MECHANICAL SCIENCE AND ENGINEERING / FALL 2016

MechSE

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MechSE alumni are encouraged to apply. Successful candidates typically have an undergraduate GPA of 3.25 or higher. The application process is easy and does not require the GRE.

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Applications for Fall 2017 are being accepted until May 1, 2017.

To find out more about this opportunity to join our program, please contact:

Katrina Hagler
Associate Director of Student Recruitment and Admissions
Department of Mechanical Science and Engineering
Call 217-244-3416 or email
mechse-grad@illinois.edu

go.mechse.illinois.edu/mengprogram

From the Department Head

Greetings from MechSE, where we are incredibly busy doing incredible things. That may sound like a tagline, but we truly have many exciting initiatives underway. In this magazine, we want to share some of our recent progress with you, along with other great news from our students, faculty, and alumni.

Welcome to our incoming freshmen (and their parents!) and to our new graduate students. If you read our Spring 2016 magazine you know that MechSE has emerged as a top program for women in mechanical engineering. We can now report that a record-setting 30% of our incoming freshmen are women. In recent years, we have made a concerted effort to improve gender balance in our programs. While we still have work to do, these efforts are now starting to really pay off, and I thank everyone in MechSE—particularly Associate Head for Undergraduate Programs **Elizabeth Hsiao-Wecksler** and Director of Undergraduate Programs **Emad Jassim**—for their roles in this success. Of course, the real payoff will be in the coming years, as we sustain this effort and see its impact on the creativity and productivity of our profession.

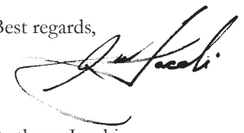
I also hope you will join me in welcoming our newest faculty members, assistant professors **Mattia Gazzola** and **Chenhui Shao**, both of whom joined us this past August. They bring new and exciting research programs to MechSE; please get acquainted with them on page 20. They are the latest additions to a phenomenal lineup of early-career faculty members who have received a record number of NSF Early Career and Young Investigator awards this year.

The **Transform MEB project** was unanimously approved by the Board of Trustees at their July 2016 meeting. While we expected approval, this step forward was essential; it allows us to kick off the project's next design phase, in which the details about the renovation and addition will be decided. Soon the Sidney Lu Center for Learning and Innovation will stand proudly at the corner of Goodwin and Green, as part of the fully renovated and re-engineered MEB. I invite you to read more about this project, news of other inspiring and generous support we've received, and how all of this fits into the growth of the entire engineering campus, starting on page 10.

Finally, I would like to point out that our newest degree program, the **Master of Engineering in Mechanical Engineering**, can now be completed online from anywhere in the world. It is a great degree to consider for both our current undergraduate students and our alumni who have not yet received an advanced engineering degree. More information can be found on the page opposite this one. I thank Associate Head for Graduate Programs **Taher Saif** and his staff for making this outstanding program available to high-achieving engineers everywhere.

As we prepare to close out 2016 and enter 2017, I wish the best for you and yours, and thank you for your continued support of MechSE.

Best regards,



Anthony Jacobi
Department Head
Richard W. Kritzer Distinguished Professor

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CNBC features Hovakimyan's drones

W. Grafton and Lillian B. Wilkins Professor **Naira Hovakimyan** was featured on CNBC's Nightly Business Report in October. The segment focused on the use of new technologies to benefit seniors and an aging population, which is expected to grow 50 percent over the next 15 years. Hovakimyan and her research group are developing autonomous drones that can perform useful household tasks. She spoke about her work at the Aging 2.0 conference in San Francisco: "We could have a slightly bigger drone that could go grab a glass of water, or reach under the table to grab a fallen object, or get something from the second floor of your home, and other simple tasks."

Coach Lovie Smith honors MechSE's Martin

Former Chicago Bears head coach and new Fighting Illini football coach **Lovie Smith** made a surprise announcement to his team in late August. He announced he was putting walk-on **Michael Martin** (BSME '15), the team's long snapper and a student in MechSE's Master of Engineering in Mechanical Engineering program, on scholarship for his final season. "He has been a great team member," Smith said. "He's been super in the classroom, representing our university the right way and our football program the right way. He's a valuable part of our football team, contributing each week. He earned a scholarship, and we were just excited to be able to give it to him. You're always excited when someone earns something."

Student-built vehicle hits 1,137 mark

The Eco-Illini team set a new University of Illinois record during Summer 2016, reaching an incredible 1,137 miles per gallon. Surpassing the old record of 1,079 mpg, the team was competing at the SAE Supermileage competition at the Eaton Proving Grounds in Michigan. "Notables were the near perfect driving by **Dinaz Bamji** on the final run and **Howard Chan** taking an emergency vacation day from Ford to drive two hours to help diagnose engine anomalies. And of course none of this would have been possible without the pertinacious and always positive leader of the group, **Shie-Jene Shan**!" said Dr. **Bruce Flachsbart**. "It was an event for which the whole team will forever be proud—a new Illinois record."

Infiniti intern returns to MechSE

Senior **Alex Allmandinger** was back on campus for the Fall 2016 semester after spending a year in England participating in the highly exclusive Infiniti Performance Engineering Academy program. Selected from 12 finalists in the U.S., he emerged as the lone U.S. participant. Part of the internship involved working with the Renault Sport Formula One team—an assignment automotive engineers everywhere could only dream of. "With Formula One being the peak of aerodynamics, I learned so much I can use in the future," Allmandinger said. "Working in the Formula One team, it was great being around experts and learning directly first-hand these extremely advanced concepts."

Forbes commends faculty startup

MechSE associate professor emeritus **Michael Philpott**'s company, aPriori, won a 2016 award from Forbes for being one of the best software startups to work for. aPriori Technologies, Inc. was founded in 2004 by Philpott and two of his former graduate students, **Eric Hiller** (BSME '95, MSME '97) and **Sebastian Schrader** (MSIESE '03), with seed funding from VC investors Bain Capital and Sigma Partners. Having raised several rounds of additional funding, the company has grown to 100+ employees throughout the U.S., Europe, and Asia. aPriori's product-costing software generates detailed cost estimates and connects all members of a product team to relevant views of cost data.

Alumnus makes Crain's #TECH50 list

Adam Tilton (BSME '10)—co-founder of Rithmio with MechSE associate professor **Prashant Mehta**—has made the #TECH50 list from *Crain's Chicago Business* for 2016. *Crain's* said: "Wearables—the most widely available examples of the internet of things—could work a lot smarter, or so this former University of Illinois researcher believes. Tilton was developing software to track missiles when he saw how lousy first-generation wearables, like the FitBit, were at tracking motion beyond walking and running. So with U of I professor Prashant Mehta, he founded Rithmio, which lets users accurately account for a range of movement, from bench presses to kettlebell swings. Last year, the Chicago company got $3 million in funding led by Intel and KGC Capital."

MechSE professor named associate dean

Professor **Harry Dankowicz** has been announced as the new Associate Dean for Graduate, Professional, and Online Education for the College of Engineering. "An outstanding teacher and a renowned researcher, Harry has been recognized by his students and his colleagues for the excellence and the innovation of his teaching, and by his peers for his contributions to the advancement of the fields of nonlinear dynamics and multibody systems," said **Andreas Cangellaris**, the Dean of the College of Engineering. "His ideas on how our College can improve its success with increasing the diversity of our graduate student body and how to build stronger and deeper engagements with industry partners resonated strongly with our expectations of the leadership of this office."

Senior Design team wins national competition

Front: Sharon Tsubaki and Naomi Audet. Back: Andrew Peterman, Luke Meyer, and Jowon Kim.

"It had the ideal combination of a challenging project with outstanding ingenuity and hard work by the student team. We think it was a perfect example of what's being accomplished within our senior capstone design program's innovative atmosphere."

A team of MechSE students submitted the winning design for an aesthetic and functional excavator cab that will be 3D printed and on display at IFPE and CONEXPO-CON/AGG at the Tech Experience in March.

The students involved were seniors **Naomi Audet**, **Jowon Kim**, **Luke Meyer**, **Andrew Peterman**, and **Sharon Tsubaki**. Their faculty advisor was Assistant Professor **Sam Tawfick**.

Student engineering teams from across the country submitted their designs for a futuristic excavator cab and human machine interface. A panel of industry experts judged the competition.

"This project was one of the very top efforts in an extremely competitive field of 28 senior design capstone projects within the MechSE Department at Illinois in the Spring 2016 semester," said Professor **Elizabeth Hsiao-Wecksler**, associate head for undergraduate programs in MechSE. "It had the ideal combination of a challenging project with outstanding ingenuity and hard work by the student team. We think it was a perfect example of what's being accomplished within our senior capstone design program's innovative atmosphere."

According to John Rozum, IFPE show director, the excavator will be on display at the joint trade shows in March and will bring to life how technology is transforming the construction industry, in line with the show's 2017 theme, "Imagine What's Next."

Keep MechSE's senior capstone design program in mind

Each semester, MechSE seniors form small teams and complete at least 24 capstone projects as part of ME 470. Thanks to our industry partners, these projects solve real-world challenges and help prepare our students for life after graduation.

We welcome projects from our alumni, friends, and corporate sponsors. If you would like to explore the sponsorship of a project—and get a fresh, out-of-the-box look at a challenging design—contact MechSE's director of undergraduate programs, Dr. Emad Jassim, at jassim@illinois.edu.

ME 370 finals straight from Star Wars universe

"The Rebel Alliance needs you to design new all-terrain walker vehicles to help in our fight against the First Order."

For the final project in Mechanical Design I (ME 370) in the Spring 2016 semester, students formed teams and built all-terrain "walkers," in a nod to the giant mechanical war machines featured in the film Star Wars: The Empire Strikes Back.

"The Rebel Alliance needs you to design new all-terrain walker vehicles to help in our fight against the First Order," read the assignment's "debriefing" statement. "To come up with new prototypes that will be optimized for many different planets with different gravity and habitats, we need you to draw biomimetic (and xenobiomimetic) designs. Design vehicles that borrow from nature to skitter like a crab, hop like a frog, walk like a bird, crawl like a lizard, trot like a horse, or trellaumph like an Andorian Kryshyk."

The objective was to design, prototype, and test walkers that could rapidly negotiate rough terrain on the Bardeen Quad.

To view the students' creative and impressive machines in action, search for "walkers" at **mechse.illinois.edu.**

MechSE undergrad Mathew Karlin and his team's walker.

Students' design idea benefits dog in need

A team of nine undergraduate students, formed out of the Biomedical Engineering Society and including MechSE students **Varun Jain** and team leader **Kevin Brenner**, created a custom orthotic to take some of the pressure off the remaining legs of a dog named **Butch**, who'd had to have his broken front right leg amputated.

"It was really service oriented. We just wanted to build something for someone who couldn't go out and buy one."

"Dogs put a lot of weight on their front legs so over time that would manifest as injuries in joints," Jain said. "Our orthotic is a precaution that mitigates that risk of injury over time."

From a 3D mesh scan, they segmented the model leg and joined the segments with rubber strips to act as ligaments and tendons. They made the shell of the brace out of carbon fiber sheets held together with epoxy. The team then put aluminum rods along the sides of the dog's forelimb to support the brace while keeping it light.

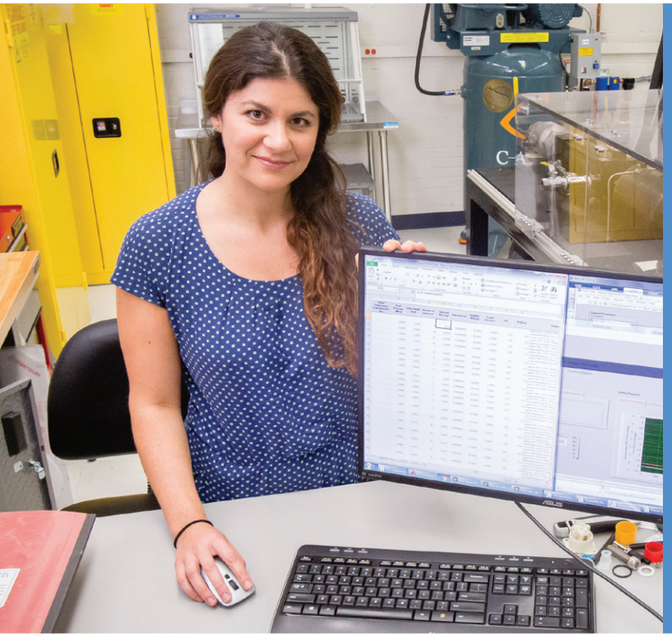
After some initial modifications were made, Butch has been moving around well.

"We weren't expecting his motion to be different. The idea was that this would just bear some of the weight but it wouldn't negatively affect the way he walked," Brenner said.

The project was not for a class or competition.

"It was really service oriented. We just wanted to build something for someone who couldn't go out and buy one," Brenner said. "We did this because we wanted to help animals, and we were all interested in this idea."

MechSE Graduate Students



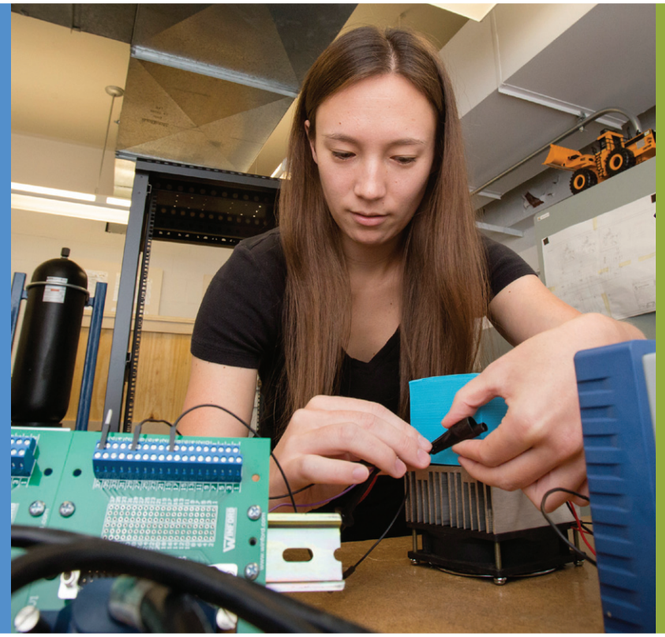
Anna Oldani

NSF Graduate Research Fellow **Anna Oldani** was chosen to receive the Society of Women Engineers (SWE) Outstanding Collegiate Member Award, which honors students who have made outstanding contributions to SWE, the engineering community, and their campus.

Oldani has also served as the Director of GradSWE at Illinois—a support community that promotes diversity in engineering and science, encourages students to attend graduate school, supports them once they're there, and helps them prepare for their future careers.

"I'm grateful for the opportunity to work with such a great group in developing programming to enhance the graduate student experience at Illinois."

Oldani works in Associate Professor **Tonghun Lee**'s Laser Diagnostics Laboratory for Advanced Energy and Propulsion Research, focusing on alternative jet fuels for the U.S. Navy and Air Force. She has also collaborated with the Federal Aviation Administration on a national archive database for alternative jet fuels.



Malia Kawamura

Mechanical engineering graduate student **Malia Kawamura** has been awarded a National Science Foundation Graduate Research Fellowship.

Kawamura does research in MechSE professor **Andrew Alleyne**'s research group, focusing on how to rapidly develop information-driven energy systems.

"Specifically, I am developing a modeling toolkit for chemical process systems that will allow different chemical plant designs to be tested," she said. "To test how a chemical plant will behave, the model will be embedded in hardware and a controller is implemented as well."

Kawamura wants to be able to create an accurate, user-friendly tool to save money and time in the development process and improve system performance in an industry setting.

"The opportunity to expand my impact to other energy fields directly aligns with my goal of becoming a leader in the energy industry to improve society through advancements in sustainable energy use," she said.

Jonghyun Choi

MechSE doctoral candidate **Jonghyun Choi** was awarded a prestigious fellowship from FMC Technologies, a company that works in subsea systems and is a leading provider of technology and services for the oil and gas industry.

"I think the company's business structure matches well with my research direction," Choi said.

His research, in MechSE assistant professor **SungWoo Nam**'s group, focuses on ultra-sensitive biosensors as well as graphene characterization and functionalization.

Choi is considering an academic career, but said he would also be interested in taking a path within private industry. He said he may want to do work similar to that of FMC Technologies.

The FMC Fellowship was created as part of a gift from MechSE alumnus **Bert Gayman** (BSME 1897), and supports scholarships, fellowships, and research.

Rajavasanth Rajasegar

Three MechSE graduate students—**Hector Lopez-Hernandez**, **Rajavasanth Rajasegar**, and **Cai Mike Wang**—were selected as Mavis Future Faculty Fellows (MF3) for 2016-2017.

The MF3 program is designed to help doctoral students in the College of Engineering become the next generation of great engineering faculty. It focuses on three components: research, teaching, and mentoring.

The research of doctoral candidate Rajasegar is focused on the application of advanced laser-based diagnostic techniques for understanding the combustion dynamics of high-speed reactive flows with emphasis on thermo-acoustic instabilities. His work also involves implementing both active and passive methods for combustion instability control, including plasma-enhanced combustion, electro-sprays, and flame interaction in meso-scale combustor arrays.

"Raja has been working on applying advanced laser and optical diagnostics to understand a phenomenon called combustion instability in practical propulsion systems," said his advisor, Associate Professor **Tonghun Lee**. "Unlike previous studies that have attempted to find operating conditions that are less plagued by this problem, Raja is seeking to actively mitigate these effects through the use of novel methods such as plasmas."

A LOOK BACK

TRANSFORM MEB

Construction of the historic Mechanical Engineering Building began nearly 70 years ago, and generations of top engineers have received their education here through the decades.

Ground was broken on the Mechanical Engineering Building in 1947 and the facility opened its doors on May 12, 1950 to host the Midwestern Conference on Fluid Dynamics and Meeting of the American Physical Society Fluid Dynamics Division. According to plan, the new building featured "113 rooms for department use, including 16 laboratories, 32 rooms for classes, 46 offices, and 19 miscellaneous special rooms. Of the laboratory rooms, there are four large and 12 smaller laboratories, all providing complete facilities for today's student."

As can be seen in the photo taken of MEB construction in the late 1940s, those lucky enough to find a spot could park directly in front of the building. Not only does Green Street now feature four full lanes and no parking, but additional bike lanes and new bus paths will soon be added. With Green and Goodwin the most heavily trafficked intersection on the Illinois campus, these updates should continue to make east-west travel quicker and safer.

Once the **Sidney Lu Center for Learning and Innovation** has been erected, extending the Mechanical Engineering Building all the way to Goodwin Avenue, MEB will have a broader frontage along historic Green Street than any other building—more linear feet than Engineering Hall, Loomis Laboratory, or even the Illini Union.

Another $1 million gift received!

We are very pleased to announce that the generosity of the MechSE family is alive and well. In September 2016, we received an anonymous gift of $1 million to go toward the completion of the Transform MEB project. Combined with previously announced gifts of $12 million from Sidney Lu (BSME '81), $2 million from another anonymous donor, and a six-figure gift from MechSE's Alumni Board representatives, the momentum toward financing this project is strong!

Please contact us to find out more about the Transform MEB project or how you can get involved:

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transformMEB.mechse.illinois.edu

PBS FEATURES MEB MURAL ARTIST

At 100 years old, artist and muralist **Eric Bransby** is far from slowing down. With PBS having premiered a biographical documentary of his life in October 2016 and the commission of two more murals for him to paint, Bransby is still hard at work making history in the art world.

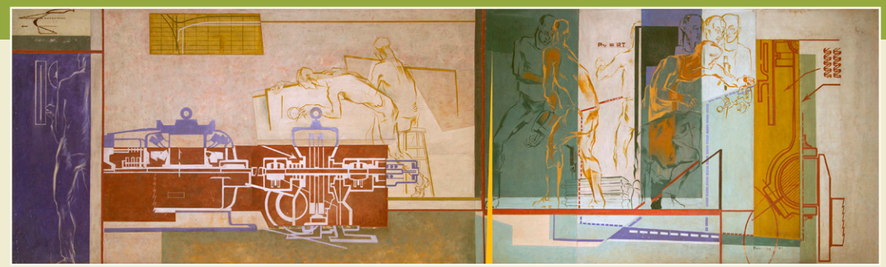
At the University of Illinois, the Mechanical Engineering Building's center entryway from Green Street contains two important Bransby murals hanging on opposite walls. Intricate and abstract, they reflect the fundamentals of mechanical engineering through art. Though perhaps overlooked in everyday routine in MechSE, these murals are an important part of Bransby's story—one that PBS filmmaker Jay Kriss shared with the world in his new film "A Last Mural."

In 1951, the University of Illinois commissioned Bransby to help reform the perception of MEB through artwork, an undertaking that also fulfilled his graduate thesis requirement for his Master of Fine Arts degree from Yale University. For the next two years, Bransby worked on his murals at MEB, inspired that this very academic and technical establishment could still express creativity and charisma through his designs.

"There was this deep, intrinsic, 'I want to tell a story' type of thing," said Kriss. "And so that's what he did. Bransby just fell in love with the idea of the mural."

The murals depict their own story: sketch-style outlines of anatomical figures at work on various machinery, apparent mathematic equations, and bold geometric figures. Both murals appear multi-layered, an effect of Bransby's technique of layering the water-based tempera paint on some parts of the wall and not on others.

Now 65 years later, as MEB is prepared for a building-wide renovation, Bransby's historic works are not forgotten, and the walls holding the murals will be preserved intact.



The south entrance of MEB features two murals painted by Eric Bransby, former Professor Emeritus in the Department of Art and Design. Started in the summer of 1951 and finished by the summer of 1953, the murals "used the ancient fresco method of painting on fresh plaster, but sometimes built out layers or cut them back to a colored mortar base under the plaster to give an effect of sculpturing relief."

"Many of our students arrive at Illinois with an innovative spirit. Many more develop that spirit during their time here. We are making the most of our opportunity to offer a design-thinking education that is unique in its breadth and depth, helping us to reimagine the land-grant university for the 21st century. It will drive students to make the most of their wide-ranging creativity and deliver new ideas to the world in unexpected, thrilling ways. It is our duty to the world to enable tomorrow's leaders; the improvements we are developing through our facilities reflect our acceptance of this responsibility."

– Andreas Cangellaris,
Dean of the College of Engineering

TRANSFORM MEB

Transform MEB is one of several current and upcoming projects that will enable us to continue the tradition of world-renowned engineering education at Illinois.

The world-renowned students and faculty in the College of Engineering at Illinois make the impossible happen every day. Their achievements surpass those from nearly any leading institution around the globe, and thanks to recent, current, and upcoming projects, the College's facilities are keeping pace as well.

This stylized illustration shows just four of the current projects happening on the Engineering campus. There are several other major projects either underway or soon to begin, including an addition to Talbot Laboratory for the Aerospace and Nuclear Engineering Departments, renovation of the Optical Physics and Engineering Laboratory for MechSE use during the MEB renovation, a new instructional facility that will be 100% classrooms (at Springfield and Wright), and possibly a new research facility on Goodwin Avenue.

Electrical and Computer Engineering Building / ECE

The new ECE Building is full of instructional lab spaces that continue the department's tradition of hands-on learning, especially on cutting-edge topics of power, nanofabrication, optics, and robotics. Students pursue their passions, innovating and experimenting in the Open Projects Lab maker-space. Students and faculty have access to many collaborative spaces, including a grand lobby filled with seating and a café plus multiple conference rooms on every floor. The ECE Building will feature solar arrays to provide electricity on its roof in Summer 2017 and eventually on the roof of a nearby parking structure. This $95 million project was 50% funded by the state of Illinois, while donations from private and corporate donors made up the other half.

Newmark Laboratory and Hydrosystems Laboratory / Civil and Environmental Engineering

The four-phase CEE Modernization Plan will renovate, upgrade, and expand the 50-year-old facilities that make up the CEE at Illinois complex. Goals include creating a living laboratory featuring the latest innovations in infrastructure sensing, a showcase for sustainable energy and environmental design options, a new campus landmark, hands-on instructional laboratories, and collaborative and classroom space for all CEE students. When complete—projected for 2024—the department's facilities will include an expansion of the Hydrosystems Laboratory, a "smart bridge" connecting the Hydro Lab to Newmark Lab, an expansion and renovation of Newmark Lab, and an already-completed student center, among many other improvements.

Everitt Laboratory / Bioengineering

The Bioengineering Department will soon call Everitt Lab its home, after renovations to the campus landmark that previously served as the ECE Department's home for more than 60 years. The 126,000-square-foot renewal is supported in part by the Grainger Engineering Breakthroughs Initiative. The project also includes the Jump Trading-sponsored Jump Medical Simulation and Education Center, part of the new engineering-based Carle Illinois College of Medicine. With these major upgrades and enhancements, Bioengineering is poised to play an even greater role in producing health-related accomplishments by supporting the people who make them happen. The Everitt Lab project provides new opportunities to continue that support and marks the next step in the growing collaboration between engineering and medicine.

Mechanical Engineering Building / MechSE

This vision of our department's home has been a long time coming. As described in recent MechSE publications, MEB is now on the brink of a complete transformation into an incredible, 21st-century facility that will inspire and empower current and future generations of MechSE students to be the best in the world. This historic project includes a five-story addition to the east of MEB, a single-story addition to the north, and 66,000 square feet of existing space reimagined, reengineered, and optimized for education, innovation, and community. More than ever before, MEB will be the place where successful careers are launched and the seeds of innovation are sown.

MechSE Alumni

In Spring 2016, we were honored to welcome back four incredibly successful alumni. **Xiangli Chen**, **Melonee Wise**, and **Zaya Younan** were named MechSE Distinguished Alumni, and **William Jackson** gave the commencement speech for the College of Engineering. They each shared thoughts and stories about their time at Illinois and some important lessons they have learned in their careers.

Xiangli Chen (MSME '88, PhDME '94)
Vice President, General Electric and President, GE China Technology Center

On working in industry, specifically at General Electric: "If you have a good idea, and if you have the data behind it and can prove that it is feasible, you might get a chance to try it. But you have to initiate it—that is the key. You have to initiate the idea, talk to the right people, and influence them. At GE, eventually we got the nod from the research center head to try out our idea (of opening a China operation) in Shanghai in 2000. So I was appointed as the first director for the research center there. I would say that the company took a chance on me, too, because at that time I had very little management experience. I had project management experience, but I never managed a big group or anything like that. It was basically a startup within a company and there was very little risk because we asked for only $200,000 for the first year. In June of 2000, I went to China, started the research center there, started hiring people, and then quite a few things happened in that time, the early 2000s or so. One is that China became a member of the World Trade Organization. China's economic growth and openness to the rest of the world was at the early stages and it was growing very fast. Now, we have about 3,000 engineers in China."

Melonee Wise (BSME '04, MSME '06)
CEO, Fetch Robotics

On the unique opportunities at Illinois: "I loved being here. It was probably the best thing that I went to U of I and not a school like MIT or Stanford because Illinois is so big and the opportunities are so broad. I had everything here. You could build cars, you could do research experiments, you could build robots, you could do anything, and there was a club for anything and everything. One of the better opportunities I had at U of I was the engineering leadership program. It was definitely a turning point for how I looked at myself, and how I interacted with other people. And I think one of the best skill sets someone can learn in college is to become introspective and be able to assess how they feel about something: Is this too hard or am I just making it hard? Is this impossible or am I just being a jerk face right now? I think sometimes technical people get wrapped up in being the best technically but there are all these other soft skills that many engineers could benefit from. I think sometimes you get in your own way by being difficult. Developing the skill set of realizing how to be humble helps a lot."

Zaya Younan (BSME '85)
Chairman and CEO, Younan Properties

On how to really succeed as an entrepreneur: "It is very good to have ideas, but having ideas by themselves really doesn't mean anything—99.9% of the people who live on this earth will come up with good ideas in their lifetime. They probably say, 'Oh man, I'm smart, I'm a great inventor, I just came up with an idea nobody else thought about.' They shouldn't feel so good about that because probably everybody else in their lifetime came up with good ideas, every human being does that. What separates an entrepreneur from a person with good ideas is that the individual can take that idea and make a product out of it, create demand, and make a market for it. I have invented a lot of products in my lifetime, and I have introduced a lot of products in the marketplace. Coming up with the invention was the easiest part of that. The most difficult aspect was, how can I take this idea and make a product out of it. Those few persons per million are the ones who say, 'No matter how hard it is, no matter what obstacles there are, I'm going to find a way through every one of them until I get to the end goal.' Having a product that people want, that people pay money for and value, that's the true entrepreneur."

William Jackson (BSME '82, MSME '83)
Vice President, Johnson Controls

On focusing on more than the end goal: "Find joy in the journey—you will have to find the joy in the journey to find the satisfaction of hard work. To be aware of what is happening around you and to free yourself from the imagined limitations. You are more capable than you think you are—trust me—a lot more capable. Every time I started a new adventure, I am always overwhelmed, sometimes confused, and I'm doubtful. I have done material research, started companies, bought companies, negotiated deals, and now I run a $14 billion business. I feel overwhelmed, but I find a way to get it done. It gets easier the more you put into it (like the hard classes). Commit to it and embrace the challenge. The only way you will commit enough time and energy to an activity is if you find the joy in it. Cherish the challenges, overcome. We have a lot of problems in this world and we're going to need you to solve them, and you need to be good enough to solve those problems. To work on difficult tasks, to become really good at a profession, requires hard work. You are only gifted up to a point; it takes really hard work and dedication to be uniquely good. The only way you will go that extra mile is if you fall in love with the process, not the result. Embrace the journey."

Alumnus heads historic toy manufacturer

From Formula to Baja to Eco-Marathon, small-model cars have become symbolic of many students' experiences during their time in the MechSE Department.

Kader Industrial Company, the Hong Kong-based corporation led by MechSE alumnus **Kenneth Ting** (BSME '68), is also well known for creating small cars. Very small.

In fact, it was battery-operated race cars—much smaller than the typical MechSE creation—that helped establish Kader as a world-class toy manufacturer in the 1950s. Founded in 1948 by Ting's father, H. C. Ting, Kader started out by manufacturing plastic household products, but within a few years shifted to the more lucrative toy market.

"In the '50s, my father started tooling mold-making facilities in Hong Kong. I think he was the first one to establish plastic mold-making there," Ting said. "That's why in the late '50s we were able to go into toys. And that's how it all started, transitioning from plastic utensils to toys."

Growth came quickly after Kader made this switch.

"We became the major manufacturer for Ideal Toys and Marx Toys, which was the toy king in the States," Ting said. "And Louis Marx had a very good relationship with Sears and Roebuck, and a good personal relationship with President Eisenhower."

The younger Ting was a child during this rise to prominence. He came to the U.S. in the '60s to pursue his college education, which began with a degree track in liberal arts at Illinois Wesleyan. After a year he transferred to the University of Illinois, transitioned from LAS to engineering, and graduated with a mechanical engineering degree in 1968.

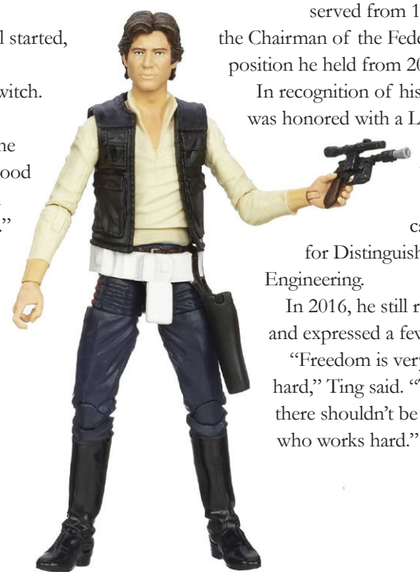
He then returned to Hong Kong to learn the family business.

"I joined the company in 1968 in the Engineering Department," Ting said. "The courses I took at Illinois had given me a good understanding of engineering. From there, I went to Manufacturing, and I was able to understand the processes better than anyone else because I could connect back to engineering. That helped me set a proper foundation for manufacturing in Hong Kong."

He ascended through the ranks under the traditional Chinese apprenticeship system. His father passed away in 1976, and in 1979 Ting became managing director and chief executive officer. His early years at the helm were pivotal for Kader, which moved its manufacturing operation to China in 1980. Soon thereafter, it began to collaborate on some of the western world's most beloved toys with companies such as Kenner, Hasbro, and Mattel.

"We made the Six Million Dollar Man, the Bionic Woman, the Star Wars figures, Strawberry Shortcake, and Teddy Ruxpin. And then a little later the Cabbage Patch Kids," Ting said. "Our workforce from Hong Kong had been about 2,000 workers. We slowly grew to 20,000 workers in China."

> "We made the Six Million Dollar Man, the Bionic Woman, the Star Wars figures, Strawberry Shortcake, and Teddy Ruxpin."



In 1985, Ting was successful in listing Kader's parent company, Kader Holdings Company Limited, on the Hong Kong Stock Exchange.

His public service record includes his participation in many civic, industrial, and governmental bodies, such as his election to the Hong Kong Legislative Council, on which he served from 1998 to 2004. He then was named as the Chairman of the Federation of Hong Kong Industries, a position he held from 2004 to 2007.

In recognition of his contributions to the industry, Ting was honored with a Lifetime Achievement Award in 2008 from his peers at the Hong Kong Toy Manufacturers' Association.

In 2012, he returned to the Illinois campus to receive the Alumni Award for Distinguished Service from the College of Engineering.

In 2016, he still recalls his days at Illinois very fondly and expressed a few words for today's students.

"Freedom is very important, but you have to work hard," Ting said. "The world is very competitive, but there shouldn't be any fear of the future for anybody who works hard."

Alumna a major tech player locally, nationally

"What I'm seeing more and more, which I really love, is geeky women being geeky women staying in the meat of engineering. Hopefully, that can continue so that long term we can have far more influence in the direction of science in our world."

Pixo president and CEO Lori Gold Patterson.

Lori Gold Patterson (BSME '90) is proving that a "humane" firm can solidly compete in the cut-throat IT consulting world while still delivering quality results.

The president and CEO of Pixo, Patterson began the company in 1998. As she has invested in people, Pixo has grown from five employees to 33 today and has greatly expanded its office space on Goose Alley in downtown Urbana.

Originally formed as On the Job Consulting (OJC), Pixo actually began as a "social experiment," Patterson said.

"We had a mission when we started this social experiment to prove to ourselves that we could operate differently in a highly competitive field (technology consulting) that had a horrible reputation of massively overworking its employees, over promising, and under delivering. We wanted to prove you could be competitive in that industry, by not leaning on the backs of individuals. That it could be a highly humane work place and still provide excellent service to our clients and, in fact, it could become the development house of choice."

Patterson believes in taking care of people on the inside by turning profits into employee benefits. For instance, Pixo has instituted Foundation Fridays, when from 1:00 to 5:00 p.m., no one does any billable client work; they instead work together on innovation and fulfilling ideas they would not otherwise have the opportunity to explore. Also, the office closes for two full weeks each year, one in early August and another between Christmas and New Year's Day.

"When you're in high-production companies and take a vacation, you oftentimes have to expend as much energy to get caught up when you return as you have gained by being away," Patterson said. "As a result, it is very hard to get a rest. We tell our clients about our closures well in advance and schedule our project plans based on the fact that we will be closed. That means that the entire company goes quiet and everyone gets to truly rest. Even though it's an expensive proposition, the return on investment through rejuvenation is mega."

Pixo's projects run the gamut from the internet of things to hardware and software integrations, business work flow systems that power the back office of large companies, and enterprise-level websites and web systems. Patterson indicates that as much as 25 percent of the company's clients now are local, partially due to the growth of the University of Illinois Research Park.

"We don't do a lot of marketing, nor do we have an elevator speech," Patterson said. "The vast majority of work walks in the door. We're known in the scientific community, both in Silicon Valley and here, and have a reputation of understanding how to take the complex and bring the human to it."

Patterson's accomplishments have led to growing recognition. She has delivered the commencement address at Parkland College and recently shared her vision as part of the Pygmalion Festival panel on "Tech in Champaign-Urbana."

She also has won the Athena Award, which is given annually by the Champaign County Chamber of Commerce and recognizes a recipient who has done outstanding work in helping women reach their potential. This last recognition, as an indicator of the ascending trends of women in tech fields, is particularly appropriate given Patterson's penchant for empowerment. She stated that she is excited to see more women "in the trenches" of engineering fields in addition to traditional management roles.

"What I'm seeing more and more, which I really love, is geeky women being geeky women staying in the meat of engineering. Hopefully, that can continue so that long term we can have far more influence in the direction of science in our world."

Chamorro aims to improve power grid, wind energy systems

Assistant Professor **Leo Chamorro** is leading a research team aiming to develop a holistic framework that closes the gap between turbulence and wind farm electric power output, and to integrate this linkage to efficiently and reliably operate power grids.

"Our holistic approach will integrate the physical processes involved in wind energy systems, the power grid, and their interface, including: uncertainties in wind power modeling; short-term and hourly-ahead forecasting of power output fluctuations at wind farm scale; and enhancing power grid operations using wind output prediction," Chamorro said.

He recently received a National Science Foundation grant for this work in collaboration with ECE Professor **Hao Zhu** and Professor **Sven Schmitz** at Penn State.

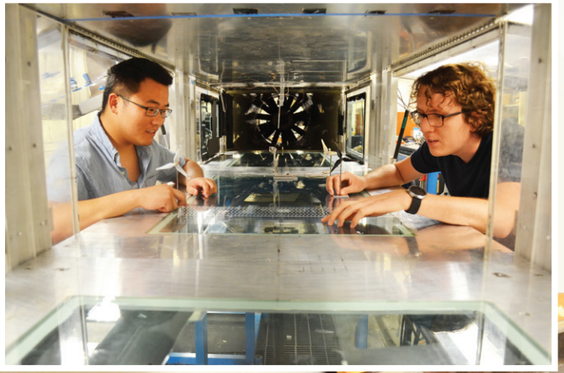
With a nationwide goal set by the Environmental Protection Agency's Clean Power Plan to cut approximately 32 percent of carbon emissions from the power sector by 2030, Chamorro's proposal is highly relevant. The research will potentially lead to more efficient wind farm operations that could help cut emissions by replacing less clean energy sources.

"Turbulence plays a dominant role in the fluctuations of wind farm power output. However, controlling turbulence is a challenging task," he said. "There's a need to understand turbulence in this context, which is where our work fits in."

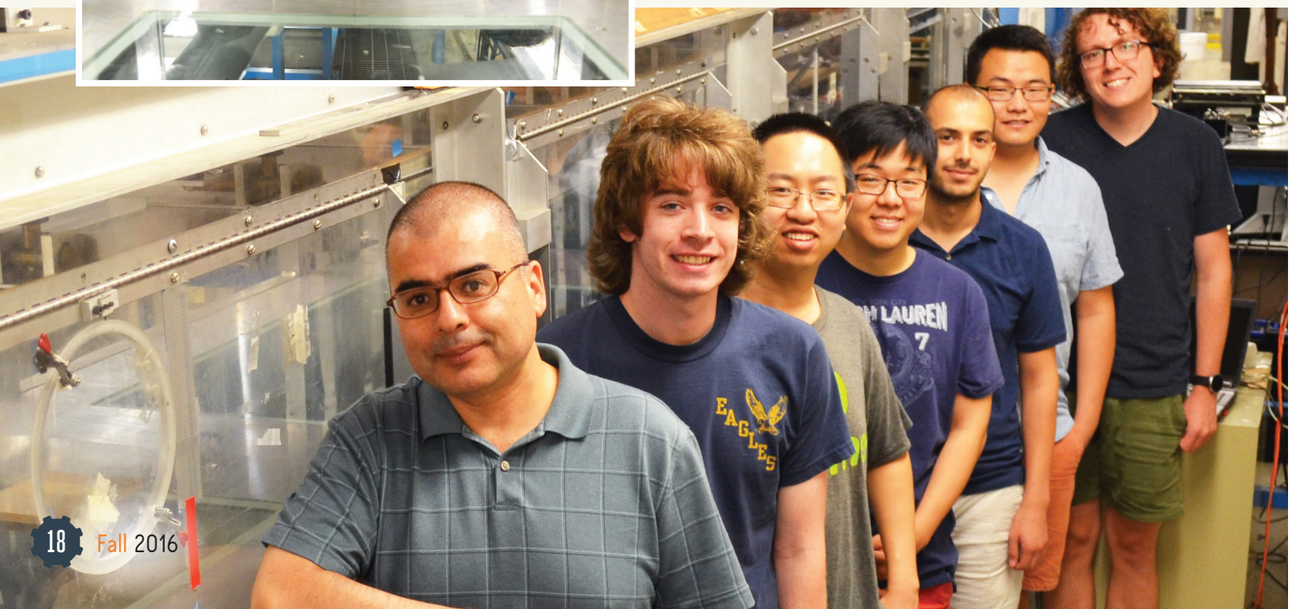
Chamorro is heavily involved in other exciting research as well. His group, the Renewable Energy and Turbulent Environment Group, conducts research on the role of turbulence in fundamental and applied problems of high interest, including turbulence over large-scale topography, wind and hydrokinetic energy, scalar transport over urban and natural environments, flow in porous media, flow-structure interaction, and instrumentation development for turbulence measurements.

The group's research insight can also be applied to evacuation planning in urban environments. Their understanding of complex topography would help to develop simplified models that could guide fast decision-making.

"Suppose you have a dangerous substance unleashed into a city atmosphere," Chamorro said. "You don't have time to do complex simulations in order to predict what will happen and what the best course of action is. We are working on ways to provide quick feedback regarding a safe and immediate course of action for evacuating people from the city. The key is to uncover dominant turbulence dynamics modulated by large-scale topography."



Left: Visiting scholar Huiwen Liu and PhD candidate Nicholas Tobin in the wind tunnel in Talbot Lab.
Below: Leo Chamorro, front, with six members of his Renewable Energy and Turbulent Environment Group.



"This information is important to us because long-term manual wheelchair users have upper extremity joint pain, particularly in the shoulder, as well as other conditions like carpel tunnel in the wrist."

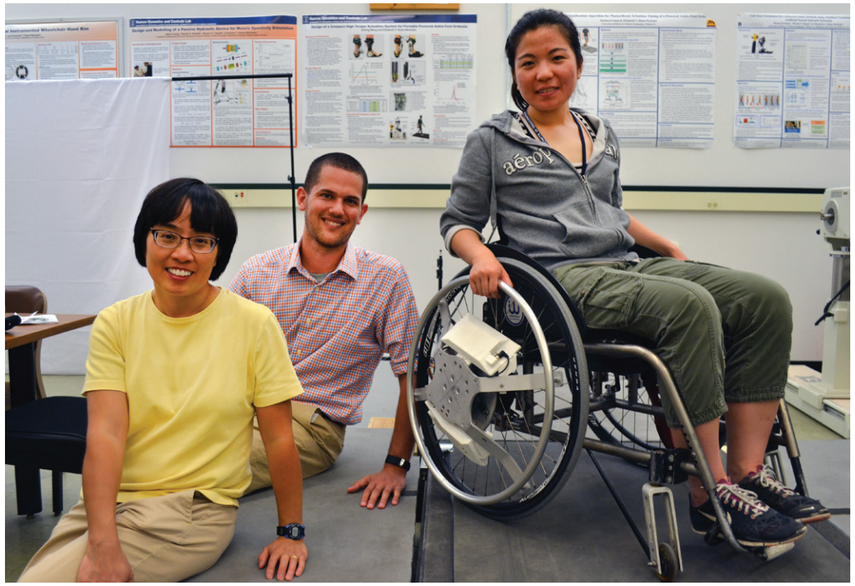
MechSE-IntelliWheels collaboration propels geared wheel technology

MechSE professor **Elizabeth Hsiao-Wecksler** and her research team are helping to develop a ground-breaking advance to prevent pain and injury for manual wheelchair users.

The project began in 2014. Hsiao-Wecksler's former graduate student **Scott Daigle** (BSME '09, MSME '11) and his Research Park-based company, IntelliWheels, received a research grant from the National Institutes of Health to advance the development of ultra-lightweight, multi-geared wheels for manual wheelchairs. The goal was to allow for easier navigation of hills and rough terrain and reduce the risk of arm injuries that often result from overuse.

Since Daigle had maintained ongoing collaborations with Hsiao-Wecksler and her Human Dynamics and Controls Lab, the two groups joined together—along with scientists at the University of Wisconsin-Milwaukee—to conduct this research on geared wheelchair technology and its potential adverse effects on users.

Hsiao-Wecksler and graduate student **Alan Gaglio** have now begun developing an instrumented hand rim that can be added to the geared wheels. This rim can record the forces and torques that the user's hand applies to the rim. Using inverse dynamics, a process utilized often in biomechanics, they aim to use these measurements to estimate the loads in the user's wrist, elbow, and shoulder joints during propulsion.



Elizabeth Hsiao-Wecksler, Alan Gaglio, and Jiahui (Carrie) Liang in the Human Dynamics and Controls Lab.

Theirs is the first instrumented geared wheelchair wheel to try to quantify these dynamic forces.

"This information is important to us because long-term manual wheelchair users have upper extremity joint pain, particularly in the shoulder, as well as other conditions like carpel tunnel in the wrist," Gaglio said. "There are commercially available wheels that allow you to measure the forces being applied to the hand rim, but those wheels are direct drive. We want to know what the forces are when using a geared system, so we could demonstrate that the forces being generated by the muscles are reduced as a consequence of lowering the gear ratio."

Hsiao-Wecksler said the wheels are designed to be easily installed on the axles of an existing manual wheelchair, and that the use of gears is similar to those on a bike. A direct drive wheelchair wheel is like using a single speed bicycle to get around; few adults ride single speed bicycles due to the greater effort needed when going uphill or through rough terrain.

"With the geared wheel, you're pushing a little faster but with less force," she said. "You wouldn't be using as much muscle strength."

According to the 2010 U.S. census, there are 3.6 million wheelchair users over the age of 15, and it is estimated that more than half of them use manual wheelchairs.

"I would argue that every manual wheelchair user could benefit from geared wheel technology," Gaglio said. "And for some powered wheelchair users who still have functional control of their upper extremities, geared wheels may allow them to move back into a manual chair by reducing the demand on their upper extremities during propulsion."

Gazzola uses simulation to analyze locomotion of swimmers

Mattia Gazzola, a new assistant professor in MechSE, is used to change. Gazzola, who started here in August 2016, has lived in five countries and seven cities before his most recent relocation to Urbana-Champaign.

Despite all of his geographical transitions, one thing that has never changed is his passion for engineering.

Gazzola was born and raised in a small town outside of Milan, Italy, where he also attended college at Polytechnic University of Milan. He received his bachelor's degree in 2003 in energy engineering and his master's degree in 2006 in nuclear engineering. Gazzola then worked as a software architect in Barcelona, Spain, before moving to Zurich, Switzerland, where he earned a PhD in mechanical engineering from ETH Zurich in 2013. That year, he moved to the U.S. for a postdoctoral position at Harvard University, and continued his research there until this year, when he accepted the position in MechSE.

Throughout his studies, he worked on research that included geometric reconstructions of vessels from MRI images, software development, and large-scale simulation in computational biology. His primary interest now lies in inverse design, which focuses on finding and calculating the best design solutions to achieve certain functions.

"I started to apply this to fluids problems, and so I thought a good place to start would be locomotion," said Gazzola. "I wanted to start understanding why a swimmer is shaped or moves a certain way."

A swimmer, as he defined it, is anything that propels in a flow by displacing the fluid around it. Particularly, Gazzola has focused on small-bodied swimmers such as small fish, and how they flex their bodies and move their tails to achieve propulsion. He then maps these calculations on large computing architectures in the form of numerical simulations, which he animates in colorful, lifelike graphics of swimmers. He has furthered his investigations by studying their collective behaviors to understand how flow and social interactions affect each other within groups of fish.

Gazzola, who is also a Blue Waters Assistant Professor at the National Center for Supercomputing Applications, is one of just a few scientists who study this topic, and he has been featured in such high-profile media as the *New York Times*, the BBC, and *Wired*. He hopes that his research will provide the fundamental understanding for future mechanical design and technological discoveries of soft robotics. This area of research is thought to lead to the creation of robots that can assist in cleaning the environment, as well as developing theories on how plant roots react to soil.

Shao to focus on big data in manufacturing

New MechSE assistant professor **Chenhui Shao** did not always plan on going into mechanical engineering.

Shao grew up in a small town in China where he spent most of his childhood in a rigorous school system.

"There wasn't much time for extracurricular activities," said Shao. "Our school days went from 7 a.m. to about 9:30 p.m."

As he completed high school and began applying for colleges, he struggled to find a major that would fit him. His father, a math teacher in China, helped guide Shao's decision to find a field of study that would both interest him and support him financially. Between his love for math, science, and research, Shao discovered that engineering was the perfect fit.

He earned his bachelor's degree in automation at the University of Science and Technology of China in 2009. Originally, Shao had no intention of studying abroad; he planned to stay close to his family and friends in his home country. But after speaking with professors and learning about the opportunities in the U.S., he decided that moving overseas could open up research possibilities that were crucial to his studies.

Shao moved to Ann Arbor, where he earned two master's degrees—in industrial and operations engineering and statistics—at the University of Michigan in 2013. Three years later, he completed his PhD in mechanical engineering, and then he continued his research with a postdoctoral position for several more months. After interviewing at the University of Illinois, he knew it was the place for him, so in August 2016 he moved from Ann Arbor to Urbana.

"I felt that I could succeed in this environment," Shao said. His positive first impressions with the faculty as well as the department's interest in his area of study made for a perfect match.

Shao's research concentrates on the development and application of statistical methods for big data in manufacturing and the monitoring and control of manufacturing processes and systems. Manufacturing plants collect massive sums of data but typically do not use it in its entirety. Thus, Shao has targeted his research on tracking the patterns in manufacturing statistics, which can provide corporations with useful data for future projects.

MechSE Faculty News

Andrew Alleyne received the 2016 Charles Stark Draper Award from the Dynamic Systems and Control Division of the American Society of Mechanical Engineers (ASME).

Gaurav Bahl is leading a team that was awarded a $2 million grant from the National Science Foundation (NSF). They make up one of nine research groups of engineering-led, interdisciplinary researchers working to break the conventional ways in which light and sound waves propagate. Bahl has also been awarded a Defense University Research Instrumentation Program grant, from the U.S. Department of Defense and the Air Force Office of Scientific Research, to support his work on Raman spectroscopy and the laser cooling of silicon.

Leo Chamorro received a two-year grant from Deere to develop advanced testing tools.

Harry Dankowicz was announced as the new Associate Dean for Graduate, Professional, and Online Education for the College of Engineering. (See page 5.)

Geir Dullerud has received the honor of being named W. Grafton and Lillian B. Wilkins Professor in the Department of Mechanical Science and Engineering.

Alison C. Dunn won a three-year grant from the National Science Foundation for her proposal, "Discovering the mechanisms of hydrogel surface weakening and wear under applied sliding conditions." The grant aims to study how hydrogels break down when sliding against other materials, so that hydrogels implanted in the body do not wear unintentionally.

Randy Ewoldt hosted a webinar for industry leader TA Instruments titled "Experimental Challenges of Shear Rheology: How to Avoid Bad Data," for more than 400 live attendees. He also joined Matt West in developing non-traditional instruction into MechSE courses—this time creating high-definition slow-motion video of a bow and arrow to demonstrate several cross-course principles in a more engaging way.

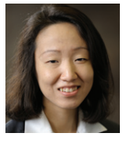
Jonathan Freund has received the honor of being named Donald Biggar Willett Professor in the Departments of Mechanical Science and Engineering and Aerospace Engineering.

Nick Glumac has received the honor of being named Shao Lee Soo Professor in the Department of Mechanical Science and Engineering.

Sascha Hilgenfeldt has been named a Fellow of the American Physical Society upon the recommendation of its Division of Fluid Dynamics.

Naira Hovakimyan completed testing of her L1 adaptive flight control system on a manned VISTA F-16 aircraft at Edwards Air Force Base in California. The F-16 round of advanced testing comes on the heels of Hovakimyan's first-ever successful test of the technology on a manned Learjet aircraft in 2015. She also gave lectures at the Aging 2.0 Optimize event, the ICNPAA World Congress, NASA Ames Research Center, and the University of Southern California.

Elizabeth Hsiao-Wecksler was invited to be the keynote speaker at the 12th Annual ASME Dayton Engineering Sciences Symposium in Dayton, OH.



Yuhang Hu was among just five researchers from Illinois to be awarded a grant from the Air Force Young Investigator Research Program.

Iwona Jasiuk hosted the annual meeting of the NSF-funded Center for Novel High Voltage/Temperature Materials and Structures (HV/TMS) with co-director Martin Ostoja-Starzewski.

Shiv Kapoor was named an Honorary Member of ASME. He was selected for "more than three decades of pioneering contributions to manufacturing engineering through basic and applied research with close collaboration with industrial users, the education and mentoring of young talent, and lifelong service to ASME and other professional societies."

Mariana Kersh instructed campers at MechSE's "Girls Building Awesome Machines (GBAM)" and "Exploring MechSE" summer camps in building a prosthetic hand, introducing them to the design process and engineering principles that are theoretical and complex, and showing them how to model the human body as a mechanical system in which muscles are like small motors and joints are like gears and constraint systems.

Seok Kim's unique transfer printing approach was published in Advanced Materials Technologies. His new developments in the field of micromanufacturing were published by *Scientific Reports*. Kim's work introduces a new level of microassembly (termed 'micro-LEGO') that involves multiple materials.

Seid Koric has published an impressive 22 papers based on research collaborations done at NCSA, making him the most prolific researcher from the world's largest open science supercomputer, Blue Waters.

Tonghun Lee was named an Associate Fellow by the American Institute of Aeronautics and Astronautics. He is also leading an effort to create a national archive database for alternative jet fuels. The database was developed as part of the Federal Aviation Administration's (FAA) Aviation Sustainability Center of Excellence program.

Moshe Matalon received the 2016 AIAA Fluid Dynamics Award at the 2016 AIAA Aviation and Aeronautics Forum and Exposition. He was honored for his "contributions to the development of combustion theory, for revolutionizing understanding of chemically reacting flows, and for work on the hydrodynamic theory of premixed flames." The award is presented annually for outstanding contributions to the understanding of the behavior of liquids and gases in motion as related to needs in aeronautics and astronautics.

Nenad Miljkovic received a two-year Petroleum Research Fund Doctoral New Investigator Award from the American Chemical Society. Using advanced nanometric resolution scanning probe microscopy techniques, Miljkovic will identify the fundamental mechanisms on engineered surfaces that govern fouling, corrosion, and degradation of hydrophobic and oleophobic coatings to develop next-generation coatings.

SungWoo Nam won the National Aeronautics and Space Administration (NASA) Early Career Faculty (ECF) award for flexoelectric actuator based on corrugated two-dimensional materials. He participated in the U.S. National Academy of Sciences fourth annual Arab-American Frontiers of Science, Engineering, and Medicine symposium. He is leading a research effort published in Nano Letters that demonstrates doping-induced tunable wetting and adhesion of graphene, revealing new and unique opportunities for advanced coating materials and transducers, in work supported by the U.S. Air Force and by NSF. His work was also published as the cover article of Advanced Materials, demonstrating crumpling of graphene to enhance graphene photodetectors' light responsivity. He also has developed a new one-step, facile method to pattern graphene by using stencil mask and oxygen plasma reactive-ion etching, and subsequent polymer-free direct transfer to flexible substrates, published in Scientific Reports.

Martin Ostoja-Starzewski has been named a Fellow in the Society of Engineering Science (SES). He also gave two prominent keynote lectures this year—at the Emerging Trends in Applied Mathematics and Mechanics Conference and at the 11th International Congress on Thermal Stresses. He also hosted the annual meeting of the NSF-funded Center for Novel High Voltage/Temperature Materials and Structures (HV/TMS) with co-director Iwona Jasiuk.

Srinivasa Salapaka received a three-year NSF grant to simplify and facilitate analyses of scientific, engineering, and healthcare-related problems that are frequently illustrated using large, complex graph-based models.

Huseyin Sehitoglu was recently appointed for a three-year term to the International Materials Reviews Committee for ASM International, the world's largest association of metals-centric materials engineers and scientists.

Petros Sofronis and the International Institute for Carbon Neutral Energy Research (I²CNER), for which he is the director, hosted the 2016 International Hydrogen Conference at the Jackson Lake Lodge in the Grand Teton National Park in Wyoming. The conference examines an incredible range of hydrogen-materials interactions.

Kelly Stephani was among just five researchers from Illinois to be awarded a grant from the Air Force Young Investigator Research Program.

Sam Tawfick was faculty advisor to a student senior design team that received widespread recognition of its 3D-printable excavator cab (see page 6). His research from the invited paper "Patterning via self-organization and self-folding" made the cover of MRS Bulletin.

Kimani Toussaint is helping implement a $5M NSF-sponsored "redshirt year" program, allowing a bridge year to prepare incoming freshmen from less affluent high schools for the rigors of engineering coursework, starting in Fall 2017. He is also the PI on a U.S. Department of Energy cooperative award—one of only six awards granted nationwide from the nearly $9M program—to reduce the cost of the solar collectors used in concentrating solar power plants.

Ning Wang was published in *Nature Materials* for vital research on the use of mechanical forces at the cellular level. How genes in our DNA are expressed into traits within a cell is a complicated mystery with many players, the main suspects being chemical. Wang's new study has demonstrated that external mechanical force can directly regulate gene expression. The study also identified the pathway that conveys the force from the outside of the cell into the nucleus. Identifying the ways mechanical forces send signals within cells has applications not only in fundamental cell biology, but also for cancer, stem cells, and regenerative medicine, Wang said.

Matt West was among the nation's most innovative engineering educators selected to take part in the National Academy of Engineering's eighth Frontiers of Engineering Education (FOEE) symposium. He also joined Randy Ewoldt in developing non-traditional instruction into MechSE courses—this time creating high-definition slow motion video of a bow and arrow to demonstrate several cross-course principles in a more engaging way.

Aimy Wissa and her bird-inspired mechanics work were featured in *Inside Unmanned Systems*. She also spent eight weeks at Wright-Patterson Air Force Base as part of the Air Force Summer Faculty Fellowship Program, where she worked with specialists on a project to improve the ability of existing unmanned air vehicles to operate in complex flight conditions, such as gust and high-angle-of-attack maneuvers.

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