair of the Department of Mechanical Engineering & Materials Science, has received a three-year, \$429,222 grant from the National Science Foundation to study directionally dependent mechanical properties in muscle, white matter in the brain or artificial tissue. In the brain, white matter holds the nerve fibers that wire cells together. Fibers in tissue also determine mechanical stiffness and strength and influence in which direction waves travel during motion. But these fibers also make it difficult to measure the properties without taking invasive measures. Bayly and colleagues plan to



use magnetic resonance elastography (MRE), a non-invasive technique, to view and measure different properties of waves when they travel in different directions in the fibrous materials.

Bayly also received a three-year, \$395,000 grant from the NSF to measure the mechanical properties and processes that lead to motion in the cilia and flagella. The team will measure the mechanics in genetically modified flagella in algae that are close in structure and behavior to human cilia. Their findings could lend new insight into how cilia fail in disease and ultimately to new diagnostic tools or therapy.

» engineering.wustl.edu/biomechanics

Iron uptake by plants focus of I-CARES grant

Both humans and plants need iron in their diets, or else they get sick and don't grow. Humans can eat iron-rich foods or take a supplement, but for plants, the process is more complicated, as iron in the soil has to be dissolved before the plant can absorb it.

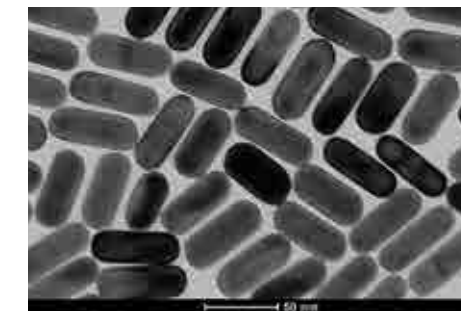
With a one-year grant from Washington University's International Center for Advanced Renewable Energy & Sustainability (I-CARES), Daniel E. Giammar, PhD, the Harold D. Jolley Associate Professor of environmental & chemical engineering, plans to use some high-tech methods to better understand the processes, mechanics and interfaces that plants use to move iron from the soil, through water and into the plant.



The team will use a technique called scanning transmission X-ray microscopy (STXM), which uses a high-powered X-ray beam focused to about 30 nanometers, providing researchers with nanoscale maps of the elements and their oxidation states.

» engineering.wustl.edu/iron

Shining a little light changes metal into semiconductor



By blending their expertise, two materials science engineers changed the electronic properties of a new class of materials — just by exposing it to light.

With funding from I-CARES, Parag Banerjee, PhD, and Srikanth Singamaneni, PhD, and both assistant professors of materials science, brought together their respective areas of research. Singamaneni's area of expertise is in making tiny, pebble-like nanoparticles, particularly gold nanorods. Banerjee's area of expertise is making thin films. They wanted to see how the properties of both materials would change when combined.

The research was published online in August in *ACS Applied Materials & Interfaces*.

The research team took the gold nanorods and put a very thin blanket of zinc oxide on top. When they turned on light, they noticed that the composite had changed from one with metallic properties into a semiconductor, a material that partly conducts current.

» engineering.wustl.edu/semiconductor

Moon receives Grand Challenges Explorations Grant from Gates Foundation



TAE SEOK MOON

Tae Seok Moon, PhD, assistant professor of energy, environmental & chemical engineering, will pursue an innovative global health and development research project to address parasite infection in people in developing countries.

While there are drugs to help kill parasite worms and eggs in the body, there is no long-term strategy to prevent disease transmission. Moon has proposed to engineer probiotic bacteria that would be added to donated foods, then reproduce in the intestine, where parasite eggs are produced, and come out of the body with the eggs in waste.

Grand Challenges Explorations (GCE) funds ideas that can break the mold in how to solve persistent global health and development challenges. Moon's project is one of the Grand Challenges Explorations Round 10 grants from the Bill & Melinda Gates Foundation.

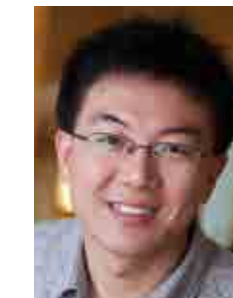
NIH awards Wang Transformative Research Award



LIHONG WANG

Lihong Wang, the Gene K. Beare Distinguished Professor of Biomedical Engineering at the School of Engineering & Applied Science, has received a 2013 Transformative Research Award from the National Institutes of Health (NIH). He was one of only 10 recipients of the award, given to scientists proposing highly innovative approaches to major contemporary challenges in biomedical research. The award promotes interdisciplinary approaches by investigators who propose research that has the potential to create or overturn fundamental paradigms.

Zhang receives prestigious DARPA Young Faculty Award



FUZHONG ZHANG

Fuzhong Zhang, PhD, has been working to find alternative solutions to replace petroleum. Now, he has received an \$860,000 award to use common bacteria to make gasoline and other chemicals derived from petroleum.

Zhang, assistant professor of energy, environmental & chemical engineering, has received a Young Faculty Award from the Defense Advanced Research Project Agency (DARPA) of the U.S. Department of Defense. He is the first faculty member at Washington University in St. Louis to receive the award, which recognizes an elite group of scientists early in their careers at research universities.

Zhang's award funds up to three years of research on his plan to engineer bacteria to produce nonnatural fatty acids, which can be easily converted to advanced biofuels and chemicals that could reduce demand on the world's petroleum supply.

Four new faculty join the School of Engineering & Applied Science

Computer Science & Engineering welcomed two new faculty members and a department chair, and Mechanical Engineering & Materials Science welcomed one new faculty member.



ROCH GUÉRIN

Roch Guérin, PhD, joined Engineering as professor and chair of Computer Science & Engineering. Guérin was previously the Alfred Fitler Moore Professor of Telecommunications Networks and professor of electrical and systems engineering and computer and information science at the University of Pennsylvania. He was installed as the Harold B. and Adelaide G. Welge Professor of Computer Science Oct. 8.



SANMAY DAS

Sanmay Das, PhD, joins the School of Engineering & Applied Science from Virginia Polytechnic Institute and State University (Virginia Tech), where he was associate professor of computer science. His research interests are in artificial intelligence, specifically in computational social science and machine learning. He received a National Science

Foundation CAREER award in 2010 and also has received research funding from the U.S.-Israel Binational Science Foundation and the Intelligence Advanced Research Projects Activity (IARPA). He has served in various roles with computer science organizations and at conferences in artificial intelligence and machine learning.

Das earned a master's and a doctorate in computer science from the Massachusetts Institute of Technology and a bachelor's degree from Harvard College. He conducted postdoctoral research at the University of California, San Diego, before joining the faculty at Rensselaer Polytechnic Institute as an assistant professor in computer science with a courtesy appointment in the Lally School of Management.

Yasutaka Furukawa, PhD, joins the faculty from Google Inc., where he was a software engineer and researched automated 3-D reconstruction and visualization techniques from images.



YASUTAKA FURUKAWA

His multiview stereo (MVS) algorithm has been recognized as the best 3-D reconstruction algorithm from calibrated photographs based on an evaluation conducted by Computer Vision researchers. The software has been used in numerous academic and industrial settings, including several visual effect companies for real film-production purposes, as well as at Google. Most recently, he developed and deployed state-of-the-art computer vision and graphics techniques into real products at Google. He also is a pioneer in the automated 3-D reconstruction and visualization techniques for indoor scenes.

Before joining Google, Furukawa was a research associate at the University of Washington. He earned a doctorate from the University of Illinois at Urbana-Champaign and a bachelor's degree from the University of Tokyo.



JESSICA WAGENSEIL

Alumna Jessica Wagenseil, DSc, joins Mechanical Engineering & Materials Science as an associate professor. Wagenseil studies cardiovascular mechanics, specifically cardiovascular development, extracellular matrix proteins and microstructurally based constitutive modeling. Her work is important for testing clinical interventions for elastin-related diseases and for designing better protocols for building tissue-engineered blood vessels.

She completed a postdoctoral fellowship in cell biology and physiology with Robert Mecham, PhD, at Washington University School of Medicine. She earned a doctorate in biomedical engineering at Washington University and a bachelor's degree in bioengineering from the University of California, San Diego. Wagenseil joins Engineering from a faculty appointment in biomedical engineering at Saint Louis University.

THE LAST WORD:

Cybersecurity

Mobile and Internet technology has become an integral part of our daily lives, and most of us don't think twice about sending information via smartphones while out in public.

But each year, about 431 million adults worldwide are victims of cybercrime, costing \$388 billion based on time and monetary loss. Each of us has a part to play in cybersecurity, from smartphone users to software developers to law enforcement.

Washington University in St. Louis is responding to the ever-increasing threats to information and cybersecurity as well as the growing need for trained professionals in the field.

In October, National Cyber Security Awareness Month, the Professional Education program in the Henry Edwin Sever Institute in the School of Engineering & Applied Science hosted a panel of faculty experts representing Engineering, Law and Business on privacy in cybersecurity, social media and big data.

In addition, the university hosted a threat-modeling workshop in September for information security officers from Monsanto Co., Wells Fargo Advisors, Scottrade, Ameren Corp., Enterprise Bank, Emerson and other leading area corporations offering hands-on experience in the best practices of countering threats to sensitive corporate information. Those who attended had the opportunity to take part in a model of an information security threat and learn from each other to be better prepared for the emerging threats security professionals face daily.

This fall, the Sever Institute, partnering with the Olin Business School, launched a master's degree in cyber security management program designed to provide area professionals and full-time students with the skills needed to prepare for and stop cyber attacks in their workplace. The master's degree is the only one in the St. Louis area and one of only a few such graduate programs in the country. The goal is to educate and train an effective pipeline of future professionals in the field.

For more information, visit sever.wustl.edu/cybersecurity

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UMSL/WUSTL JOINT ENGINEERING PROGRAM 20th CELEBRATION
This year marks 20 years of the Joint Undergraduate Engineering Program offered between the University of Missouri–St. Louis and Washington University. From left: Joseph O’Sullivan, dean of UMSL/WUSTL Joint Undergraduate Engineering Program, WUSTL Chancellor Mark Wrighton, UMSL Chancellor Emeritus Blanche Touhill, WUSTL Emeritus Chancellor William Danforth and UMSL Chancellor Tom George.

RAY MARKLIN

#wustlengineers:

