ENGINEERING Momentum

Across Disciplines. Across the World® // FALL 2014

How does climate change impact you?

Washington University in St. Louis

In this issue //

FALL 2014

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Engineering Momentum is published by the School of Engineering & Applied Science at Washington University in St. Louis. Unless otherwise noted, articles may be reprinted without permission with appropriate credit to the publication, school and university.

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Dear friends,

When I started my tenure as dean nearly five years ago, I wanted to enhance interdisciplinary activity throughout the school and build on the premise of converging disciplines, which is the principal theme of our strategic plan. I am proud of the numerous faculty who engage in such efforts, including a campus-wide initiative on climate change that follows in this magazine. The interdisciplinary partnerships described throughout this edition are essential to find solutions for today's complex and difficult problems.

I believe converging disciplines is a factor in why we have record student and faculty numbers — quantitatively and qualitatively — and why they attain significant visibility in their research, creativity and entrepreneurism. Their energy and interactive nature have no boundaries, and as a result, they are serving society in novel and innovative ways. Our alumni continue to be a source of inspiration for us all, too. This edition includes a story about the family of Langsdorf Scholars who are an impressive example of more than 500 alumni who have reached great achievements and success and are models for current students as they give back to Washington University through time and financial support.

In an extraordinary decision to give back, one alumni couple recently made a generous $10.2 million planned gift — the largest non-facilities gift in the school's history — to ensure future students have even more opportunities for an outstanding engineering education.

We deeply appreciate this anonymous planned gift and its inspiration to others as they consider support for *Leading Together: The Campaign for Washington University.*

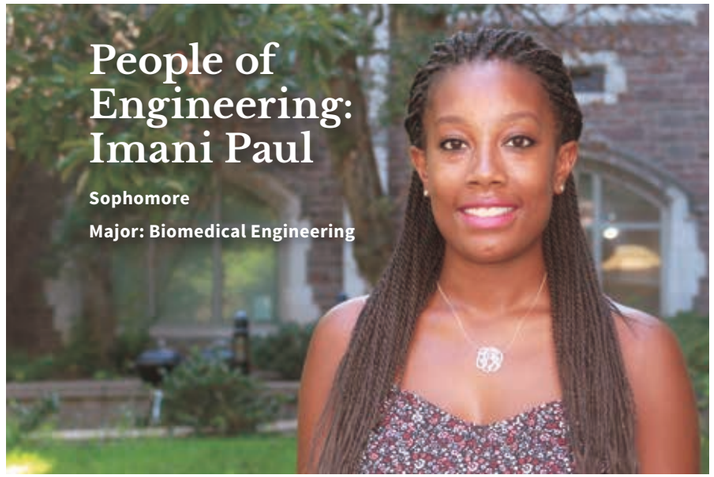
Finally, I want to thank my team in the Dean's Office and all other staff for their dedication and commitment to excellence, as they are a major part of the school's success during the past five years. Although I decided not to continue as dean after June 30, 2015, I am working hard to achieve my final goals so that the school is in an even better position for the next dean. I will be forever grateful for the support and commitment of the university's administration; the school's faculty, staff, parents and students; the alumni, and the countless others who are part of our school's family. I am not leaving Washington University, so I look forward to many more years with you.

Sincerely,

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

SOCIAL MEDIA BUZZ

#wustlengineers

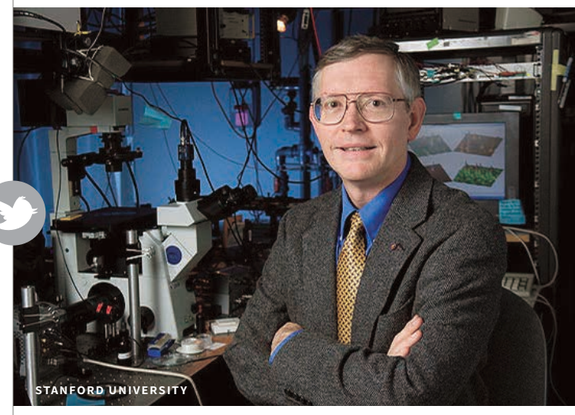


Q. What would you say to someone who might be interested in doing an internship next year?

A. What I found really helpful was leveraging our alumni network. That's actually how I got this internship. I emailed a few alumni from the school. You can narrow it down by field, so I narrowed it down by biology and by city. I knew I wanted to stay at home and to do something in the city. I found two or three alumni, and I emailed them, asking them if they had any positions or knew of any to please let me know. One alumnus worked in that lab at Sloan Kettering, and he forwarded my résumé to them, and asked them to call me. I had a phone interview a week later, and a week or two after that, I was notified that I had the internship for the summer.

Orientation Instagram Winner

#wustleng18 WE ARE ENGINEERS!!!



Electrical engineering alumnus and Langsdorf Scholar W. E. Moerner, PhD, was one of three scientists to receive the 2014 Nobel Prize in Chemistry. Read more about Moerner on page 22.

A Day at Ballpark Village

Engineering alumni event
Sunday, Aug. 17


Gini and Hank Schreimann


Floyd and Ramona Williams


Jennifer and Lance Finney

When Ralph S. Quatrano, PhD, steps down as dean June 30, 2015, after five years of leadership, he will be remembered not only for his tremendous success and accomplishments, but also for his congeniality that won the admiration of faculty, staff and students.

2010-2015

JOB WELL DONE

Written by **BETH MILLER**

As dean, Quatrano has designed and is implementing the school's ambitious strategic plan, which focuses on creating interdisciplinary collaboration across departments and schools and with other institutions, growing the faculty and student populations, completing the new engineering complex and developing academic programs to prepare engineers for leadership in the 21st century. He is only the 11th dean of the school since 1870.

"Under Ralph's leadership, the School of Engineering & Applied Science has experienced great success in a number of important areas, including faculty recruitment and sponsored research activities," Chancellor Mark Wrighton says.

While his hard work has resulted in a very positive outcome, Quatrano says it wasn't always easy.

"My first experience as a dean was as interim dean of Arts & Sciences; that experience gave me my first insight into university administration and finances, which I avoided for 38 years," he says, laughing. "But in Engineering, it was clear that every time I looked at something in detail, it needed close attention. The first year was not only correcting and fully understanding what needed to be done, but also assuring the alumni that we do have a strategic plan, we are moving ahead, there is a bright future for Engineering, that we would be hiring faculty and increasing our student population."

Quatrano has hired one-third of the current 91 tenured and tenure-track faculty, including two of the five department chairs, and has built a sustainable research infrastructure across all levels of the faculty that has enabled research programs to expand and succeed in each of the departments. During the past year alone, research awards increased by more than 25 percent.

"Ralph took over at a difficult time for the school, breathed new life into it, has led the school back on track and has done a wonderful job," says Stephen F. Brauer, chairman of Hunter Engineering Co. and of the School of Engineering & Applied Science National Council. "He took a very methodical approach to all the difficult issues the school faced and took them all on and has the school on an even keel now and an upward trajectory."

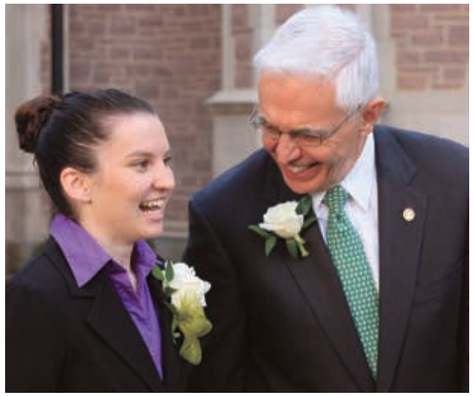
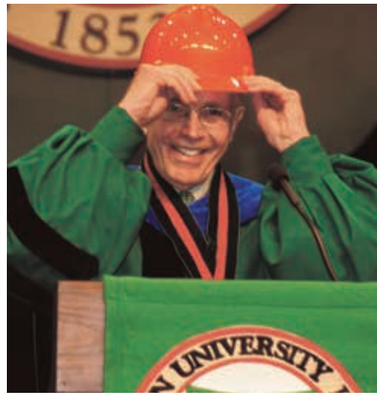
Quatrano came to Washington University in 1998 to assume the chair of one of the nation's most highly regarded biology departments, where 11 of those that were hired when he was chair are now tenured. In addition to serving as chair, he was director from 2005-2007 of the Division of Biology and Biomedical Sciences, a university-wide consortium including medical, engineering and arts & sciences programs. He will continue as the Spencer T. Olin Professor in Arts & Sciences.

WASH U PHOTO

"Under Ralph's leadership, the School of Engineering & Applied Science has laid out an innovative and far-reaching plan for the school's expansion, which includes development in the near future of Jubel Hall. I have no doubt that history will show that the last four and a half years have been an era of strategic and thoughtful growth."

— CHANCELLOR MARK WRIGHTON, PHD



Recognizing the university's priority for a diverse faculty, Quatrano has increased the number of women faculty by 40 percent and hired African-American and Hispanic faculty members.

"He reinvigorated the faculty, added new faculty, enlarged the student body, and welded a disparate group of individuals into a smoothly functioning, welcoming environment with purpose and enthusiasm for the future of the school and the future of engineering as a discipline."

— KATHERINE DAY, CHIEF ADMINISTRATOR AT THE MINDLIN FOUNDATION

In addition to more than 20 young faculty members recruited to the school, Quatrano was also instrumental in recruiting senior faculty, including Kathy Flores, PhD, professor and associate chair for materials science; Roch Guerin, PhD, chair of the Department of Computer Science & Engineering and the Harold B. and Adelaide G. Welge Professor of Computer Science; Steven George, PhD, chair of the Department of Biomedical Engineering and the Elvera & William Stuckenberg Professor of Technology & Human Affairs; and Shantanu Chakrabartty, PhD, professor of computer science & engineering; as well as associate professors Jessica Wagenseil, PhD, in mechanical engineering & materials science, and Sanmay Das, PhD, in computer science & engineering.

Under his leadership, student enrollment has increased more than 20 percent to 2,257 this semester, creating the school's largest-ever undergraduate and graduate classes. He also rejuvenated the Dual Degree Program, which is at its highest enrollment in 20 years. The school is ranked No. 7 for undergraduate student selectivity.

Among other highlights of his tenure, Quatrano has helped build and expand graduate education, including professional master's programs such as the master of cyber security management in collaboration with the Olin Business School and an interdisciplinary doctoral program in materials science and engineering in collaboration with the Graduate School of Arts & Sciences. Under his leadership, 13 new undergraduate and graduate academic programs have been developed.

Top row, from left: Ralph Quatrano, PhD, with Steven Chu, PhD, former Secretary of the U.S. Department of Energy and former Provost Ed Macias; Stephen F. and Camilla T. Brauer, Quatrano, Chancellor Mark S. Wrighton; U.S. Sen. Claire McCaskill, Quatrano; alumna Dani Hoover, Quatrano; Quatrano at Commencement; Bottom row, from left: Quatrano, Blanche M. Touhill, chancellor emeritus of University of Missouri–St. Louis; the Langsdorf Scholars with Quatrano and Lee Anne Quatrano; Tony Thompson, chairman and CEO of Kwame Building Group, Wrighton, Elizabeth Mohr, Pratim Biswas PhD, chair of Energy, Enivornmental & Chemical Engineering, Steve Hoffner, associate vice chancellor for operations, Nick Stoff, director of parking & transportation services, Quatrano; Quatrano with families during the Langsdorf Welcome Dinner

To promote the application of new discoveries by enhancing the culture of entrepreneurism, Quatrano created the Discovery Competition, an annual competition that gives undergraduate students the opportunity to develop solutions for real-world problems and to compete for $25,000 to help turn their ideas into businesses.

"Ralph has been an inspiring leader and colleague," says Mahendra R. Gupta, PhD, dean of the Olin Business School and the Geraldine J. and Robert L. Virgil Professor of Accounting and Management. "His willingness to work across disciplines and encourage students and faculty to do the same has led to new collaboration between the engineering and business schools. From dual degree programs to successful startups, Ralph has opened doors — and minds — to the importance of teamwork. We have all benefited from his leadership."

Engineering's facilities have expanded under his tenure as well. Preston M. Green Hall, the third building of the new engineering complex on the east end of the Danforth Campus, was completed in 2010, and plans are underway for the fourth building in the complex, to be named Henry A. & Elvira H. Jubel Hall, which will house Mechanical Engineering & Materials Science.

Also during Quatrano's time as dean, nearly $60 million has been raised as part of *Leading Together: The Campaign for Washington University.*

"None — and I emphasize none — of this would have been possible without the academic and financial support of university administration," Quatrano says. "It was their vision as well to build an Engineering school which, in their minds, was just as essential for the future of the university as it was in my mind. It was an across-the-board commitment of the Board of Trustees, the Engineering National Council and higher administration to build the Engineering school, and I valued that very, very much."

That hard work solving problems and devising ways to improve is something he'll remember of his time as dean, as well as of the environment and energy level he helped to create in the school.

"I'm proud of the positive outlook that the school, the alumni and the administration have despite the continuing challenges, and the feeling by the faculty and the school that they want to and will succeed in building a better Engineering school and having the will to make that happen," he says. ◆



How does climate change impact you?

Climate change — two words that stir up passion on either side of the issue among scientists, politicians and the common man. But what does it really mean? Climate change is the theory that man's contributions to the environment are leading to more extreme temperatures and weather conditions that have resulted in the melting of polar ice caps, the current drought in California and detrimental effects on the health and well-being of humans, animals and plants.

At Washington University in St. Louis, researchers in all seven schools are studying climate science from myriad perspectives, from medicine to anthropology to business, not just in Engineering. As leaders in their fields, they see how climate change is impacting the parts of the world they study so closely. Here, we present those perspectives in the faculty members' own words to allow readers to consider these viewpoints when thinking about climate change.

Photos by **WHITNEY CURTIS**

Left to right:
T.R. Kidder, PhD
Maxine Lipeles, JD
Anjan Thakor, PhD

ANJAN THAKOR, PhD

John E. Simon Professor of Finance

Olin Business School

While the vast majority of experts seem to agree that global warming is occurring, there seems to be some disagreement over the causes. Is this a man-made phenomenon or is it attributable to solar activity? This question is important because it influences the potential remedies we might adopt to deal with the issue. As an economist, that question is less interesting than how global warming, assuming it is part of a sustained trend, will affect the global economy. I will identify a few areas in which we are likely to see changes.

Farming: Global warming leads to more extreme weather patterns, which makes traditional farming more challenging. This will accelerate the development of alternative farming technologies as scalable choices for farmers. Food will become more expensive, but prices will stabilize over time, and we will consume more organically grown food that has travelled shorter distances to reach us.

Drinking water: Although a large fraction of this planet is covered by water, only a small percentage is available as fresh drinking water. Extreme weather patterns associated with global warming lead to more frequent droughts and floods, exacerbating drinking water shortages. Traditional farming consumes huge quantities of fresh water. We will see the development and commercialization of new technologies that not only promote vertical farming and water conservation, but that also extract fresh potable water from human waste, using other byproducts for fertilizer.

Growth of securitization in financial markets: Many of these new technologies and firms will be financed in the capital market through innovative securitization techniques that will permit individual and institutional investors to invest in companies that are commercializing these new technologies and will enable these companies to raise financing from the capital market. Consequently, the capital market will experience rapid growth.

Thus, while it is common to view global warming as a threat, it will also prove to be an opportunity. It will lead to an explosion of new technologies, change the way we farm and eat, and lead to the emergence of many innovative financial instruments that will provide a plethora of new investment opportunities and hedging/risk management opportunities for farmers and firms.

MAXINE LIPELES, JD

Co-Director, Interdisciplinary Environmental Clinic and Senior Lecturer

School of Law

Based in Washington University's School of Law, the Interdisciplinary Environmental Clinic has a dual mission of providing pro bono legal and technical assistance to non-profit organizations and offering hands-on educational opportunities to students. Each semester, students in law, engineering, environmental studies, medicine, public health and other programs participate in the clinic for academic credit.

The clinic handles matters involving air and water pollution, land disposal and contamination, energy and sustainable development. It assists clients in a wide variety of contexts, including participating in the development of new and amended regulations and legislation, assisting with shareholder advocacy and resolutions and strategic planning. In the process, the clinic is training the next generation of environmental professionals.

Several of our cases on behalf of a variety of clients involve the coal plants that ring the St. Louis metropolitan area. Those cases focus on ensuring that the plants comply with all applicable requirements governing their air and water pollution and waste products. Other cases involve air pollution generated by large Metro East facilities, upgrading Missouri's water quality standards and protection of wetlands and floodplains.

Many clinic alumni credit it with helping them to launch a variety of careers as environmental and energy professionals, including at the U.S. Environmental Protection Agency, the U.S. Department of Justice, the National Renewable Energy Laboratory and renewable energy companies, among others.

T.R. KIDDER, PhD

Edward S. and Tedi Macias Professor and Chair, Department of Anthropology, and Professor of Environmental Studies

Arts & Sciences

A pressing question in climate change research involves understanding how human societies respond to and adapt to changing climatic conditions and their consequences. One way to better appreciate the possibilities of human responses to climate change is to explore and understand how people in the past reacted when confronted by similar stresses. Archaeology is one way to peer into the past to see how changing climates affected human societies.

Archaeologists are uniquely poised to use the sweep of human history as one tool to measure what happens when climates change and when environments respond to these changes.

We are not in the business, though, of using the past as a predictive tool. What happened in the past won't tell us what will happen in the future, but it does allow us to see some of the envelopes of possibility for human action and reaction.

My work explores how changing climates affect small-scale hunter-gatherer societies in eastern North America and large, complex civilizations in China. By investigating how different types of societies, each with different social structures and economic-political practices, we can begin to tease out from the historical and behavioral record what sorts of responses happened and their successes and failures. Our work has important implications because it is very evident that climate change itself does little to alter human social systems. Climate change is felt through and moderated by a variety of human social institutions — political, social, economic, religious and ritual, among others.

Future research, informed by an understanding of past human practice, needs to focus on how these social systems engender responses to changing climates and which among the myriad possible responses might be most suitable for a given social system.

WILLIAM POWDERLY, MD

Director, Institute For Public Health, J. William Campbell Professor of Medicine and Co-Director of the Division of Infectious Diseases

School of Medicine

There is considerable evidence of both direct and indirect consequences for human health from climate change. In particular, there is a wide range of infectious diseases that are influenced by changes in climate and weather. Currently, climate determines the range of the vectors of many vector-borne infectious diseases; as current warming trends continue we are seeing evidence of vector-borne infections in parts of the world where they have previously been unknown or uncommon. Some of the best evidence for the effect of warming comes from changes in the altitude at which certain vector-borne diseases can be transmitted.

Mountain ranges provide an excellent opportunity for assessing biological changes associated with global climate change. The temperature cools rapidly as one rises in altitude, and consequently, the ecosystem can change from deserts to tropical to polar without significant change in latitude. Warming results in a shift in susceptibility to vector-borne illnesses. Examples include dengue fever and malaria outbreaks in areas that previously were inhospitable to the anopheles mosquito and the malaria parasite. There is also evidence of changing risk of infectious diseases associated with warming in previously colder latitudes, such as tick-borne infectious diseases.

The severity of weather may also affect risk of outbreaks of infection. We have long known that outbreaks of diarrheal illnesses have been correlated with heavy rainfall and flooding, and global climate change has clearly been linked to more episodes of extreme weather, which can in turn affect the timing, the intensity and the exposure of outbreak-associated infectious diseases.

In the late 1970s, medical experts confidently predicted the end of infectious diseases as a major human threat. Since then, we have had an era of emerging, reemerging and resurgent infectious diseases globally. However, climate changes, global warming and other weather-related extremes have played and will continue to play an important role in the emerging and reemerging infectious diseases.

SARAH GEHLERT, PhD

E. Desmond Lee Professor of Racial and Ethnic Diversity

The Brown School and School of Medicine

The impact of climate change on population health and social behavior has received much less attention than has its more immediate impact on crops, soil and other aspects of the environment. These more distal impacts are more difficult to measure, because they may occur over long periods of time, yet they must be considered to fully understand the effects of climate change and to design interventions to halt it.

Weather patterns that result from climate change, such as heavy rainfall, prolonged heat and drought, heavy winds, tropical storms and coastal flooding, are linked to increased rates of vector-borne infectious disease, allergies and asthma. Higher temperatures also can produce water shortages and wildfires. These disproportionately affect persons marginalized by poverty, as well as the very young and old, the disabled, and racial and ethnic minorities, thus contributing to increasing health disparities seen in the United States and around the world. The effects of drought, storms, wildfires and flooding challenge the ability of marginalized persons to consistently obtain affordable, healthful food, adding to their overall burden of disease from stressors that increase risk for chronic illnesses.

Preventing the deleterious effects of climate change relies on public awareness and collaborations between public health officials and other policymakers, scientists and community stakeholders. Successes such as those of the Inuvialuit people of western Canada, who have tracked climate change, varied the species that they hunted, and developed new ways to share food and other resources, provide hope.

BRENT WILLIAMS, PhD

Raymond R. Tucker Distinguished I-CARES Career Development Assistant Professor

School of Engineering & Applied Science

My research is focused on determining the sources and fate of natural and human-influenced emissions of gases and particles in our atmosphere and investigating their associated health and climate impacts. You often hear how increased greenhouse gas emissions act to warm our atmosphere, but particles in the atmosphere also play a major role in altering our planet's energy balance. Particles directly absorb or scatter sunlight and alter cloud formation and cloud properties such as reflectivity and lifetime.

Due to variations in the physical and chemical properties of atmospheric particles, which change with particle source type and aging in the atmosphere, we are uncertain about the particles' impact on the climate. Combustion-related soot particles are detrimental to human health and cause atmospheric warming by absorbing sunlight, making it a clear choice to reduce emissions of these particles. However, scientists estimate that when averaged worldwide, particles have a net cooling effect on the planet, acting to partially counter the warming effect from greenhouse gases.

This creates a dilemma for our decisions to curb other human-influenced emissions of particles without an accompanied decrease in greenhouse gases.

All of these particles have the ability to negatively impact human health, but some of these non-soot particles actually act to increase sunlight scattering and cool our planet.

Our research goals are to learn more about how particles are impacting our climate, which will assist in understanding how our climate would respond to changes in particle emissions.

Left to right:
Brent Williams, PhD
Sarah Gehlert, PhD
William Powderly, MD

Left to right:
Himadri Pakrasi, PhD
Ray Arvidson, PhD
Bruce Lindsey, MArch, MFA

HIMADRI PAKRASI, PhD

Myron and Sonya Glassberg/Albert and Blanche Greensfelder Distinguished University Professor, and director, I-CARES

School of Engineering & Applied Science and Arts & Sciences

Across the university, faculty, staff and students are deeply engaged in issues related to climate change. Multidisciplinary teams are challenging our understanding of the anthropogenic impact on our world by using advanced techniques to fully understand the footprints of ancient civilizations.

Faculty, staff and students are engaging with industry, using university investments in off-campus housing rehabilitation as real-world natural laboratories to test innovative designs that will bring us closer to net-zero energy and water use.

And teams are seeking to better understand natural processes, developing knowledge that can be used to increase the effectiveness of solar energy production and, in the longer-term, to use plants and microorganisms as green production sources for chemicals and fuels.

Under the umbrella of I-CARES, the university continues to invest significantly in institutional resources such as the Tyson Research Center, Consortium for Clean Coal Utilization (CCCU), McDonnell Academy Global Energy and Environment Partnership (MAGEEP), Photosynthetic Antenna Research Center (PARC) and the Washington University Climate Change Initiative (WUCCI) to provide critical infrastructure for these endeavors.

Tyson was officially welcomed as a Smithsonian Institution Forest Global Earth Observatory. CCCU won a $3.4 million grant from the U.S. Department of Energy to develop advanced oxy-combustion technology. MAGEEP contributed to the October 2014 McDonnell Academy Fifth International Symposium that addressed the role of great research universities in issues related to aging; food, water and climate change; energy and the environment; and public health. PARC successfully received renewal funding of $14.4 million to develop more efficient biohybrid and bioinspired systems for efficient utilization of solar energy. And our newest signature initiative, the WUCCI, was launched with workshops on public health and agriculture in the Midwest.

RAY ARVIDSON, PhD

James S. McDonnell Distinguished University Professor, Department of Earth & Planetary Sciences, and director, Earth and Planetary Remote Sensing Laboratory

Arts & Sciences

The Pathfinder Program in Environmental Sustainability allows a relatively small group of incoming freshmen to enroll in courses that relate to regional to global-scale changes associated with anthropogenically-induced greenhouse warming. Topics include the physics of greenhouse warming, expected changes to Earth's water cycle and ecosystem and likely consequences for mankind.

Discussions focus on the natural climatic excursions from "snowball" Earth to times when polar caps did not exist, demonstrating the wide range of past climatic conditions that existed before humans populated the Earth. We then raise the question, "Why should we be worried about current greenhouse warming, given the huge natural excursions evident in the geologic record?" The answers focus on the tight coupling between the current climate and water cycle and national economies, highlighting the importance of a stable agricultural system, particularly for developing countries. The intent is to have the Pathfinders understand the causes and consequences of greenhouse warming and thus become informed and active participants in developing methodologies and policies that will be needed to meet current and upcoming climate-related problems.

BRUCE LINDSEY, MArch, MFA

Dean, College of Architecture/Graduate School of Architecture & Urban Design, and E. Desmond Lee Professor for Community Collaboration

Sam Fox School of Design & Visual Arts

Climate change will play out most dramatically in cities. As widely reported, the world is now more urban than not, with more than 50 percent of the world's population living in cities and growing at a rate of about a million people a week. By 2050, 70 percent of the population will live in cities, with the largest percentage of that growth in the developing world and in the informal settlements of cities such as Rio de Janeiro and Mexico City. Here are some other reported statistics:

Cities use 75 percent of the planet's resources but occupy just 3 percent of its landmass; and 75 percent of the world's CO_2 emissions are produced by cities.

Now, here's the good news: Eighty percent of future economic growth is projected to be in cities, and the world's 40 "hyper cities" (20 percent of the world's population) account for 66 percent of all economic activity and about 85 percent of technological and scientific innovation.

I am proud that Washington University is home to the second-oldest urban design program in the country. Some of the most significant and celebrated urban designers have either graduated from the program or served as faculty members. Building on this rich history, we are launching a doctoral program in sustainable urbanism in 2014. Through this first-of-its-kind program, we can bring emphasis on health and resiliency — the ability of cities and citizens to equally flourish and recover in the face of a rapidly changing and unequally resourced world. Given this, the design of cities will be our best hope for both the mitigation of our contributions to climate change and our adaptation to these changes, which by definition is a creative process. ◆

David Peters: Inspired by Sputnick

RON KLEIN

Written by **TONY FITZPATRICK**

In 1970, David A. Peters, PhD, faced a dilemma. He had been offered an attractive position with a U.S. Army Laboratory in Ames, Calif., to further his research on helicopters — his expertise — which was highly coveted by the Army in the midst of the Vietnam War. There was just one catch: Peters was deferred from military service because he was employed by defense contractor McDonnell Douglas Corp., and the U.S. Selective Service System had just ruled that such a deferment was one-time only and not portable. Mobility was not an option.

When Peters, now the McDonnell Douglas Professor of Engineering in the Department of Mechanical Engineering & Materials Science, told his potential boss, Paul Yaggi, PhD, of his dilemma, there was a long pause at the other end of the line.

"Dr. Yaggi finally said, 'David, we ARE the U.S. Army, and we'll get you the deferment and also send you to Stanford to get your PhD.' I didn't even ask what the salary was. We were on our way."

Peters and his wife left for California and came back to St. Louis and Washington University in 1975, with children Michael and Laura in hand (son Nathan was later born in St. Louis). In 1974, at the urging of then Mechanical & Aerospace Engineering chair Salvatore Sutera, PhD, Peters interviewed for a faculty position at Wash U, but turned down a job offer. A year later, he and his wife discussed the decision one morning and concluded that they'd made a mistake. Later that same day, Peters received a letter from Sutera,

"I was meant to be a professor and just didn't know it. I owe my career to Sal Sutera."

— DAVID PETERS, PHD

who once again offered him the position.

"I was overjoyed," Peters says. "We came back and never regretted it."

Sutera is now senior professor and was dean of the School of Engineering & Applied Science from 2008-2010.

Peters was born in East St. Louis, Ill., and grew up near Fairview Heights. A product of the space race era, he was motivated at age 10 by a little Russian satellite.

"We'd go out in the back yard and watch Sputnik go over," Peters recalls. "It was such a shock that the Russians had this and we didn't. I'd thought that America was the greatest country in the world, and all of a sudden we're not. That was when I decided to be a space engineer."

He was admitted to Washington University in 1965 with a full scholarship from Procter & Gamble.

Sutera encouraged Peters to pursue his master's even before he had finished his undergraduate career. His introduction to helicopters came through legendary helicopter pioneer Kurt Hohenemser, co-producer of the first operational helicopter, then a researcher at McDonnell Douglas and adjunct WU faculty member, who became his adviser.

For more than four decades, Peters and his group have made globally recognized contributions to helicopter research, especially in the realm of mathematical models of helicopters. The algorithms he has developed are cornerstones of helicopter design: His mathematical models can predict the real-time response of a helicopter to a wide range of flight conditions and can be put into a flight simulator for pilot training. He is especially interested in models of how the air is being pumped.

A current thrust of his research is "green aviation." He and his group are working on developing a more efficient helicopter that uses much less fuel.

In addition, Peters studies wind energy as a national renewable energy source, considering world energy needs, various alternative energy sources and the role that wind energy could play towards a sustainable energy program. He has presented his research at several conferences and taught a workshop on wind energy to area high school teachers.

Since 2007, Peters, who chaired the department a total of 15 years, has been the department's director of graduate studies, a position that provides him access to students (many of them part-time and from industry, just as he was years ago at McDonnell Douglas), research, industry consultation and classroom teaching. During his tenure, he has trained and mentored more than 70 doctoral students in his lab.

"It's the perfect fit for me, and I love it," he says. "One thing that I tell my students is that I won't teach them anything that I didn't actually use for somebody who paid me to do it. Hockey great Wayne Gretzky's father told his son not to go where the puck is but where it's going to be. That's the neat thing about research. We can point people to where things are going to be 10 to 20 years from now, so we don't teach for just the present, but for lifelong learning." ◆

COURTESY PHOTO

Peters is a fellow of the American Institute of Aeronautics and Astronautics (AIAA), of the American Society of Mechanical Engineers (ASME) and of the American Helicopter Society (AHS). He received the NASA Scientific Contribution Award, the Reed Aeronautics Award from the American Institute of Aeronautics and Astronautics, the Spirit of St. Louis Medal of the American Society of Mechanical Engineers and the Nikolsky Lectureship of the American Helicopter Society.

Left: Peters and his wife, Deborah, at Pt. Loma Park in San Diego

Since the late 2000s, Peters has been the media "go-to guy" for commentary about the physical aspects of his favorite sport: baseball. An avid St. Louis Cardinals' fan, Peters has commented on everything from the advantages of being left-handed in our national pastime to whether a runner might get an edge diving into a bag rather than running through it, to the importance of bat speed in hitting.

Langsdorf Scholars

Building a Family

Langsdorf Scholars at the 2014 Family Welcome Dinner

RAY MARKLIN

1966

The first class of Langsdorf Scholars with Dean Emeritus Alexander Langsdorf

UNIVERSITY ARCHIVES

They are the Langsdorfs — and they are more than 500 strong. They have gone on to successful careers in medicine, law and engineering; in industry, research labs, the military, consulting and higher education, among others.

Written by **MARY ELLEN BENSON**

The thread that ties the generations of Langsdorfs together is that they have pursued undergraduate study in the School of Engineering & Applied Science with a Langsdorf Fellowship.

The Alexander S. Langsdorf Fellowships in Engineering are a pioneering merit-based award begun in 1966 by then-Dean James M. McKelvey, PhD, for up to 10 incoming freshmen with high academic potential. He named the program after Langsdorf, a major figure in engineering education at Washington University who was dean of the school from 1910-1920 and again from 1928-1948.

"It was a fellowship with a program wrapped around it," says David "Dave" Rossetti, who retired as vice president of university relations and research at Cisco and who earned a bachelor's degree in computer science and applied mathematics in 1974 — the fourth class of Langsdorf students to graduate. He says they were interviewed by and introduced to the existing Fellows, expected to help "shepherd in" the next classes of Langsdorfs and to be part of the "'society' of Langsdorfs."

Langsdorfs
Leading the way

High expectations continue for today's students in the Langsdorf Scholars Program, says Lee Anne Quatrano, co-adviser to the program with Kim Shilling, assistant dean for engineering student services.

"We look for top scholars who have already taken on leadership roles, have organized and taken part in successful activities and are looking for ways they can be involved," Quatrano says.

> "We look for top scholars who have already taken on leadership roles, have organized and taken part in successful activities and are looking for ways they can be involved."
>
> — LEE ANNE QUATRANO

And they certainly are meeting those expectations. Senior Arunita Kar, who is majoring in electrical engineering and applying to graduate schools, started an outreach program for the James M. McKelvey Undergraduate Research scholars — an award she also holds — for which they visit local middle and high schools doing hands-on activities with the students to get them interested in pursuing engineering.

"I've always loved physics and math," she says, "but I wanted to apply those and do something that will help others. I think engineering's a great skill for that."

She also is conducting research in nanophotonics in the lab of Lan Yang, PhD, the Das Family Career Development Associate Professor in electrical & systems engineering.

"Research is definitely something I want to keep as part of my life," she says. "It's the very first step where all the ideas and work go into it before something becomes public and worldwide."

Research and community service are important, too, to sophomore Ananya Benegal, who is majoring in biomedical engineering. Also a McKelvey Research Scholar, she is working in the lab of Philip Bayly, PhD, department chair and the Lilyan and E. Lisle Hughes Professor of Mechanical Engineering, where the focus is on the biomechanics of traumatic brain injury.

This past summer she spent two weeks in Guatemala with Engineers Without Borders working at Roosevelt Hospital, a poorly funded public hospital that uses old, donated and often broken equipment. Benegal and the other students repaired broken ventilators and other machinery.

Like the other current scholars, Benegal was energized by the first-ever Langsdorf Scholars retreat, which took place at Pere Marquette State Park in Illinois just before fall classes started.

"To continue to build the Langsdorf family, we wanted the new freshman scholars to bond with the present ones," Quatrano says.

Freshman Sydney Katz says the retreat was a good experience.

"We didn't really know each other that well coming in, but after we left, we felt like we'd known each other for a really long time," she says.

Katz remembers being at a sports practice when she got the call from Ralph S. Quatrano, PhD, dean of the School of Engineering & Applied Science, that she had been chosen to receive the Langsdorf scholarship.

She tentatively plans to major in electrical engineering with a minor in aerospace engineering. Her interest in space resulted in two summers as an intern at NASA Glenn Research Center in Cleveland. In 2013, she worked in a chemistry lab developing high-temperature materials, and in 2014, she was part of a COMFORT team, which develops new designs for a satellite or rover. She says her "dream job" would be to work at Mission Control in Houston or in the project to send humans to Mars.

For sophomore Maxwell Wang, the best part of being in the program is getting to know the other Langsdorf Scholars, as well as learning from Langsdorf alumni. He is pursuing a double major in electrical and biomedical engineering and taking graduate engineering math courses.

A McKelvey Research Scholar, Wang is conducting research in a computational neuroscience lab with ShiNung Ching, PhD, assistant professor of electrical & systems engineering.

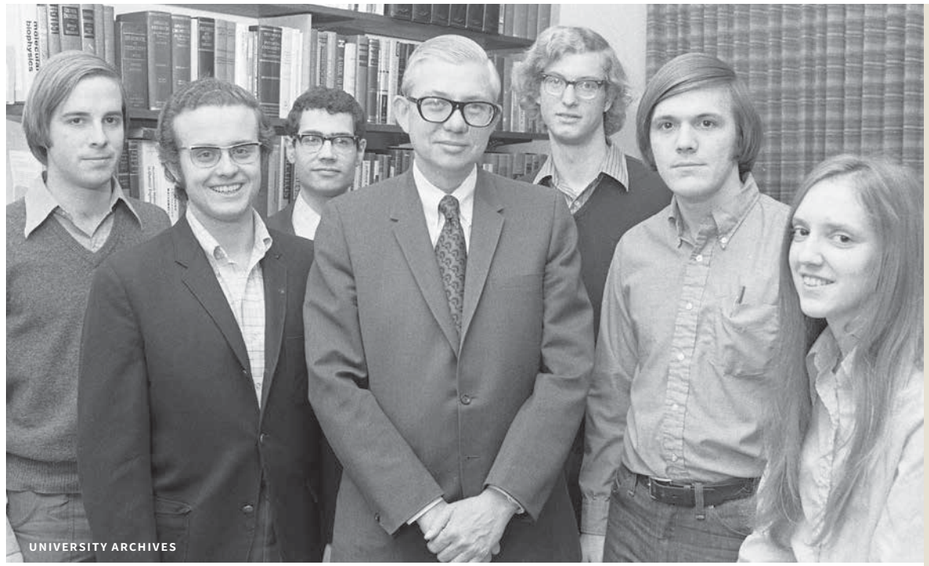
A dancer since age eight, Wang continues to study ballet and plans to dance in Washington University Dance Theatre's emBodied Language concert Dec. 5–7, 2014. Whether it is an early alum like Dave Rossetti or a more recent graduate like Elizabeth "Liz" Phillips, who graduated in 2012 with a degree in biomedical engineering, being a Langsdorf was vital to their undergraduate experience. For Phillips, now a medical student at the University of Pennsylvania — as for so many others — the award "made it financially possible for me to attend Wash U," she says. "I know wherever I go and whatever career I pursue, there will be a Langsdorf scholar nearby who can give me advice and support."

W. E. Moerner receives the 2014 Nobel Prize in Chemistry

W. E. Moerner, PhD, a 1975 electrical engineering alumnus of the Washington University School of Engineering & Applied Science, has been awarded the Nobel Prize in Chemistry for 2014, the Royal Swedish Academy of Sciences announced Oct. 8.

He shares the Nobel Prize in Chemistry with Eric Betzig, PhD, of the Howard Hughes Medical Institute in Ashburn, Va., and Stefan W. Hell, PhD, of the Max Planck Institute for Biophysical Chemistry and the German Cancer Research Center in Germany. The three received the award for developing super-resolved fluorescence microscopy.

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



The 1972 class of Langsdorf Scholars with then-Dean James M. McKelvey, PhD

Lasting impact

The Woodward Scholarship, a half-tuition merit scholarship, was later rolled into the Langsdorf Fellowship, creating a community of 500 students, who have continued that leadership into their respective careers, which span from engineering to medicine, research, law and entrepreneurship. Some examples include W. E. Moerner, PhD, the Harry S. Mosher Professor in Chemistry and Professor, by courtesy, of Applied Physics, at Stanford University, who shares the 2014 Nobel Prize in Chemistry with two other scientists; Anna Patterson, vice president of engineering at Google Inc.; Matthew Ettus, founder and president of Ettus Research LLC; Christine Lorenz, vice president, research & clinical collaborations, molecular imaging, Siemens Healthcare; and Howard Demsky, vice president, planning and development for SeaWorld Parks & Entertainment. As a group, they continue to make an impact on and contributions to society that reflect the culture of Engineering at Washington University and to continue growing the family. ◆

Where are they now?

Here is a sample of Langsdorf and Woodward scholars:

Olani Beal
CTO, CenturyLink

David Becker
CEO of Cottingham & Butler

Stuart B. Brown
Managing Principal, Veryst Engineering

Andrew Bursky
Chairman, Atlas Holdings

Matthew Ettus
President and Founder, Ettus Research

Alexander Gray
Senior Vice President, Customer Services & Support, Juniper Networks

Philip Hoen IV
Senior Vice President, Bank of America

Hershel Kleinberg
CEO, Insuractive

Christine Lorenz
Vice President, Research & Clinical Collaborations, Molecular Imaging at Siemens Healthcare

Mitchell Parker
Vice President & General Manager, Cloud Services, Citrix

Anna Patterson
Vice President of Engineering, Google

Todd Przybycien
Professor and Head of Biomedical Engineering, Carnegie Mellon

Scott Quinby
President, Compu Smile

Charles Simmons
Vice President, Corporate Development, Sun Microsystems (ret)

Ira Spector
Executive Vice President, Analytics & Consulting, ICON plc

Andrew Srenco
President, Hatch Street Capital

Ellen Zegura
Chair of Computer Science, Georgia Tech

Hazel and Arnold Donald

DEVON HILL

ARNOLD & HAZEL DONALD

always giving back

It's often said that a degree in Engineering is a universal degree and can be used in nearly any profession. Arnold and Hazel Donald are two strong examples of that as alumni of the Dual Degree Program who earned engineering degrees at Washington University in St. Louis, but took those degrees in very different directions in their successful careers.

Written by **BETH MILLER**

Arnold, a native of New Orleans, and Hazel, a native of Boston, came together to Washington University from Carleton College in Northfield, Minn., where they met prior to their freshman year and married at the end of their sophomore year. As students in the Dual Degree, or 3-2, Engineering Program, Arnold earned a degree in economics at Carleton, while Hazel earned a degree in math. At Wash U, Arnold earned a degree in mechanical engineering and Hazel earned a degree in systems science and mathematics.

While Arnold had offers to continue his education at other schools, including Stanford University and Columbia University in New York, they chose Washington University, crediting former academic dean Harold P. Brown, who launched the Dual Degree Program in 1973. The program allows undergraduate students to earn two bachelor's degrees in five years at two universities: a non-engineering degree at another university and an engineering degree at Wash U.

Since they were married, it was important that the school they chose was a good fit for both of them. The Donalds say Brown was very supportive, both academically and personally, even giving them a crib for their first baby, born six weeks before they graduated from Wash U in 1977.

Their Washington University education has taken both of them far.

Arnold Donald has an impressive résumé, currently as chief executive of Carnival Corp.; and previously as president and chief executive of the Juvenile Diabetes Research Foundation; chairman of Merisant Co., which makes and markets Equal sweetener; and in a variety of executive roles during more than 20 years at Monsanto Co. He serves numerous boards of for-profit companies and nonprofit organizations. At Wash U, he is a member of the Board of Trustees, a member of the School of Engineering & Applied Science National Council and co-chair of the school's *Leading Together* capital campaign.

Left: Hazel at the City Academy 15th birthday celebration. Hazel is a board member at the school located in North St. Louis.

Right: Arnold (right) and William Hopkins in 1976, both members of the Wash U Society of Black Engineers.


COURTESY PHOTO


UNIVERSITY ARCHIVES


RAY MARKLIN

Arnold Donald speaking at an Engineering Dual Degree event.

Watch how Arnold Donald is using his engineering degree: engineering.wustl.edu/yourway

He began at Monsanto as a summer employee while still a student at Washington University. During that summer, Arnold built a linear programming model — something no summer employee had done before — attracting management's attention.

"Someone recognized in me a personality trait that they thought would do well in marketing and general management, but I had been locked in on being in a plant," he says. "That job opened my mind to other possibilities of career choices."

> "I felt like I could touch lives and make people feel confident in their ability to do math. I don't care if you love it or not, but you need to believe you can do it."
>
> — HAZEL DONALD

After graduating, Arnold joined Monsanto full-time and later used another model he built to save a customer a significant amount of money.

"Engineering gives you critical thinking, analytical thinking and quantitative analysis, so it's helped me in everything I've done," Arnold says. "Engineering also causes you to question everything, which is a very good thing in business, because the obvious answer isn't always the right one. It's really healthy to question your conclusion and ask what could make this the wrong conclusion."

Hazel worked as an actuary for several years after graduating from Wash U, then as a systems engineer for IBM working on mainframe computers. She later returned to Wash U to earn a master's in teaching in 1991 and became a math teacher. She also had two more children during this time.

"Engineering helped me as a teacher, because when the kids would say, 'Why do we need to know this?' I had lots of answers to pull out," Hazel says.

Changing from a career in math and engineering to teaching came from her desire to make a difference in people's lives.

"I felt like I could touch lives and make people feel confident in their ability to do math," Hazel says. "I don't care if you love it or not, but you need to believe you can do it."

In their last year at Wash U, the Donalds were resident advisers in a residence hall. In addition, Arnold was an assistant to then-Dean James McKelvey, PhD, and helped found the Society of Black Engineers to support other African-American students in Engineering and to prevent students from leaving Engineering.

"There were a lot of students struggling, not because they couldn't do the work, but because there was no support," Hazel says. "The number of African-American students wasn't that high, and it doesn't take a lot to make an inhospitable environment."

The society was modeled after the black student union they had been a part of at Carleton. Shortly after the Wash U society formed, similar groups at other schools reached out, and together they decided to create a national organization, now called the National Society of Black Engineers (NSBE). Donald ran for vice president of the national group.

"I decided I wanted to be vice president so I wouldn't have to do anything, but could still put it on my résumé," he says, laughing. "Instead, as vice president I traveled around the country talking to companies to get funding."

NSBE now has more than 30,000 members worldwide in 394 active student and professional chapters.

Those skills he developed influencing corporations to give of their resources for NSBE built on his background, which stressed the importance of sharing and giving back. The Donalds are very generous with their time and resources in the St. Louis area and nationally, including funding a scholarship at Wash U.

"Both of us grew up in families that shared whatever we had with others," Hazel says. "We decided that St. Louis was going to be our home, so it's good to try to make it the best place it can be."

For Arnold, his generosity is a way to give back to those he says helped him through his education and career.

"So many people helped me — my family, Dean Brown, people in administration, and before that my church, the priests and seminarians," he says. "So many people adopted me at Monsanto, took me under their wings and helped me. There's no way I would have had the great experiences I've had in life — I wouldn't have met Hazel — if I hadn't had a whole lot of help along the way. It's fun to give back, it's rewarding to give back and it's natural to give back." ◆

The Donalds have been taking cruises for many years — long before Arnold began his current role with Carnival. Both said their favorite cruise was to Antarctica.

"There are not words to describe it — it is phenomenal," Hazel says. "It's just one of those things that you have to see."

New faculty join the School of Engineering & Applied Science

Rajan Chakrabarty, PhD

- Assistant Professor in the Department of Energy, Environmental & Chemical Engineering
- PhD, chemical physics, University of Nevada-Reno
- Research: aerosol physics and atmospheric radiation transfer in addressing current energy issues

Zach Feinstein, PhD

- Assistant Professor in the Department of Electrical & Systems Engineering
- PhD, Princeton University
- Research: operations research and financial engineering to study and define the formulation for dynamic risk measures in markets with transaction costs

Steven George, MD, PhD

- Elvera & William Stuckenberg Professor of Technology & Human Affairs and Chair of the Department of Biomedical Engineering
- MD, University of Missouri–Columbia; PhD, University of Washington
- Research: creating microphysiological systems, vascularizing engineered tissues and linking optical and mechanical properties of tissue

Brendan Juba, PhD

- Assistant Professor in the Department of Computer Science & Engineering
- PhD, computer science, Massachusetts Institute of Technology
- Research: theoretical approaches to artificial intelligence founded on the theory of algorithms and computational complexity

Angelina Lee, PhD

- Assistant Professor in the Department of Computer Science & Engineering
- PhD, computer science, Massachusetts Institute of Technology
- Research: making parallel programming accessible so that any programmer can rapidly develop high-performance software that takes advantage of commodity multicore hardware

Mark Meacham, PhD

- Assistant Professor in the Department of Mechanical Engineering & Materials Science
- PhD, mechanical engineering, Georgia Institute of Technology
- Research: transport phenomena and the thermal-fluid sciences to develop and evaluate microfluidic and micro-electromechanical systems

Ben Moseley, PhD

- Assistant Professor in the Department of Computer Science & Engineering
- PhD, University of Illinois, Urbana-Champaign
- Research: theoretical computer science, including the design, analysis and limitations of online and approximation algorithms

Elijah Thimsen, PhD

- Assistant Professor in the Department of Energy, Environmental & Chemical Engineering
- PhD, Washington University; Postdoctoral associate, University of Minnesota
- Research: gas-phase synthesis of inorganic nanomaterials for energy applications

Not pictured:

Shantanu Chakrabartty, PhD

Roman Garnett, PhD

Matthew Lew, PhD

Silvia Zhang, PhD

A rendering of the new Professional Education Technology and Leadership Center

Engineering launches Professional Education Technology and Leadership Center

To better meet the needs of the regional information technology community, the Center for the Application of Information Technology (CAIT) at Washington University has become the Professional Education Technology and Leadership Center.

In addition to the new name, the Professional Education Technology and Leadership Center will offer new classes and will move to a newly renovated, state-of-the-art training center on the Danforth Campus in Lopata Hall. Beginning next year, the schedule will include new technical and leadership courses in topics such as organizational behavior, managing teams, high-performance computing and more. Classes will begin to be scheduled in the new facility by the end of the year, phasing out classes at the West Campus location.

The center will also launch the Data Science and Analytics Roundtable, which was developed in collaboration with leading St. Louis companies and the Olin Business School to help address concerns and questions about how to interpret and manage "big data," or the enormous amount of data that corporations are collecting.

Walk through buildings from your own device

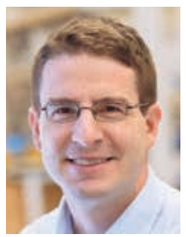
Yasutaka Furukawa, PhD, assistant professor of computer science & engineering, combines 3-D computer vision of indoor scenes with the capabilities of Google Maps and Google Earth to create a unique, high-resolution, photorealistic mapping experience of indoor spaces. Though he is starting with public spaces such as well-known museums, he intends to bring his technology to St. Louis — specifically, Washington University's Danforth Campus.

"I make the mapping experience of indoor space from the aerial viewpoint, which is good for navigation and exploration," Furukawa says. "But you really have to have the two layers. One is the ground level, or panorama, where you really look at the details and feel immersed, but also the high level, aerial viewpoint, where you can navigate and see the whole structure."

Washington University and Indian Institute of Technology Bombay announce corporate alliance

The Washington University (WUSTL) and Indian Institute of Technology Bombay (IITB) Corporate Alliance provides innovative solutions and talent development through collaborative programs and projects in thematic areas of strategic importance to society, industry and the government.

Giammar promoted, named Browne Professor



DAN GIAMMAR

Daniel Giammar, PhD, was promoted to professor of energy, environmental & chemical engineering Sept. 15. In addition, he will be installed as the Walter E. Browne Professor in Environmental Engineering Dec. 1.

Giammar, who joined Washington University in 2002, focuses his research on chemical reactions that affect the fate and transport of heavy metals and radionuclides in natural and engineered aquatic systems. He has investigated interactions of lead and phosphate at mineral-water interfaces, adsorption of arsenic to novel sorbent materials, control of lead concentrations in drinking water, environmental applications of nanostructured materials and the environmental biogeochemistry of uranium.

RAY MARKLIN

Steven George (center), MD, PhD, chair of the Department of Biomedical Engineering, was installed as the Elvera & William Stuckenberg Professor of Technology & Human Affairs at a ceremony Sept. 22.

Numbers for the class of 2018

6,500 applicants

238 entering freshmen

31% women

1,319 fall 2014 undergraduate enrollment

1991: **1,333** applicants; **1,091** undergraduate enrollment

Engineering alumnus win $10K Global Impact Award

Nathan Brajer, a 2014 graduate in biomedical engineering, and Evan Madill, a 2014 graduate in biology, won $10,000 in the Suren G. Dutia and Jas K. Grewal Global Impact Awards Oct. 6, sponsored by the university's Skandalaris Center for Entrepreneurial Studies.

Their company, called ViFlex, offers simple, low-cost eyeglass kits to people in developing countries. In the spring, the team, then called Envisioning Solutions, tied for first place in the 2014 Discovery Competition at the School of Engineering & Applied Science.

Another Discovery Competition finalist, ZnDermal, was a finalist for the Global Impact Award and received $2,000.

Engineering student team wins national design competition for zinc patch

For the third straight year, a team from Washington University in St. Louis School of Engineering & Applied Science has won the Engineering World Health's Design Competition for its device to improve health care in the developing world.

The ZnDermal team, made up of four Engineering students from the Engineers Without Borders chapter, won $3,000 in the prestigious competition, outdoing teams from Clemson and Cornell universities.

Wash U now has the most winning teams in the competition's five-year history. The team now known as Sparo Labs won in 2012, and the Electroluminescence Biliblanket team won in 2013. All three teams were finalists in the School's Discovery Competition prior to winning the EWH Design Competition.

The team's members are Andrew Chang, a sophomore majoring in mechanical engineering; Nicole Ensz and Braden Perkins, both senior dual-degree students majoring in biomedical engineering; and Julie Knowles, a junior majoring in computer science and mathematics.

The ZnDermal team has created a transdermal patch, similar to a nicotine patch, that transmits zinc that can be used with children with diarrheal diseases. Currently, these types of diseases are the second-leading cause of death for children under age 5 and the fifth-leading cause of death worldwide, according to the World Health Organization. Although zinc tablets can be used to treat these diseases, it is not always the most effective method, Ensz says.

Wang receives prestigious NIH BRAIN initiative award


LIHONG WANG

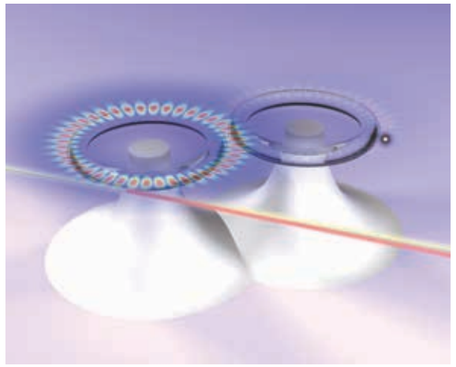
Lihong Wang, PhD, the Gene K. Beare Distinguished Professor of Biomedical Engineering, has received a prestigious BRAIN Initiative Award from the National Institutes of Health (NIH).

Wang's three-year, $2.7 million award, is one of 58 grants totaling $46 million announced Sept. 30 by Francis S. Collins, MD, PhD, director of the NIH, in Washington, D.C.

The award is part of the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative, a national research effort launched by President Barack Obama last year to revolutionize the understanding of the human mind and uncover new ways to treat, prevent and cure brain disorders such as Alzheimer's disease, schizophrenia, autism, epilepsy and traumatic brain injury.

Wang's grant will fund his research to develop a high-speed, high-spatial resolution, deep-penetration photoacoustic computed tomography (PACT) system for real-time imaging of action potentials, or spikes in electrical activity, in mouse brains. He plans to develop an unprecedented hardware imaging system that will provide deeper penetration than existing imaging protocols for whole mouse brain imaging.

Engineers find a way to win in laser performance by losing



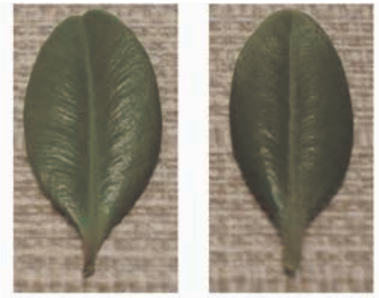
Energy loss in optical systems, such as lasers, is a chief hindrance to their performance and efficiency, and it occurs on an ongoing, frustrating basis.

To help laser systems overcome loss, operators often pump the system with an overabundance of photons, or light packets, to achieve optical gain. But now engineers at Washington University in St. Louis have shown a new way to reverse or eliminate such loss by, ironically, adding loss to a laser system to actually reap energy gains. In other words, they've invented a way to win by losing.

The results were published in the Oct. 17 issue of the journal *Science*.

In a series of three experiments, Lan Yang, PhD, the Das Family Career Development Associate Professor in Electrical & Systems Engineering; Sahin Kaya Ozdemir, PhD, a research scientist; and Bo Peng, a graduate student in Yang's lab at Washington University, and their collaborators, Carl M. Bender, PhD, the Konneker Distinguished Professor of Physics at Washington University; Franco Nori, PhD, at RIKEN in Japan; and Stefan Rotter, PhD, at Vienna University of Technology in Austria, showed in a first experiment that they could change the coupling between two microresonators by changing their distance and introduce on-demand loss controllably to one of them.

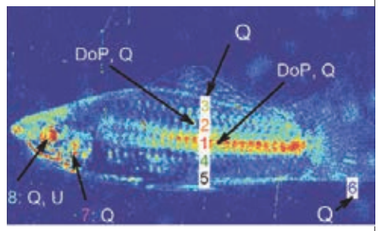
"The loss added beyond a critical value increased the total light intensity and its distribution between the resonators," Peng says.



WUSTL researchers among group awarded $20 million for climate variability research

The goal: to find early indicators of illness and stress before drought and other ecological foes cause too much damage.

The researchers include Robert Pless, PhD, professor of computer science, and Kilian Weinberger, PhD, associate professor of computer science. Pless' role is to analyze long-term, time-lapse images of plants, either in the lab or from public webcams, to estimate when plants flower, how much they grow and how long their growing season is. Weinberger will analyze data and build predictive models.



Camera sheds light on mate choice of swordtail fish

Marine biologists at the University of Texas at Austin used a bioinspired polarization camera developed by Viktor Gruev, PhD, associate professor of computer science & engineering at Washington University, to make the discovery. His camera has been used in other applications in marine biology and also is now being used at the School of Medicine to help physicians and researchers see cancer cells very early in development.

The research was published online Sept. 2 in the *Proceedings of the National Academy of Sciences Early Edition.*

Gruev's camera is similar to polarized sunglasses, which reduce glare by blocking polarized light. The camera is built with nanomaterials inside the camera, allowing it to capture the polarization properties of light in real time.

"We changed the polarization so that the large males with high contrast showed good contrast in their polarization ornaments," Gruev says. "When we suppressed the polarization ornaments externally with light, the females didn't pay attention to the males. When we changed the light sources to change the polarization signals on the fish body, the social interactions between female and male swordfish significantly increase."

Mechanical journey of cancer cells focus of new study

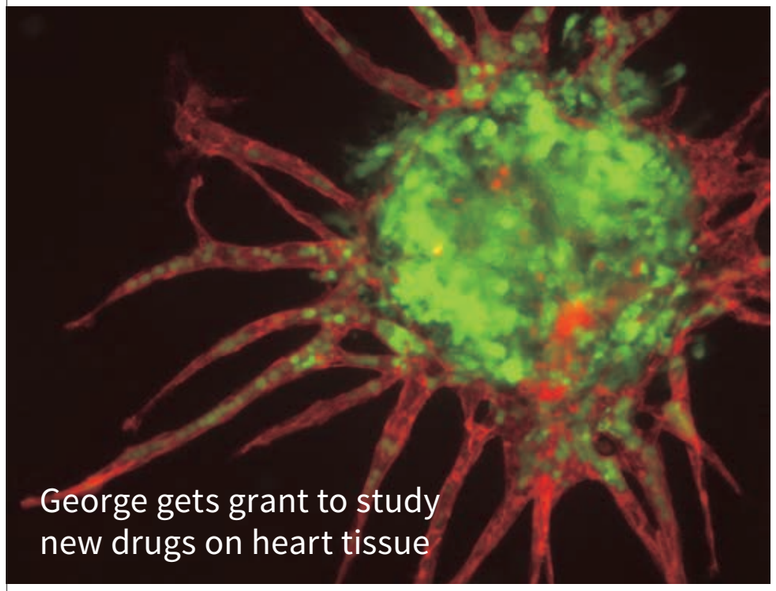

AMIT PATHAK

Amit Pathak, PhD, assistant professor in mechanical engineering & materials science, has been awarded a three-year, $180,000 New Investigator grant from the Edward Mallinckrodt, Jr. Foundation.

Pathak was one of eight recipients from 165 applicants. He is the first nominee and recipient from the School of Engineering & Applied Science in the history of this award.

With the funding, Pathak will study how the mechanical journey of cancer cells is affected by the heterogeneous tissue environments around them. He will deconstruct multidimensional aspects of tumor invasion by adopting an innovative combination of engineering, biomaterials and cancer cell biology-based approaches.

Pathak says these gaps in the understanding of tumor invasion remain due to a lack of engineering-based approaches that mimic tissue-like conditions and allow "time and space" deconstruction of this multistep program.



George gets grant to study new drugs on heart tissue

As part of a national effort to predict drug safety and effectiveness, Steven C. George, MD, PhD, chair of the Department of Biomedical Engineering, has received a grant from the National Institutes of Health (NIH) to continue developing an integrated in vitro model of perfused tumor and cardiac tissue.

The grant is one of 11 awarded nationwide totaling $17 million over at least three years.

George's project will use iPSC technology to create a system for anti-cancer drug discovery that will minimize the chance of cardiac side effects.

‘Get a bigger hammer’

Written by **BETH MILLER**

The machine shop in Urbauer Hall is a place where Engineering students learn to use hand and power tools to turn their ideas into reality. But that’s not all they learn there. With Pat Harkins at the helm of the shop for the past 26 years, thousands of Engineering students have learned persistence, patience and how to address problems with sometimes unconventional solutions.

While Harkins’ official title is technician, alumni say he is much more than that: mentor, teacher, surrogate father and friend. Working in a machine shop includes a significant amount of hands-on skills, but Harkins also provides life and people skills through his sense of humor and unpretentious charm.


WASH U PHOTO

“Pat Harkins: There might well be no two other words that, in tandem, compel such a fond grin from those who have had the privilege of crossing paths with the legend himself,” says Eric Jensen, who works in business development at Boeing Phantom Works and earned a bachelor’s degree in mechanical engineering in 2008. “My admiration of Pat stems from his genuine compassion for students, his innate skill for fostering an environment wherein aspiring engineers are free to learn by experience, and an incomprehensible ability to resolve any problem with two grunts and a bigger hammer.”

A lifelong St. Louisan, Harkins came to Washington University in 1988 to run a machine shop. Over time, he has picked up more responsibility, adding teaching to his résumé. This fall, he is teaching four classes — two sections of Machine Shop Practicum and two sections of Mechanical Engineering Design and Build. In the spring, he adds another class. He also works with the Formula SAE (Society of Automotive Engineers) Race Car team, which builds a new car each year, and the Battle Bot Club.

When students start working with Harkins, often they aren’t sure if some of his catchphrases are serious or not.

Steven Schleibaum, a member of the FSAE team, recalled a couple of Harkins gems.

“Having Pat around literally saved our FSAE team more times than I can count with his unconventional and out-of-the-box solutions,” says Schleibaum, who earned a bachelor’s degree in mechanical engineering in 2013. “These usually involved ‘getting a bigger hammer,’ and if that didn’t work, it was clearly for a very specific and oftentimes true reason: we weren’t holding our mouths right.”

At the Formula SAE Michigan Collegiate Design Series in May 2013, the differential on the FSAE race car came apart during a test run 90 minutes before the end of the day’s events. The team had to remove and dismantle the part, diagnose the problem, fix and reinstall it all within an hour or


WHITNEY CURTIS

Pat Harkins working in the machine shop with Clayton Keating, an undergraduate Engineering student

“You trusted him because it was obvious that he cared. In fact, he cared enough not only to praise you when you did well, but set you straight when you messed up.” — RICH OCKERS

Watch a video of Pat in the machine shop: youtube.com/WUSTLEngineering

risk losing points. Harkins quickly took control of the situation, and within five minutes he had begun the repair “with nothing but a file and the biggest hammer in Michigan,” Schleibaum recalls.

The repair was a success, and the team completed all of the dynamic events and had the best finish of any Wash U team competing in the event.

“Pat was the sole reason for this accomplishment,” says Schleibaum, an engineer at Chrysler Institute of Engineering,

Working with the FSAE team is a natural choice for Harkins, who has been a car enthusiast since he was a young boy. In fact, he learned to drive at age 10, and his grandfather gave 13-year-old Harkins his own truck. Since then, working on cars has been his hobby and sometimes side business. He had to have the side business to fund his own habit of racing dragsters at local raceways.

“In the ’70s, my neighbors would bring their cars and some oil over, and I’d charge 50 cents for an oil change,” Harkins says. “A tune-up was $2 if they brought the parts.”

But it wasn’t just simple maintenance that Harkins did in his home shop — he built race cars, street rods and show cars, and chassis parts and roll cages for race cars. He also bought old cars to strip them of their parts to sell.

“At one time I had, oh, probably 15 projects sitting in the yard,” he recalls.

How many cars has he had in his lifetime?

“Oh, you don’t want to know,” he says with a laugh and a twinkle in his eye.

Now, he has just three cars, including a red 1998 Corvette that was a 60th birthday present from his wife, Carolyn.

Rich Ockers, now an MBA student at the Olin Business School who earned a bachelor’s degree

in mechanical engineering in 2008, said Harkins quickly became his mentor and friend.

"Pat is one of those special guys that you never forget and still think the world of even after they just finished adjusting the extent to which your head was screwed on properly."

Armen Nazarian, an integration engineer with Tesla Motors, said some of his fondest memories of his years at Wash U were learning to use the mill as a freshman, spending countless hours bouncing design ideas off Pat in his office on some graph paper, and fixing a broken suspension linkage with nothing but a bucket of washers, a Dremel tool and a MIG welder when the FSAE team competed in Michigan in 2013.

"As adviser to the Formula SAE team and a racing and fabrication expert, Pat taught me everything I know that is worth knowing about designing and building things — most importantly to never give up on finding a way to make things work (even if the solution requires a really big hammer)," says Nazarian, who earned bachelor's degrees in mechanical engineering in Engineering and in managerial economics and strategy from the Olin Business School in 2012. "Year after year, Pat's seemingly endless wisdom and patience help students find their passion in engineering by gaining hands-on experience building the projects they dream up."

"Year after year, Pat's seemingly endless wisdom and patience help students find their passion in engineering."

— ARMEN NAZARIAN

Nikolaos Rigas, PhD, who earned a doctorate in chemical engineering in 1991 and is now senior scientist and director of the SCE&G Energy Innovation Center at Clemson University, was the first graduate student Harkins worked with at Washington University. He says Harkins taught him more than how to use the equipment he needed to do his work and how to keep the shop clean.

"I was a reservist with the Navy while I was working on my PhD," Rigas says. "I was recalled to active duty suddenly one day in support of Desert Shield and eventually Desert Storm. Pat became very emotional over the issue as well as angry. I remember he had tears in his eyes as I left the lab that day, and he hugged me telling me that he expected me back and to finish this degree I started. By then he had become my mentor and surrogate father."

Harkins says since his wife retired, she asks him often when he plans to do the same.

"I don't want to retire," he says. "I have too much fun." ◆

2013 WU Racing team in Michigan

COURTESY PHOTO

mentor

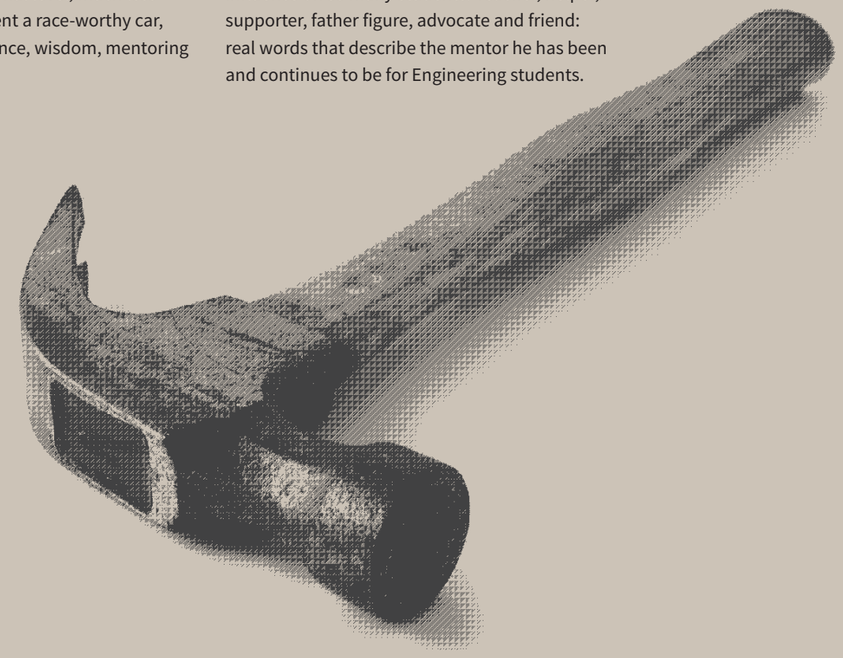
"We never know which lives we influence, or when, or why." — STEPHEN KING, AUTHOR, *11/22/63*

Of all of the words that could be used to describe Pat Harkins, one that surfaces most is mentor. Teaching incoming freshmen how to use hand tools and other equipment in the machine shop could be nerve-wracking, yet Harkins uses his tremendous amount of patience, coupled with his years of experience, to show the students the best and safest way to make their ideas come to life while keeping a smile on his face and his sense of humor. In the process, he provides encouragement and support to students for both individual projects and group projects, such as the Formula SAE race car. Alumni who were members of several FSAE teams say they would not have been able to compete at the national level, much less design, build and present a race-worthy car, without Harkins' guidance, wisdom, mentoring and friendship.

As a mentor he taught students never to give up on finding a way to make things work, even if the solution required a bigger hammer. Instead of correcting students' mistakes, he tells dramatic stories about someone who made the same mistake and had an unpleasant demise. His ability to remain calm in situations in which students feel their project is ruined provides a wordless example to roll up one's sleeves and find a solution rather than giving up.

When an alumnus sent Harkins some titanium with which to craft wedding rings for the alumnus and his bride, Harkins gladly made them.

Harkins' title of technician doesn't begin to describe the man who has had such an influence on so many students. Teacher, helper, supporter, father figure, advocate and friend: real words that describe the mentor he has been and continues to be for Engineering students.



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$$p = mv$$

Snapshot //

The Upsilon Pi Epsilon chapter at Wash U held the university's first large-scale hackathon, called WUHack, Sept. 12-14 in Lopata Hall.

RAY MARKLIN

#wustlengineers: