DEPARTMENT OF
Mechanical Engineering
UNIVERSITY OF WISCONSIN–MADISON

FALL 2014
www.engr.wisc.edu/me

INNOVATIONS

As we approach the end of this year, it's a good time to reflect on the past year's activities and accomplishments. I took over as chairman in September 2013, and it has been a whirlwind year. We entered the fall semester with 30 faculty members, more than 675 undergraduate students, and approximately 230 graduate students.

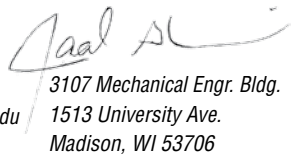
This is a record number of undergraduates, and we are working hard to manage this surge. But, this is a good thing! It is heartening to realize that mechanical engineering—after all of these years—is such a sought-after major, and that this increase in enrollment has not been accompanied by any easing of our entrance standards.

I get the sense that students have an increased desire to build things, which is fueled by manufacturing innovations, such as 3D printing; low-cost electronics hardware, like the Arduino, that make sophisticated control feasible; and the prevalence of mobile computing hardware. The skills needed to build things are rapidly transitioning from old-school metal cutting and joining into the digital realm.

This is also relevant to the research activities of the department. Professor Lih-Sheng (Tom) Turng is heading up UW-Madison's participation in the newly created Digital Manufacturing and Design Innovation (DMDI) Institute, which could lead to research funding of up to $2 million per year for the next five years. Advanced manufacturing will also be one of the thrust areas in the newly formed Grainger Institute for Engineering that College of Engineering Dean Ian Robertson announced in June. This is an exciting time for manufacturing, which plays into one of the department's strengths, and is also critical to the state's economic future.

In the past year, the department underwent major reviews from both internal and external committees. These reviews have highlighted the challenges that we face maintaining our prominence in the changing education and research landscape. We are using this input to adapt our operation in ways that will enhance the department and allow it to maintain its prominence in the future.

On Wisconsin!



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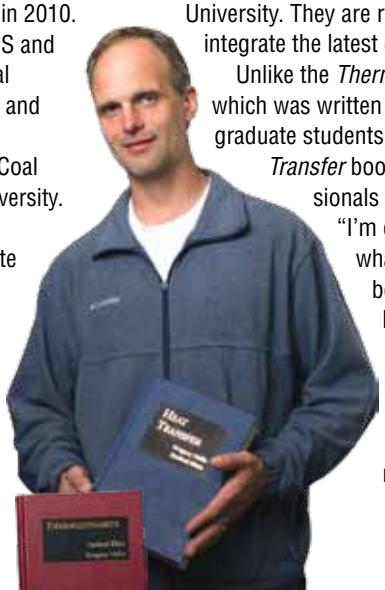
Professorship gives faculty freedom to pursue new directions

Kaiser Chaired Professor Greg Nellis knew there was a need for an updated thermodynamics textbook that included information on using essential computer tools to solve problems. "Writing a new textbook that addressed this issue was something I wanted to do for a long time, but it's hard to justify the time when you're looking for funding for your research programs," he says.

An opportunity arose when Nellis was named the Elmer R. and Janet Ambach Kaiser Chair in Mechanical Engineering in 2010. The late Elmer Kaiser received BS and MS degrees from the mechanical engineering department in 1934 and went on to positions at Battelle Memorial Institute, Bituminous Coal Research Inc., and New York University. He established the endowed professorship in 1987 to promote and recognize excellence in teaching and research.

Nellis credits the professorship, which provides annual discretionary funding to support research and teaching, with allowing him to devote time to write the text, *Thermodynamics,* with Sandy Klein, the Ouweneel-Bascom Professor. Nellis says the textbook enriches learning by helping students gain proficiency in the computer tools that employers expect grads to know how to use.

Currently, Nellis is using funding from his professorship to work on writing a second edition of Cryogenic Heat Transfer with Randall F. Barron, professor emeritus of mechanical engineering at Louisiana Tech University. They are revamping the book to integrate the latest computer tools.



Unlike the *Thermodynamics* textbook, which was written for undergraduate and graduate students, the *Cryogenic Heat Transfer* book is directed at professionals working in industry. "I'm doing it because that's what universities should be doing—taking knowledge like this and getting it to people working in the field," he says. "And this book will probably be much more impactful than a paper. Having a chaired professorship lets you start thinking about what you should be doing with your time versus what you have to do to get funding for your research. It's been great having it. It has definitely freed me to go in directions I wouldn't have otherwise gone professionally."

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If you'd like to target your gift in a specific way, please contact Brad Green for more information on how to give:

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Hybrid team experience leads to grad research

Jake Riederer attended his first meeting with the UW-Madison Hybrid Vehicle Team as a freshman, prompted by his passion for cars. He didn't anticipate his involvement with the team would have a major impact on his academic career at UW-Madison—even influencing his decision to pursue graduate research with the Engine Research Center (ERC).

The hands-on learning opportunities with the hybrid team immediately resonated with Riederer. "The very first meeting I went to with the team, I welded together the frame of the car, because I knew how to weld," Riederer recalls. "I got very involved right off the bat."

As he was considering a major, he noticed that many of his hybrid vehicle teammates were mechanical engineering majors. His experiences on the team helped him decide to also pursue mechanical engineering.

"I really fell into the mechanical engineering department through the automotive teams, and I feel lucky to have found it," says Riederer, who is from Menasha, Wisconsin.

As an undergraduate, he also worked for two years as an hourly assistant in the ERC, where he assisted graduate students on a variety of different projects. Through that exposure to graduate-level research, he realized there were appealing similarities between the ERC research projects and the research conducted by the vehicle teams. "I really started to enjoy research on engines," he says. "It's amazing how robust the internal combustion engine is, and a lot of the work to develop the next generation of engines is being done here."

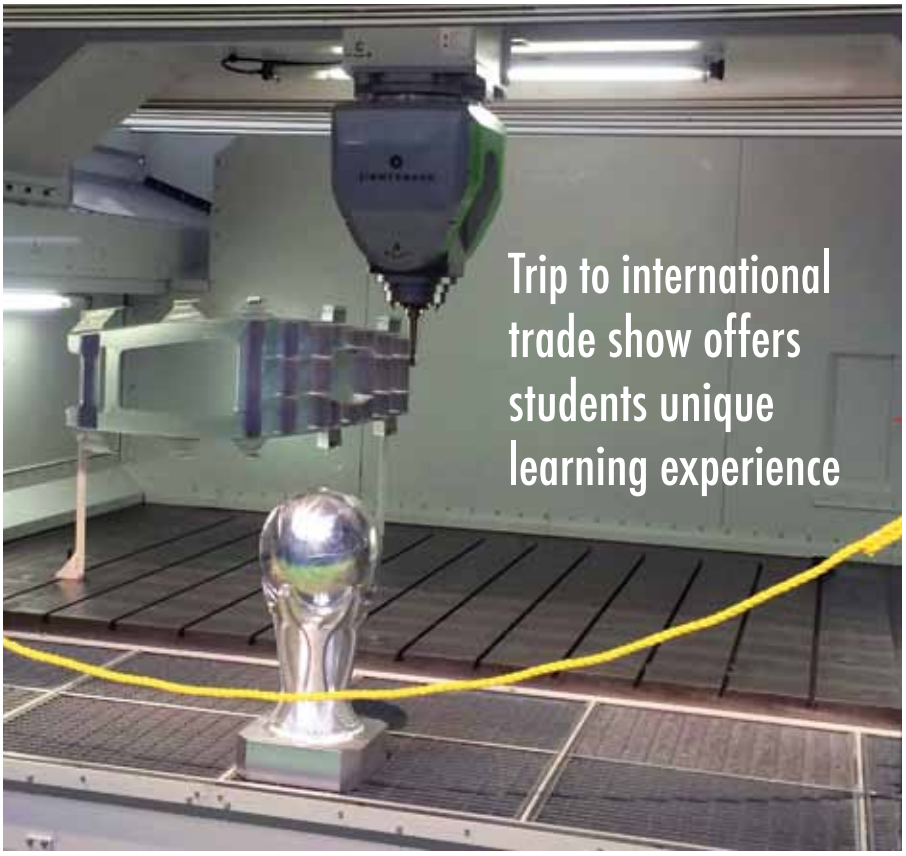
With a growing interest in graduate research and engines, he started seriously considering pursuing a master's degree. For Riederer, the ideal scenario would be an opportunity to combine his passions for engine research and the hybrid vehicle team.

Fortunately for Riederer, the ERC graduate program, which he started in fall 2014, offered him just such an opportunity. Researchers in the ERC, led by Wisconsin Distinguished Professor Rolf Reitz, pioneered an alternative combustion mode, called reactivity controlled compression ignition, or RCCI. Using the RCCI technology, which is patented by the Wisconsin Alumni Research Foundation, the researchers developed the most efficient compression ignition engine ever. ERC researchers installed an engine using RCCI technology into the hybrid team's series electric car as a proof-of-concept vehicle, essentially turning it into a mobile laboratory and enabling road tests. In his graduate work in the ERC, Riederer will conduct research on the hybrid car and study calibration and refinements to the RCCI combustion mode.

"It's been very cool and unique to get the opportunity to continue work on a project I've already taken part in during my five years with the hybrid team, but to do research in a very different role than before," he says. "I think I really lucked out being at Wisconsin and getting to work with the ERC for a master's degree."

Riederer credits Glenn Bower, the faculty advisor for the automotive projects, with forming various relationships that that gave the hybrid team the amazing opportunity to work with the ERC.

"I've been impressed with how our team has continued to work with full-on hybrid electric vehicle development and research," Riederer says. "I don't think that opportunity could exist at any other school. With the people and resources we have here, the pieces all fit perfectly."



Trip to international trade show offers students unique learning experience

5-axis portal-style machining center at IMTS 2014. *(Photo courtesy of Frank Pfefferkorn.)*

Pfefferkorn

For years, Associate Professor Frank Pfefferkorn has chartered a bus to take a group of students to the International Manufacturing Technology Show in Chicago. However, 2014 was the first time he needed a double-decker bus to accommodate all the people interested in going.

"This year's turnout was by far the largest," Pfefferkorn says. "We had twice as many students participating compared to previous years."

In all, 55 engineering students reserved a seat on the bus, as well as four faculty and six student shop staff, for the day trip to IMTS on September 12. Pfefferkorn says the high turnout shows an increasing interest in manufacturing activities at UW-Madison.

Pfefferkorn started the IMTS bus trips primarily for his ME 429 metal-cutting class, but he extends the opportunity to all mechanical engineering students who may be interested in discrete part manufacturing, as well as to industrial and systems engineering and manufacturing systems engineering students, faculty and staff.

Pfefferkorn says attending IMTS is an important practical learning experience for students. As one of the largest trade shows in the world, attracting more than 100,000 visitors from more than 112 countries, IMTS gives students a unique opportunity to see the breadth of real-world applications for what they're learning in class. "I still remember going to this trade show as a young graduate student and being overwhelmed by the huge breadth of technologies that I had not heard of or learned about," Pfefferkorn says.

Pfefferkorn says exposure to the vast array of exhibits at the show is valuable for students because it introduces them to new technologies and can help them discover possible career directions or companies they may want to work for. "IMTS gives students insight into this sector of the economy and a sense of the international flavor of the industry," he says.

Pfefferkorn says feedback from students about the experience was overwhelmingly positive, with many students wishing they could have spent more time at the show. Pfefferkorn credits the Obert Fund, which paid for the bus, for making the trip possible. The Obert Fund was established to fund activities that benefit undergraduate students in the Department of Mechanical Engineering.

"Without that fund, or something like it, we probably wouldn't be able to do trips like this. It's a real benefit to the students, and it gives them some of these opportunities that they wouldn't otherwise get."

XIAOPIN QIAN

Using computers to analyze and design 3D shapes

Advances in 3D sensors and 3D shape modeling have made it easier for engineers to create three-dimensional computer models from a physical object.

In his research, Associate Professor Xiaoping Qian, who recently joined the faculty, aims to efficiently acquire scan data from 3D objects and to analyze and model that data using computer-aided geometric design and geometry processing methods.

Qian's research in geometric modeling, shape analysis, and shape/topology optimization has diverse applications, including product design, manufacturing, 3D printing, reverse engineering and biomedical applications.

To analyze and model the geometry of a physical object, Qian first conducts detailed laser scans of its surface. Complex 3D objects require scans from multiple sensors at many different angles to construct a complete point cloud, the tens of thousands of data points that make up the contours of the object's surface. Then, Qian uses geometry processing algorithms to massage that raw "point cloud" data, knitting the multiple scan data sets together to reconstruct the physical object as a digital 3D shape model. The digital 3D model file can then be used for various applications, such as reproducing the object through additive manufacturing.

Similar to how advances in camera sensors allow higher-resolution photos, rapid advances in 3D sensing techniques and laser sensor resolutions enable engineers to acquire much more data than before—in this case, massive point cloud data from 3D objects. With the growing use of massive point cloud data in various 3D applications, Qian's research focuses on developing a mathematical foundation and computational techniques for effectively processing dense point cloud data for product development use. He previously worked on a National Science Foundation-funded project researching direct digital design and manufacturing from massive scan data.

"When you laser scan a physical object, like a mechanical part, you can acquire massive scan data, which is usually raw data. I'm interested in how to make sense of the data, process it, and extract meaningful information, and how to feed that data into design and manufacturing applications," Qian says.

Qian joined the Department of Mechanical Engineering with tenure in spring 2014, coming from the Illinois Institute of Technology. He previously worked as a research engineer at GE Global Research Center in Niskayuna, New York. Qian earned his bachelor's and master's degrees in mechanical engineering at Huazhong University of Science and Technology in China, and he received his PhD from the University of Michigan-Ann Arbor in 2001.

At UW-Madison, Qian directs the Computational Design and Manufacturing Lab, where his team conducts fundamental research in computer methods for design and manufacturing automation. This research also involves shape design, in which his team uses computer models to analyze ways a shape can be optimized by adjusting its geometry.

Qian says the opportunity for interdisciplinary collaboration was a big factor in choosing to come to UW-Madison. "People here have very diverse backgrounds. I don't have to go far to work with people in different disciplines, and that's one of the main attractions," Qian says. "Researchers at UW-Madison are already doing a lot of outstanding work in my area, so hopefully I'll have more opportunities to collaborate and grow as well."

Qian says he's already talking with faculty in the statistics department who are experts in analyzing big data, and he's also looking for potential collaborations with people in biomedical engineering and the UW-Madison Medical School.

Since he joined UW-Madison, he has been awarded two new NSF grants, with one focusing on improving virtual product development through a new geometric design and analysis technique, and the other focusing on shape optimization for improving energy absorption efficiency in organic solar cells.

Q&A with Professor Emeritus John Mitchell

Professor Emeritus John Mitchell retired from the department in 2001 after 39 years with the College of Engineering. Since then, he has continued to serve the department in a couple of roles while also working on other projects. We sat down with Mitchell to find out what he has been doing in retirement.

What have you been up to since retiring from the department?

Since about 2005, I've been the awards chairman for the department. I help faculty secure university, College of Engineering, and national professional society awards. I work with them to apply for awards that are appropriate and help develop the nominations to take that burden off the faculty. We make nominations for close to a dozen awards each year.

Since roughly 2010 I've been the department's assessment chair. The Accreditation Board for Engineering and Technology (ABET) requires a fairly hefty report detailing the program. ABET has shifted into more of a performance-based mode, where they want us to identify educational objectives and student outcomes, and then they want us to assess whether the students have achieved those by collecting data. And then they want us to modify the courses to improve the rate or effectiveness of achieving those things. So this requires, in our case, doing a set of assessments for courses every three years. In the fall we're starting this assessment of our capstone mechanical engineering courses.

I've also been involved in developing a number of online materials for undergraduate courses. Some colleagues and myself received a grant to develop some online materials—modules—for fluid mechanics and for thermodynamics that have been used quite successfully both for mechanical and civil engineering classes.

We've tried to encourage the use of these online modules for a blended classroom approach, where you assign a module ahead of class and a student will look at a module on fluid statics, for example, and it will cover a lot of really basic ideas. Short quizzes are embedded in these modules, so after three or four slides, students can test themselves to see if they're understanding the material. Then, in class, the instructor can focus on answering questions and problem solving rather than spending time going over the basic material. We've developed enough modules so that there is roughly one module per class period.

Why were you interested in developing online learning materials?

As I neared the end of my career, I began to no longer be so heavily involved in research. So I began to become more involved in new educational techniques. I was involved with the National Science Foundation-sponsored Foundation Coalition, a coalition of seven schools working together to make engineering education more effective, and a lot of things developed from it. So this is a continuation of that interest, and I now have the time to work on it.

Now that you have more time available, are you working on anything else?

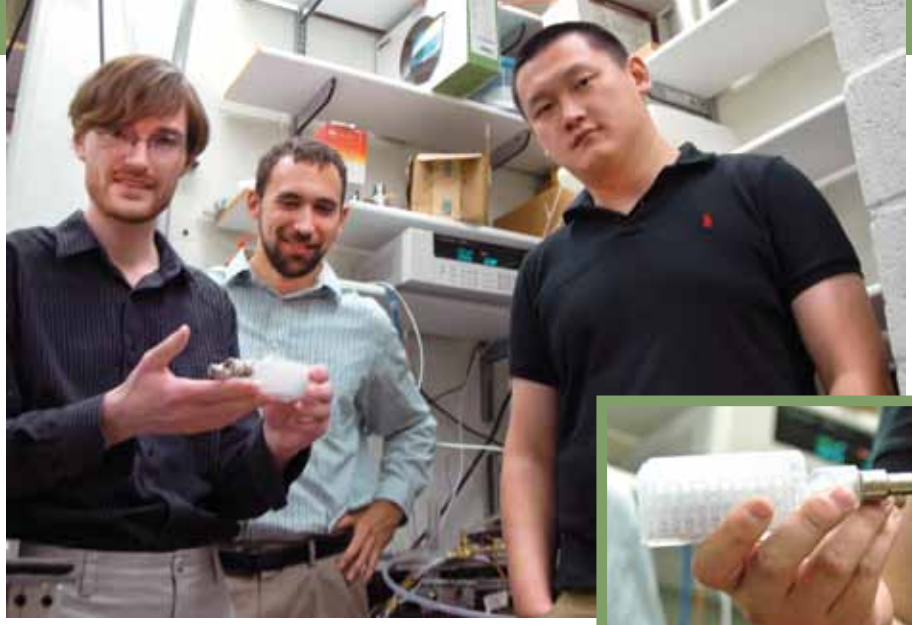
I've been asked by Wiley Publishing Company to be the technical editor for another revision for a very popular fluid mechanics textbook by Robert Fox and Alan McDonald out of Purdue. So I've been working on that about four months now, re-doing the material, developing new problems, updating some things and trying to expand the online offering. So, again, I'm working on moving toward the ability to do this more in a blended classroom mode. It keeps me busy.

Outside of professional projects, what have you enjoyed doing with your time?

For about the last 10 years, my wife and I have gone to Tucson, Arizona, in the winters, and we now have a condo there, so we're about 50/50 Arizona and Madison residents. I very much enjoy the ability to engage in outdoor activities all year round, like hiking, biking, running and birding. There are some really neat birds in Arizona, and so we like to go on birding trips. It's relaxation but it also keeps our minds and our eyes active. It's a lot of fun.

Are there things about retirement that you particularly enjoy?

I enjoy not having a detailed schedule of commitments and meetings. With the book revision, I have deadlines and things like that, which are perfectly fine, but I like being able to take mornings and hike Sabino Canyon and then have the flexibility to work on the book project in the afternoon. The freedom with my schedule is something I really appreciate.



PROTOTYPING SUCCESS:

Students harness startup principles in ambitious design project

For a small group of seniors who took a capstone design course during the 2014 summer term with Associate Professor Tim Shedd, the experience was at times more similar to working on an early-stage startup than a college course.

That was by design. When teaching design courses, Shedd says he emphasizes concepts that are common in the startup world, such as the importance of prototyping and iterating, knowing one's market, and getting real feedback from users or potential users of the product.

So when the team of seniors Kevin Ripley, Tony Taylor and Brian Liu decided to tackle an ambitious project in their eight-week course, they started out by producing a short video to pitch their concept. They posted the video and their feasibility analysis on online engineering forums and LinkedIn groups to solicit input from experts and potential users. The idea was to gauge the potential market and see if their idea was worth pursuing.

In all, the students received about six pages of written feedback from people in the forums. "The feedback was mostly positive and constructive, and it gave us more confidence in our direction," Ripley says.

For their project, the students set their sights on designing a heat exchanger for cooling desktop computers that performs better than a leading heat exchanger on the market. The students' thornier challenge, however, was to also design their liquid-air heat exchanger to be smaller, weigh less, and cost less than the commercial model. "I told them that's going to be hard to do," Shedd says. "I was expecting them to take on an easier project."

The team chose a novel material and approach: to make a polymer heat exchanger using 3D printing. Using 3D printing processes gave the students more freedom in designing structures that would help them overcome the limits of polymers in heat transfer.

The students used the UW-Madison Polymer Engineering Center's (PEC) selective laser sintering (SLS) machine, purchased with money from the $1.5 million gift from alumnus Robert Cervenka and his wife, Debbie, to create an early prototype. In working with the operators of the SLS machine in the PEC, the students gained valuable insights that impacted their design. In parallel, they worked with staff at Midwest Prototyping LLC, of Blue Mounds, Wisconsin, to learn how to design within the constraints of an additional 3D printing process, stereo lithography.

"They learned a lot of the practical issues involved in designing for this technology—everything from tolerances to shrinkage that might occur, to designing for removing the unused material, which is a really big deal and affected the design," Shedd says.

Taking what they learned from the PEC and Midwest Prototyping engineers, the students made substantial design changes and improvements in the next iteration of their prototype. This process of prototyping and iteration, Shedd says, is essential to design. Shedd emphasizes to his students that prototyping and iteration are just as important as the pure engineering—the math and computer modeling—when designing a new product.

"Models are really important. You've got to start there," Shedd says. "But then you've ultimately got to build and test it, because modeling just tells you where you can go—it doesn't get you to a useful product that actually works. Designing something that is usable, affordable and able to be manufactured requires creativity, being able to think differently about things, and being able to prototype."

Because prototyping is a fundamental skill for future mechanical engineers, the department is working to incorporate more prototyping into senior design courses as well the overall design curriculum, Shedd says. He says money from the Cervenka gift has been instrumental in enhancing the design curriculum and enabling more prototyping.

At the end of the course, the students tested their final prototype against the commercial model, and demonstrated that they had achieved their ambitious goals. Testing showed that although it was smaller and weighed less than the commercial model, the students' polymer heat exchanger outperformed the competition by roughly a factor of two. With the savings in materials, the polymer heat exchanger could also be manufactured at a competitive cost.

"The folks I showed it to in Silicon Valley were amazed by it," Shedd says.

DeVries elected honory member of ASME

Warren DeVries (BSME '71, MSME '73 and PhDME '75) has been elected an honorary member of ASME, which is the highest level of society membership. DeVries was awarded honorary membership for distinctive contributions to engineering education and research as a professor; for dedication to advancing the frontiers of discovery and innovation through public service; and for striving to advance the recognition of engineering's contributions to humankind through leadership in professional societies. DeVries received the award at the ASME Congress in Montreal November 17, 2014.

First awarded in 1880, ASME honorary membership recognizes people who have made outstanding contributions to engineering, science, industry, research, public service or other pursuits allied with and beneficial to the engineering profession. Previous recipients of the award include inventors, business leaders and U.S. presidents, as well as famous engineers and scientists from around the world. "I'm honored to be included in this group," DeVries says. "For me it all began with a great education, great faculty and wonderful lifelong friends made during my time in Madison."

After eight years as dean of the College of Engineering and Information Technology at the University of Maryland-Baltimore County, DeVries stepped down from that position and continues as professor of mechanical engineering.

ME alums honored at ENGINEERS' DAY 2014

Two ME alums received College of Engineering awards during the ENGINEERS' DAY celebration on Oct. 24 on the UW-Madison campus.

Early-Career Achievement Award

Michael T. Casper
BSME '04

Mike Casper says that participating in the Innovation Days competition as a student stoked his entrepreneurial spirit and inspired him to transform a student design project into a successful hardware technology startup.

As an undergrad, Casper and his teammates won a $7,000 Schoofs Prize in 2004 for inventing the "Ice Light," a replaceable edge-lighted film that creates illuminated images such as logos or advertising within the ice of hockey arenas. "The competition provided us the opportunity to create a solution on our own with no structure, and helped build my confidence that with hard work and the right team, anything can be created," says Casper, a native of Fond du Lac, Wisconsin.

After graduating with his bachelor's degree in mechanical engineering and a certificate in business in 2004, Casper became a consultant with ZS Associates in Chicago, while continuing to pursue the illumination technology in partnership with other UW-Madison grads.

In 2008, Casper and the team founded FLEx Lighting, a hardware technology startup that produces ultra-thin optical films. The FLEx technology evolved from the team's 2004 Innovation Days entry and today provides previously unachievable levels of display performance and power savings in electronic devices. Casper developed business plans and led investor presentations to raise $8 million in financing, and the company now employs more than 15 people in a 13,000-square-foot facility in downtown Chicago. FLEx has 12 granted patents and more than 60 pending patents on its illuminated optical film technology. In 2012, Casper received an MBA from the Kellogg School of Management at Northwestern University. He has returned to UW-Madison to serve as a judge for the Innovation Days competition, awarding startup prize money to students by evaluating the technical novelty and market potential of new inventions.

In his spare time, Casper is a professional mentor for the Science, Engineering and Entrepreneurship program at Nettelhorst School, teaching and guiding eighth-grade students through the product development process. He also coaches youth baseball and football and has competed in the Ironman triathlon and various marathons.

Casper lives in Chicago with his wife, Julie, and their three children.

Distinguished Achievement Award

Michael F. Molnar
BSME '85, MSMSE '87

Although he coordinates the United States government's efforts in advanced manufacturing, Mike Molnar likes to be introduced simply as "a manufacturing guy from industry." After a 25-year industry career in advanced manufacturing, Mike took on a public role becoming the first chief manufacturing officer of the National Institute of Standards and Technology (NIST) in 2011. He founded the NIST Advanced Manufacturing Office, which serves as liaison to industry and academia and manages new NIST extramural programs.

Molnar was also asked to be the founding director of the interagency Advanced Manufacturing National Program Office, with a mission to foster industry-led partnerships and to form a "whole of government" approach to strengthen competitiveness and innovation in U.S. manufacturing. This interagency team is responsible for designing and establishing the National Network for Manufacturing Innovation, a presidential initiative with eight pilot institutes now under formation.

After receiving his bachelor's degree in mechanical engineering from UW-Madison in 1985, Molnar earned a master's degree in manufacturing systems engineering from UW-Madison in 1987. "I was privileged to be a part of the MSE program when it was founded as an innovative and groundbreaking systems-oriented program," he says. "Today, more than ever, engineering is a team sport, interdisciplinary and collaborative, and these UW strengths served me very well in my career." He also earned an executive MBA from the University of Notre Dame in 2002.

Molnar's engineering passion is designing and building things—with a career in creating robotic workcells, assembly and test systems and launching state-of-the-art manufacturing plants. His experience includes leadership roles in advanced manufacturing, metrology, manufacturing systems, quality, technology development, sustainability, and industrial energy efficiency. He has served as a federal fellow in the White House Office of Science and Technology Policy, and was elected a fellow of both the American Society of Mechanical Engineers and the Society of Manufacturing Engineers (SME). He's very active in professional societies, and presently is serving as the president of SME.

Molnar lives in Gaithersburg, Maryland, with his wife, Karen, and their three children. The family enjoys travel and the outdoors. As a youth, he was an Eagle Scout and Sea Explorer, and he's proud to volunteer as assistant scoutmaster as both his sons have chosen scouting and have set their sights on earning Eagle in less time than it took their dad.

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Shapiro receives 2014 Design Automation Award from ASME

Bernard A. and Frances M. Weideman Professor Vadim Shapiro has received the 2014 Design Automation Award from the American Society of Mechanical Engineers. The award recognizes sustained meritorious contribution to research in design automation. Shapiro was given the award based on the number of groundbreaking contributions he has made in the area. His research is in the foundational issues in computer-aided engineering that span three interacting concentration areas: geometric modeling, physical modeling and simulation, and computational design, and are at the very core of design automation.

Shapiro has developed new geometric modeling representations that overcome critical bottlenecks in CAD technology that have affected the architecture of most CAD systems in use today. The award is given from time to time but never more than once each year.

College of Engineering
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Student leader encourages other women to pursue engineering

It's a more than a little ironic that the 2014 president of the UW-Madison Society of Women Engineers student section originally didn't want to be an engineer. "I didn't want to do engineering, and I think so many girls stray away from it when we need more women in the field. So I've been passionate about being active with SWE and encouraging other women to pursue engineering," says Samantha Betlej, a senior from Milwaukee majoring in mechanical engineering.

Although she excelled at math and science in high school, Betlej was one of those girls who thought engineering wasn't for them. "I thought that it'd make such a boring career. I thought you'd just sit at a table all day and be doing calculations and crunching numbers," Betlej says. Instead, she thought about going to art school. She also considered being a newscaster, as well as a many other career paths. "I was all over the board," she says.

But things changed when Betlej mentioned to her mom that she was interested in maybe becoming an inventor. Her mom learned about a summer camp at UW-Madison for high school girls interested in engineering and the sciences, and Betlej attended the Engineering Tomorrow's Careers camp the summer after her junior year.

The camp, hosted by SWE, upended many of Betlej's preconceptions about engineering. "I saw how interactive and hands-on it can be, and really how creative engineering can be, too," she says. "Seeing how you could use your creativity and mix that with math and science was really eye-opening for me. The camp inspired me to major in engineering."

During her first year at UW-Madison, she decided to major in civil and environmental engineering. But as with the SWE camp, another experience unexpectedly altered her career path.

Her first summer internship, in research and development at Spectrum Brands in Madison, involved a lot of mechanical engineering. During her internship, Betlej discovered that she really enjoyed working on products like Remington hair straighteners and dryers and Black and Decker blenders. She was excited to see products she worked on at stores, and she was even included on an invention disclosure that potentially could turn into a patent. By the end of the summer, she decided to change her major to mechanical engineering.

"The internship helped me realize, 'Oh, this is what a mechanical engineer does. I could see myself doing this.' Before I just thought mechanical was all about cars. I'm glad I did an internship early on," she says.

During her time at UW-Madison, Betlej has kept busy with internships, co-ops and holding various SWE officer positions while regularly being named to the dean's list for her academic excellence. She was a manufacturing intern with Procter & Gamble and did a plant project engineering co-op with Bemis Company, Inc. In summer 2014, she interned with UOP, a refining and petrochemical company owned by Honeywell. She also studied abroad for a summer in Hangzhou, China, through the College of Engineering International Engineering Studies and Programs.

Throughout her entire time at UW-Madison, Betlej has remained very active in SWE. Grateful for her early exposure to the organization, Betlej says she wants to give back by inspiring other young women to realize the full potential of a career in engineering.