McCormick

Northwestern Engineering

Civil and Environmental Engineering

Robert R. McCormick School of
Engineering and Applied Science
Northwestern University

SPRING 2013

Jan D. Achenbach Lecture Honors Longtime McCormick Faculty Member

LECTURE SERIES SUPPORTED THROUGH GENEROSITY OF McCORMICK ALUMNI AND FRIENDS

SAVE THE DATE

Inaugural Jan D. Achenbach Lecture
May 14, 4 p.m.
Northwestern's Evanston campus
Featuring Professor Lambert Ben Freund, Achenbach's first PhD student

McCormick has announced the creation of a new lecture series in honor of Jan D. Achenbach, a longtime faculty member and preeminent researcher in solid mechanics and quantitative non-destructive evaluation.

The Jan D. Achenbach Lecture recognizes Achenbach for his extraordinary contributions to the field of mechanics, as well as his profound impact on McCormick's Departments of Mechanical Engineering, Civil and Environmental Engineering, and Engineering Sciences and Applied Mathematics.

An endowment for the lecture series was provided through the generous contributions of McCormick alumni and friends and by the scientific publishing company Elsevier. The lecture will bring a high-profile speaker to campus each year.

"We are grateful for the support of the alumni and friends who wished to honor Jan's distinguished career," said Dean Julio M. Ottino. "Jan has made significant contributions to McCormick and to mechanics research over the past five decades, and this lecture is a fitting tribute to his impact."

Achenbach is Walter P. Murphy and Distinguished McCormick School Professor Emeritus of Civil and Environmental Engineering, Engineering Sciences and Applied Mathematics, and Mechanical Engineering.

Born in the Netherlands, Achenbach became a member of Northwestern's faculty in 1963. Since then, he has become highly respected for his work in the areas of wave propagation in solids and for pioneering the field of quantitative non-destructive evaluation.

> "Jan has made significant contributions to McCormick and to mechanics research over the past five decades, and this lecture is a fitting tribute to his impact."
> *Julio M. Ottino*

Achenbach received a National Medal of Technology in 2003 for his contributions to engineering research and education and for pioneering methods for detecting dangerous cracks and corrosion in aircraft, advances that have led to improved air safety. He was also awarded a 2005 National Medal of Science, the nation's highest honor for innovation in technology and science.

Jan Achenbach

He was elected a member of the National Academy of Engineering in 1982, a member of the National Academy of Sciences in 1992, and a fellow of the American Academy of Arts and Sciences in 1994. In 1999, he was elected a corresponding member of the Royal Dutch Academy of Sciences, and in 2009, he was elected a fellow of the World Class Universities Program of the National Research Foundation of Korea. He is also an honorary member of the American Society of Mechanical Engineers and a fellow of ASME, ASA, SES, AMA, and AAAS. His awards include the 2012 ASME Medal, the Timoshenko Medal, the William Prager Medal, and the Theodore von Karman Medal. In 2011, he was awarded a rare honorary doctorate degree from China's Zhejiang University.

Achenbach is founder of Northwestern's Center for Quality Engineering and Failure Prevention, a state-of-the-art laboratory for quality control in structural mechanics.

Message from the Chair

For the students, staff, and faculty of the Department of Civil and Environmental Engineering, the past year has been as exciting and productive as ever. Here are some highlights of the progress and achievements we have made.

One of the most exciting pieces of news I want to share with you is that both our BSCE and BSEE programs received full accreditation from ABET. The review was conducted in November 2011, and we were officially notified of the results in summer 2012. ABET accreditation is critical to our graduates who go on to become registered professional engineers. More than a dozen states require that all registered engineers must be graduates of an ABET-accredited engineering program.

Another exciting piece of news is that George Wells will join our faculty this fall as a tenure-track assistant professor. Wells is currently conducting his postdoctoral research in the Swiss Federal Institute of Aquatic Science & Technology. He received his BS in chemical engineering and BA in environmental engineering from Rice University in 2004, and his MS and PhD in civil and environmental engineering from Stanford University in 2006 and 2010, respectively. Wells' dissertation focused on elucidating the diversity, dynamics, and relative importance of ammonia-oxidizing bacteria and newly discovered ammonia-oxidizing archaea in nitrifying wastewater treatment plants, and on employing nitrifier microbial ecology to recover energy from nutrient removal processes.

Over the past two years, we have revitalized our student organizations. Membership in Northwestern's chapter of the American Society of Civil Engineers has risen from a handful to over 60. Last year marked the first time in a long time that both the Steel Bridge and Concrete Canoe Teams participated in competitions; the Steel Bridge Team also qualified and participated in the National Steel Bridge competition. The Tiny House built by the Northwestern chapter of Engineers for a Sustainable World (with our faculty serving as civil engineering advisers) was exhibited at Chicago's Museum of Science and Industry. And in fall 2012, the environmental engineering student group Environmental Engineering Undergraduate Society (EnvEUS) was re-established.

For many years, the enrollment in our MS degree program had stayed around 10 students each year.

> "It is time for us to express our gratitude by keeping you informed of what we do in the department."
> *Jianmin Qu*

In an effort to meet the professional needs of civil and environmental engineering, we made a conscious decision two years ago to increase our MS enrollment by redesigning the curricula and better marketing the program. These efforts have paid off, as we have seen a steady increase of MS students. This spring, close to 60 MS students matriculated. Our professional Master's in Project Management (MPM) program has also seen a sharp increase from about 20 students per year to more than 50 this year.

By this September, I will be finishing the fourth year of my five-year term as department chair. Over the last few years, we have established a strong and effective leadership team to handle the day-to-day operation of the department. This allows me to be more outward-focused. One of my strategic focuses during my remaining term is to better engage our alumni. I say this without any hesitation that our alumni are second to none; over the years, you have supported the department by donating your money, time, experience, and wisdom. Your generosity has made a significant difference in our students' learning experiences and made huge impacts on their lives.

It is time for us to express our gratitude by keeping you informed of what we do in the department. In addition to communicating with you through department newsletters, I plan to travel to different cities around the country to visit with you, report our progress, and seek your feedback. Please consider this letter as a "heads-up" so you will not be surprised when I show up at your doorsteps in the near future.

Jianmin Qu
Walter P. Murphy Professor

UPCOMING EVENTS

CEE Distinguished Annual Lecture

"Sustainability—Taking The Long View"
Wayne Clough, secretary, Smithsonian Institution
Friday, May 3, 4 p.m.
ITW Classroom, Ford Motor Company Engineering Design Center

Great cultural and educational institutions leave their marks on society for years, decades, even centuries. Their lifespan allows institutions to take a long view, maximizing sustainability in areas such as aesthetics, education, buildings, and transportation. They can also apply historical lessons of sustainable living from traditional cultures as well as implement cutting-edge knowledge.

Join Clough for a discussion about how the world's largest research and museum complex is being transformed through an institution-wide commitment to sustainability, including integrating sustainability and energy efficiency into its construction projects, changing the way its land is managed, and revamping transportation systems. *For more information, visit http://cee.northwestern.edu.*

EMI2013: Engineering Mechanics Institute Conference

"Mechanics for Sustainable and Resilient Infrastructures"
Sunday, August 4 to Wednesday, August 7
Northwestern's Evanston campus

The American Society of Civil Engineers' 2013 EMI Conference will be held at Northwestern this year, where it is being chaired by Gianluca Cusatis, associate professor of civil and environmental engineering.

The program will provide a forum for engineers and mechanicians to contribute their expertise to one of the most pressing questions of our society: How can we make the nation's infrastructures safer, more durable, more affordable, and more environmentally friendly during their entire lifetime?

The deadline for online registration is July 1. *For more information, visit www.emi2013.northwestern.edu.*

Murphy Society Grant Helps Develop Hands-On Structure Experiments


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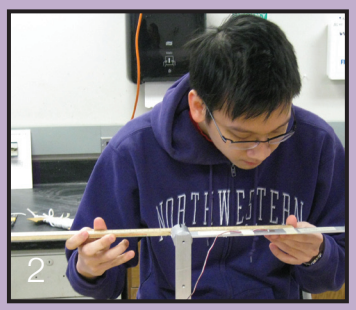
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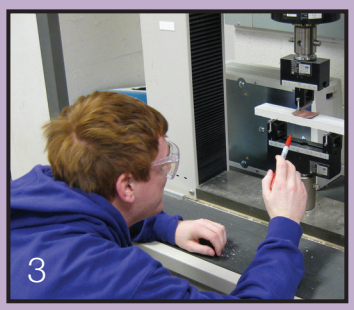
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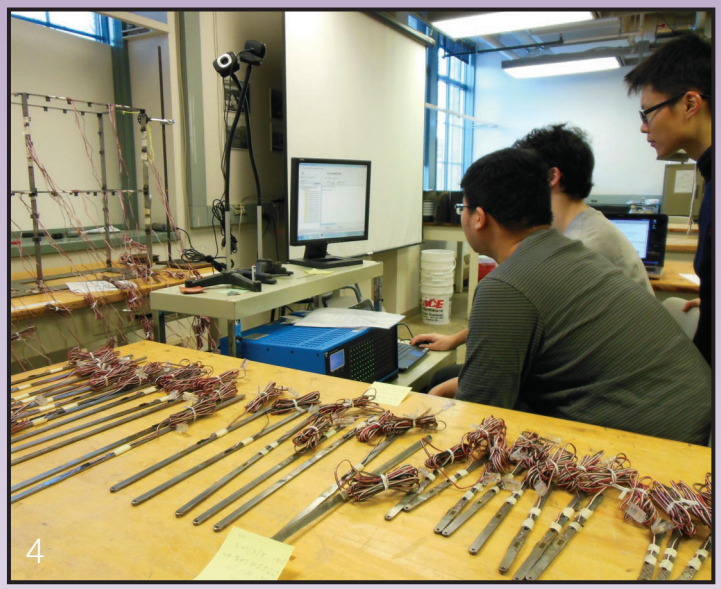
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Thanks to funding from the University and valued supporters, civil and environmental undergraduates now have enhanced access to technology within their department.

Karen Chou, assistant chair and clinical professor of civil and environmental engineering, was awarded a Murphy Society grant with matching funds from the department's Pepper Foundation Fund to improve hands-on experience in structures. Since spring 2011, Chou has been designing experiments, acquiring equipment, and upgrading the capability of the department's MTS machine for undergraduate use.

As of now, students have used the MTS machine to test small concrete cylinders for concrete canoe and steel connections for steel bridge; to conduct experiments for honor theses; and to test concrete beam specimens for the required Reinforced Concrete course (CivEnv 325).

Students in the Theory of Structures I and II courses (CivEnv 221 and 319) have the opportunity to relate the theory learned in class with the data obtained from the scale model "field" test. In CivEnv 221, the students saw a demonstration of a cantilever beam and a portal frame subjected to loads being tested. In CivEnv 319, the students were given the opportunity to install a strain rosette onto a soda can for testing. In both courses, the students have to analyze the test data collected using theory they learn in classes.

Students have used the MTS machine to test small concrete cylinders for concrete canoe and steel connections for steel bridge; to conduct experiments for honors theses; and to test concrete beam specimens.

Finally, the students work in a team on a lab project to test the effectiveness of bracing configuration on a steel frame subjected to lateral loads. Additional experiments are being designed to provide a spectrum of hands-on experience for the students in solid mechanics courses.

1: Students in the Reinforced Concrete (CivEnv 325) course prepare their concrete beam samples; 2: Tee Jin Cheong (civil engineering, '13) records specimen information in Theory of Structures II (CivEnv 319); 3: Observing cracks on concrete beam sample induced by load; 4: CivEnv 319 students set instrument for structural testing; 5 and 6: Students prepare formwork and concrete mix for concrete beam samples in CivEnv 325.

2012 Civil and Environmental Engineering Commencement Reception

On June 15, nearly 70 graduating seniors, MS, and PhD candidates from the Department of Civil and Environmental Engineering gathered for one of their final activities as McCormick undergraduates and NU graduates: the 2012 Civil and Environmental Commencement Reception. In tribute to the graduating class, the event highlighted special student awards and achievements within the department and provided time for students, faculty, and families to connect before students moved on to their next endeavors.


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1. Seniors Tim Healy and Nana Ohene-Adu; 2. Prof. Jianmin Qu welcomes students and guests at the ceremony; 3. Each departing student received a gift from the department; 4. Professor Edwin Rossow; 5. Madison Fitzpatrick; 6. Graduates take an oath; 7. Benjamin Li and Prof. Jianmin Qu; 8. (left to right) Kelsey Watterworth, Professor Karen Chou, Wesley McMinimy, Sebastian Galvez, Elif Koru, and Nana Ohene-Adu


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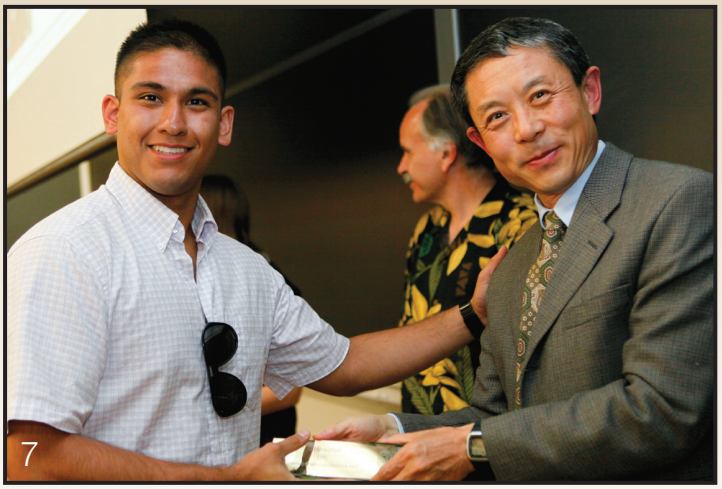
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Far left: Samuel Malin (civil engineering, '12) received his award from Professor Jianmin Qu; Left: Sara Thomas (environmental engineering, '12) shook hands with Professor Jean-François Gaillard.

SIX GRADUATES FROM CLASS OF 2012 RECEIVE DEPARTMENTAL AWARDS

During the Commencement Reception in June 2012, the Department of Civil and Environmental Engineering presented awards and prizes to six graduating seniors. Sebastian Galvez-Martin received the Civil Engineering Senior Award; Michael Giannetto received the Environmental Engineering Senior Award; Elif Koru and Samuel Malin received Wallis S. Hamilton Award for Civil Engineering; Sara Thomas received the Jimmie E. Quon Memorial Award for Environmental Engineering Senior; and Galen Reed received the Edwin C. Rossow Prize for Structural Engineering Senior.

Master of Project Management Experiences Great Success

THE MASTER OF PROJECT MANAGEMENT (MPM) PROGRAM IS CURRENTLY EXPERIENCING ITS MOST SUCCESSFUL YEAR IN TERMS OF STUDENT ENROLLMENT

Forty-eight new students entered the MPM program for the 2012-13 year— roughly twice the normal number — bringing the total number of students to more than 70. Over the years this program has attracted students from about 45 different countries, and it continues to have global appeal.

To further broaden MPM's appeal and enhance its success, new specialization areas are being developed in transportation management, sustainability, and real estate development. At present, the program offers 27 custom-designed courses taught primarily by an adjunct faculty of about 30 professionals, but these numbers will increase as the new offerings become operational.

As the next step to building on the success of the MPM program, the department has developed a new certificate/MS program in Executive Management for Design and Construction (EMDC). This program transcends the tactical skills needed to manage projects and emphasizes the more strategic competency and insights required to lead an organization. It is designed for individuals with 10 or more years of progressive experience who are on a track to advance into senior leadership positions in architecture, engineering, or construction firms.

Students may choose to complete a certificate program or an MS degree. The certificate program consists of six courses that meet from 9 a.m. to 4 p.m. every other Friday and Saturday for 15 weeks from late September through May. These courses are taught by faculty with a minimum of 20 years experience in the design and construction industries.

Forty-eight new students entered the program for the 2012-13 year — roughly twice the normal number — bringing the total number of students to more than 70. Over the years this program has attracted students from about 45 different countries, and it continues to have global appeal.

Students wishing to continue beyond the certificate to obtain an MS degree must take six additional courses chosen with each student's individual needs and goals in mind. As such, the program provides a fast-tracked, highly customized learning opportunity for individuals eager to enhance their career portfolio and move into senior management roles. No other executive development program offers the same level of customized curriculum and intense focus on the design and construction industries. For more information, visit the program website at http://emdc.northwestern.edu.

Clever Battery Completes Stretchable Electronics Package

RECHARGEABLE BATTERY CAN STRETCH, TWIST AND BEND – AND RETURN TO NORMAL SHAPE

McCormick's Yonggang Huang and the University of Illinois' John A. Rogers are the first to demonstrate a stretchable lithium-ion battery — a flexible device capable of powering their innovative stretchable electronics.

No longer needing to be connected by a cord to an electrical outlet, the stretchable electronic devices now could be used anywhere, including inside the human body. The implantable electronics could monitor anything from brain waves to heart activity, succeeding where flat, rigid batteries would fail.

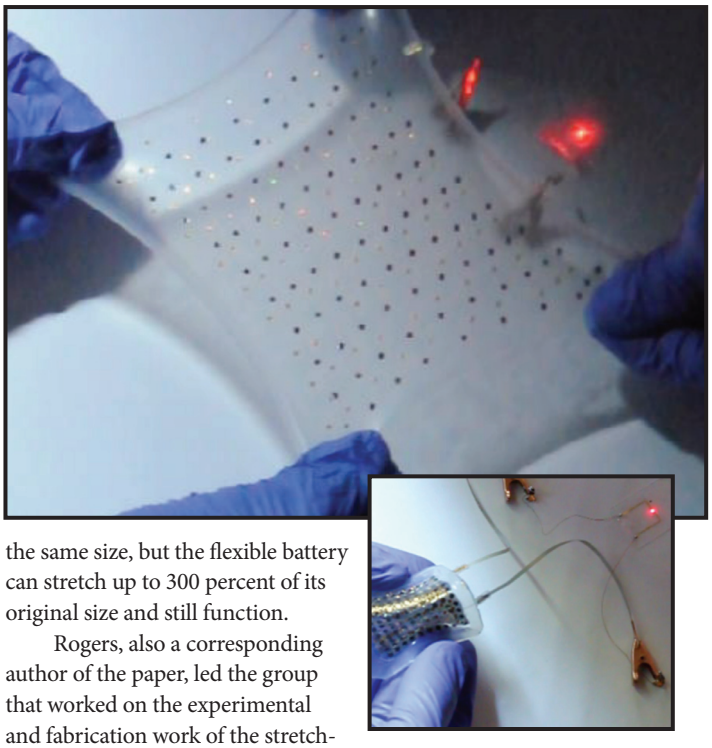
Huang and Rogers have demonstrated a battery that continues to work — powering a commercial light-emitting diode (LED) — even when stretched, folded, twisted, and mounted on a human elbow. The battery can work for eight to nine hours before it needs recharging, which can be done wirelessly.

The new battery enables true integration of electronics and power into a small, stretchable package. Details were published February 26 by the online journal *Nature Communications*.

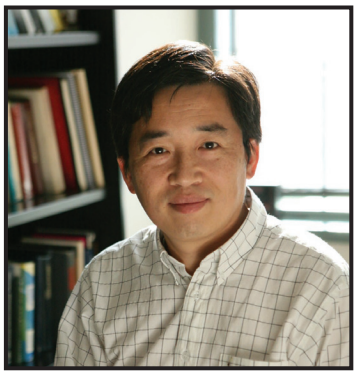
"We start with a lot of battery components side by side in a very small space, and we connect them with tightly packed, long wavy lines," said Huang, a corresponding author of the paper. "These wires provide the flexibility. When we stretch the battery, the wavy interconnecting lines unfurl, much like yarn unspooling. And we can stretch the device a great deal and still have a working battery."

Huang, Joseph Cummings Professor of Civil and Environmental Engineering and Mechanical Engineering at McCormick, led the portion of the research focused on theory, design, and modeling.

The power and voltage of the stretchable battery are similar to a conventional lithium-ion battery of the same size, but the flexible battery can stretch up to 300 percent of its original size and still function.



A stretchable lithium-ion battery developed by Yonggang Huang (below) and collaborators at the University of Illinois can stretch, bend, and be implanted and recharged inside the human body.



Rogers, also a corresponding author of the paper, led the group that worked on the experimental and fabrication work of the stretchable battery. He is the Swanlund Chair at the University of Illinois at Urbana-Champaign.

Huang and Rogers have been working together for the last six years on stretchable electronics, and designing a cordless power supply has been a major challenge. Now they have solved the problem with their clever "space filling technique," which delivers a small, high-powered battery.

> "We start with a lot of battery components side by side in a very small space, and we connect them with tightly packed, long wavy lines. These wires provide the flexibility."
> *Yonggang Huang*

For their stretchable electronic circuits, the two developed "pop-up" technology that allows circuits to bend, stretch, and twist. They created an array of tiny circuit elements connected by metal wire "pop-up bridges." When the array is stretched, the wires — not the rigid circuits — pop up.

This approach works for circuits but not for a stretchable battery. A lot of space is needed in between components for the "pop-up" interconnect to work. Circuits can be spaced out enough in an array, but battery components must be packed tightly to produce a powerful but small battery. There is not enough space between battery components for the "pop-up" technology to work.

Huang's design solution is to use metal wire interconnects that are long, wavy lines, filling the small space between battery components. (The power travels through the interconnects.)

The unique mechanism is a "spring within a spring": The line connecting the components is a large "S" shape and within that "S" are many smaller "S's." When the battery is stretched, the large "S" first stretches out and disappears, leaving a line of small squiggles. The stretching continues, with the small squiggles disappearing as the interconnect between electrodes becomes taut.

"We call this ordered unraveling," Huang said. "And this is how we can produce a battery that stretches up to 300 percent of its original size."

The stretching process is reversible, and the battery can be recharged wirelessly. The battery's design allows for the integration of stretchable, inductive coils to enable charging through an external source but without the need for a physical connection.

Huang, Rogers, and their teams found the battery capable of 20 cycles of recharging with little loss in capacity. The system they report in the paper consists of a square array of 100 electrode disks, electrically connected in parallel.

Huang's research was supported by the Initiative for Sustainability and Energy at Northwestern University (ISEN).

The paper is titled "Stretchable batteries with self-similar serpentine interconnects and integrated wireless recharging systems." In addition to Huang and Rogers, Yihui Zhang from Northwestern is one of two co-first authors of the paper. Other authors include Yewang Su and Huanyu Cheng of Northwestern.

Department News

FACULTY NEWS

Jan D. Achenbach and ***Zdeněk P. Bažant*** received prestigious honors from the American Society of Mechanical Engineers (ASME) in 2012. Achenbach was awarded the 2012 ASME Medal, while Bažant was recognized with an ASME 2012 Honorary Membership.

Bažant also received honorary professorships from the Southeast University in Nanjing and Xi'an Jiaotong University. He also gave a distinguished lecture at the School of Engineering at the University of Akron.

The U.S. Association of Computational Mechanics has named a top medal in honor of ***Ted Belytschko***. The USACM's Belytschko Computational Structural Mechanics Medal will recognize outstanding and sustained contributions to the field of computational structural mechanics, with a focus on important research results that advance theories and methods in the field.

Karen Chou received an Illinois Section ASCE Civil Engineer of the Year Award and received a National ASCE Certificate of Commendation for Excellence Service as faculty adviser to the Northwestern ASCE.

Isaac Daniel was elected a foreign member of the Russian Academy of Engineering. He also received a Best Paper Award from SAGE Publications and the *International Journal of Damage Mechanics* for the most highly cited paper in the journal over the last 10 years. Finally, Daniel was the plenary speaker at the 10th International Conference on Sandwich Structures, in Nantes, France in August 2012.

Charles Dowding delivered the keynote at the Nordic Ground Vibration Conference in Oslo in October 2012.

Kimberly Gray received a National Academies Keck Future Initiatives grant.

Yonggang Huang was named editor of the *ASME Transactions — Journal of Applied Mechanics* and was named a board member for the journal *Current Opinion in Solid State & Materials Science*. He was also appointed to the board of directors and elected vice-president of the Society of Engineering Sciences. Huang's paper on transient electronics, published in *Science*, has been widely reported by all major media. In December, Huang gave a plenary lecture at the AEPA 2012 conference in Singapore.

Sinan Keten has received the ASME Applied Mechanics Division Haythornthwaite RIG Award.

Hani Mahmassani delivered a plenary keynote at the 1st European Symposium on Quantitative Methods in Transportation Systems in Lausanne, Switzerland in 2012, and he delivered a keynote talk at the 25th anniversary celebration of the University of Minnesota's Center for Transportation Studies. He has been appointed to the editorial board of two new international journals in transportation and was invited to brief about 200 officials at the U.S. Senate on crowd dynamics and management in connection with the January 2013 inauguration of President Barack Obama.

Aaron Packman was awarded a Fulbright Distinguished Chair in Hydrology and Hydraulic Engineering at the Politecnico di Torino. Packman also received McCormick's Cole-Higgins Award for Excellence in Advising.

Joseph Schofer has been named a national associate of the National Research Council, a lifetime appointment. He gave the Annual Melvin Webber Memorial Lecture at the University of California, Davis in April 2012, and was appointed for a three-year term to the Advisory Council on Transportation Statistics for the Department of Transportation effective September 13, 2012.

Surendra Shah served as chair of the Nanotechnology and Sustainability in Concrete Construction Workshop in Toledo, Spain from March 10-16, 2013, and is co-chair of the Fourth International Conference on Self Consolidating Concrete, which will be held in May 2013 in Chicago. He was co-chair of the International Conference on Advanced Materials for Energy Efficient Building in New Delhi, India, in February 2013, and gave a keynote lecture at the International Conference on Sustainability Design of Structures in Hong Kong in December 2012. Finally, Shah was given an honorary professorship at the Dalian Maritime Institute, China in June 2012.

STUDENT AWARDS

Michael Chen (civil engineering, '13) and his team took first place in the 2012 Design Competition, in which students design, build, and program robots to operate autonomously.

Tee Jin Cheong and ***Joanna Sokolowski*** (civil engineering, '13) were named to the Illinois Technology Foundation's "Fifty for the Future" list.

Michael Giannetto (environmental engineering, '12) received the 2012 Academic Excellence Award from Central State Water Environment Association.

Katie Kalscheur (PhD '12) was selected to the 2011-12 Associate Student Government Faculty and Administrator Honor Roll. She was instructor of a number of department courses in the past three years.

PhD student ***Kevin Schwartzenberg*** was awarded the 2013 Graduate Student Award in Environmental Chemistry from the Division of Environmental Chemistry of the American Chemical Society.

Sara Thomas (environmental engineering, '12) was awarded an Undergraduate Student Award in Environmental Chemistry from American Chemical Society.

Derek Kit Ho Cheah (civil engineering, '14) was awarded the 2013 Institute of Transportation Engineers Illinois Section Undergraduate Scholarship Award.

ALUMNI AWARDS

Michael Goodkind (PhD '73), a member of the External Advisory Committee, received the 2012 William H. Wisely American Civil Engineer Award.

Professor ***Phillip L. Gould*** (MS '66) of Washington University in St. Louis was named a distinguished member of the American Society of Civil Engineers and also received the Alfred E. Alquist Special Recognition Award from the Earthquake Engineering Research Institute. Gould received the awards for developing innovative technology for the design and construction of large cooling tower shells, applying finite element technology to the development of prosthetic heart valves, and promoting earthquake hazard mitigation worldwide through research, teaching, and leadership.

David Boyce (civil engineering '61), also an adjunct faculty member at McCormick, received the Best Paper Prize at the 50th anniversary meeting of the Japan Section of the Regional Science International Association. His paper was titled, "Predicting Road Traffic Route Flows Uniquely for Urban Transportation Planning."

Cooking Tradition Continues

CEE STUDENTS, FACULTY, AND ALUMNI SOCIALIZE IN THE KITCHEN

One Saturday morning in January, more than 20 students, faculty, alumni, and family members gathered at the Technological Institute's Cohen Commons — not to work, but to cook. Under acting-chef Karen Chou, the group learned to cook spring rolls, dumplings, crab rangoon, and fried rice. They then got to enjoy the food together.

The idea for a department cooking outing started in 2011 when the Northwestern University ASCE Steel Bridge Team asked Chou, who grew up in Hong Kong, to teach them how to make a few of their favorite Chinese dishes.

About a half dozen students gathered at Ken Fuller's (civil engineering, '11) apartment to learn to make the food. The event is now back by popular demand, and this year it was sponsored by Northwestern's Office of the Provost with a Student-Faculty Interaction Grant, a program that fosters extracurricular interactions between students and faculty.

The civil and environmental engineering department gathered in January to cook Chinese food together, the second cooking event of its kind.

McCormick

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NORTHWESTERN UNIVERSITY

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