$148 Million Federal Project Will Showcase ME Strengths

Farhang Pourboghrat, professor of mechanical engineering, represented the College of Engineering at the White House on Feb. 25 when President Barack Obama announced the creation of the American Lightweight Materials Manufacturing Innovation Institute (ALMMII). The $148 million federal project will use a consortium of university and business partners that will focus on advancing lightweight and modern metals manufacturing.

The institute will be built near Canton, Mich., and is expected to bring as many as 10,000 new manufacturing jobs to the region. Consortium leaders are the University of Michigan, Ohio State University, and EWI of Columbus.

The Department of Mechanical Engineering’s role will center on developing materials that could enhance performance in transportation and energy systems, and lead to improved fuel efficiency in vehicles. “We have a good reputation,” Pourboghrat said. “We can provide expertise in the leading technologies or complement them in key ways.”

He and Patrick Kwon, professor of mechanical engineering, will work with three MSU faculty members from chemical engineering and materials science—Thomas Bieler, Carl Boehlert, and Martin Crimp—on the federal project.

“MSU has a lot of expertise in materials, such as titanium alloys, aluminum alloys, and advanced high-strength steels,” he said. “We will concentrate on very strong and incredibly light metals for use in automotive, aerospace, and other industries.”

Pourboghrat said “a phenomenal opportunity” awaits both graduate and undergraduate students in this endeavor. “Some of our undergraduates are very interested in rolling up their sleeves and getting to work in the laboratories. It’s natural, because our students are fantastic builders. They are thirsty to see what they can do, which is tremendously important for our future success.”

He added, “This institute represents a foresight that needs to be nourished in this country. For MSU, it is a chance to work with hand-selected scientists across the United States on topics that we are already experienced in and passionate about.”

BIOSENSORS IN CLOTHES MAY SOMEDAY WARN OF ILLNESS

Smart Socks

How cool would it be if your undershirt or socks not only kept you warm but also warned you about an oncoming infection, too? A $400,000 National Science Foundation CAREER Award granted to Peter Lillehoj, assistant professor of mechanical engineering, may soon make that a reality.

Lillehoj will spend the next five years advancing research on innovative wearable biosensors that can be used to detect illnesses and monitor health. Funding began Jan. 1, 2014.

“This technology will lead to lightweight and unobtrusive...
Once again, I am very glad to have this opportunity to bring you news from our Department of Mechanical Engineering.

It has been some time since we last met in this space and much has happened since then. I hope you find in these pages the sense of excitement and purpose that I see around me every day, among our students, and our faculty and staff.

In my last letter I commented of the fast growth of our program, particularly in our undergraduate population. This growth has continued, and our student population is now at record highs. Our growth has outpaced every department in the College. We have hired new faculty and are still in the process of hiring more.

Last year we were joined by two excellent assistant professors, Rebecca Anthony and Junghoon Yeom. You will find more about them—and other new arrivals in our department—and their work elsewhere in this document. Along with Dr. Peter Lillehoj, who came a year earlier, they are excellent examples of the changing face of mechanical engineering, extraordinary individuals doing research that expands the traditional boundaries of our profession. Peter has already started to make his mark at MSU. This year he received a prestigious National Science Foundation (NSF) CAREER award to continue his work on wearable biosensors for health monitoring and disease diagnosis.

Our research program continues to expand in traditional areas of strength, as well as in new areas. Our engines group received a $1.2 million grant from the NSF and the U.S. Department of Energy to study advanced combustion engines. Professor Steve Shaw and his collaborator, MSU physics professor Mark Dykman, received a $1 million grant from DARPA to study the effect of nonlinearities in micro-electro-mechanical systems. Professors Seungik Baek and Jongeun Choi received a prestigious National Institutes of Health grant to study abdominal aortic aneurysms, with participation of researchers from Seoul National University in South Korea.

This is typical—research programs in our department are at the center of collaborations with researchers from around MSU and around the globe. In June this year, we will host the 17th U.S. National Congress on Theoretical and Applied Mechanics, an event organized by ME professors Tom Pence and John Foss that is expected to bring more than 600 researchers from across the United States to our campus.

There is a sense of purpose in our department. And, while growth at an accelerated pace brings along significant challenges, we adapt, we improve, and we prepare. We are ready to meet these challenges and bring our department forward, into an exciting and positive future. Come along!

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**Powder Processing Leads to Perspirable Skin Prototype**

It was the space shuttle Columbia disaster that got Patrick Kwon thinking.

He was saddened by the loss of its seven-member crew, who died when the shuttle disintegrated upon its return from space in 2003.

As a professor of mechanical engineering, he knew more research was needed on the materials expected to endure high temperatures, better than the current tiles that protect the shuttle as it re-enters the atmosphere.

“My original thought was tied to the Columbia disaster,” Kwon said. “A couple of years later I began to explore some ideas for such high temperature application.”

He proposed his idea to the U.S. Air Force Office of Scientific Research (AFOSR) and is currently in the fourth and final year of a $500,000 AFOSR grant.

“All materials have limited lives in high temperatures,” Kwon explained, “so they need a material with a self-cooling capability. Nothing traditional and homogeneous, but new materials like functionally graded materials assembled in a set of tiles.”

Kwon’s research has led to the creation of perspirable skin, a prototype material about the size of a U.S. quarter, which was created in the MSU College of Engineering Research Complex laboratories. Through experimentation with powder processing, Kwon developed a material that activates a self-cooling device upon extreme temperatures—protecting, among other things, a re-entry vehicle’s nose and the tips of wings.

“I was trying to design a material that will be like a skin but opens a gap when it gets hot. When you heat it up, air comes out to the surface to prevent or limit frictional heating.”

Early tests on turbine blades have successfully injected cool air into the perspirable skin. “We have been able to demonstrate using a furnace that the prototype collapses to the necessary opening for cooling air when the temperature is high enough. We are now trying to refine it.

“No one has approached it this way yet,” he added. “We’ll look more into how to reverse back to its original ‘flat’ skin and whether 3D printing will work in real applications.”

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*From the Chair*

Alejandro Diaz

*Powder Processing Leads to Perspirable Skin Prototype*

Patrick Kwon

*Development of New Generation of Perspirable Skin*

Patrick Kwon

Department of Mechanical Engineering
Michigan State University
East Lansing, Michigan

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**DEPARTMENT OF MECHANICAL ENGINEERING**

**WINTER/SPRING 2014**
sensing systems that can be directly integrated onto fabrics and garments,” said Lillehoj.

One of Lillehoj’s overall goals for this project is to advance wearable sensor technology, which is currently limited to measuring physiological parameters, such as heart and respiratory rates, and blood pressure.

“Little has been done to create wearable sensors for biomolecular detection. This research is aimed at developing wearable sensing systems that can detect biomarkers in secreted body fluids, such as sweat or urine.”

Lillehoj will also focus on developing textile batteries that are activated by body fluids for on-demand electricity generation. Based on this approach, the same fluids that are being detected could also power the device, minimizing its overall size and weight.

In addition to his research activities, he will also use the NSF CAREER Award to develop new courses and outreach programs that promote micro- and nanotechnologies for biomedical applications. Lillehoj said he hopes that more high school and college students become interested in this field as well as other STEM disciplines, preparing them for future educational training and careers in biomedical research.

“By creating diagnostics that are fast, low cost, and non-invasive, we can do a better job of supporting preventive medicine through early disease detection,” he said. “Ultimately, this will reduce healthcare costs worldwide and offer low-cost diagnostics in places where resources are limited, such as developing countries.”

Lillehoj joined MSU in the fall of 2012 and becomes the 20th member of the MSU College of Engineering faculty to receive an NSF CAREER Award since 2007.

The Faculty Early Career Development (CAREER) Award is among the NSF’s most prestigious honors, recognizing young faculty members who are effectively integrating research and teaching.

Keeping Up with Trends in 3D Printing

Excitement is building one layer at a time in the Department of Mechanical Engineering over the purchase of 3D printing technology. The Stratasys uPrint Plus SE printer arrived in March 2013 and is currently being utilized in Kathy Stevenson’s ME285 advanced NX course. Students receive an introduction to 3D rapid prototyping by developing a concept of their own and bringing that concept to life using 3D printing.

“What makes this course fun for students is the ability to be creative with their design and yet be precise as an engineer,” she said. “With the use of virtual technology (CAD) and 3D printing, students can physically see design flaws and troubleshoot solutions. As an end result, students learn real-life industry applications and gain experience in the design process. In addition, it’s a great piece they can add to their portfolio to show to prospective employers.”

Even though the College of Engineering has several types of 3D printers, such as the ZCorp, Makerbot, and Objet printers, what makes the uPrint Plus ideal for ME is the printing material: acrylonitrile butadiene styrene (ABS plastic). This type of material combines rigid yet flexible properties that are ideal for components that require strength and durability. During printing, material is fed into a cartridge head from a weed whacker–style spool and is laid out in thousands of fine layers as the plastic is heated. Although there are some limitations with the build envelope, the printer has a fine resolution and is cost-effective.

Today, ME285 is the only ME course that uses 3D printing technology in its curriculum, but not for long. “The ultimate goal is to purchase more printers for ME and implement this technology across the program. Keeping up with industry trends prepares our students for employment and provides a fun way to learn,” Stevenson said.

DOE Grant Improves Engine Performance

A team led by Guoming “George” Zhu, professor of mechanical engineering and electrical and computer engineering, successfully completed the modeling, simulation, design, and construction of a prototype spark ignition engine capable of homogeneous charge compression ignition combustion that—when combined with other fuel economy technologies—could achieve 54.5 miles to a gallon in cars and trucks. The project is a major step toward improving fuel efficiency up to 20 percent. Zhu’s team built an engine that perfected a smooth mode transition between homogeneous charge compression ignition (high fuel efficiency and low emissions) and conventional spark-ignited engines (that provide on-demand power for passing). Current engine technology that offers the two combustion modes already exists, but the transition in Zhu’s engine is so smooth that drivers won’t notice the difference—a value sought by automakers. The research was funded by the U.S. Department of Energy, which will make the research findings available on the DOE public website.
New Faculty

Javier Alcazar joined the ME department as a teaching specialist in November 2013. He received BS degrees in physics and mathematics, and a master’s degree in electrical engineering at Columbia University. He also earned a master’s and a doctorate degree in mechanical and aerospace engineering from Cornell University.

Alcazar has experience with General Motors Research and Development as a researcher in the Vehicle Dynamics Research and Manufacturing Systems Research Laboratories. His area of expertise is human-vehicle interaction and human-robot collaboration applied in the automotive industry. He has worked on the joint GM/NASA Robonaut 2 project, focusing on the physical and mechanical interactions for autonomous grasping using dexterous robotic hands.

He is the IEEE Robotics and Automation Society chair for southeast Michigan.

Rebecca Anthony joined the ME department as assistant professor in August 2013. She majored in physics at Carleton College in Minnesota, and received her PhD in mechanical engineering from the University of Minnesota (UMN) in 2011. Prior to coming to UMN, she taught undergraduate courses in thermodynamics and heat transfer at UMN and did postdoctoral research on diagnostics of dusty plasmas.

Anthony’s research at MSU will be a continuation of plasma synthesis and processing of semiconductor nanocrystals with an emphasis on gas-phase techniques. Her goals are to develop new ways to streamline nanomaterial synthesis and surface treatment, followed by direct layer formation onto device substrates—all in avoidance of solution-phase steps.

Geoffrey Recktenwald joined the ME department as a teaching specialist in August 2013. He earned his BS in mechanical engineering and physics from Cedarville University in Ohio, and completed his PhD in theoretical and applied mechanics at Cornell University.

Recktenwald worked as a visiting faculty member in mechanical engineering, theoretical and applied mechanics, and mathematics teaching engineering courses at Cornell. Most recently, he was working on sustainable energy and radiation transport problems (nuclear and solar) at the University of Texas. His areas of expertise include vibrations and stability, methods development, and modeling radiation transport.

Kathy Stevenson joined the ME department as an academic teaching specialist in May 2012. She holds a degree in product design and a BS degree in applied technology from Eastern Michigan University. Before coming to MSU, she taught in product design and development at EMU and did postdoctoral research on diagnostics of dusty plasmas.

Stevenson will start his research career at MSU putting an emphasis on three areas: continuing to develop scalable and inexpensive patterning techniques and nanomanufacturing platforms for assembling various nanomaterials; manufacturing portable/wearable gas sensing systems for military and consumer applications; and synthesizing and testing high-temperature, regenerable sorbents that help to remove sulfur-containing or other catalyst-poisoning impurities in gasified syngas feedstock.

Facility News

Tamara Reid Bush, assistant professor, was selected as one of 73 innovative young engineering educators from across the country to participate in the National Academy of Engineering’s fifth Frontiers of Engineering Education (FOEE) symposium. Faculty members from a variety of engineering disciplines came together for the symposium in October in Irvine, Calif., to share ideas, learn from research, and discuss best practices in education. Participants were nominated by fellow engineers or deans. Earlier in 2013, Reid Bush was elected vice chair for ASME’s Design, Dynamics and Rehabilitation Technical Committee.

John Foss, professor, was elected to the 2013 class of American Physical Society (APS) Fellows in September for his outstanding contributions to physics. Foss was specifically cited for “fundamental experimentation of complex flows, novel surface topology analyses, and for groundbreaking vorticity measurements.” Each year, elected APS Fellows number no more than one-half of one percent of the APS membership. Fellowship is a distinct honor signifying recognition by one’s professional peers for exceptional contributions to physics.

On March 26, Foss was presented with the 2013 MSU Award for Outstanding Service to Study Abroad. The prestigious university-wide award recognized his outstanding contributions to international
understanding and to the global mission of MSU. The award was presented during the 24th Annual International Awards Ceremony, hosted by International Studies and Programs at MSU.

Foss has been a faculty member at Michigan State since 1964.

Nicholas Gianaris, professor and director of the Composite Vehicle Research Center, was elected vice president of the Society for the Advancement of Material and Process Engineering (SAMPE). SAMPE, an international professional member society, provides information on new materials and processing technologies through chapter technical presentations, two journal publications, symposia, and commercial expositions in which professionals can exchange ideas and air their views. As the only technical society encompassing all fields of endeavor in materials and processes, SAMPE provides a unique and valuable forum for scientists, engineers, designers, and academicians.

Steve Shaw, University Distinguished Professor of mechanical engineering, received the N.O. Myklestad Award from the American Society of Mechanical Engineers (ASME) in recognition of his work and contributions to the area of vibrations.

Shaw’s research interests are in dynamical systems and mechanical vibrations, including micro/nano-scale resonators with sensing and signal processing applications, and nonlinear vibration absorbers with automotive applications. He currently serves in editorial capacities for the *SIAM Journal on Applied Dynamical Systems*, *Nonlinear Dynamics*, and the *ASME Journal of Vibration and Acoustics*. He is a fellow of ASME and the recipient of several honors, including the SAE Arch T. Colwell Merit Award, the Henry Ford Customer Satisfaction Award, and the ASME Henry Hess Award.

This award is named for Nils Otto Myklestad, an American mechanical engineer and engineering professor who made significant contributions to both engineering practice and engineering education.

Guoming “George” Zhu, professor, was elected a 2012–2013 fellow of SAE International. He and the other fellow inductees were recognized during ceremonies at the SAE 2013 World Congress in Detroit in April 2013. He is also a fellow of the American Society of Mechanical Engineers (ASME).

Zhu’s current research interests include closed-loop combustion control of internal combustion engines as well as application of advanced control techniques to powertrain and engine systems.

SAE International is a global association of more than 138,000 engineers and related technical experts in the aerospace, automotive, and commercial vehicle industries. Fellow is the highest grade of membership bestowed by SAE International. The program, established in 1975, recognizes an average of 20 recipients worldwide for this honor each year.

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2013 ME Distinguished Alumni Award

Randall Stephens (es ’85) received the 2013 Mechanical Engineering Distinguished Alumni Award at the annual College of Engineering Alumni Awards Banquet in May. Established in 2004, this award honors a graduate of the department who has a minimum of 15 years of professional experience in an engineering or engineering-related field; provides leadership in engineering, engineering education, the related sciences, or technical management; contributes to the department, the college, or MSU; and is actively involved in the community.

Stephens is a chief engineer in the product development office at Toyota Technical Center (TTC), located in Ann Arbor, Mich. TTC, Toyota’s North American R&D center, is a division of Toyota Motor Engineering & Manufacturing, North America, Inc. (TEMA).

Stephens, currently a member of SAE International (formerly the Society of Automotive Engineers), says that the practical teaching methods and analytical education he received at MSU prepared him for just about any industry. He especially remembers Professor Ron Rosenberg. “He made learning fun and was careful to make sure that all students learned the fundamentals of mechanical engineering,” Stephens recalled.

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Retired Professor Inducted into SCCA Hall of Fame

Retired biomedical engineering professor Robert Hubbard was inducted into the Sports Car Club of America Hall of Fame March 8 for inventing a safety device that has saved the lives of countless racer drivers. Hubbard and Jim Downing, a driver himself and Hubbard’s brother-in-law, developed the Head and Neck Support device, or HANS, in the mid-1980s, following the death of a racer friend as a result of a skull fracture.

“It’s extremely gratifying to know that something I’ve worked on for almost 20 years has become truly beneficial,” said Hubbard, who retired from MSU in 2006.

Since 1990, drivers have put more than 200,000 HANS devices into use.
IN MEMORIAM

- Dennis Earl Condon (as ‘53) of Okemos, Mich., died Dec. 4, 2013, after a 30-year struggle with heart disease. He was 82. Condon followed his father, uncles, and a brother into engineering, which had always been a family calling.
- Stuart L. DeWitt (as ’48) of Greenville, Mich., died Nov. 7, 2013, at Spectrum Health United Memorial Hospital in Greenville.
- C. Paul Fowler (as ’57) of Jackson, Mich., died Dec. 11, 2013.
- Donald L. “Don” Harris (as ’51) of Battle Creek, Mich., died Dec. 7, 2013, at Lifespan Good Samaritan Hospice Residence, Battle Creek, following a brief illness.
- Robert (Bob) William Jurgensen (as ’49) of Worthington, Ohio, died Sept. 19, 2013, at Saint Ann’s Hospital. He was 89.
- John Edgar Peterson (as ’57) died Oct. 21, 2013, at his home in Vero Beach, Fla.
- Donald James Vanderwall (as ’50) died Feb. 11, 2014, at his home in Bellevue, Wash.

To read complete obituaries, go to www.eegr.msu.edu/alumni/class-notes-obituaries
Internship Experience Leads to Subsea Engineering Career

While more than 80 percent of MSU College of Engineering students participate in a co-op or internship during their undergraduate years, recent graduate Rami Janoudi (as ‘13) didn’t complete just one—he completed four.

Janoudi landed his first internship the summer of 2010 with Nexteer Automotive in Saginaw. He performed noise testing in the labs and worked in manufacturing plants disassembling faulty power steering components and preparing them for repair.

As a sophomore, he was encouraged by a BP company representative to apply for a summer internship with the company. Janoudi had first connected with BP when he participated in the College of Engineering’s 2010 Spring Break Corporate Tour, during which a group of MSU undergraduate students visited several corporations in Texas, including BP.

Janoudi spent his first internship with BP, during the summer of 2011, as an operations–mechanical engineering intern in the Houston area and offshore in the Gulf of Mexico. He also interned with BP the following summer as a facilities engineering intern.

During Janoudi’s third internship with BP in the summer 2013, he worked on the subsea operations team for BP’s largest Gulf of Mexico asset—the Thunder Horse platform.

“When my first two internships with BP I worked on the ‘topsides’ team; I worked on the equipment actually above water, on the platform itself,” Janoudi said. “This past summer, my offshore time was spent on a vessel, assisting engineers and technicians with inspections of subsea oil and gas equipment on the ocean floor.”

Other projects included future subsea construction projects, maintenance of currently installed equipment, and work on a subsea equipment inspection vessel in the Gulf of Mexico.

“Through this experience, I applied my technical background but also got a chance to build great relationships with the others on the vessel, who came from diverse backgrounds and were of all different ages and levels of expertise.”

Janoudi’s advice to engineering students in their first or second year of college: “Never underestimate your ability to get an internship. Demonstrate your drive and show employers that you have made the most of your past experiences—even if not directly related to engineering. But don’t think that you are above any internship, or company, or salary when starting out; take whatever opportunity you get. Just because you start out at one company, it doesn’t mean you will work for them forever.”

Or, maybe you will. Janoudi, who received his bachelor’s degree in December, begins his full-time job in subsea operations in June at BP in Houston. He plans to pursue a master’s degree in subsea engineering.

MasterCard Foundation Scholars Program: Leading Change through Education

In fall 2012, MSU began partnering with The MasterCard Foundation on its Scholars Program, which provides full tuition scholarships to undergraduate and master’s degree students from Sub-Saharan Africa who have demonstrated academic talent, are economically disadvantaged, and have a personal commitment to give back to their countries.

Mukangwa Masamba, a freshman from Zambia studying mechanical engineering, is one of the 26 scholars selected for the fall 2013 cohort. The MasterCard Foundation Scholarship will enable Masamba to develop the skills needed to bring development to his home country. He anticipates being introduced to new engineering trends that would enable him to conduct research in design and management of manufacturing systems to improve the efficiency of consumer products. His perspective is that this may help alleviate issues like the energy crisis and pollution problems, which are currently plaguing Zambia and global society. He hopes that his career as an engineer will revolutionize his country’s engineering profession and capabilities so that it will have an impact on the economy of his country, thereby bringing development not only to Zambia but across Africa. His long-term goal is to start an automotive company that will deal in motor vehicle assembly, repair, and development of new technologies—leading to job creation.

MSU will receive $45 million in funding from the foundation to support 185 scholars throughout the nine-year program.

Senior Elected President of NAESC

Kyle Watts, a mechanical engineering senior, is president of the National Association of Engineering Student Councils (NAESC).

College of Engineering’s Got Talent!

Steve Price, better known as “Sprice” to the national audiences for America’s Got Talent viewers and Twitter, is an MSU mechanical engineering sophomore from Canton, Mich. The talented 4.0 student and creator of Rube Goldberg machines made it through two rounds of auditions on the primetime NBC television show this past summer. He advanced to the quarterfinals at Radio City Music Hall in New York City in late August.

To view a video, go to www.youtube.com/watch?feature=player_embedded&v=7UdzAaw-Hoo.
Construction began June 19 on a new 130,000-square-foot, four-story Bio Engineering building where scientists will collaborate on innovative research in the human health areas, nanotechnology, robotics, tissue engineering, and imaging. The $60.8 million facility is planned to open August 2015 and is located between the Life Science and Clinical Center buildings on the south side of campus.

The project was authorized by the Board of Trustees in April 2013 to bring together research teams from the Colleges of Engineering, Human Medicine, and Natural Science to promote the development of bio engineering and engineering health sciences. “By housing faculty from several colleges in this facility—with complementary research talent—we will be able to make great strides in medical technology through daily collaboration,” said Leo Kempel, acting dean of the College of Engineering. “This not only benefits the research enterprise, but it also will provide new learning opportunities for our students.”

The engineering focus will be on translational technologies in home healthcare, outpatient, and hospital use. Examples of research projects include body-worn sensors to detect biometric details of a patient’s home-based physical activity to help nurse practitioners in their delivery of health care; devices designed to aid physicians in re-training a patient’s nervous system to overcome physical limitations; and research in patient physical manipulation to avoid pressure ulcer formation (bed sores).

The increase in space facilitates the hiring of new faculty for the College of Engineering—about 30 faculty members can be housed in the new building.