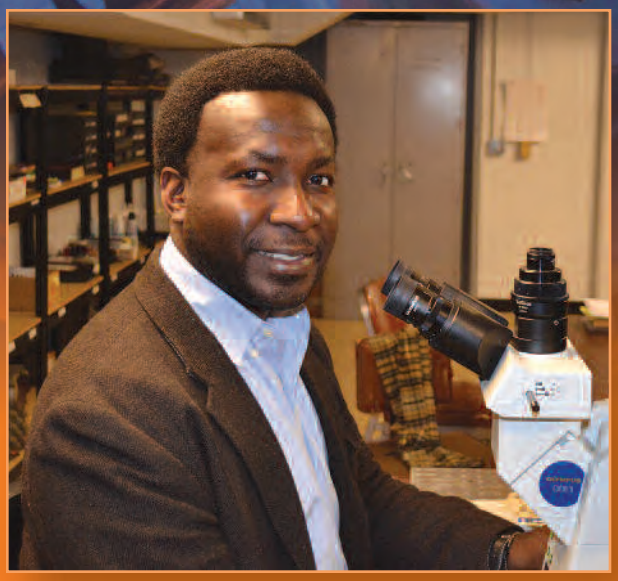
ENGINEERING AT ILLINOIS

Spring 2013

Mechanical

SCIENCE AND ENGINEERING



Moving the World Forward

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New website launched!

We are pleased to announce we have launched a new MechSE website. It contains more photos and information about our great department, allows for easier navigation, and still highlights all of MechSE's news and events. We invite you to visit often!

mechse.illinois.edu

Join our social networks—just go to mechse.illinois.edu!

From the Department Head

Heading into the Spring 2013 semester, I am pleased to report much great news from the Department of Mechanical Science and Engineering at Illinois. As you will read in the pages of this magazine, MechSE students, alumni, and faculty continue to move the world forward through their incredible talent and dedication. We are proud of them and proud to share their news with you.

You'll read about several of our amazing students, including one Senior Design team that not only prototyped a highly innovative water pump for use in Cambodia, but after graduation actually traveled overseas to implement it on site. To help students prepare for life after Illinois, our staff organized a corporate after-hours event in September 2012, which served as an excellent way for our students to meet with top companies seeking to hire our graduates. We are also finding new ways to improve incoming students' experience in MechSE, and in October 2012 we held our second annual open house for our new freshmen and their families.

It was announced this fall that our undergraduate department reached a ranking of No. 5 in the nation for 2013 by *U.S. News & World Report*, and the donations we receive are largely responsible for our ability to maintain such a high-ranking program. We want to thank our alumni and our other friends who have been so generous in their gifts to the department. MechSE alums continue to push boundaries in their professions and their entrepreneurial accomplishments. Last year's Distinguished Alumni Award recipients included **Neel Kashkari** (BSME '95, MSME '98), who managed the federal government's TARP program, while a previous recipient, **Shahid Khan** (BSIE '71), has taken ownership of an NFL franchise, among many other former students making their mark on the world.

In MechSE staff news, please note that advancement director **Chad Rohlfs** has left the university to move closer to his family in South Dakota. But, with luck on our side, longtime department member and friend **Bob Coverdill** (BSME '83, MSME '85) has returned to MechSE to take Chad's place, working with our alumni and other friends. One of his major projects will be seeking input and support for the new MEB renovation and east wing addition. Bob has built strong relationships with many students and former students, and his return to MechSE is being met with excitement. Please join me in welcoming him back!

MechSE faculty members are leading the way in many research areas, both through already-established research centers and through new ones on the horizon. **Petros Sofronis** continues to take the I²CNER Center to the front of hydrogen-energy research, while **Iwona Jasiuk** and **Martin Ostoja-Starzewski** are finding new and better ways to deliver energy to end-users through their proposed HV/TMS Center. And professors **Scott Stewart** and **Nick Glumac** have essentially formed their own shock-physics center without the formality of giving it a name. Professor **Kenneth Christensen** has taken on a new role as our associate head for mechanics programs, and we look forward to his leadership in this area. We have also included a profile of **Michael Philpott** and his car teams. Mike officially retired in June but has stayed on as our acting associate head for undergraduate programs and faculty advisor for all of our car teams. We are deeply indebted to him for his dedication to our department and our students.

Mechanical Science and Engineering has forged its way into exciting new areas—and different aspects of society are being helped because of it. We have included a detailed look at some of our faculty members who are working to push biology and medicine ahead through mechanical science, in the areas of biomechanics and mechanobiology. Their work is truly impressive, and the people of the world will benefit from it greatly. Many students are included on these research teams, and even more are exposed to these professors' boundary-pushing work through classes and projects. As a result, we consistently see evidence—through Kashkari, Khan, and many others—that our alumni take this open and ambitious mind-set with them into the world.

Finally, if you have not heard, we lost a treasured faculty member this fall. **Mark Shannon**, who was our James W. Bayne Professor, passed away in October after battling Lou Gehrig's disease for three years. Continually making advances on behalf of society and enormously dedicated to his students and the department, Mark was one of the most impressive and inspirational members of the MechSE family. He will be missed dearly.

Thanks to all of you for your continued collaboration and support. We hope you enjoy this magazine and reading about the latest happenings in MechSE.

With best regards,

Placid Ferreira
Department Head
Grayce Wicall Gauthier Professor

U.S. News & World Report

Both the Mechanical Engineering program and the College of Engineering overall ranked 5th in the U.S. for undergraduate programs for 2013. While rankings are only one measure of the excellence of our programs, our consistent recognition as a leading institution confirms our reputation as a leader in engineering education. As published in *U.S. News & World Report* in September 2012, the ranked undergraduate engineering science specialties in the College of Engineering* include the following:

- 8 - Aerospace
- 1 - Agricultural
- 18 - Biomedical
- 9 - Chemical
- 1 - Civil
- 5 - Computer Engineering
- 4 - Electrical/Electronic/Communications
- 2 - Engineering Physics
- 4 - Environmental/Environmental Health
- 11 - Industrial/Manufacturing
- 2 - Materials
- 5 - Mechanical

**U.S. News and World Report* does not include Engineering Mechanics, General Engineering, Nuclear Engineering, or Computer Science among its undergraduate engineering program rankings.

Illinois presents international hydrogen research conference

In September, the 2012 International Hydrogen Conference was held at the Jackson Lake Lodge in Grand Teton National Park in Wyoming. It was presented by the University of Illinois at Urbana-Champaign, and the conference co-chairs were MechSE professor **Petros Sofronis** and Dr. **Brian Somerday** of the Sandia National Laboratories.

Professor Sofronis and Dr. Somerday were named co-chairs of the past two conferences in the series by their fellow hydrogen researchers, based upon their long history of successful and productive collaboration. Indeed, Professor Sofronis' and Dr. Somerday's past work has gained international recognition for both UIUC and Sandia National Laboratories. Similar to their many research projects on hydrogen, the 2012 International Hydrogen Conference was a decided success.

"We had a full session with industrial partners from all over the world—from the U.S., from France, Norway, Brazil, Argentina, Japan, and other countries," said Sofronis, who is also the director of the International Institute for Carbon Neutral Energy Research (I²CNER).

"We had the U.S. Department of Energy present to speak about materials and the hydrogen economy. There was clear dialogue between all of the key players on advancing the issues of materials for the hydrogen economy."

Sponsored by I²CNER, Exxon Mobil, Air Liquide, and ASME, the conference examined an incredible range of hydrogen-materials interactions, providing rich, expert feedback on a wide array of challenges and ideas for advancing hydrogen research. The covered topics included material science, computational science, engineering, solid mechanics, electrochemistry, and other areas.

"There were scientists who studied how the electrons are behaving when hydrogen comes in contact with the material," Sofronis said. "At the same time, there were scientists who said, 'here is an enormous pipeline: how can we design it safely?' Or, 'there is this landing gear off a jumbo jet that hits the tarmac, and it gets humidity from the air: what are the effects and concerns, regarding the hydrogen out of the water?'"

The International Hydrogen Conferences have been the premier topical meetings on hydrogen effects in materials, and there continue to be extensive citations of the conference proceedings in technical literature. The continuation of this conference series is proving to be quite timely, since interest in developing hydrogen as a fuel is casting more attention on hydrogen-materials interactions.

"There was exchange, debate, and conversation," Sofronis said. "All that happened in good spirit in a congenial environment where the elder statesmen of the field criticized constructively and gave input to the younger generation, including students."

A large contingency of I²CNER members from Kyushu University in Japan were in attendance at this year's conference. Previous conferences in this series were held in 1973, 1975, 1980, 1989, 1994, 2002, and 2008. The next meeting will be scheduled when the community feels that research and findings in the field have advanced sufficiently.

"THERE WAS EXCHANGE, DEBATE, AND CONVERSATION. ALL THAT HAPPENED IN GOOD SPIRIT IN A CONGENIAL ENVIRONMENT WHERE THE ELDER STATESMEN OF THE FIELD CRITICIZED CONSTRUCTIVELY AND GAVE INPUT TO THE YOUNGER GENERATION, INCLUDING STUDENTS."
– PETROS SOFRONIS

Top: I²CNER brought many representatives to the 2012 International Hydrogen Conference. Right: I²CNER Director and MechSE professor Petros Sofronis addresses the conference attendees.

MechSE professors plan new NSF energy research center

While the MechSE Department has several faculty members involved in new ways of generating energy, two MechSE professors are now making strides toward improving systems for delivering energy to end-users.

Professors **Iwona Jasiuk** and **Martin Ostoja-Starzewski** are proposing a National Science Foundation-supported industry/university cooperative research center called the Center for Novel High Voltage/Temperature Materials and Structures (HV/TMS), along with researchers from the University of Denver and Michigan Technological University. The NSF granted them funding for their pre-proposal, so they are now finding additional collaborating partners before heading to the full proposal stage.

The center's primary aim is to find the best structures, materials, and methods for replacing the nation's system of electrical power lines.

"The demands for electricity are increasing by businesses and residential consumers alike, and the current power lines are becoming inadequate to meet these demands," Jasiuk said. "There is an urgent need to transport more electrical power more efficiently."

The combination of aging lines and outdated technology has resulted in significant energy losses in the electricity sent through most current power lines. Another problem is that the current all-metal, high-voltage conductor materials suffer from line sag, which becomes a safety hazard, particularly in high winds and other inclement weather.

Top: MechSE professors Iwona Jasiuk and Martin Ostoja-Starzewski. Inset: The wire strands inside power cables are some of the proposed HV/TMS Center's primary research concerns.

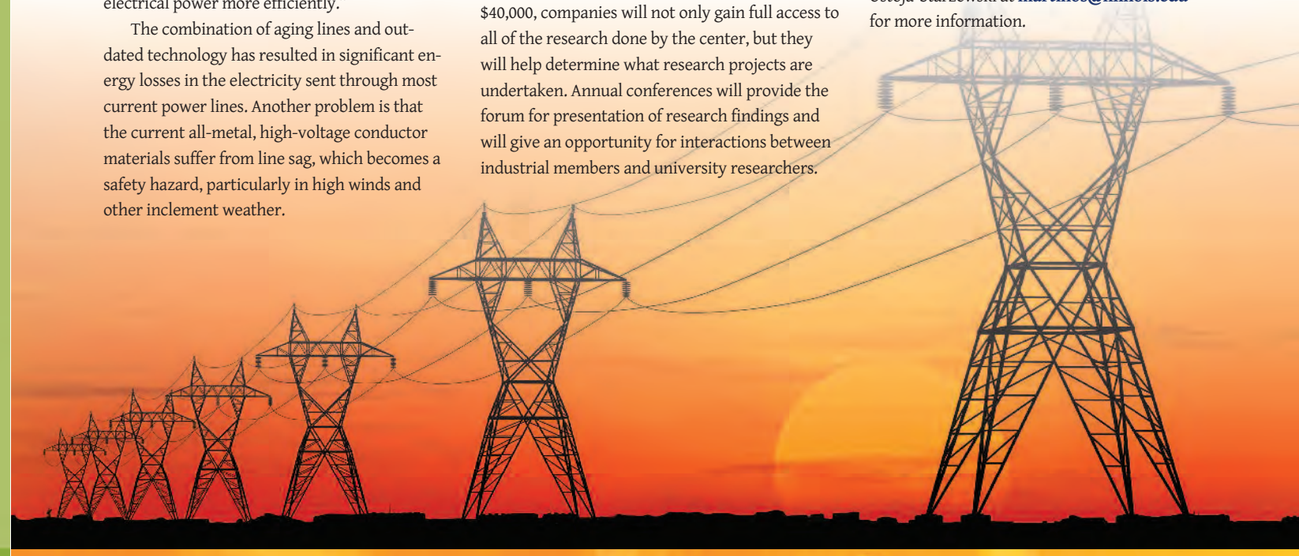
"We are looking for companies to join us in this effort," Ostoja-Starzewski said. "We're looking for not only companies in the power industry from various states and other countries, but actually for aerospace companies, too. Strong similarities exist between the power industry and the aerospace industry's materials and structures."

Member companies from industry will join universities, federal laboratories, and the NSF in a four-pronged approach to creating the HV/TMS Center. The initial research goals are being defined now and at a planning meeting in early December 2012. Further goals will be defined by what the center's industry members identify as vital problems the center's research can solve.

For an annual membership fee of about $40,000, companies will not only gain full access to all of the research done by the center, but they will help determine what research projects are undertaken. Annual conferences will provide the forum for presentation of research findings and will give an opportunity for interactions between industrial members and university researchers.

"The needs in a given sector are identified by a number of companies," Ostoja-Starzewski said. "The research portfolio is shaped and the direction of the research is aligned with their needs and financially subsidized by the NSF."

The planned HV/TMS Center has gained interest from several U.S. corporations. Jasiuk and Ostoja-Starzewski expect several more companies to step forward before the December planning meeting, and that even more will join before the final proposal to the NSF is delivered in March 2013. Interested companies, faculty, and students may contact Iwona Jasiuk at **ijasiuk@illinois.edu** or Martin Ostoja-Starzewski at **martinos@illinois.edu** for more information.



Senior Design students
build sustainable pump for Cambodia—and deliver it

"This kind of international exchange is what makes these projects so rewarding. Taking an idea formed in Brooklyn, a staff of insightful, driven young men and women in Cambodia…engineers in Illinois…advice from Wisconsin, Washington, Australia, the UK, and several other places…and turning it into a workable solution to solve a very real problem for Cambodian farmers."

–Ian Berg

In Cambodia, one of the poorest nations in Asia, farmers need a way to irrigate their fields during dry months, when the water table sinks to seven meters below the surface. A simple water pump could offer a solution, opening the way for a significant increase in the nation's agricultural productivity and profitability. That pump would need to be inexpensive both to produce and to operate. More importantly, it would need to be sustainable.

"The farmers in the two provinces we work in now make between 43 and 54 cents a day," said **Paula Shirk**, founder of the U.S. nonprofit Brooklyn Bridge to Cambodia (BB2C), which worked with students from MechSE to develop an affordable pump for rural farmers. "If the farmers buy these pumps, and they break down, those farmers won't eat."

Add to that challenge the requirements that the pump be highly portable and durable, easy to use in a wide range of environments, and simple enough that Cambodian farmers can set it up and fix it without tools or special training. All that, and local labor would need to be able to manufacture it with local materials and sell it for $50 or less.

That might sound like a tall order, but five undergraduates volunteered for the challenge as their senior design project in ME 470. From January to May 2012, **Bryce Austell** (BSME '12), **Ian Berg** (BSEM '12), **Anthony Cerqua** (BSEM '12), and **Joe Colmone** (BSME '12), along with **Kenny Long** (BS MatSE and MCB '12), designed and assembled a prototype pump to fit the order. Long and Berg traveled to Cambodia in June 2012 to help local engineers build a prototype using local materials and test it in real-world conditions.

The Senior Design team that developed the water pump for Cambodia consisted of (from left): Bryce Austell, Ian Berg, Anthony Cerqua, Joe Colmone, and Kenny Long.

Cheap, reliable irrigation during the five-month dry period of the monsoon cycle would allow farmers to cultivate vegetables either for subsistence or to generate income. Not only would year-round agriculture create economic opportunity, it would allow for crop rotation, helping nourish the soil that constant rice production has depleted of nutrients.

A treadle-operated pump called the Super MoneyMaker, successfully used by the nonprofit KickStart in Africa, has shown promise in preliminary field tests BB2C conducted in Cambodia. Farmers were able to grow vegetables, including pumpkins, peppers, and marigolds, in the dry season, but also used pumps during the rainy season for household uses like providing water for laundry, bathing, and flushing toilets.

"For the rural poor to escape poverty, they must have access to water," Shirk said. "And they must take a part in their own development."

This last part is critical for BB2C, which sells the pumps instead of giving them away, so that the farmers see them as an investment. Unfortunately, imported from China at $125 each, the Super MoneyMaker is too costly for most Cambodian farmers. BB2C sells them for $95, absorbing the $30 difference, but that is an unsustainable model for the small nonprofit and even at that price most farmers cannot afford a pump. As a result, Shirk has been seeking help to develop a similarly effective pump that could be built for less than $25 in materials.

"BB2C identified the need for essentially a successful, low-cost, sustainably designed pump on their own, and then they realized that they didn't have the expertise to do it," Long said.

The New York-based non-profit reached out to several university chapters of another nonprofit, Engineers Without Borders (EWB), hoping to get the engineering support it needed. After talking to Long, then president of the Illinois EWB chapter, Shirk chose to work with students at Illinois, who she called "practical idealists." Long helped get initial approval for the project from the student group's advisory committee, but chose a different approach after talking further with Shirk.

"It became pretty apparent that [BB2C] wanted a pretty accelerated timeline," Long said. "And it just didn't really quite fit with the way that Engineers Without Borders works."

Long was a Materials Science and Engineering major, but felt MechSE students would have the skills he needed, so he reached out to Dr. **Emad Jassim**, MechSE's director of undergraduate programs, to begin the process of adding the project into the Spring 2012 ME 470 course. Jassim obtained Shell Oil Company sponsorship to fund the project. Next, Long recruited a team of students who all agreed to work beyond graduation, if need be, to make the pump a success.

In designing their pump, the team aimed to meet or exceed performance characteristics advertised for KickStart's Super MoneyMaker, but they declined having one sent to them so that it would not influence their own design. The team consulted with BB2C's engineers in Cambodia to learn about locally available material and received additional advice from groups in Wisconsin, Washington, Australia, and the United Kingdom. The final design called for a single-cylinder pump, an innovation which differs from the double-cylinder Super MoneyMaker and cuts down on materials, reducing both cost and weight.

"I told them, 'Please try something different,' and that's what they did," Shirk said. "And what they came up with weighs 10 times less and meets all the standards of the KickStart pump."

By June, the team had built two prototypes; Berg and Long took the second one on an 8,670-mile trip to Cambodia to help BB2C's in-country team build a version using local materials and field test it. Once there, the team encountered a few challenges, including some that required hard work, like lugging the pump up a spiral staircase or threading hoses over balconies, and others demanding "creative design work," according to Berg's account of the trip at www.apumpforcambodia.wordpress.com.

These complications created opportunities for the Illinois and Cambodian teams to learn from one another. Cambodian engineers taught Illinois engineers how to weld a bolt to the end of an unthreaded rod, while Long demonstrated to BB2C's engineering staff how to use a die and handle to thread the other end.

"This kind of international exchange is what makes these projects so rewarding," Berg wrote on the blog. "Taking an idea formed in Brooklyn, a staff of insightful, driven young men and women in Cambodia...engineers in Illinois... advice from Wisconsin, Washington, Australia, the UK, and several other places...and turning it into a workable solution to solve a very real problem for Cambodian farmers."

After a successful build and test in Cambodia, Berg and Long returned to Illinois in early July. Shirk reported a week later that Cambodian engineers had built two more prototypes and were preparing to begin long-term field testing of the system that she dubbed The RUDI Pump after her adoptive Cambodian son.

"Cambodia gave my son Rudi to me, the source of my joy," Shirk said. "We now give The RUDI pump back to Cambodia. May it be a source of life."

Top: Ian Berg explored Angkor Wat, the largest Hindu temple complex in the world. Left: Ian Berg and Kenny Long work with Cambodian engineers on implementing the design team's water pump.

Left: Family members were encouraged to explore several different student-built cars in Mechanical Engineering Laboratory. Above: MechSE grad student Miki Takagi (BSME '10) spoke with students about the MNMS Cleanroom, where she is a lab specialist.

Fall open house

welcomes prospective students and freshmen alike

Engineering Open House has long been a spring tradition at the University of Illinois, and the MechSE Department is always a strong participant, featuring many of the College of Engineering's most hands-on and exciting exhibits. Now, for the past two fall semesters, the department has started a new tradition: a fall MechSE Open House taking place about a month into the new school year at Mechanical Engineering Laboratory.

Held on the day of the department's annual Scholarship and Fellowship Banquet, the open house reaches two distinct audiences: prospective students from area high schools in the early afternoon and MechSE freshmen and their families in the late afternoon. Some of the high school students come individually with their parents, while many others come by the busload, organized by their school counselors and science teachers.

"It's really a wonderful way to showcase all of the great things about MechSE for both our new freshmen and their parents, and for prospective students," said Department Head **Placid Ferreira**. "And it's quite remarkable the way MechSE staff, faculty, and students come together to host everyone and give them a true sense of what the department is all about."

Attendees receive a tour of several labs and see exhibits that feature various research areas and student societies. They also get a first-hand look at MechSE's student-built cars, including the Formula, Baja, and Hybrid cars from SAE and the Eco-Marathon cars. In addition, prospective students attend a short formal presentation in the John Deere Pavilion and take home handouts that include information about the department and how to apply.

Both open houses were very well-attended and considered very successful events, Ferreira said. He notes that having current students staff the exhibits and give the tours helps the new and prospective students envision how much they could learn over their next few years.

To find out more about the MechSE Open House or learn how to attend the Fall 2013 event, please contact **Betsy Powers**, MechSE's student and alumni relations coordinator, at **epowers2@illinois.edu.**

Scholarships

Scholarships are an important way for MechSE to attract top undergraduate students from Illinois and around the world. Listed below are MechSE's scholarship recipients for 2012-13. We congratulate these students and would like to express our thanks to the alumni and friends who made these honors possible.

MechSE Endowed Scholarships

James W. Ashbrook Scholarship
Julia Huynh
Andrew Jacobs

A. Richard Ayers Scholarship
Jacob Haseltine

James and Loretta Bayne Scholarship
Bruno Abdelnour
Sarah Coady
Anne Goering
Michael Martin
Neeraj Ramachandran

Paul A. and Edna M. Beckemeyer Scholarship
Madison Whitt

Thomas J. Breen and Gail Schaller Breen Scholarship
Matthew Carmody
Matthew Piper

Donald E. Carlson Scholarship
Arik Avagyan
Kendall Rak

Bei Tse and May Chao Scholarship
Timothy Garbaciak
Justin Hunter
Karen Lipa

Guy Richard Collins Engineering Scholarship
Timothy Chen
Sebastian Guevara
Vincent Hughes
Inwho Hwang
Joshua Kim
Lawrence Kim
Michael Mata
John Meehan
Alec Mori
Jonathon Nord
Abraham Phillips
Daniel Tisza
Thomas Tong
Chashak Tulsyan
Alexander Wendling

Phillip A. Dethloff Scholarship
Andrew Bell
Andrew Lee
Cassidy Warning
Scott Zacek

Patrick B. and Janet A. Flanagan Scholarship
Niket Patel

A. G. Friederich Memorial Scholarship
Christopher Moss
Zachary Weiner

C. J. Gauthier Mechanical Science and Engineering Scholarship
Maggie Naden
Adam Rosenbaum

Margaret L. Gongaware Scholarship
Anthony Bruno
Quinton Ford
Carl Handley
Scott Kramer
Matthieu Kruyswyk

Al Hallene/Pella Corporation Engineering Scholarship
Marc Deetjen
Alexander Gruebele

Roger and Sandra Heath Scholarship
Christine Littrell

Henneman Scholarship
Jacob Avery
Christopher Johnson
Zachary Renwick

Miles and Louise Hinsley Scholarship
Chee Haw Chan
Richard Deering
Prashant Guha
Grant Hallan
Jennifer Lin
Jarrod Martis
Jeffrey Smith
Alex Studnicka
Jason Troutner

Illinois ME Scholarship
Jessica Simpson

Erle E. Johnson Scholarship
Michelle Diaz
Harry Rocha

Karl W. Kolb and Arden M. Kolb-DeBolt Scholarship
Gideon Horberg
Kevin Kibler

Arthur W. Lindstrom Scholarship
Kaleb Collier
Michael Hafeman
Logan Wan
Samuel Zschack

John H. and Billie Jean Marsh Scholarship
Alexander Smillie

Robert E. Miller Scholarship
Drake Hislop
Gregory Wilk

James E. Peters Scholarship
Robert Born
Nikhil Kapur

Mark E. Prasse Memorial Scholarship
Hannah Brown
William Gray

Ben Jay Rosenthal Scholarship
Adam Flanders
Daniel Wong
Alex Wu

Sam Sachs Memorial Scholarship
Michelle Boehm

Kent F. and Carol Ann Schien Engineering Scholarship
James Leigh

Fred B. Seely Scholarship
Daniel Borup
Ian McNamara
Mustafa Mohamad

George M. and Ruth N. Sinclair Scholarship
Zachary Berent
Eric Hansen
John Leighton

Earl and Althea Smith Scholarship
Stephen Carrington
Logan Farrell

Soo Family Scholarship
Jaclyn Coyle
Ann Zuzuly

Morris Stern Scholarship
Michael Holz

Wilbert F. Stoecker Scholarship
Sonja Brankovic

Charles E. Taylor Scholarship
Ryan Mott

Thomas-Lain Scholarship
Michelle Boehm
Sonja Brankovic
Jaclyn Coyle
Jill Godman
Anne Goering
Grant Hallan
Nikhil Kapur
Neeraj Ramachandran
Jason Troutner

James R. Tucker Scholarship
Mason Blake
Joanna Bober

Raymond and Birute Viskanta Scholarship
Marissa Herpfer
Michael Hubner
Kyle Johnston

Eleanor and Eugene Wesselman Scholarship
Alec Uy
Jeffrey Winegar

Steven Kyoon Yun Memorial Scholarship
Jonathon Ervin
Kathryn Neville

MechSE Annual Scholarships

William L. Fourney Scholarship
Aaron Danielsen
Ben Shields

MechSE Outstanding Scholarship
Stefan Dao
Austin Herman
Kenneth Swartz

MechSE Alumni Scholarship
Karthik Arunachalam
Muyun Cai
Xiaoyue Chen
Yuanshan Chen
Zonghe Chua
Shaival Desai
Robert Donahue
Ryan Han
Abhishek Harish
Rohan Khanna
Roy Lee
Boqi Li
Yue Liang
Ting Liao
Ruobing Ma
Amit Madhukar
Donald Magnani
Danielle Malone
Katie McGrew
Max Methling
Mahmoud Mohammed
Nathan Rapp
Avery Rosenbloom
Brendan Ryan
Yichuan Song
Justin Yi Ming Tan
Daniel Whitt
Kaiyuan Zhu

MechSE Corporate Scholarships

Anheuser-Busch Foundation Scholarship
Monica Ngo

Caterpillar Scholarship
Rebecca Byrd
Timothy Ewan
Gabriel Gaeta
Charles Orozco
Ryan Ruddell
Alejandro Scholcoff
Albert Xiao

ExxonMobil Scholarship
Erik Anderson
Bobby Baer
Elizabeth Bertness
Gail Butler
Eric Eckstrum
Jill Godman
Stuart Herndon
Michael Hutchinson
William Iverson
Rohan Karmarkar
Jessica Simon

Illinois Tool Works Foundation Scholarship
Anthony Cao
Nathan Dostart
Alexander Gui

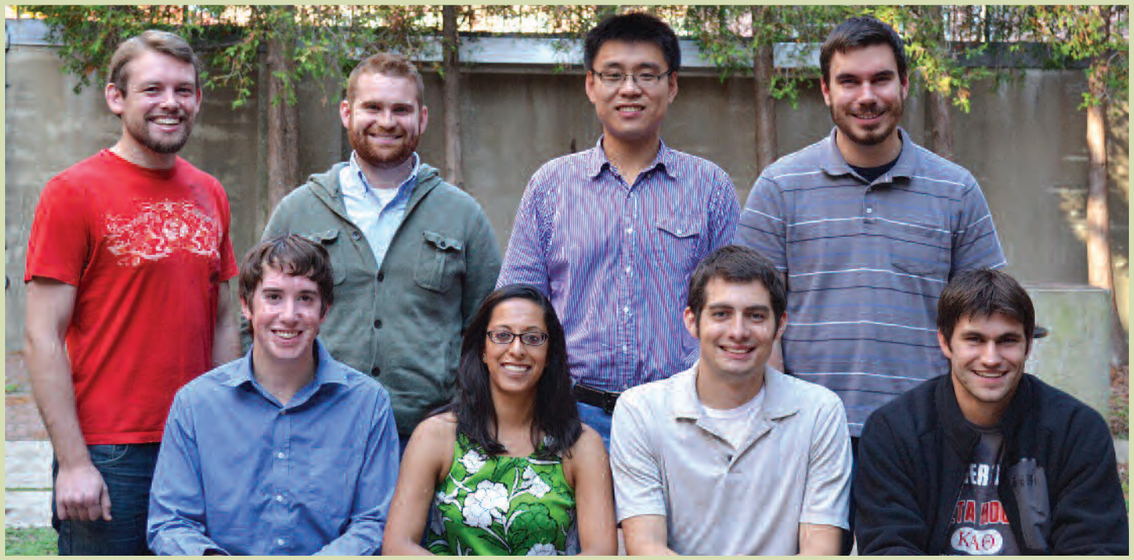
Kaiser Aluminum Scholarship
Andrew Goldberg
Christopher Herrera
McKenzie Lavalle
Christopher Sanders
William Smith
Nathan Zimmerer

Parker Hannifin Scholarship
Scott Schilling

Shell Oil Company Scholarship
Alexandra Klieger

Trane U. S. Inc. Scholarship
Christopher Marry
Athrey Nadhan
Eric Staniszewski

MechSE students win fellowships from DoE, NSF, ASHRAE



Fellowship winners (from left): James Henry Pikul, Justin Koeln, Jonathan Robert Felts, Neera Jain, Hanfei Tuo, Brian McGuigan, Eduardo Torrealba III, and Matthew Rosenberger. Not pictured: Bruno Azeredo and Elizabeth Jones.

Department of Energy Fellowships

From controlling air conditioning systems to making smaller power sources, MechSE grad students are making real contributions to energy research. Four students won Department of Energy (DoE) Fellowships in recognition and support of their work. The DoE grants each fellowship recipient a stipend of $35,000 a year, eligibility to receive up to $10,500 toward university fees, and $5,000 a year for research.

James Henry Pikul's research is among the projects that the DoE helps fund every year. MechSE professor **William King** and affiliate professor **Paul Braun** envisioned the day a cell phone charger powers an entire home. Pikul, a graduate research assistant, said he and the professors will probably start by powering smaller objects, working on increasing the amount of energy a small charger provides to as much as 2,000 times of what it is now.

"Basically, we create novel nanoarchitectures (microscopic DNA structures) to reduce the diffusion length and active material to get a really fast transfer of lithium ions and electrons," Pikul said. "Therefore, we get much higher power densities."

Along with the fellowship, students are also invited to attend the annual DoE meeting, where they meet other fellowship recipients. **Neera Jain**, a graduate research assistant and DoE fellowship recipient for the past three years, said her experience at the meetings across the country was a much appreciated perk.

"I've been an engineer now for 10 years and most of my friends are engineers," Jain said. "It was eye-opening to learn about their (students studying other areas of science) perspective, because the way they look at research is different than the way that engineers do."

With advising from Professor King, fifth-year PhD candidate **Jonathan Robert Felts** finds alternate uses for polymer, also used in hot glue for glue guns, to create a conductive system and produce electricity.

"Polymer technology is going to be very big in the future because it is lightweight, flexible, and you can do all the same things you can do with conductors," Felts said.

He plans to work on his project well after funding from the DoE ends.

Another DoE fellowship recipient, **Matthew Rosenberger**, has more time to think about continuing his research post-funding as he enters the first year of his fellowship. He works with Professor King to measure heat flows using bimaterial beams, or microcantilevers. These beams bend when heated, so measuring cantilever bending allows Rosenberger to quantify heat flow through the cantilever.

"My work aims to optimize the materials and geometry of bimaterial microcantilevers in order to improve the sensitivity of this technique," Rosenberger said.

National Science Foundation Fellowships

Bruno Azeredo, National Science Foundation (NSF) Fellowship recipient, wants to restore waste heat from engines ranging from automobiles to power plants. He builds high-aspect-ratio silicon nanostructures to suppress heat conduction and improve thermoelectric effects in semiconductors.

"If you think of a phonon traveling through a very confined space, defects become extremely important at preventing heat conduction," Azeredo said. "By adding certain kinds of defects, we reduce the thermal conductivity by several orders of magnitude while maintaining good electrical properties."

The NSF Fellowship funds most of Azeredo's research, which focuses on large-scale and economic manufacturing processes to realize novel nanotech products. He spent six months preparing his fellowship application, which turned out to be time well-spent.

Five MechSE students were awarded the NSF Fellowship, which provides each student with three years of financial support, a $30,000 annual stipend—which is expected to increase by $2,000 next year—and $12,000 to the institution. The program also offers research opportunities abroad and access to the TeraGrid supercomputer.

Brian McGuigan, a master's student, uses his funding to research the efficiency of solar cells with Professor **Harley Johnson**.

"Grad students with funding are cheaper to the professors," said **Elizabeth Jones**, a Ph.D. student in theoretical and applied mechanics. "It gives you more flexibility on what you want to work on."

While Jones began some of her initial design work at the large-scale machinery manufacturer Caterpillar, she has since moved on to exploring the expansion and contraction of electrical conductors (electrodes) in lithium batteries with MechSE affiliate professor **Nancy Sottos**.

Justin Koeln, a master's student and the Getaway Special program student at National Aeronautics and Space Administration (NASA), concentrates his work on controls research. He conducts research to improve the performance and efficiency of heating and air conditioning systems with MechSE professor **Andrew Alleyne**.

Master's student **Eduardo Torrealba III**'s completion and application of his own research to places outside the laboratory may have helped him earn his fellowship.

"It is something that started at my school and I helped with a micro-hydroelectric project in Honduras. I was involved in a group called Engineers with a Mission and that was similar to Engineers Without Borders. We put in a hydroelectric generator and made it generate light," Torrealba said. "It was something I was pretty passionate about, which is developing technologies that will have impact abroad."

Since earning the fellowship, Torrealba has shifted his focus to studying heat transfer improvement on micro-textured surfaces with Professor King.

ASHRAE Fellowship

A fourth-year Ph.D. student, **Hanfei Tuo** said he was fortunate to have MechSE research professor **Pega Hrnjak** recommend him for the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Fellowship program.

Tuo is also student president of the ASHRAE chapter at Illinois. With his leadership role, he organizes seminars and activities related to work fields in ASHRAE.

"It is important for students to get involved with ASHRAE academics," Tuo said. "But there are other students who also get the fellowship without any titles in ASHRAE in student chapters."

Tuo has already begun to carry out his fellowship proposal, which focuses on improving the efficiency of residential air conditioning systems.

Fellowships

Fellowships are an important way for MechSE to attract top graduate students who have achieved success at Illinois or at other top institutions throughout the world. Listed below are MechSE's fellowship recipients for 2012-13. We congratulate these students and would like to express our thanks to the alumni and friends who made these honors possible.

MechSE Endowed Fellowships

Eugene and Lina Abraham Fellowship
Joseph Fasl
Lili Feng
Lihan Xu

Pat and Bette Calabrese Fellowship
Joseph Fasl
Matthew Fitzgerald
Matthew Williams

Wen Lung Chow Fellowship
Megan Kania

George A. Costello Memorial Scholarship
Sushil Kumar
John Sanders

Thomas J. and Virginia Fisher Dolan Fellowship
Joseph Fasl
John Sanders

C. J. Gauthier Mechanical Science and Engineering Fellowship
Justin Koeln
Young Joon Koh

George B. Grim Fellowship
Jangho Choi
Kartik Marwah
Yu Wang

Henry L. Langhaar Fellowship
Amanda Jones

Louis J. Larson Fellowship
Peter Maginnis

MechSE Alumni Teaching Fellowship
Wael Abuzaid
Ali Ashraf
Han Na Cho

Robert E. Miller Fellowship
Sarah Mannen

James E. Peters Fellowship
Eduardo Torrealba III

Shao Lee Soo Fellowship
Jangho Choi
Brian Williams

Stoyke Fellowship
Michael Wineman

H.C. Ting Fellowship
Raymond Essick
Mei Kuen Hsu
Michael Johnston

College of Engineering Fellowships

Mavis Fellowship
Wylie Ahmed
Vikhram Vilasur Swaminathan
Yangmin Xie

Graduate College Fellowship Board Block Grant Funding
Raymond Essick
Matthew Fitzgerald
Mei Kuen Hsu
Michael Johnston
Megan Kania
Kartik Marwah
James Pikul
Matthew Rosenberger
Lihan Xu

SURGE (Support for Under-Represented Groups in Engineering) Fellowship
Amanda Jones
Sarah Mannen
Eduardo Torrealba III

Roy J. Carver Fellowship in Engineering
Omkar Lokhande

Yee Memorial Fund Fellowship
Lihan Xu

Graduate College Fellowships

FMC Educational Fund Fellowship
Harinshankar Manikantan

Illinois Distinguished Fellowship
Anna Oldani

Corporate-Sponsored Fellowships

Department of Energy Fellowship
Jonathan Felts
Neera Jain
James Pikul
Matthew Rosenberger

Sargent and Lundy Fellowship
Brian Williams

National Fellowships

ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) Fellowship
Hanfei Tuo

NSF's Integrative-Graduate and Research Training Program (IGERT) Fellowship
Samantha Knoll
Daniel Perlitz
Xin Tang

NSF (National Science Foundation) Fellowship
Bruno Azeredo
Elizabeth Jones
Justin Koeln
Brian McGuigan
Eduardo Torrealba III

Seniors reminisce on academics, friendship, life at Illinois

MechSE seniors **Ann Zuzuly** and **Val Laguna** were in the same small group at Women In Engineering (WIE) camp in the fall of 2009. They didn't become BFFs overnight, but after hanging around each other via a mutual group of friends and serving together in numerous professional organizations, by junior year, they were roommates. Val calls Ann "My rock; we talk every night about our day." Ann's response? "She's my rock, too!"

Ann reminisces about meeting Val at WIE camp their freshman year: "They break you into groups within your major, so we were in the same group and did a lot of the same activities. So we met a lot of the same friends. We didn't become friends right away, but freshman year is a lot about exploring who you are, figuring out who your friends are. So as freshman year progressed, we ended up becoming really, really close friends."

Part of what began for Ann and Val that first day through WIE and professional societies in which they have participated since was a sense of belonging to a community. Says Val: "I'm really big about feeling comfortable in the community that I'm in, and Illinois Engineering has really provided that for me, which is what makes it so great. That's why I get passionate about recruiting. It's because I've had such a good experience; I have felt so comfortable here that I really want to show that to people. I really want them to feel that same thing."

However, Val's career at Illinois hasn't always been bright and sunny. She weathered some storms when, as a sophomore, she failed two classes. When she got those bad grades, she remembers, "I had multiple deans email me and say, 'Hey, what happened? Are you going to be ok?'" When she approached the director of the MechSE undergraduate office in trepidation, expecting the worst, he asked, "'What do you think we can do differently next semester? What resources are you going to need to be successful?' It was all about me and what I needed." Val didn't quit, and when her grades improved the next semester, she even got the "Most Improved Student" award. When students would ask her how she got the award, she would say, "You don't want to know."

Val claims that what helped her during those rough times was "the community of support at Illinois. We have this joke that says, 'When you go to Illinois Engineering, you go to a small private school. And if you want to go to a big public school, cross the street!' And I feel like that's really true. Here in the Engineering Quad, we have our own little world."

Ann agrees: "Illinois has been really great about preparing me for the future. It's given me everything I need in terms of practicing leadership skills, learning a lot academically, gaining technical knowledge through design projects and research. It's just been a really powerful impact in developing me as a person."

Both Val and Ann have participated in numerous student organizations. Val recited a litany of the roles they have played in numerous engineering professional societies, both as members and leaders. Also, both have been Engineering Learning Assistants (ELAs) in the iEFX Engineering 100 course. While Val is lead ELA for MechSE this year and also leads an Engineering 100 discussion group, Ann is in charge of all the ELAs this year. And neither has been afraid to "cross the street." Ann played in the band; Val is on the Illinois Club Tennis Team.

Ann Zuzuly

Val Laguna

One of Val's favorite activities has been being an Engineering tour guide for prospective students, as well as already-admitted students. "They got in; we really want to impress them," Val said. "I'm really passionate about anything that has to do with recruiting. My experience at Illinois has been amazing, in a big part because of the friendships that I've made and the communities that I've been able to be a part of."

Because of the support they've received from each other and others throughout their careers, both are set to graduate: Ann in May 2013; Val in December. What then?

Ann's ultimate career goal is designing more energy-efficient buildings. She is currently heavily involved in designing and building Solar Decathlon's Net-Zero Energy House. Not only that, her senior design project is a net-zero energy design for MechSE's building remodel. Of these opportunities, she calls them "really, really good hands-on technical experience that will help me when I go out into the workforce."

What does Val want to do when she graduates? Manufacturing. "My dream job out of college is to be at a manufacturing site, working on equipment, being out on the line, steel-toed shoes, safety glasses, safety vest. I'm okay with all of that. And that's actually why I went into mechanical engineering." She relates, "People always ask me, 'So, why mechanical engineering?'" Her response: "I like conveyor belts."

– Written by Betsy Innes, I-STEM Education Initiative

"We have this joke that says, 'When you go to Illinois Engineering, you go to a small private school. And if you want to go to a big public school, cross the street!' And I feel like that's really true. Here in the Engineering Quad, we have our own little world."
– Val Laguna

MechSE students mix with company reps at Corporate After-Hours

MechSE students were able to speak with representatives from a wide range of companies at the Fall 2012 Corporate After-Hours event, which was held in Mechanical Engineering Laboratory.

In order to provide greater employment opportunities for the department's students and to strengthen ties with industrial partners, MechSE hosted its inaugural Corporate After-Hours social event in September 2012.

Held in Mechanical Engineering Laboratory, the gathering enabled MechSE juniors, seniors, and grad students to meet with corporate representatives in an informal setting and gain a better understanding of each company and its hiring needs. Holding the after-hours on the same day as the Engineering Career Services fall career fair allowed the corporate reps to maximize their time on campus and ensured they would get quality time with MechSE students, who comprise some of their most valued recruits.

"As one of the top mechanical engineering programs, it is vital that we continue to build the strongest possible relationships with corporate partners in our industries," said MechSE department head **Placid Ferreira**. "By working closely together, there are nothing but benefits to be found for the students, the companies, our faculty, and the department."

In surveys that were collected after the event, the corporate reps' overwhelming consensus was that the event was beneficial and they would attend again in the future. Some of the reps requested that MechSE freshmen and sophomores be included at future events, particularly students seeking internships.

On the students' surveys, results were similarly positive, with 100% stating they would attend this event in the future.

The department is considering expanding the event to be held in both the fall and the spring. For more information on attending, companies are encouraged to contact **Betsy Powers**, MechSE's student and alumni coordinator, at **epowers2@illinois.edu**.

Car programs prepare students **to problem-solve down the road**

You could say MechSE's acting associate head for undergraduate programs, **Michael Philpott**, has been working double shifts. Most days, he can be found in the undergrad programs office. And as the instructor for ENG 491/ME199 SAE and faculty advisor for ME 470 Senior Design, Philpott serves as faculty advisor to Illinois' five multidisciplinary race car teams—a huge time commitment in itself.

The three Illini Motor Sports teams—Formula SAE (the most developed program, with about 80 students); Baja (off-road); and Hybrid (electric and gasoline)—race as part of SAE International (formerly Society of Automotive Engineers). The Shell Eco-Marathon Prototype and Urban Concept teams strive for fuel efficiency.

Students on these teams register for one of the courses, plus participate in extracurricular, student-run organizations. For example, Formula SAE team students register for ENG 491: SAE section (for seniors) or ME 199 SAE (for underclassmen) and also participate in Illini Motorsports. EcoMarathon team members take ME 470 senior design and are part of Eco Illini or Illini EcoConcept.

Unique, multidisciplinary engineering courses, ENG 491/ME 199 don't just involve designing and building a car. After receiving instruction on relevant topics, students from engineering (mechanical, electrical, aerospace, agriculture, computer, etc.) and also non-engineering disciplines, such as business, divide into sub-teams: engine, chassis, body, electronics, and even business. Not only is a business presentation part of the competition, but teams require a lot of sponsors.

"One of the challenges," explains Philpott, "is to design and build a car in budget. You only have a certain amount of money. One of the jobs of business sub-teams...is to get sponsors and to get money out of them, as well as in-kind contributions, for example, give us tires." Plus, teams need to purchase parts from companies who make them according to student-designed specifications.

While most courses are taken only once, students take ME 199 each year. Structured to evolve, the course addresses different topics each year, including presentations by guest speakers from sponsors whose logos are emblazoned on the cars, such as Bosch, Caterpillar, Ford, Lockheed, SpaceX, etc.

Besides being multi-disciplinary, teams are comprised of students of all ages and structured so younger students learn from the older. Joining as freshmen, students work their way up to become sub-team leaders or team leaders. Seniors, who know the ropes, typically run the training and the competition. This continuity allows teams to evolve their previous year's design, rather than starting from scratch each year.

In fall and early spring, teams design and build the car, and compete from April through June. The programs all have different races in different places, with students competing both nationally and internationally.

But the competitions are about more than just racing. SAE teams all have both static and dynamic events. Static events involve categories like business and design. On the business end, students make presentations showing the project details, like cost of materials. Judged on design elements, cars receive a technical inspection of key items, such as brakes.

For the noise-testing event, the vehicles have noise limits, which Philpott finds to be "a little bit disappointing, because, after all, the whole point of Formula is to be a little bit noisy. But they don't allow us to go above a certain DB. I think it's 109. It's still pretty noisy." Illinois' team is perennially challenged by the noise limit: "We actually struggle with that every year because our car is inherently noisy. That's partly because the students create it so, because they like a good roaring sound, and then we have to tone it down a little bit."

Another limit: cars are not allowed to have greater than a 600cc engine. Illinois' engine, a stock motorcycle engine students modified, is 599cc.

Competitions also have dynamic events, such as Skid Pad (a fast figure 8) and Acceleration (the car accelerates from 0–60 mph in a straight line). While the vehicles' acceleration is competitive with any race car, top speed is limited. Because the air intake diameter is limited to restrict power, and because the layout of the race track has no long straights, the cars don't really get a chance to build up to a very high speed with the power available "because generally, we don't like to kill students," Philpott joked.

And finally, the teams race. Autocross is a one-lap, timed event; students don't race against each other. Most similar to the traditional car race is the Endurance event, where vehicles race against each other, five cars at a time, for 20 one-mile laps. However, cars take off at different times, and drivers must allow someone coming from behind to pass. Despite these differences, the race is still competitive, because those with the best times in autocross race against each other.

Simon Du, Michael Philpott, and Mark Teramoto examine the Hybrid car's circuitry.

Michael Philpott with students Katie Birkel and Paul Hummon show off the Baja car's fresh coat of Illinois mud.

Philpott reports that the Endurance race is not so much about speed as about surviving—not breaking down or losing any liquid or any part of their car. In fact, only about 50 cars actually finish without overheating or a chain breaking. "It's surprisingly challenging. It's quite a distance."

The other SAE teams have mostly the same events. However, instead of Skid Pad, the Baja SAE (off-road) program, has an event called the Rock Climb, where cars climb a very steep surface. The Hybrid (a combination electric and internal combustion), requires an enormous amount of electrical technology. The car's side pods have 300 A123 batteries and a sophisticated system for charging and monitoring them. Because the Hybrid is mostly electric, Professor **Phillip Krein** from ECE joins Philpott as joint faculty advisors for the team.

The Shell Eco-Marathon team cars are designed for energy efficiency. Illinois has two teams: EcoIllini, the prototype class (two cars), and Illini EcoConcept, an urban concept car, which must have everything a commercial car has, right down to the windshield wipers. Held in downtown Houston the first week of April, the race is on six miles of cordoned-off streets. Each team receives a very carefully measured glass vial of gasoline; after (or if) they complete the race, the car's miles per gallon is computed based on the amount of gas used. The 2012 mark to beat: 2,188.6 mpg!

Illinois' top finishes have come from the Eco-Marathon teams. Last year, the urban concept car won the hydrogen fuel cell car division. The year before, the prototype won the ethanol.

So who gets to drive? Students must compete for the honor. On weekends, they put out cones in the Assembly Hall parking lot and have driver training sessions and competitions, "because drivers have to learn to race." Philpott adds, "We want to win. We want to do the best we can. Obviously we will choose the better driver. By the time we go to competition, we normally know who the best drivers are and who to select." They typically select four, just before the competition.

Philpott said the most rewarding aspect of his involvement is watching the students develop over the years. "It's phenomenal how a freshman coming in knows absolutely nothing about any of these things, and yet, by the end, they're so confident, so capable. And I think the fact that the students get so much out of it. It's a combination of enjoying it as well as learning a lot from it."

What do students get for all their time commitment? Six hours of ENG 491/senior design and tech elective credit. But they get a lot more than just a few hours of credit; they also learn engineering via practical, hands-on experience.

"When you think of the time invested over four years, it's a phenomenal amount of time, actually. But it's a huge learning experience, and they'll all tell you so. Just going through the process of designing, building, and competing an engineered product. It doesn't matter that it's a race car. There are plenty of people that they're not that into cars. But they get the experience; they learn to weld; they learn to use all of the machines in the machine shop; they learn to build stuff. There's really no class where you can do that other than this."

And all of that hands-on experience turns them into sought-after engineers.

> "It's a phenomenal amount of time, actually. But it's a huge learning experience, and they'll all tell you so. Just going through the process of designing, building, and competing an engineered product."
> – Michael Philpott

"A lot of companies take our students when they graduate, because they know that they know the hands-on stuff." He went on to mention SpaceX, a young company that put up the first rocket that interfaced with NASA's space station, is using engineers mostly from Formula SAE teams. "Three of the people that were very much involved with that space station activity, while we were watching it on television, I was texting—they were my students; they were our students. The team captain last year joined SpaceX just this summer."

Senior **Zach Weiner** is the perfect example of what four years in SAE can do for a student. He reports that as a freshman, "It was very intimidating at first. There was a lot going on. There were a lot of tools and equipment I didn't know how to use. But it was very good knowing that everyone on the team was willing to teach me. I would have never thought that I would know how to weld or do something on the lathe." Now, three years later, he's an expert, and will be teaching a class on welding for freshmen. What else has he gotten out of it? "There's a lot of teamwork in SAE; it also makes you deal with problems you wouldn't deal with every day. These are new challenges for many students, and challenges that you don't get in any coursework."

– Written by Betsy Innes, I-STEM Education Initiative

Scott Daigle (BSME '09, MSME '11) continues to work successfully in his start-up company, IntelliWheels, a Champaign-based firm he founded with **Marissa Siebel**. They expect their product known as the Easy Push to be available on the market in January 2013. Easy Push is a set of wheels that can be adjusted to fit any wheelchair and makes it twice as easy for wheelchair users to get around. This product will first be made available to targeted patients at a few hospitals in the Midwest, but Scott expects to launch the Easy Push nationwide in March 2013.

Christopher Delaney (BSME '12) graduated from the University of Illinois last May and took a position with Anheuser-Busch InBev. As a global management trainee, he has had the opportunity to do quite a bit of traveling around the country. Chris has spent some time in St. Louis for training, worked in Georgia for a couple of months in a brewery, and flew to Palo Alto to meet the board of directors. He has also had the chance to go to Anheuser-Busch InBev's sales convention in Chicago and work on the east coast as a sales manager. Even with all of this travel, Chris had the chance to come back to campus to help recruit for Anheuser-Busch InBev. He found this experience to be very interesting because he had the opportunity to be "on the opposite side of the table" as a recruiter at the career fair. During this coming year, Chris will have one more rotation before he will receive his first permanent assignment with the company.

Kuo-Ting Wang (PhDME '11) published the book *On Phase-Transition Radiation of Water—A First Fundamental Approach* in August 2011. It was based on research that he conducted while pursuing his Ph.D. in the MechSE Department under the advisorship of Professor **Quinn Brewster**.

Shahid Khan (BSIE '71), the CEO of the Urbana-based Flex-N-Gate, has taken ownership of the NFL's Jacksonville Jaguars. Since becoming an NFL owner, he has appeared on the cover of the September 24, 2012 edition of *Forbes* magazine, along with a feature story, and was also profiled on the CBS News program *60 Minutes*. This segment, "Shahid Khan: From Pakistan to pro-football," which aired on October 28, 2012, showed his path to becoming one of America's most successful businessmen. It highlighted the significance of his experience as a student at the University of Illinois and his current venture to transform the Jaguars into a top NFL team.

While reflecting on his research and this accomplishment, he stated, "I never dreamed about doing water energy research in Urbana, nor did I imagine that my research work would draw attention from publishers in the U.K. and Germany. The idea underlying this research is very simple: If energy between water's different phases can be released as heat, why not photons?"

Kuo-Ting is currently working as an engineer in Corona, California for M&O Perry Industries, a manufacturer for pharmaceutical industries, and enjoys conducting research for fun during his spare time. He welcomes any discussions, comments, and recommendations from the readers, and he can be reached at kwang@moperry.com. His book is available through amazon.com, bookbutler.de, barnesandnoble.com, morebooks.de, and other online retailers.

Rong Zhang (PhDME '02), worked at General Motors' R&D in Michigan on smart cars that would drive themselves after graduation from Illinois. He completed his MBA on the West Coast where he had the opportunity to catch up with fellow alumni that were working in the Valley. From there, he worked as a consultant for Fortune 500 companies at McKinsey in China. Since 2010, he has worked for John Deere's global strategic marketing team and has spent time in eight countries during the past two years.

Harry Nagel (BSME '36) celebrated his 100th birthday on November 14, 2012. He was born in Paducah, Kentucky, and after graduation from Illinois, he began his career working for American Rolling Mill, ARMCO, in Middletown, Ohio. His next position was with Bucyrus-Erie, where he trained with the International Division. From there, he moved to Buenos Aires, Argentina for three years, during which he worked with excavation equipment. During WWII, Harry served as a Captain of the Army Corps of Engineers in Ft. Belvoir and the Philippines. His division tested numerous chainsaws for the removal of trees for landing space for the military's planes. After the war, he served as President of the International Overseas Automotive Association and worked in the international automotive export industry. He later served as Vice President of Fram Filters and Dayco. Harry, an avid gardener, even owned an art gallery with his wife, Charlotte, in the 1970's. Harry and Charlotte, who were married in Milwaukee, Wisconsin in 1942, had two daughters, Harriet and Dee Dee. Harry lived in Dayton, Ohio for 43 years and currently lives in Tucson, Arizona.

Rankin joins McGinnis, Khan in College of Engineering Hall of Fame

Alexander Rankin V (BSME '57) was a 2011 inductee to the College of Engineering Hall of Fame. Rankin joined MechSE alumni **Shahid R. Khan** (BSIE '71) and **Gerald E. McGinnis** (BSME '58), who both were among the inaugural Hall of Fame class in 2010.

Alexander Rankin V

In 1967, with the founding of Vulcan Spring and Manufacturing Company in his basement, Rankin achieved a goal he had set when he graduated from the University of Illinois a decade earlier: to start his own business in 10 years.

Six months later, after starting with an old, modified spring coiling machine, one order, and a single customer, Rankin expanded Vulcan, moving it into a small factory and adding three more machines to the operation. He designed his own machines and developed new and unique products to meet his customers' needs. Today, Vulcan boasts computerized manufacturing equipment and has earned the distinction of having the fastest time to market in its industry.

The first commercial use of a Vulcan spring, the speech mechanism in "Talking G.I. Joe" dolls, was more than 40 years ago. Later, the company introduced PULLBOX® security devices, used widely in product displays, one of the most popular products in Vulcan's catalog. Rankin's son now runs Vulcan, and this pioneering company in spring technology now occupies a 60,000-square-foot facility in Telford, Pennsylvania. It has supplied more than 2,000 corporate customers with more than 6,000 different custom-made products.

In 1998, Rankin endowed the James W. Bayne Professorship, honoring his machine design professor whose instruction he credited with the success of his initial and subsequent spring manufacturing machines. Additionally, in 2003 he established the Alexander Rankin Professorship in honor of the men whose name he shares: his father, grandfather, great-grandfather, and great-great-grandfather. Illinois has honored Rankin with the MechSE Distinguished Alumnus Award and the College of Engineering Alumni Award for Distinguished Service.

MechSE Department Head Placid Ferreira joins Alexander Rankin V after the 2011 College of Engineering Hall of Fame induction ceremony at the Thomas M. Siebel Center.

Gerald E. "Jerry" McGinnis

McGinnis founded Respironics in 1976 and served as its president and chief executive officer for 18 years. In 1994, he was elected chairman of the board and advanced technology officer.

Combining his engineering expertise with an understanding of business and medicine, McGinnis created a successful manufacturing firm that has had a significant impact on the medical products industry. Respironics has developed devices for the diagnosis and treatment of sleep apnea, including continuous and bi-level positive airway pressure machines (CPAP and BiPAP), oxygen concentrators for patients requiring supplemental oxygen, infant apnea monitors for infants at risk of sudden infant death syndrome, asthma treatment solutions, and hospital ventilators.

In 2006, after 30 years of making medical devices that help people sleep and breathe easier, Respironics surpassed $1 billion in revenues. In 2007, Respironics entered into a merger agreement with Royal Philips Electronics. Prior to founding Respironics, McGinnis worked 11 years for Westinghouse Electric Corporation, where he became manager of the bioengineering department in 1963. He later founded his first company, Lanz Medical Products, in 1971, while serving in the critical care department at the Presbyterian University Hospital in Pittsburgh.

McGinnis has authored and co-authored a number of scientific papers and holds 15 registered U.S. patents. He is also a strong advocate for education. He has served on the advisory board of Point Park University, the Pittsburgh High Technology Council, and MechSE's Alumni Board. He received MechSE's Distinguished Alumnus Award in 1991 and the Alumni Award for Distinguished Service from the College of Engineering in 1993.

Shahid R. Khan

When he was 16, Khan came to the U.S. to study at the University of Illinois. He spent his first night in Champaign in a $2.00 per night room at the YMCA. In 1970, he began working at Flex-N-Gate Corporation, while studying Industrial Engineering at Illinois; by 1975 he was the company's chief engineer.

In 1978, Khan left Flex-N-Gate to found Bumper Works, where he created an innovative one-piece bumper system that would become the industry standard for pickup trucks and sport utility vehicles. Two years later, he purchased his former company and merged the companies' operations. Today, Flex-N-Gate and its subsidiary, Ventra Group, manufacture a wide variety of automotive parts for General Motors, Ford, Toyota, Nissan, Honda, BMW, and Volkswagen. Khan remains the sole owner of the company, which employs more than 15,000 associates and has annual revenues of around $3 billion.

In his most headline-generating undertaking, Khan purchased the National Football League's Jacksonville Jaguars in 2011. This highly publicized investment has resulted in extensive media coverage for Khan (see page 16).

Khan has served on a number of boards within the university, including the College of Engineering Board of Visitors, Business Advisory Council for the College of Commerce and Business Administration, the Krannert Art Museum Council, the University of Illinois Foundation, of which he is a director, and the MechSE Alumni Board. He is also a member of the University of Illinois President's Council. In 1999, MechSE honored Khan with its Distinguished Alumnus Award, and the College of Engineering recognized Khan with the Alumni Award for Distinguished Service in 2006.

Alumni In Memoriam

1939
C.H. Adams, 5/29/2012
Ralph M. Oberlink, 3/11/2012

1941
Robert V. Johnson, 12/11/2011
Lyle E. Schaffer, 12/4/2011

1942
William S. Castle, 12/5/2011
Marcellus W. Lechtenberg, 5/30/2012
George G. Luce, 2/9/2012
George E. Neilson, 7/12/2011
Howard R. Schmidt, 2/20/2012

1943
Desle O. Miller, 8/2011

1944
Norman A. Buckley, 5/10/2012
Gordon F. Leitner, 8/25/2011

1945
Fred R. Lofthouse, 6/5/2012

1947
Paul D. Gilson, 5/21/2012
David W. Locklin, 10/11/2011
Philip G. Maser, 3/11/2012
Robert H. Maximoff, 10/2/2011

1948
Frank J. Cordera, 9/18/2011
Gerald Geraldson, 6/4/2012
Richard E. McGrath, 8/16/2011
Leslie E. Roby, 10/5/2011

1949
John J. Campbell, 5/29/2012
Charles E. Drury, 12/25/2011
Philip Garman, 7/6/2011
Paul F. Halfpenny, 11/6/2011
Irving Warso, 7/25/2011

1950
Robert D. Crawford, 12/6/2011
Donald F. Denhart, 12/27/2011
Chester J. Gawlik, 8/10/2011
John L. Kohlbecker, 5/12/2012
Glenn D. Lawson, 12/26/2011
Ronald L. Moe, 6/12/2012
John I. Newcomer, 11/4/2011
Richard M. Schroeder, 7/30/2011

1951
Richard C. Costello, 10/9/2011
Julian T. Englehardt, 7/17/2011
George F. Parsons, 6/16/2012
Donald W. Smith, 6/6/2012
Harrison Streeter, 4/10/2012
Ivan M. Viest, 2/11/2012
Louis G. Vock, 3/3/2012
Robert L. Wehe, 3/16/2012

1952
Charles M. Burlingham, 5/19/2012
Leonard E. Ferguson, 2/18/2012
Paul M. Hassler, 11/10/2011
Donald J. Heming, 12/23/2011

1953
William J. Haley, 10/3/2011

1955
Armando Cardenas, 2/18/2012
Anton Gapp, 5/30/2012
Richard J. Gillen, 3/28/2012
Arthur Langas, 9/10/2011
Charles R. Reinthaler, 5/6/2012

1956
Paul R. Broward, 10/8/2011

1957
Hubert N. Leipzig, 1/18/2012
Ronald W. Slonneger, 1/18/2012
Raymond T. Wolf, 12/22/2011

1958
John S. Frew, 12/12/2011
Thomas M. Scopelite, 11/5/2011
Ronald G. Westbrook, 12/26/2011

1959
Daniel G. Barbee, 3/12/2012
Donald R. Fisher, 2/2/2012
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1975
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1976
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1983
David L. Collum, 7/14/2011

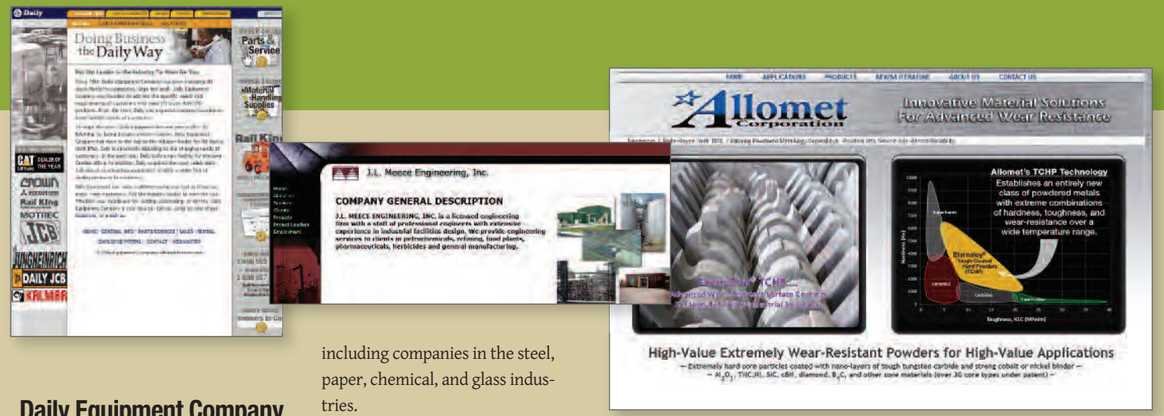
1987
Denise M. Storm, 5/18/2012

1990
David K. Hinde, 3/14/2012

MechSE featured **entrepreneurs**

MechSE graduates head out into the world prepared to succeed, and many of them do so through entrepreneurship. We are proud to feature five of these business pioneers here, helping to build the incredible contacts available to our graduates through the MechSE alumni network.

If you have started your own business, we want to hear from you. Please contact us at MechSE-Advancement@illinois.edu and provide a short description of your company.



Daily Equipment Company

Founded by **Emmerson Daily** (BSME '71) in 1985, Daily Equipment Company is a material handling distributor representing Caterpillar, Mitsubishi, and Crown lift trucks, as well as Rail King rail car movers. The company has locations in Mississippi (Jackson and Biloxi) and Louisiana (New Orleans, Shreveport, Baton Rouge, and Lake Charles).

Daily Equipment has been recognized as Caterpillar Lift Truck Dealer of the Year in 1988, 1993, 1994, 1996, and 2009.

Those who want to read more about Daily Equipment Company can visit its website at www.dailyeq.com. Emmerson Daily can be contacted directly by email at edaily@dailyeq.com or by phone at 601-932-6011.

JCC Energy-Solutions, LLC

Jack C. Ciesa (BSME '71) is the owner of JCC-Energy Solutions, LLC, a company based in Akron, Ohio that specializes in manufacturing energy efficiency. JCC's clients range from light industrial to large industrial complexes that use significant energy, including companies in the steel, paper, chemical, and glass industries.

JCC has entered current and previous contracts with the state of Ohio and its energy efficiency office, as well as the U.S. Department of Energy and its Save Energy Now program. The company has conducted several energy audits across the country based on the DoE format, and it holds specialist certifications in steam and process heat with considerable experience using the DoE energy efficiency software to model different energy systems.

Jack C. Ciesa can be contacted directly by email at jccesolutions@yahoo.com or by phone at 330-864-1204.

J. L. Meece Engineering, Inc.

Jerry L. Meece (BSME '67) is the owner of J. L. Meece Engineering, a small consulting engineering company that deals primarily with process plants, refining, chemicals, food plants, metals, power, and general manufacturing. The company was founded in 1978 and is located in Coal City, Illinois.

Those who want to read more about J. L. Meece Engineering can visit its website at www.jlmeece-eng.com. Jerry L. Meece can be contacted directly by email at JMeece@jlmeece-eng.com or by phone at 815-634-2727, ext. 211.

Allomet Corporation

Founded by **Richard (Rick) Toth** (BSME '63, MBA '67), Allomet Corporation opened its doors in 1998 in Savannah, Georgia. Its manufacturing plant and headquarters are located in North Huntingdon, Pennsylvania.

Allomet produces and sells "EternAloy," a solid-sinterable and surface-coatable powder consisting of extremely hard nano-scale to micron-scale particulate core materials individually coated with extremely tough materials. These coated particles, called TCHP (Tough-Coated Hard Particles) create materials having the highest known combination of hardness and toughness when sintered as tools or wear parts or applied as protective coatings on other articles.

Those who want to read more about Allomet Corporation can visit its website at www.allomet.net. Rick Toth can be contacted directly be email at ricktoth@aol.com or by phone at 724-864-4787.

Vogel's Tooling, Inc.

Founded by **Frank L. Vogel** (BSME '69) in 1977, Vogel's Tooling evolved into a tool and die shop making dies and fixtures for companies throughout the state of Iowa that were in need of short-run production.

Among its projects, the company designed a hot air solar heating system, manufacturing and selling several working systems. It also has designed and built two 36-volt, 32-amp wind generators.

Frank L. Vogel can be contacted directly by email at flvogel@iowatelecom.net or by phone at 641-792-8394 or 641-831-3534 (cell).

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Newell retraces historic car trip in electric style

Left: Professor Emeritus Ty Newell poses with his new electric car, The Sun Catcher. Inset: Ty Newell.

A landmark event in automobile history, **Roy Chapin**'s 1901 road trip from Detroit to New York City changed the way people thought about automobiles at the time. During this past summer, MechSE professor emeritus **Ty Newell** retraced Chapin's journey in reverse, from New York City to Detroit, in an all-electric Ford Focus EV. His trip received a lot of media attention and may end up changing the way many think about electric vehicles today.

Newell, who focuses on solar energy, energy efficiency, and resource conservation, could not wait for Ford to begin selling its new electric vehicles in Illinois, so he ordered one from a dealer in Long Island, New York. In early July, he and his wife, **Deb Newell**, flew out to Long Island to pick up their new car, which Newell dubbed "The Sun Catcher," and bring it home to Urbana. They would travel by way of Detroit, where the vehicle had been built in Ford's renovated Michigan Assembly Plant (MAP), roughly following Chapin's course.

Chapin, a young engineer and test driver at the Oldsmobile Company in the early days of the automotive industry, made the 760-mile trip at a time before paved roads connected towns and when there were no gas stations or garages along the route. Chapin endured frequent setbacks: a broken transmission, broken suspension, and tires he had to inflate every few miles by hand pump. The trip took ten days and he arrived just in time for the New York Auto Show, only to be turned away because he was covered in mud.

"The toils and tribulations of our trip were nothing compared to Roy's," Newell wrote for his road trip blog at www.focusonsolar.com. "We had a GPS that marked any and everything coming up. Our anxiety over charging stations only meant that if a 'fast' charger was not available, we would need to 'slow' charge for a few more hours at someone's wall receptacle."

Newell said that vehicle costs for electric cars will drop as auto manufacturers' profit margins increase, due to the simplicity and low manufacturing costs of electrics versus internal combustion (IC) engines. While electric engines have one moving part—the rotor—IC engines have hundreds. Electric engines also eliminate the need for exhaust systems; air, oil, and fuel filters; and several sensors that IC engines require. Additionally, electric engines are quiet, meaning the car's sound system will sound better than ever before, Newell promised.

Independence from oil and other fossil fuels is an idea Newell has instilled in his students throughout the years. Awarded a MechSE Alumni "most effective" teacher award, he has mentored students such as **Jigar Shah** (BSME '96), who created the solar energy firm SunEdison and later became the first CEO of The Carbon War Room, which seeks to leverage the efforts of entrepreneurs to fight climate change.

But the message is not just something he preaches; it's also how Newell lives. He and his son, **Ben Newell** (BSME '02, MBA '08), built an energy-efficient, solar-powered home, called the "Equinox House," in late 2009 and 2010. Newell also works with Ben at their company, Equinox Built Environment Engineering, where they invent technologies for designing and building healthy, sustainable lifestyle solutions.

Arriving at the Ford MAP in Wayne, Michigan, on July 13, Ty and Deb Newell were greeted with applause. Not only did the Ford plant's senior supervisors greet them and give them a tour, but Roy Chapin's grandson, Bill Chapin, president of the Automotive Hall of Fame, was also there to congratulate them.

In the end, Newell estimates his 1,650-mile trip (including touring around New York and the leg from Detroit to Urbana) required 370 kWh of energy, or about 4.4 miles per kWh. At a total energy cost of $46, based on 12.5 cents per kWh of solar-generated electricity, Newell made his trip for significantly less than the average 30 mile-per-gallon car, which would have used 55 gallons of gas at a total fuel cost of $165 to $220, assuming fuel prices of $3 to $4 per gallon. But Newell foresees efficiencies in charging technology and increases in electric vehicle range that may lead to a day when stopping to charge will no longer be necessary.

"And this is just the beginning," Newell said. "Our great research universities are providing the tools and solutions we need for sustainable living. Entrepreneurs will rapidly move these technologies into the marketplace as we've seen with so many other technologies."

Many MechSE professors are working at the crossroads of **mechanical engineering** and **biology**

Mechanical engineering is an exceptionally broad discipline in that the laws of mechanics can be applied to almost anything that moves or experiences a force. The general perception of mechanical engineering is usually that it only relates to metals, cars, electronics, and other such man-made materials and products—but because the laws of mechanics dictate the behavior of so much of the outside world, it is only natural that mechanical engineers turn these principles inward as well, in a blend of biology and mechanical engineering. This is known generally as "biomechanics," or when it specifically relates to work with cells, "mechanobiology."

Engineers' deeper understanding of biology can lead to advances in medicine—and even engineering—as researchers delve deeper into the properties that govern living tissue. Proof of this can be seen in the research that thrives in our own department.

Many MechSE professors have chosen to use their engineering expertise to further advances in these areas. Those profiled here include **Taher Saif, Jimmy Hsia, Sascha Hilgenfeldt, Srinivasa Salapaka, David Saintillan, Kimani Toussaint, Iwona Jasiuk, Amy Wagoner Johnson,** and **Ning Wang.**

"Whether or not mechanical engineering is relevant to biology is not even a question now," said Wang, who has led breakthrough research on the effects mechanical forces have on cells.

"Now the question is: how do you use engineering principles or mechanical approaches to solve important biological questions? We want to improve the lifestyle and the general health of the public. And to do that, you have to first understand the mechanisms that make it happen."

Mechanobiology could explain mystery of relapses in cancer patients

The recurrence of cancer is one of the greatest mysteries plaguing the medical research field. After weeks or even years of being declared cancer-free, a patient can see their cancer return stronger than it was before. It is every cancer survivor's greatest fear.

Professor Wang has been applying mechanical engineering to biological questions for nearly 30 years. Recently, his research has turned its focus to the disease that is estimated to kill about 500,000 people each year, and specifically, on the mystery of its recurrence.

Wang's most recent work tries to explain why patients experience relapses in cancer. It is unclear why or how cancer relapses. Experiments have shown that between 250,000 and 1 million typical cancerous cells are required to regenerate a tumor, but there aren't that many cancer cells in the patient when they are declared to be in remission.

Research has recently surfaced that not all cancer cells are the same. Most cancer cells do not have an unlimited capacity to multiply and create tumors. For the majority of cancer cells, if they somehow escape the parent tumor to other parts of the body, they die there, unable to reproduce. However, there are a small percentage of cancer cells that can replicate indefinitely, and it is believed that they are responsible for tumor growth. They are called cancer stem cells, tumor founding cells, or tumor repopulating cells. Where it takes hundreds of thousands of normal cancer cells to regenerate a tumor, it only takes 10 tumor repopulating cells to do so.

Wang's research has found a way to identify these cells using mechanics.

"There was a lot of controversy and debate about it. People were using everything they could to try and identify them," Wang said, "but their results couldn't be replicated by other groups because different groups used different mechanical environments. So we basically unified them and thought that if we controlled the mechanical environment, we could actually separate the tumor-creating cells."

By realizing the importance of mechanical forces on cells, Wang said his group discovered what other research groups could not. These cells have been found to be extremely resistant to chemotherapy and even to cancer-treating drugs that have proven effective against normal cancer cells.

"So this raises the question why are they like this?" Wang said. "And the answer is that we don't know. That's the problem we're working on."

Wang has applied his mechanical engineering knowledge to many other biological mysteries. For example, how do mechanical forces on the cell translate to different cellular behaviors? The process is called mechanotransduction: mechanical forces can go through specific molecules and proteins in the cell membrane, cross the membrane, and transduce signals to the interior of the cell. Wang postulated that the initial mechanical energy was transmitted through filaments within the cell all the way to the nucleus, and could therefore alter genetic expression with unpredictable results.

"You can't just relate one force and one gene," Wang said, "because when you apply one force, you cannot say just one gene gets turned on and turned off. It's not that simple. It could be a few, or a group of genes."

Another of his recent significant breakthroughs was discovering that using a soft substrate to culture stem cells would keep them in their pluripotent state. Previously, researchers had used expensive chemicals called growth factors to keep the stem cells from spontaneously differentiating. The more inexpensive solution of using a soft substrate to keep them in their dedifferentiated state is a major step forward for stem cell research.

"What kind of impact is our research going to have on the rest of the nation or the world?" Wang said. "Can we make a big impact? Can we make others follow our work? That's how science progresses. And I think our department is working in the right direction in biomechanics. We focus our expertise on certain areas to do pioneering work, work that people can follow. That's really the most important."

Mechanical forces in cells could provide new information on cancer, Alzheimer's

MechSE professor **Taher Saif** is no stranger to the world of the microscopic. He is the director of the MEMS/Micromechanics lab, and has developed several MEMS (microelectromechanical systems) devices for use in his own research, studying the mechanics of the very, very small—including the cells that make up the human body.

Much of his research examines single cells and biological microenvironments. One subject of this research is the neuron, and the effect of mechanical forces on neuronal growth and memory. Neurons stretch as a person grows; Saif and his group try to study why the neurons do not fail as they stretch, how their mechanical properties help them to cope with the stretching, and most importantly, how memory storage and learning ability evolve with this stretch.

"What we find is that without this mechanical force as we grow, the learning process may not happen," Saif said. "So the long-term goal is that if we can understand the effect of mechanical forces on the neurons, then we might be able to look at neurological diseases such as Alzheimer's from a different point of view."

Saif, in collaboration with Professor **Akira Chiba** in the Department of Cell and Structural Biology at the University of Miami, discovered that the mechanical tension in the axon of a neuron has a strong effect on neurotransmission, or the process in which a neuron passes a signal to other neurons. If it is determined that diseased neurons in an Alzheimer's patient don't have the same mechanical properties as a healthy cell, they may be able to find a treatment focusing on restoring these properties. Saif emphasizes that this is a long-term goal, but that the research has great potential.

Another way he applies mechanical expertise to cellular biology is in his studies of cancer metastasis. Specifically, he researches the beginning of metastasis, and what causes the cancer cells to break away from the parent tumor. The answer may lie in the mechanical properties of the cells.

"In some of our work," Saif said, "we see that the stiffness of the tumor, or the mechanical microenvironment of the cancer cells, reaches a certain softness. Then somehow that mechanical softness can send a signal to the cells, and they begin to come off from the parent tumor and spread around the body. We are trying to understand what this mechanical signal is."

The answer to this question could lead to great advances in cancer research and treatment, and most importantly in the control and prevention of metastasis in cancer patients.

MechSE faculty leads interdisciplinary effort to create biological machines

Saif and fellow MechSE professor **Jimmy Hsia** have positioned themselves at the forefront of an emerging field of bioengineering: creating living, multi-cellular machines.

"This is a very new project; the idea is still far in the blue sky area," Saif said. "No one has ever done this before. The hope is that we can make biological cells get together by themselves, with some guidance, and that they would evolve into a moving machine that could perform some useful function."

They are both leaders in the NSF center for Emergent Behaviors in Integrated Cellular Systems (EBICS), a multi-institution science and technology center intended to "create a new scientific discipline for building living, multi-cellular machines that solve real-world problems in health,

security, and the environment." Hsia is the associate director of the center from the University of Illinois, and Saif is the lead investigator in the "Cell Clusters" thrust, which creates the components of the biological machines. These machines could have locomotive and sensory abilities, which would allow them to move through the bloodstream to deliver a drug to a local area, or to clean up oil spills and other environmental toxins. They could even have the ability to reproduce, making more identical units with the same functionalities.

There are distinct advantages to using biological machines rather than man-made machines. While they may be more complicated and more difficult to create, biological machines are capable of learning functionalities that are either impossible or impractical for man-made machines. They are more adaptable and versatile at responding to external stimuli, and learn responses much faster and more effectively.

Another of their objectives is to develop educational programs based on this research and involve groups in their research that are traditionally underrepresented in science.

"There are other components of a center besides research," Hsia said, "such as creating the next generation of research and education leaders, training these students with not just the research and courses, but also in leadership skills, communication skills, ethics issues, entrepreneurship. We need to do this for all research, but for the most part only a center like ours, a research and technology center, would have an organizational structure to really pursue these other components vigorously."

For this reason, EBICS is sponsoring a freshman-level course at Illinois called "Interdisciplinary Research and Education in Biology, Engineering, and Health Science." The idea behind the course is to introduce students to interdisciplinary scientific work, including EBICS research, to promote interest and understanding, and to attract underrepresented minority and female students to the fields of biology and engineering.

"We are redefining mechanical engineering," Saif said. "Traditionally if you think of mechanical engineering, what probably comes to mind is machines, cars, nuts, and bolts. But now I think mechanical engineering is very, very broad. We're connecting the concepts of mechanical engineering with the biological world. It's a very exciting time."

Geometry in eye of fruit fly suggests relation between energy and morphogenesis

The most common organism used for biological modeling, with its minimal care and efficient breeding, is *Drosophila melanogaster*: the common fruit fly. Mechanical engineers are no strangers to modeling—so naturally, when biologists studying morphogenesis in fruit flies started to consider mechanical factors, they needed someone with a strong mechanical background in soft tissues.

MechSE associate professor **Sascha Hilgenfeldt** studies the geometry, structure, and evolution of foam and soft condensed matter. This specialization lends itself very well to the study of cellular structures and biological tissues, specifically the mechanical forces and statistical trends that affect their growth. Using the eyes and wings of the fruit fly as models, Hilgenfeldt's work is increasing biology's understanding of morphogenesis: how organisms and their components develop their shape.

"Biologists know a tremendous lot about what proteins are involved in the morphogenesis of each shape," Hilgenfeldt said. "But knowing which proteins are being used doesn't directly relate to the shape."

Hilgenfeldt started by writing an energy functional (the calculated total energy of the system, dependent on the state of the system) for the structure of a fruit fly's eye. Since a system can only be in equilibrium when the total energy has been minimized, the functional calculated what pattern of shapes would create the lowest possible energy. Impressively, the shapes that required the minimal amount of energy to maintain exactly matched the shapes present in the ordered pattern of a fruit fly's eye.

"The shape is a consequence of passive energy minimization, and not of active biological processes," Hilgenfeldt said. "This amazingly regular shape was ultimately made from something that was very disordered to start with, less than two days before. And that has huge consequences, because if we were to really understand all the processes during morphogenesis, then we could manipulate the morphogenesis, we could generate tissues, we could tailor tissues that are grown in the lab to purposes that we'd like."

These ordered shapes can be quantitatively explained by the minimization of energy. However, this model only works in tissue with a regular cellular pattern, such as that of a fruit fly's eye. The tissue of a fruit fly's wing is disordered, with an irregular pattern that changes from fly to fly. Hilgenfeldt therefore chose to approach the problem from a statistical angle, taking into account the number of neighbors each cell has and the area of each cell. He found that as the wing develops, the probability distribution of both variables narrows over time.

"What's important is that we can get analytical solutions for the general appearance of the tissue using only the characteristic width of the area distributions," Hilgenfeldt said. "I don't need to know anything about the biological processes."

The universality of this property means that it cannot be specific, and therefore cannot give a diagnostic value for an individual pattern. If, for example, one tried to tell the difference between healthy and diseased wing tissue, the correlation between area distribution and neighbor distribution should hold for both.

Hilgenfeldt still thinks there are more answers to be found.

"The ultimate goal is to understand the development from one pattern to another over time," Hilgenfeldt said. "We'd like to identify better diagnostic measures from the statistical analyses. And in the course of doing that, hopefully be able to connect back to the mechanics of the system. I think there's a bridge to be constructed between the statistical analysis and the mechanical analysis, and I hope to pursue that more."

Drug discovery made easier through statistical physics

A medicinal drug can be created from any combination of millions of chemical compounds. Experimenting with all of these combinations can be costly when trying to develop a new drug—but MechSE professor **Srinivasa Salapaka** in collaboration with ISE professor **Carolyn Beck** have simplified the problem using tools and concepts from statistical physics and statistics in what is called combinatorial library design.

Combinatorial drug discovery is a computational approach to developing potential pharmaceuticals. In order to find a drug to treat a certain disease—to kill certain types of cancer cells, for example—researchers will try many different combinations of compounds and measure their effectiveness. If they are effective, they are selected as potential drug candidates and tested further.

"We are redefining mechanical engineering. Traditionally if you think of mechanical engineering, what probably comes to mind is machines, cars, nuts, and bolts. But now I think mechanical engineering is very, very broad. We're connecting the concepts of mechanical engineering with the biological world. It's a very exciting time." –*Taher Saif*

The challenge is that there are so many compounds, doing experiments with all of them is extremely costly. But some compounds are exceptionally similar in several qualities to groups of other compounds. In this way, a compound can be experimentally representative of its entire library. Selecting them is called lead compound selection.

"This is numerically a very hard problem," Salapaka said. "It takes a very large number of computations. So we developed some algorithms to do such a selection process. The compounds that we choose are representative of their entire library; that is, we are making sure that all of the properties of the compounds in the original library are represented."

Organizing compounds by library is determined by the compounds' properties. All of the compounds in a certain library will have about the same value for all of the desired properties of the potential drug. On a graph of two values, for example, the compounds in a certain library can be seen in a cluster around their values for those two properties.

"You choose one representative from each of these clusters to represent the entire library," Salapaka said, "because doing an experiment with one of these compounds is the same as doing the experiment with any of the compounds in that cluster. It saves a lot of time and money."

Considering that combinatorial libraries typically consist of several million compounds, this system is the only way that makes combinatorial chemistry techniques even remotely practical. But its ability to create molecules and test them en masse could revolutionize drug discovery.

Applying fluid mechanics to bacterial suspensions has broad implications

Bacteria are some of the most abundant life forms in the ecosystem. The biomass of bacteria on Earth is greater than that of plants and animals combined, and there are 10 times more bacterial cells than human cells in the human body.

MechSE assistant professor **David Saintillan** specializes in fluid mechanics and has developed algorithms and models for different types of fluid systems. Some of his more recent work has been with "active suspensions" or fluidic suspensions with self-propelled particles—in this case, bacteria.

"When you have a lot of them together, you can see that bacteria affect flows on very large scales," Saintillan said. "And most of the work that I've been doing over the past few years is trying to understand why that happens, and what the implications could be."

Because of the prevalence of bacteria, the implications are broad. Studying these active suspensions could lead to a better understanding of how bacterial infections spread through the body or how microorganisms in the oceans influence the mixing of oxygen and other elements. In fact, the mixing that goes on in active suspensions is so effective that researchers have attempted to use bacteria in engineering devices to mix fluids more efficiently.

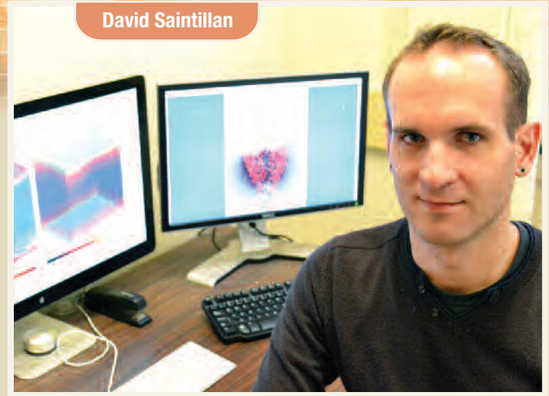
There's also some study into how the fluid dynamics of these active suspensions could give rise to the growth of bacterial biofilms, or collections of bacteria on a surface, in the human body. The most prevalent example is dental plaque, which can cause tooth decay and gum disease. Biofilms are also thought to play a role in infectious diseases such as microbial infections and may impair the healing of cutaneous wounds. A better understanding of how they are created may be helpful in preventing infections in the future.

Saintillan and his group are also studying biological polymers, specifically the dynamics of flexible filaments within the cell. Actin and microtubules are flexible rods in a cell that are important for locomotion, cell division, and for the structure of the cell.

"We're trying to understand what their behavior in flow is," Saintillan said. "You can cause buckling in different ways by compressing them with different flows, and so we're trying to understand this effect. Depending on how strong the flow is, you can get different shapes."

For this study, however, the application is not quite clear yet.

"You've got a lot more processes going on in the cell," Saintillan said. "It's very complicated, so we're basically stripping it down and looking at the basic mechanics, characterizing the dynamics of the fluid inside the cell, looking at it from more of a physics side, and basically just improving our understanding of what goes on inside the cell."


David Saintillan

MechSE professor applies unique imaging technique to biological tissue

Collagen fibers make up 25% of the total protein mass in mammals, providing tensile strength in bone, transparency in the cornea, and elasticity in skin. Because they are so prevalent in certain tissue types, it can be useful to analyze their structure to see if the tissue is damaged or unhealthy. Perfecting the right imaging process for such diagnostics, however, is not an easy task.

MechSE assistant professor **Kimani Toussaint** specializes in optics, particularly relating to biophotonics. A major part of his research deals with the quantitative imaging of collagen fibers using nonlinear optics.

"Ideally you want to be able to take pictures without destroying what you're looking at," Toussaint said. "And then, you want to be able to quantify certain features, so that you have pictures with approaches or methods that allow you to quantify information that you've extracted. We have found second harmonic generation to be a very good technique for this."

Second harmonic generation (SHG), also called frequency doubling, is a process in nonlinear optics in which pairs of photons are "combined" in a nonlinear material to form new photons with twice the energy, and therefore twice the frequency and half the wavelength of the original photons. SHG microscopy uses this effect to create an image of the object by measuring the frequency-doubled photons as they scatter off of the nonlinear object. For example, if a red laser light is sent in, photons at blue wavelengths would be scattered back. Filtering the imaging process for these blue scattered photons can create an image of the object.

SHG has several advantages for biological tissue imaging. The process avoids exciting the molecules in the tissue, which can sometimes have ill effects. SHG can also construct three-dimensional images, and can probe relatively deep into thick tissues compared to conventional imaging approaches.

"One tends to use this type of tool for systems that typically would lend themselves to automatically giving you this contrasting color," Toussaint said. "So if I were to look at cells, this may not be the best tool to use. But if I were to look at collagen fibers, this would be a better tool to use."

Spatial harmonic analysis can be used to quantify the spatial organization of the structure. Toussaint and his group have combined this tool with SHG imaging in order to create detailed, three-dimensional analyses of the way collagen fibers are organized in a tissue, which has high diagnostic value. Toussaint and his group have found that this method can help stage breast cancer by imaging the collagen structure within the stroma.

"The initial results in our paper seemed to indicate that the technique is promising, and discriminated between some of those stages (of cancer)," Toussaint said. "It has very good diagnostic potential. There's still more work to be done to really prove it."

MechSE faculty taking two paths to healing bones

The 206 bones in an adult human body make up the skeleton, one of the body's vital mechanical systems. MechSE faculty members **Iwona Jasiuk** and **Amy Wagoner Johnson** are delving deeper by exploring the internal structure of bone itself. And while they share the broader goal of improving medicine and treatment for diseases and traumatic injuries, they are taking two different paths to arrive there.

Wagoner Johnson's main work with bone involves creating ceramic "scaffolds" to heal large gaps in bone. These gaps can occur either with serious trauma or the removal of diseased bone due to such diseases as osteoporosis or bone cancer.

"If the defect is too big, the bone won't bridge the defect on its own," Wagoner Johnson said. "So the idea is to put a scaffold in there that allows bone to grow in, called an osteoconductive structure. And there are factors that don't just allow the bone to grow in, but actually encourage it to do so, and so we try to figure out what kind of variables encourage bone formation."

Professor Jasiuk is also looking at the structural properties of bone as a material, but in a slightly different way. While she also studies bone regeneration, her main focus is in how bone structure changes when it is affected by age or disease, especially osteoporosis, a disease that affects more than 10 million people in the United States today.

"The idea is that bone has a very complex structure at different hierarchical scales, and the structural and compositional properties of bones change with age," Jasiuk said. "We are interested in the structure of healthy bone and deviations from it, with the hope of finding or assessing medications for curing or treating it or for early diagnosis of osteoporosis."

Her work involves aging bone, diseased bone, bone regeneration, and the growth of bone due to mechanical motion such as exercise. She studies bone both as a structural material, and also as a biological (living) material that changes both structure and composition with different environments and stimuli.

"We are investigating fundamentally what processes are taking place during regeneration," Jasiuk said.

"WE ARE INVESTIGATING FUNDAMENTALLY WHAT PROCESSES ARE TAKING PLACE DURING REGENERATION. MOST STUDIES FOCUS ON THE FINAL OUTCOME—WHETHER REGENERATION TAKES PLACE OR NOT. WE'VE SHOWED THAT YOU CAN REGENERATE BONE, USING A SPECIFIC APPROACH, AND NOW WE WANT TO UNDERSTAND FUNDAMENTALLY WHAT TAKES PLACE IN A SUCCESSFUL REGENERATION AS OPPOSED TO A REGENERATION THAT IS NOT SUCCESSFUL."
–IWONA JASIUK

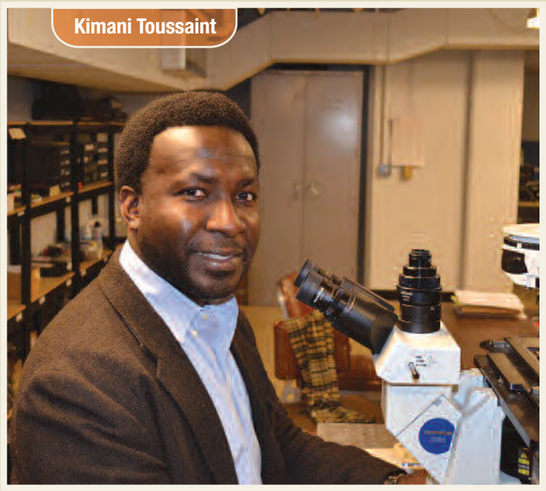
"Most studies focus on the final outcome—whether regeneration takes place or not. We've showed that you can regenerate bone, using a specific approach, and now we want to understand fundamentally what takes place in a successful regeneration as opposed to a regeneration that is not successful."

Both research groups have the same long-term goal: to find effective and safe methods for repairing or treating broken or diseased bone.

"I feel like I'm doing something good for somebody," Wagoner Johnson said. "I think it's really neat to be able to use engineering skills and technology and apply them to biomedical problems. It's so much more motivating to me to have that application."

For Jasiuk, the biological connection was a pleasant surprise.

"I was always very interested in biology and biological applications," Jasiuk said, "but at the time when I was making decisions about my studies, I did not know I had that option. I enjoy it very much."


Kimani Toussaint

Much more research being done

Other MechSE faculty members are making significant advances in biomechanical research as well. Professor **Jon Freund**'s microcirculation simulations provide detailed information about how the transportation of white blood cells affects the inflammatory response to an injury. And Associate Professor **Prashant Mehta** applies nonlinear control methods to analyze the firing of neurons in the brain.

Even when biological tissue and fluids aren't the direct subjects of research, mechanical engineering expertise has a lot to offer the biological and medical sciences. Professor **Shiv Kapoor**'s research in microscale milling/drilling machines represents a significant step toward a desktop factory capable of manufacturing biomedical implants. Professor **John Georgiadis** is working on developing and refining a new generation of Magnetic Resonance Imaging (MRI) methods for microfluidics. And Associate Professor **Liz Hsiao-Wecksler** uses mechanics to analyze gait and balance in order to develop more effective orthotics, and to learn more about problems such as slipping, tripping, and asymmetric gaits.

Across the board, these and other MechSE faculty members are making a difference in the field of biology with their expertise in engineering.

–Written by Meredith Staub (BS Physics '15)

Faculty Appointments

New Faculty

Gaurav Bahl

After receiving three degrees in electrical engineering (Ph.D. and M.S. degrees from Stanford and a B.Eng. degree from McMaster University in Ontario, Canada), new assistant professor **Gaurav Bahl** has needed to switch gears in joining the Department of Mechanical Science and Engineering.

"Throughout my education there has been some element of mechanics present," Bahl said. "I was also surrounded by mechanical engineers, so I was actually integrated into a group in mechanical engineering."

Bahl uses elements of mechanics in his work, using photons to create mechanical vibrations. Before finishing his post-doctorate studies, he used optomechanics to excite vibrations in a microfluidic channel.

"Now, we can have a way in which we can couple a fluid with light, not just a solid object," Bahl said. "The flows and the vibrations within a fluid, the acoustical vibrations within a fluid, we can couple that directly to light as well."

In Fall 2012, his first semester at Illinois, he taught the special topics course, Photonic MEMS (microelectromechanical systems).

SungWoo Nam

The academic path taken by new assistant professor **SungWoo Nam** was not the standard one. Before he entered the Ph.D. program at Harvard, he had already logged three years of industry experience working at a carbon nanotube manufacturing factory.

"With academia, if you have crazy ideas, you can try them," Nam said. "In industry, we have a goal we want to accomplish. In a lot of cases, it is related to cost and efficiency."

Accordingly, in his Fall 2012 ME 498 course, he included an array of areas in engineering that are not usually discussed in the same classroom, including material and manufacturing issues as well as electrical engineering.

For the years ahead, Nam plans on teaching more undergraduate courses, engineering thermodynamics classes, and integrating lab work into his class structure.

Before attending Harvard for an M.A. in Physics and a Ph.D. in Applied Physics, Nam earned an M.Eng. in Materials Science from Yonsei University and a B.S. in Material Science and Engineering from Seoul National University.

New Appointments

Narayana Aluru

In June 2012, MechSE professor **Narayana Aluru** was appointed the Director of Computational Science and Engineering for the College of Engineering. A Richard W. Kritzer Professor, his research has significantly advanced the understanding of physics at the micro and nanoscale—particularly with respect to microelectromechanical (MEMS) and nanoelectromechanical (NEMS) systems and nanofluidics.

"I try to predict things before experiments take place in some cases—computational discoveries," Aluru said.

Aluru's research spans several engineering disciplines and he currently holds affiliations with the departments of Bioengineering, Electrical and Computer Engineering, Computational Science & Engineering, and the Beckman Institute for Advanced Science and Technology.

He joined the Illinois faculty in 1998 after a postdoctoral stint at MIT and earning his Ph.D. from Stanford. He joined MechSE in 2004 as an associate professor and became a full professor in 2006.

Kenneth Christensen

Since August 2012, Professor **Kenneth Christensen** has held the title of Associate Head for Mechanics Programs in MechSE. He now oversees both the undergraduate program in Engineering Mechanics and the Masters and PhD programs in Theoretical and Applied Mechanics. These programs and their accompanying degrees have been part of the department since TAM and Mechanical Engineering merged to form the MechSE Department in 2006.

"We have many extraordinarily talented students, both in the EM and TAM programs," Christensen said. "I am excited to interact with them and witness their progress firsthand."

In addition to his new position, Christensen will continue to direct the Laboratory for Turbulence and Complex Flow. The lab's research activities include experimental studies of turbulence, microfluidics, and geophysical flows, as well as instrumentation development. His group has studied the impact of complex surface topography on flow evolution, with particular attention to surface damage that occurs during the operating lifetime of engineering systems.

"Flows over complex surfaces typically will occur in engineering systems like gas turbine engines, where the blades are damaged over time and that damage reduces the operating efficiency of the turbine," Christensen said. He is hopeful this work will lead to more accurate predictions of engineering system performance and perhaps ways of mitigating such damage.

William King

MechSE professor **William P. King**, a College of Engineering Bliss Professor, has been named director of the National Science Foundation (NSF)-Funded Center for Nanoscale Chemical-Electrical-Mechanical Manufacturing (Nano-CEMMS).

"Manufacturing science and technology is one of the top federal research priorities, and the University of Illinois is known as a center of excellence in nano-manufacturing," said Michael Bragg, interim dean of the College of Engineering. "I greatly appreciate Professor King's willingness to step forward and accept this important position in the College. He has been an important member of the Center to date, and we look forward to his leadership as its director."

"Manufacturing is critically important for product innovation, and today there is a huge demand for the benefits enabled by nanotechnology and new materials," King explained. "The Center for Nanoscale Chemical-Electrical-Mechanical Manufacturing Systems creates new nanotechnologies and enables their insertion into the product innovation cycle."

King's own research focuses on nanoscale thermal and mechanical measurements, engineering of nanomechanical devices, nanomanufacturing, and nanometrology.

Two professors make energetic (materials) team

Two MechSE professors are breaking new ground—and getting widespread attention in academia and industry—with the shock-physics research methods they have teamed up to develop.

Shao Lee Soo Professor **Scott Stewart** handles the computational modeling side of the research, while Professor **Nick Glumac** addresses the experimental. Their research into chemical reactions in condensed "reactive materials" has potential in military, electronics, biomedical, aerospace, and high energy density energy storage applications.

"There's a whole class of condensed phase reactions that have potential, with a huge amount of energy liberated from them," Stewart said. "The molecules react in a very short length scale, and diffusion is very limited because these are dense materials. The reactions complete on very short, almost atomic length scales."

Involving materials such as titanium and boron, Stewart's research on computational modeling of shock physics systems provides insights that would be nearly impossible to study by direct observation. The materials are not optically accessible, and that makes it challenging to understand the physics and chemistry in the material when they are deforming or under high pressure and temperature.

"It's all computational modeling and materials science research, but specifically related to phase transformation and chemical reactions," Stewart said. "For everything we're doing, we try to have to have an experimental context and a system. It's a niche subject, but it's a very fundamental subject."

Stewart's computational modeling work is closely matched to provide analysis and feedback for the experiments in Glumac's lab, that has wide-ranging and first of their kind capabilities that employ high temperature optical spectroscopy during the combustion of the reactive materials.

Glumac's research makes use of the shock tube facility developed by MechSE research professor **Herman Krier**. Researchers have used shock tubes for decades for gases, but what makes MechSE's shock tube unique is that it is used for particles. Glumac said it is now "the premier way" to look at how energetic particles burn under the conditions they will be used in.

"Our teaming is a classic case where two people from entirely different backgrounds need each other," Glumac said. "And as a result we've found opportunities to work together, and it's been effective."

The partnership has led to development of a unique core of expertise and capabilities, and the result is long line of companies and agencies wanting to fund projects with them.

MechSE professors Nick Glumac and Scott Stewart.

"We are getting incredible opportunities these days," Stewart said. "And people recognize us as a team and seek us out."

One pair of grants held by the combined Glumac/Stewart team was awarded through the U.S. Defense Threat Reduction Agency, which develops systems with the unique capability to defeat weapons of mass destruction. This project may help the government develop a way to combat chemical and biological agents in a manner that reduces the likelihood of unintended disbursement of those agents.

"Over the the last three or four years, by working together we've brought on all these new projects," Stewart said. "Our two groups together form a center. It's not called a center, but that's what it is."

They have used this funding to build a large and powerful team of colleagues within their research groups. From Ph.D. students and in-house research engineers, to faculty across the campus and national laboratory fellows sprinkled around the U.S., they are tapping top minds to keep making substantial forward progress on every project.

"Scott's just done a phenomenal job of collecting outstanding people to work as affiliates with this group," Glumac said. "Not only is he good by himself, but he's really good at getting people around him to tap into, to kind of leverage his abilities with theirs, and take it all to the next level. That's a really powerful combination."

Stewart is also partnering with researchers from the University of Southern California and Washington State University for a five-year, multiple-university research initiative, funded by the Office of Naval Research. A similar project with MechSE professor **Moshe Matalon**, funded by the Air Force of Scientific Research (AFOSR), with the University of Missouri and CalTech has just started. These projects will further the fundamental understanding of energetic chemistry in condensed media, with Illinois doing continuum simulations and modeling in Stewart's group.

An additional grant from AFOSR will fund Stewart's work in computational and applied mathematics looking at fundamental methods of high-order accuracy, multi-material simulation capabilities.

"We're learning lots of things that people didn't know before because we can actually run these controlled experiments," Glumac said. "It's been a very powerful tool for us. We're getting lots of continued mileage out of it."

Funding agencies now approach Stewart and Glumac, instead of the other way around, and each of them now manage approximately a million-dollar budget. This results in more time available to run their research programs.

"We're getting a lot of attention, a lot of interaction," Glumac said. "I have visitors all the time from other universities and from industry as well."

"People come in to use our facilities to test their materials and to learn from our diagnostics."

Faculty News

Narayana Aluru has been named the Director of Computational Science and Engineering for the College of Engineering (see page 30). He also has been named a Fellow of the U.S. Association for Computational Mechanics.

Gaurav Bahl has joined the department as an assistant professor (see page 30).

Joseph Bentsman has been named a Fellow of the American Society of Mechanical Engineers (ASME).

Kenneth Christensen has received a promotion to full professor in 2012 and has been named a Fellow of the American Society of Mechanical Engineers (ASME). He also has been named MechSE's Associate Head for Mechanics Programs (see page 30).

Harry Dankowicz has been named a Fellow of the American Society of Mechanical Engineers (ASME). He is the Principal Investigator on $1M NSF INSPIRE Award on "Asynchronous communication, self-organization, and differentiation in human and insect networks." He also authored *Recipes for Continuation,* a book to be published by SIAM in 2013.

Jonathan Dantzig has received the 2012 Brimacombe Prize for outstanding achievements in materials processing. He and his co-workers also received the Best Poster award at the conference Modeling of Casting, Welding and Advanced Solidification Processing – XIII.

Naira Hovakimyan has received the Technical Achievement Award at the 9th International Conference on Mathematical Problems in Engineering, Aerospace, and Sciences.

Predrag Hrnjak has been named a Fellow of the Society of Automotive Engineers (SAE).

Harley Johnson has been named a Fellow of the American Society of Mechanical Engineers (ASME).

William King has been named the Director of the NSF Center for Nanoscale Chemical-Electrical-Mechanical Manufacturing (NanoCEMMS) at Illinois (see page 30). His work also earned the Innovation That Could Change the Way You Manufacture from the Society of Manufacturing Engineers (SME).

Dimitri Kyritsis has joined the Editorial Board of *Combustion and Flame* and been named Associate Editor of the *Journal of Energy Engineering.*

Moshe Matalon has been named a Fellow of the American Institute of Aeronautics and Astronautics (AIAA).

SungWoo Nam has joined the department as an assistant professor (see page 30).

Martin Ostoja-Starzewski has been named an Honorary Fellow by the Australian Institute of High Energetic Materials. He has been named the Chair Managing Editor of *Mathematics and Mechanics of Complex Systems (MEMOCS)*. He was the Timoshenko Distinguished Visitor at Stanford University January-February 2012 and a Visiting Professor at Paris-East University in April 2012.

Carlos Pantano-Rubino has received a promotion to associate professor.

Michael Philpott has retired from the department. He has been named an associate professor emeritus. He continues to serve as MechSE's acting associate head for undergraduate programs and faculty advisor for the SAE and EcoMarathon car teams (see page 14).

Brian Thomas was awarded the Jerry Silver Award from the Association for Iron and Steel Technology.

Pratap Vanka has retired from the department and has been named a professor emeritus. Specializing in computational fluid dynamics, Professor Vanka joined the department as an associate professor in 1989 and was named a full professor in 1993. An ASME Fellow, he won this group's Freeman Scholar Award earlier this year. A scientist at Argonne National Laboratory from 1979 to 1988, Professor Vanka holds an MBA from the University of Chicago in addition to his mechanical engineering degrees: a Ph.D. from Imperial College in London, an M.Tech (Engg) from the Indian Institute of Technology in Kanpur, and a BSc (Engg) from Banaras Hindu University in India.

Amy Wagoner Johnson has received a promotion to associate professor.

Matthew West has received a promotion to associate professor.

Faculty In Memoriam

We have recently lost several of the faculty who helped make the storied history of engineering at Illinois. They will be missed, and we hope to carry on in the great tradition they have bestowed upon us.

Frederick G. Bauling, assistant professor emeritus of theoretical and applied mechanics, died September 9, 2012 at his home in Sidney, Illinois. He was 86. Bauling was raised on a farm outside of Rockton, Illinois, close to Beloit, Wisconsin. In 1943, he began studies at Illinois, but he was soon drafted into the U.S. Army and served as an armored infantryman in the 6th Armor Division, detailed primarily to General Patton's 3rd Army. He fought in the Battle of the Bulge, earning three Bronze Battle Stars. Following World War II, he returned to the university and completed his bachelor's degree in mechanical engineering (1949). He also began work for TAM professor H. John Schraeder, who was in charge of the railroad investigation at that time, and completed his master's degree in theoretical and applied mechanics (1953). Bauling then began lecturing formally in TAM, and in 1957 was named an assistant professor. He retired in 1983. During his career, he taught courses in statics, dynamics, strength of materials, advanced strength of materials, materials laboratory, and experimental stress analysis. He also conducted research on spallation in railway car wheels and consulted with U.S. Steel and other companies. He was a member of the American Society of Mechanical Engineers and the American Society for Engineering Education.

William E. Dunn died December 31, 2011 at Carle Foundation Hospital in Urbana. He was 61. Dunn earned a bachelor's degree in engineering mechanics at Northwestern in 1972 and studied under the late Professor Bei Tse Chao at Illinois, earning his master's and doctorate in nuclear engineering in 1974 and 1977, respectively. He joined the Mechanical and Industrial Engineering faculty in 1977, was promoted to associate professor in 1983, and retired in 2006. He was perhaps best known for his research with Argonne National Laboratory on the dispersal of pollutants, particularly aerosol contaminants, in the atmosphere. With his students he modeled, for example, the dispersion of smokestack emissions in turbulent flows over complex terrain and the dispersal of bio-agents in subway systems. To conduct his research, he and a colleague successfully purchased the first mini-computer on the Illinois campus. At the time, all campus computing was done on a central CDC Cyber machine, which had limited memory and tightly regulated access. Dunn and his colleague broke the campus barrier on individual purchases and opened the floodgate for others across campus.

Helmut Hans Korst died June 1, 2012 at his home in Champaign. He was 96. He was born and raised in Vienna, Austria. He received his undergraduate degree in engineering from the Vienna Technology University in 1941. Post World War II, he was instrumental in re-opening the Vienna Technical University. In 1948, Korst accepted a visiting lectureship in gas dynamics within the Mechanical Engineering Department at Illinois, where he stayed until his retirement in 1984. As head of the department from 1962 to 1974, he attracted some of the most talented minds in the mechanical engineering discipline to Illinois, with 136 doctorates awarded and a departmental ranking that reached fourth in the country. He consulted on missile aerodynamics for the USAMC, NASA, NATO/AGARD, and aerospace organizations such as Convair, GE, Boeing, Rocketdyne, and The Redstone Army Missile Command. Among Korst's honors, he was an honorary member and fellow of a number of engineering societies, including the American Society of Mechanical Engineers (ASME) and American Institute of Aeronautics and Astronautics (AIAA). He also received the American Society for Engineering Education Centennial medal in 1993. Of his many honors and awards, he was proudest of being named the recipient of the 1994 Guggenheim Medal in Aeronautics.

Curtis Oneal Pedersen, professor emeritus, died July 10, 2012 at his home in Hastings, Minnesota. He was 77. In 1956, Pedersen received a B.S. degree from South Dakota State University, followed by an M.S. degree in 1958 from the University of Minnesota and a Ph.D. in 1968 from Carnegie Mellon University, all in Mechanical Engineering. Pedersen joined the department as an assistant professor in 1967 and became an associate professor in 1972. His research areas included building simulation, heat transfer, energy systems, and thermodynamics. He became a full professor in 1988 and a professor emeritus in 1993. Pedersen also consulted with Salem Corporation in Carnegie, Pennsylvania for many years and did work for General Electric Company and Honeywell, Inc., among others. He was a NASA-ASEE summer faculty fellow at NASA's Johnson Spacecraft Center in 1971 and 1972. He was a member of the American Society of Mechanical Engineers and Sigma Xi, and a fellow of the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE). In 1992, Pedersen was awarded the Commander's Award for Distinguished Public Service from the U.S. Army Construction Engineering Research Laboratory. Pedersen directed the BLAST program (Building Loads and System Thermodynamics), the predecessor to today's Energy Plus building modeling program used throughout the world.

Mark A. Shannon, who was a current MechSE professor, passed away October 14, 2012. Please see page 34 for more on Professor Shannon.

Omar Marion Sidebottom, professor emeritus of theoretical and applied mechanics, died July 8, 2012 in Marion, North Carolina. He was 93. Born in Forest City, Illinois, Sidebottom studied at Lincoln Junior College before earning his bachelor's degree in mechanical engineering at the University of Illinois in 1942. He completed his master's in theoretical and applied mechanics in 1943 under Dimitry Morkovin, who had himself just completed his doctoral studies under the legendary TAM professor Herbert F. Moore. Sidebottom became an instructor in 1947, assistant professor in 1948, associate professor in 1953, and full professor in 1957. He retired in 1982 after 40 years of teaching at the university, having advised or co-advised more than a dozen doctoral students in experimental plasticity, multi-axial creep, and stress analysis. He was named a fellow of the American Society of Mechanical Engineers in 1972 for, in part, "several new concepts for analysis of time-dependent inelastic behavior" of metallic and nonmetallic materials. Sidebottom is perhaps best known outside the campus for his textbooks on mechanics of materials, including several editions of the popular graduate text *Advanced Mechanics of Materials.*

In memoriam: Professor Mark Shannon

"When you think about it, we can't exist without water. There is not going to be a post-water era, not for humans. If there is a post-water era, we're not going to be involved."
– Mark Shannon

In 2009, MechSE professor **Mark Shannon** was diagnosed with amyotrophic lateral sclerosis (ALS), also known as Lou Gehrig's disease. Despite battling this debilitating disease's effects, he continued to teach and hold office hours for students up until his final days, to the amazement of all around him. He was 56 years old when he died, on October 14, 2012.

The dedication he showed throughout his illness was truly an extension of the passion he brought to his work during his entire career. As a scientist and engineer, Professor Shannon took on some of our grandest challenges, contributing significantly to the fields of water purification and desalination, microfabrication, medicine, and energy production.

His passion for his work was evident whether he was teaching students or testifying before Congress. Through his boundless energy and tenacity, Professor Shannon was able to attract colleagues from across the campus and around the world to share his vision and work to solve society's problems.

"I cannot begin to express how indebted our department is to Mark. A true visionary, Mark was an extraordinary person who dedicated his work and efforts to our students," MechSE department head **Placid Ferreira** said. "He was an inspiration to all of us and we will always remember his generosity and strength. He will be missed in every facet of our academic endeavors."

Born December 2, 1955, Professor Shannon received his B.S., M.S., and Ph.D. degrees from the University of California at Berkeley, where he also held a post-doctoral appointment. Then it was time to find a job.

"I wanted to teach at a school that was like Cal," Professor Shannon said. "Very few schools meet those criteria. In my first year of graduate school, my wife and I made a list of dream jobs to have if I was to go on for my Ph.D., and Illinois topped that list. When I amazingly became a professor at Illinois, I found that its culture has so much more that allowed me to thrive."

It was 1994 when he joined the University of Illinois faculty, and he went on to make significant and lasting contributions to the department, the university, and throughout the world. After becoming a Kritzer Faculty Scholar in 2003 and a Willett Faculty Scholar in 2004, he was named the James W. Bayne Professor in 2006.

"I have collaborated with professors and students throughout the university on projects that address major problems facing the world," Professor Shannon said. "Very people-focused—that's Illinois. That is why we like it so much here."

In addition to teaching, Professor Shannon was the director of the Micro-Nano Mechanical Systems (MNMS) Laboratory and, perhaps most notably, the Center of Advanced Materials for the Purification of Water with Systems (The WaterCAMPWS). The fight for clean water—and the life-saving impact it holds for society—was his greatest passion. He made it his mission to bring attention to the impending problems associated with the world's highly vulnerable fresh water resources.

"We are a water planet; we are awash with water," Professor Shannon said. "There is 99.23 percent of the water on Earth that is not available for humans without some treatment, and of the remaining 0.77 percent, we've been polluting it up so much that we have to treat it again."

He received numerous teaching and research awards and honors, including nominations for Water Technology of the Year at the Global Waters Conference in Zurich, Switzerland in 2009 and was appointed to the U.S. EPA Science Advisory Board Environmental Engineering Committee in 2009.

Professor Shannon was the co-inventor of a gate that is able to move and filter materials at the molecular level. The molecular gate may one day be used in devices that diagnose and treat illnesses, infections, and contaminations. He also co-developed a fluidic chip that uses molecular gates to separate, manipulate, and analyze minute amounts of specified molecular compounds, such as toxins and proteins, from blood, saliva—and natural water.

"There is a 10 to 20 percent chance in the next 10 years that water intakes will drop to levels that will cut off 30 million Americans from water within days – days," Professor Shannon said. "But at the same time we're not doing anything to try and prevent that."

Professor Shannon gained an international reputation as a leading expert in water purification research through this numerous talks and keynote lectures. He lectured in Canada, China, Cyprus, Denmark, France, Germany, Great Britain, Greece, India, Ireland, Israel, Italy, Japan, Korea, Mexico, the Netherlands, and Switzerland on this topic. He also testified before the U.S. House of Representatives Science and Technology Committee and the Senate Environment and Public Works Committee about the need to secure and sustain the fresh water resources in the U.S.

"When you think about it, we can't exist without water," he said. "There is not going to be a post-water era, not for humans. If there is a post-water era, we're not going to be involved."

Colleagues said Professor Shannon had a passion for "advancing the state of knowledge" in science and technology and teaching his students how to do the same. This passion lives on through his family and his students.

"Mark was an extraordinary person who dedicated his work and efforts to our students...He will be missed in every facet of our academic endeavors."
– *Placid Ferreira*

Message from the Advancement and Communications Office

Dear Alumni & Friends:

There is a well-known saying that goes something like this: "Life is what happens to us while we are making other plans." In some respects, this happened to me in a big way this fall. In August 2011, I left the MechSE Department after 24 years, during which I served in a wide variety of roles. This was a difficult decision, as I love this department and all the people that make it special. Fifteen months later, an unexpected vacancy for a Director of Advancement occurred, and I was thrilled to be asked to fill the position. I truly feel like I am "back home," working with the amazingly talented faculty, students, staff, and alumni of this great department.

I have a 31+ year relationship with this organization—as an undergraduate and graduate student, alumnus, staff member, and parent of a student who has two degrees from MechSE! During that time I have gotten to know hundreds of students who are now our alumni. While my position is still considered interim, I intend to be here long-term, and will soon be on the road, meeting and thanking our generous alumni who so selflessly support the mission of this department. I look forward to seeing you again and learning how your experience in mechanical engineering, engineering mechanics, or TAM prepared you for your career, and discussing how you would like to partner with us. You don't have to wait to hear from me, however. I can be reached via phone or email as shown below. I promise to answer every message on a timely basis, so please be in touch!

We have several priorities in our efforts to support MechSE, but among the most significant are scholarships (for undergraduates) and fellowships (for graduate students). As you are likely aware, tuition has risen 123% in the last decade, so we need to work doubly hard to ensure that we continue to attract the very best students, and that financial need is not a barrier.

The other major priority is the upcoming Mechanical Engineering Building East Wing addition project. I had the privilege of working on the preliminary design for this addition during its conceptual phase in the 1990's with Professor **Tad Addy**, and I am committed to making this vision become a reality. This addition will feature student-centric spaces, with emphasis on design, innovation, and entrepreneurship. Our students are outstanding, and we expect the East Wing will help spawn their many innovative ideas into companies, products, and services. We will be seeking your assistance with this, both financially and programmatically. Watch for updates in future correspondence.

With warmest "Illini" regards,

Robert Coverdill
Director of Advancement and Outreach Activities (Interim)
217-333-4109 or **coverdil@illinois.edu.**

Mark A. Shannon Scholarship Fund

A student scholarship has been created to honor **Mark A. Shannon**, who was the J.W. Bayne Professor of Mechanical Science and Engineering until his passing in October 2012. MechSE will award this scholarship annually to an outstanding undergraduate student in recognition of Mark's contributions to the department, the College of Engineering, and the University of Illinois.

As described on the facing page, Mark was an incredible individual who continually amazed us by his ability to secure research funding, as well as his tireless work ethic, which regularly entailed working through the night.

We hope you will join us in honoring Mark and supporting his commitment to excellence and leadership in engineering students at the University of Illinois by making a contribution to the Mark A. Shannon Scholarship Fund. To make a gift, you can use either the secure website at **mechse.illinois.edu/giving** (select the Mark A. Shannon Scholarship Fund) or contact **Bob Coverdill** at 217-333-4109 or **coverdil@illinois.edu.**

Giving a gift to MechSE online is simple and secure. Just go to **mechse.illinois.edu/giving.**

If you have a smart phone, you can access this page by scanning the accompanying QR code.

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Keep in touch

Keep up to date with the MechSE Department! Just go to **mechse.illinois.edu/contact** to sign up with your current contact information or email us **MechSE-Advancement@illinois.edu.** If you have a smart phone, you can access this page by scanning the accompanying QR code.

Attention, entrepreneurs!

MechSE wants to hear from all of our alumni who have started their own businesses. Please contact Bob Coverdill at **MechSE-Advancement@illinois.edu**, and provide a short description of your company. We will be assembling this information for future publication.

Join our social networks—just go to mechse.illinois.edu!

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