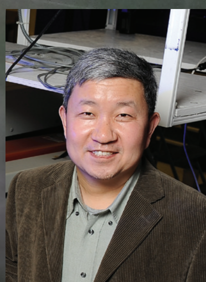
Iowa State University
College of Engineering

DIMENSIONS

Department of Mechanical Engineering

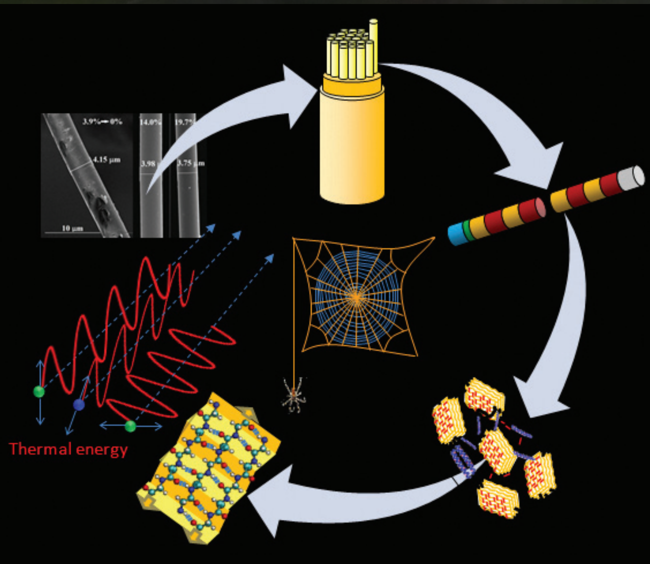
Volume No. 21 | Issue No. 1

Iowa State's Spider Man!



SPIDER SILK: SUPER HEAT CONDUCTOR

The hierarchical structure of spider dragline silk favors super heat conduction. The micro-size dragline silk mostly made of protein has an exceptionally high thermal conductivity that beats most materials. The highly oriented antiparallel β-pleated sheets in silk fibrils are expected to have a much higher thermal conductivity. It is also surprising that the thermal conductivity of silk increases significantly with strain. These new secrets of spider silk are expected to strongly stimulate innovations on design paradigm of synthetic and gene-modified natural polymer fibers to revolutionarily improve their thermal conductivity and its tunability.



Message from the Chair

Ted Heindel

The end of the academic year marks a time to reflect on the many successes we as a department have experienced this past year. We did make adjustments due to our record enrollments by adding additional laboratory sections to many of our classes. We also expect a record number of graduates this year with nearly 240 bachelor of science degrees in mechanical engineering being award this academic year. We are proud of all our graduates and wish them well as they begin the next phase of their life.

In my opinion, ME students are the best the college has to offer; they are involved throughout campus and the community. Several examples from the past year are highlighted in this issue of Dimensions. **Chloe Dedic** is one example. She is finishing her BSME degree this semester while also starting her MSME degree, and she has been involved in campus and community life since arriving at ISU just 4 years ago. Other examples include **Tom Naert** and **Katie Goebel** – they presented two of the three projects Vice President Joe Biden toured during a March visit to the college.

ME faculty are also the best the college has to offer. The cover story talks about our own Spiderman, Professor **Xinwei Wang**, and his discoveries related to the thermal properties of spider silk. Assistant Professors **Baskar Ganapathysubramanian** and **Song Zhang** recently received the prestigious NSF CAREER Award for their innovative research proposals on organic solar cells and 3D imaging, respectively. Pioneering work from other faculty is also summarized in the pages that follow.

The end of the academic year also marks the formal announcement of a new chair of the Department of Mechanical Engineering. Professor **Caroline Hayes** from the University of Minnesota will become our chair on October 1, 2012. I will remain the interim chair until she arrives. I have enjoyed my time leading a very productive department thanks to the talented faculty, staff, and students with whom I have had the pleasure of working. We are well-positioned to educate the engineers of the future.

To all of our alums, including recent graduates as well as not-so-recent graduates, please continue to let us know how your ISU ME degree is helping you reach your career goals. You will always be a valued member of the ISU ME family. Feel free to stop by whenever you visit campus. We would also enjoy your shared correspondence sent to mealumni@iastate.edu.

Caroline Hayes appointed new ME department chair

Caroline Hayes has been named the College of Engineering's next chair of mechanical engineering. She will also hold the positions of professor of mechanical engineering, and Lynn Gleason Professor of Interdisciplinary Engineering. Her appointment will begin October 1, 2012.

Hayes, a native of Pennsylvania, holds bachelor's, master's, and doctoral degrees from Carnegie Mellon University. She most recently served with the Department of Mechanical Engineering at the University of Minnesota, where her duties also included serving as director of graduate studies for human factors and ergonomics, and faculty liaison to the Minnesota legislature.

"My plan is simple: to provide Iowa's diverse and vibrantly creative young people with the best quality mechanical engineering education possible," Hayes said. "Channeling their natural curiosity towards discovery, invention and entrepreneurship is the most direct way to insure Iowa's lead in the high tech global economy."

Hayes has served as a principal investigator on more than 30 research grants and contracts, and is the author of nearly 150 articles, presentations and book chapters on the subjects of human factors, robotics, and human-computer interaction. She is also active in developing STEM (Science, Technology, Engineering and Mathematics) initiatives for girls, underrepresented minorities, and young people. Hayes recently consulted with the Science Museum of Minnesota on its upcoming Journey into Space exhibit.

Caroline Hayes

"We're extremely pleased to welcome Caroline Hayes to Iowa State," said engineering Dean Jonathan Wickert. "Caroline's administrative experience, combined with her thought leadership in robotics and human-computer interaction, will enable her to lead the department forward during this period of unprecedented growth."

Wickert, in announcing the appointment, expressed appreciation for Professor Ted Heindel, who has served as interim department chair since 2009.

"Ted has done an outstanding job," Wickert said. "Under his leadership, the department has made important new hires, built collaborations across the college, and strengthened relationships with alumni and corporations."

Wickert also expressed his thanks to the search committee, led by aerospace engineering Chair Rich Wlezien, for their efforts on behalf of the college.

On the cover

***Xinwei Wang** discovers spider silk conducts heat better than metals.*

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Wang discovers spider silk conducts heat as well as metals

Xinwei Wang had a hunch that spider webs were worth a much closer look.

So he ordered eight spiders – Nephila clavipes, golden silk orbweavers - and put them to work eating crickets and spinning webs in the cages he set up in an Iowa State University greenhouse.

Wang, an associate professor of mechanical engineering at Iowa State, studies thermal conductivity, the ability of materials to conduct heat. He's been looking for organic materials that can effectively transfer heat. It's something diamonds, copper and aluminum are very good at; most materials from living things aren't very good at all.

But spider silk has some interesting properties: it's very strong, very stretchy, only 4 microns thick (human hair is about 60 microns) and, according to some speculation, could be a good conductor of heat. But nobody had actually tested spider silk for its thermal conductivity.

And so Wang, with partial support from the Army Research Office and the National Science Foundation, decided to try some lab experiments. Xiaopeng Huang, a post-doctoral research associate in mechanical engineering; and Guoqing Liu, a doctoral student in mechanical engineering, helped with the project.

"I think we tried the right material," Wang said of the results.

What Wang and his research team found was that spider silks – particularly the draglines that anchor webs in place – conduct heat better than most materials, including very good conductors such as silicon, aluminum and pure iron. Spider silk also conducts heat 1,000 times better than woven silkworm silk and 800 times better than other organic tissues.

A paper about the discovery – "New Secrets of Spider Silk: Exceptionally High Thermal Conductivity and its Abnormal Change under Stretching" – has just been published online by the journal Advanced Materials.

"Our discoveries will revolutionize the conventional thought on the low thermal conductivity of biological materials," Wang wrote in the paper.

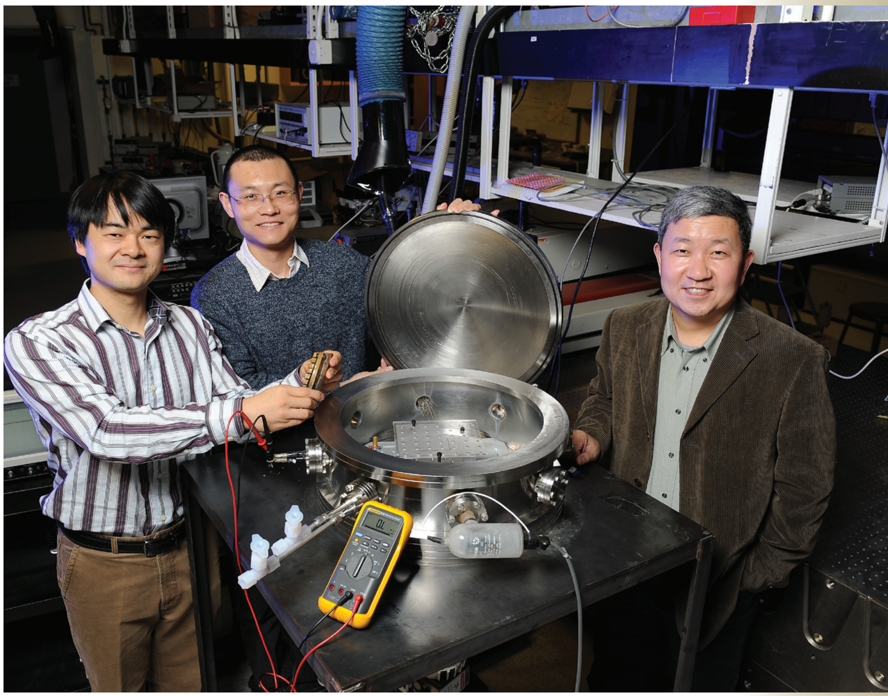
The paper reports that using laboratory techniques developed by Wang – "this takes time and patience" – spider silk conducts heat at the rate of 416 W/m-K. Copper measures 401 W/m-K. And skin tissues measure 0.6 W/m-K.

"This is very surprising because spider silk is organic material," Wang said. "For organic material, this is the highest ever. There are only a few materials higher – silver and diamond."

Even more surprising, he said, is when spider silk is stretched, thermal conductivity also goes up. Wang said stretching spider silk to its 20 percent limit also increases thermal conductivity by 20 percent. Most materials lose thermal conductivity when they're stretched.

That discovery "opens a door for soft materials to be another option for thermal conductivity tuning," Wang wrote in the paper.

And that could lead to spider silk helping to create flexible, heat-dissipating parts for electronics, better clothes for hot weather, bandages that don't trap heat and many other everyday applications.



Xiaopeng Huang, Guoqing Liu and Xinwei Wang, left to right, show the instruments they used to study the thermal conductivity of spider silk. Photo by Bob Elbert

What is it about spider silk that gives it these unusual heat-carrying properties?

Wang said it's all about the defect-free molecular structure of spider silk, including proteins that contain nanocrystals and the spring-shaped structures connecting the proteins. He said more research needs to be done to fully understand spider silk's heat-conducting abilities.

Wang is also wondering if spider silk can be modified in ways that enhance its thermal conductivity. He said the researchers' preliminary results are very promising.

And then Wang marveled at what he's learning about spider webs, everything from spider care to web unraveling techniques to the different silks within a single web. All that has one colleague calling him Iowa State's Spiderman.

"I've been doing thermal transport for many years," Wang said. "This is the most exciting thing, what I'm doing right now."

Contributed by News Service

Graduate student honors and awards

Chloe Dedic
• Spring 2012 Seward, Ratcliffe, and Galloway Foundation Mechanical Engineering Fellow
• Technology Association of Iowa Collegian Innovation and Leadership Award

Nathan Johnson
• Fall 2011 Teaching Excellence Award

Bethany Juhnke
• Fall 2011 Seward, Ratcliffe, and Galloway Foundation Mechanical Engineering Fellow
• Finalist, Technology Association of Iowa Collegian Innovation and Leadership Award

Nik Karpinsky
• 2011 National Science Foundation Graduate Research Fellowship

Lin Liu
• Fall 2011 Research Excellence Award

Marisol Martinez
• Fall 2011 Seward, Ratcliffe, and Galloway Foundation Mechanical Engineering Fellow

Joseph Miller
• Fall 2011 Research Excellence Award

Joanna Peddicord
• Fall 2011 Seward, Ratcliffe, and Galloway Foundation Mechanical Engineering Fellow

Yufeng Wu
• Fall 2011 Research Excellence Award

Zhuoru Wu
• Fall 2011 Seward, Ratcliffe, and Galloway Foundation Mechanical Engineering Fellow

Yannan Zhang
• Fall 2011 Seward, Ratcliffe, and Galloway Foundation Mechanical Engineering Fellow

Can Zhu
• Fall 2011 Seward, Ratcliffe, and Galloway Foundation Mechanical Engineering Fellow

A computational approach to improving organic solar cells

Integrating computational thinking with experimental analysis in renewable energy research, **Baskar Ganapathysubramanian**, assistant professor of mechanical engineering, is focused on designing better organic solar cells.

The computational tools he is developing will help classify and characterize the way the plastic thin film cells respond to different conditions and configurations. He explains that doing this work computationally cuts down on the wide range of experiments that need to be run, allowing for a more systematic approach to understanding how to make the cells more efficient.

A $400,000 National Science Foundation CAREER award is supporting Ganapathysubramanian's project "A predictive modeling framework for exploring process-structure-property relationships in organic solar cells."

Research on organic solar cells has taken off over the past decade because of the affordability of the technology compared to silicon-based solar cells. Plastic cells can be produced at a fraction of the cost of their silicon counterparts. They are flexible and produced on a rolling mat, and when used as a coating for surfaces, they can harness energy for everything from operating a laptop to cooling a home.

Ganapathysubramanian describes the way the key component of plastic solar cells are made as similar to painting a wall.

"There are two materials (polymers or plastics) that perform different duties," he said. "One absorbs sunlight and creates charges (called the donar), while the other (called the acceptor) helps transport the charges to the electrode."

The materials are mixed together, dissolved in a solvent (just like in house-hold paint), and then coated on a surface. "As the solvent evaporates out, it creates a thin layer of solar cells," he explained. "The process is exactly like the volatile solvent evaporating from the paint to leave behind the colored residue on your wall."

Researchers in the field initially focused on developing the best material for the cells, but they soon realized how the cells are manufactured plays an important role in the efficiency of the cells. "We're now looking at answering questions like what's the optimal weight for material A and material B, what's the best way to mix them, what solvent do you use, and how do you coat it," Ganapathysubramanian said.

Baskar Ganapathysubramanian

His project will model and simulate the fabrication process of thin film solar cells. Using computations allows Ganapathysubramanian to go through hundreds of thousands of formulations in a few weeks time compared to experimentalists trying out formulations one at a time.

To create the models, his research group has been working to understand what drives the process. Using simple conservation laws, principals of thermodynamics, and phase separation theories, the team develops equations to discover the rate at which the material properties and distribution is changing.

Olga Wodo, a postdoctoral research associate in Ganapathysubramanian's group, has been developing methods that are allowing the group to solve these sorts of equations over an extended period of time. The process involves tracking the evolution of the materials every millisecond (or smaller) for at least an hour.

"The techniques Dr. Wodo has created, combined with the high performance computers at Iowa State, are allowing us to do what has never been possible in the field," said Ganapathysubramanian.

For this project, Ganapathysubramanian has partnered with assistant electrical engineering professor Sumit Chaudhary, who received a CAREER award in 2011 to improve organic solar cells. He also works with researchers at the King Abdullah University of Science and Technology in Saudi Arabia. "It's important to have partners who are on the experimental side of a project," said Ganapathysubramanian. "We are going to see more of these sorts of partnerships as science and engineering begin to see the advantages of modeling complex technologies."

The project also features an educational/outreach component that will emphasize the importance of using computational resources and how the technologies can advance renewable energy. These lessons will be integrated into courses at different collegiate levels in addition to several activities at the K-12 level, including a "NanoDays" event at the Science Center of Iowa and a simulation of computational data displayed at the Virtual Reality Applications Center on campus.

Contributed by ECR

Exploring advanced imaging and diagnostic systems

Visiting undergraduate students from other institutions participated in the MoSAIc Research Experience for Undergraduates at Iowa State.

The Microscale Sensing Actuation and Imaging (MoSAIc) Research Experience for Undergraduates (REU) at Iowa State provided eleven students with the opportunity to explore advanced imaging and diagnostic systems, and gain experience with designing and manufacturing microscale and nanoscale sensors, actuators, and smart materials.

In order to help students build an understanding of how materials interact, MoSAIc projects ranged from examining the microscale details of burning aluminum to discovering how small surface sensors aid 4D imaging. Participants use precise methods and powerful equipment to obtain findings. This kind of work has the potential to be used in making new devices and materials and is often applied to chemical and biological research projects.

MoSAIc is led by mechanical engineering associate professors **Sriram Sundararajan** and **Pranav Shrotriya**.

Gabe Davis, an electrical engineering student from Savannah State University, had the chance to work with high-intensity focused ultrasound. Each evening, Davis mixed samples before leaving them to solidify for eight hours. The next morning, he used a soft-tissue ultrasound to measure the cavitation volume of each sample. His research contributed to a larger project that aims to determine the impact different tissue factors have on the volume of ultrasound results.

Davis attended MoSAIc at the recommendation of a professor at his university, and his mentor during the event was an electrical engineer with many related academic interests. "The experience was a good reinforcement for me that I am in a field I enjoy," says Davis.

Leah Merner, mechanical engineering student at Iowa State, originally became interested in MoSAIc as a way to reconnect with engineering after a year of studying abroad in Italy. The chance to put her education to the test and gain work experience as an undergraduate drew her to the opportunity.

"Eventually, school is going to end, and knowing how your field applies to real life is going to be important," says Merner. "I'm interested in research and development, so I thought MoSAIc would give me great insight into research."

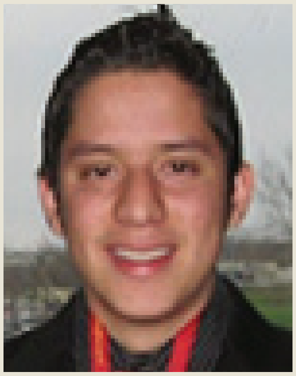
Merner's work took her outside her comfort zone and into a research lab specializing in 3D imaging. She worked with shape measurement systems, improving the accuracy of transferring 2D images into 3D.

"The more I looked into the program, the more I realized computer work seems to be a good supplement to mechanical engineering," says Merner. "I think the more I know about electrical engineering and emerging technologies, the more of an advantage I will have in the professional world."

Merner continues, "This experience has helped me discover certain types of research I'm not as interested in doing. However, I have learned so much that will be beneficial to me, and this has been such a great opportunity that I wouldn't trade it in for anything."

Contributed by ECR

ME sophomore gains early experience in research



Alex Avendano

Alex Avendano, a sophomore in mechanical engineering, took advantage of an early start on research experience – and it's paying off. Avendano, originally from Carolina, Puerto Rico, began his career at Iowa State the summer before his freshman year as part of the MoSAIc REU program. This sparked his interest in DNA based sensors. Avendano conducted a series of experiments, directed by **Pranav Shrotriya**, associate professor in mechanical engineering, for measuring the immobilization density of DNA strands on gold surfaces.

He submitted a research paper on his work, "Surface Coverage of Thiolated Molecules on Microsurfaces for Microcantilever Sensors" to the 47th Annual Technical Meeting of the Society of Engineering Science. Avendano was selected for a travel fellowship to present his paper in the undergraduate student paper competition, the only freshman competing. Because of this participation, Avendano was named a Hispanic Engineer National Achievement Awards Corporation (HENAAC) scholar at Great Minds in STEM.

In the summer of 2011, Avendano worked with research on delivery vectors for gene therapy treatment of cancer. The research was performed at Rice University in Houston through a collaboration with Princeton University. This summer Avendano will be interning as a durability engineer at General Electric Transportation Division in Erie, Pennsylvania. He aspires to become a university professor and manage his own research group someday.

Zhang looks to develop platform for 3D sensing technology

Imagine seeing live, three-dimensional video of rapid phenomenon like a beating heart. Then, imagine being able to use that data to evaluate disease or even perform surgery.

A sensing technology with this sort of capability would need to be fast, and it would need to be precise. And if it is both of those things, it could be used for much more.

Song Zhang, assistant professor of mechanical engineering, is hoping to take his 3D technology to a new speed with the project "Dense superfast 3D sensing of extremely rapidly changing mechanical and biological scenes." The project is supported by a $400,000 National Science Foundation CAREER award.

The sensing technique he is working to develop would capture images at kilohertz to megahertz speeds. To put it into perspective, one hertz completes a cycle in a second, and a megahertz is 1,000,000 times faster than that.

Differing from the 3D technology seen in movies and on newer 3D TVs, Zhang's technology generates 3D images that users can interact with and manipulate.

Take an image of the heart, for example. Zhang is collaborating with researchers in St. Louis who study heart disease with a method that requires the heart to be immobilized. Clearly, this approach isn't feasible for studying humans. Using Zhang's high-speed 3D imaging to develop a virtual image of the beating heart would allow the heart to be studied in an immobile state.

"When all is said and done, this is a platform technology that can be applied to many different areas," explained Zhang. "Superfast three-dimensional sensing technology could lead to major breakthroughs in fields important to public health and safety."

What sorts of breakthroughs?

Improving surgeries involving the brain and spine by providing a clearer, more accurate live image of the area during surgery than a pre-scanned MRI or CT image. Providing surgeons with more intuitive situational awareness during robotic procedures. Even helping autistic children feel more comfortable socializing with others through a 3D model.

Beyond biology, high-speed imaging can also improve the design of earthquake-resistant structures, allowing engineers to create safer buildings for people to work and live in.

"As we continue to make progress on the technology, I'm planning to work with Sri Sritharan in civil engineering to gather experimental data to understand collapse of structures that happens suddenly during earthquakes. We intend to study weak structural members that initiate collapse when a building is overloaded during a seismic event. By understanding and preventing collapse, we can avoid unnecessary loss of lives in future earthquakes," Zhang said.

Song Zhang

There are also immediate applications to use the imaging to study wind energy, fluidics, inspections, and agriculture.

Zhang says he must first overcome the challenge of storing all the data generated by these high-resolution videos and images before the technology can go more mainstream. "3D is at least 10 times bigger than 2D video. Current hardware doesn't have the capacity needed for general use of the technology," he said. Zhang's lab is also working on 3D video compression techniques to conquer this challenge. He also noted increasing the precision of the data collected will be important to focus on, especially when considering the technology could be used in biology or for inspections.

People will be introduced to the technology through interactive welcome messages during public events at Iowa State, such as tours of the Virtual Reality Applications Center. Zhang says he also plans to get students involved in summer internships. "Anything we can do to get more students interested in the engineering will serve the field well," he said.

They may even see the technology in less conventional places, like Radiohead's "House of Cards" music video.

"I regularly get requests for collaboration that I have to evaluate and determine whether my technology is a good fit," he said. "With faster, more precise imaging capabilities, we will be able to work with even more people and make this technology widespread."

Contributed by ECR

Zhang's research group is working on 3D video compression techniques to store the data required for their high-resolution videos.

Departmental honors and awards

Richard H. Stanley (BSME/BSECpE'55) received the Distinguished Alumni Award, the highest honor given to ISU alumni that recognizes preeminent contributions to their professions or life's work.

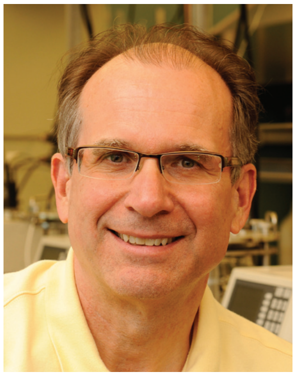
Pranav Shrotriya was selected to join the third cohort of the Emerging Leaders Academy (ELA) at Iowa State. The ELA provides participants with the opportunity to learn institutional best practices and explore scholarly research on leadership. In a series of highly focused sessions, participants will have the opportunity to be intentional about their own personal leadership development and proactively collaborate with other emerging leaders across the institution. The program includes four core curriculum sessions, five workshops dealing with aspects of the ISU environment, a mentoring experience for each member of the cohort, and a graduation celebration.

Mark Bryden, **Atul Kelkar**, and **Xinwei Wang** were elected to the grade of Associate Fellow in the American Institute of Aeronautics and Astronautics (AIAA). AIAA Associate Fellows are individuals of distinction who have made notable and valuable contributions to the arts, sciences, or technology of aeronautics or astronautics. The Associate Fellows were invited to attend the AIAA Associate Fellow Dinner in where they were presented with their pin and certificate.

The American Institute of Aeronautics and Astronautics' Terrestrial Energy Systems Technical Committee elected **Mark Bryden** as the new chair. The committee addresses the application of engineering sciences and system engineering to the production, storage, distribution, and conservation of energy for terrestrial uses. He will be taking the position effective May 1, 2012.

ISU engineers establish national panel to advance a carbon negative economy

A national panel led by Iowa State University engineers is launching an effort to research and develop technologies that capture, use and sequester carbon while enhancing food production, ecosystems, economic development and national security.



Robert Brown

The 33-member National Panel for a Carbon Negative Economy recently met for the first time in Chicago. Participants represented universities, companies, federal agencies and non-governmental agencies, including the Massachusetts Institute of Technology, ConocoPhillips, the National Renewable Energy Laboratory and the International Biochar Initiative.

"Our goal is to help develop an intellectual framework for this new field and help move it forward," said **Robert C. Brown**, the leader of the carbon negative project, an Anson Marston Distinguished Professor in Engineering, the Gary and Donna Hoover Chair in Mechanical Engineering and the Iowa Farm Bureau Director of Iowa State's Bioeconomy Institute.

The panel meets at least twice a year with the next meeting scheduled for May 2012. Potential next steps include preparing a white paper detailing key aspects of a carbon negative economy, presenting the concept at professional conferences and in high-profile scientific journals, bringing the idea to federal agencies and private foundations, and continuing joint activities that strengthen the collaborations initiated at the first meeting of the national panel.

Iowa State's Initiative for a Carbon Negative Economy is one of three projects that each received three-year, $500,000 grants from the College of Engineering. The grants from the Dean's Research Initiatives program were announced in March 2011 and allow teams of faculty members to build interdisciplinary, public-private research partnerships that can successfully compete for multi-million dollar research projects while also sparking economic development and spinning off new technologies. The grant program is also supporting teams building partnerships and projects in computational biology and wind energy.

"This National Panel for a Carbon Negative Economy is a great example of the partnerships and research programs we're building with the Dean's Research Initiatives," said Jonathan Wickert, dean of Iowa State's College of Engineering. "These initiatives are advancing the college's research mission in areas where we have comparative advantages. And they're putting science and technology to work to help Iowa and the world meet the challenges of the 21st century."

One of those challenges is not only reducing emissions of greenhouse gases but also removing carbon dioxide from the atmosphere.

Brown and his colleagues think they have a solution: "Our proposal envisions a carbon negative economy, which goes beyond current efforts to reduce greenhouse gas emissions, by adopting a strategy of actively removing carbon dioxide from the atmosphere," says the project's proposal to the college. "This captured carbon is sequestered in soils, sediments, and oceans as part of the natural carbon cycle of the biosphere while supporting economic activities of human society."

The objective, in other words, is "to develop technologies that take carbon out of the atmosphere and make money while doing it," said Jill Euken, a member of the new panel and deputy director of industry and outreach for Iowa State's Bioeconomy Institute.

The initiative envisions fixing carbon from the atmosphere by growing cellulosic crops such as switchgrass and aquatic species such as microalgae. The harvested biomass would be thermochemically converted to a biocrude that can be used for transportation fuels, biobased chemicals or the generation of electricity. The thermochemical conversion also produces biochar, a carbon-rich solid similar to the charcoal produced in fires. Applying biochar to agricultural soils can sequester the carbon and boost soil fertility.

And now a national panel led by Iowa State engineers is working to advance that idea.

"The meeting helped the participants identify new opportunities for scholarship within and among our disciplines," Brown said. "But this is more than an academic exercise. The concept of carbon negative economic activity may be the only practical way to reverse the flux of carbon between the geosphere and the atmosphere."

Contributed by News Service

METaL: Multimodal Experience Testbed and Laboratory develops multiple ways to experience virtual reality

Judy Vance and her research group experiment with virtual reality in METaL.
Photo by Bob Elbert

ISU doctoral students Leif Berg and Ryan Pavlik handed over a Wii Remote and a pair of 3-D glasses.

A visitor to Iowa State's newest virtual reality lab - METaL, the Multimodal Experience Testbed and Laboratory - took the tools and began walking the virtual floor of a factory. And there, to the left, were three, yard-long metal pieces ready for assembly.

Berg, who's studying human computer interaction, and Pavlik, who's studying human computer interaction and computer science, offered a few tips for operating in the virtual factory. And then it was time for some assembly work.

The big green frame piece went front and center. Then the smaller blue piece had to be turned and twisted into place, metal clangs marking each time the parts collided. Then, after lots of looks all around the parts and through the holes in their sides, a white pin finally lined up and went through both pieces.

"This lab is similar to what you'd find in industry," said **Judy Vance**, Iowa State's Joseph C. and Elizabeth A. Anderlik Professor of Engineering and a professor of mechanical engineering. "This is something we use often. We can run over here and fire it up. We can bring projects in here and work with them on a daily basis."

METaL, operating since February 2011, is designed to be a versatile, everyday research tool. It's not meant to be C6, Iowa State's six-sided virtual reality laboratory. The C6 provides an extremely high resolution and fully immersive virtual environment through the use of 24 projectors and 48 computers. METaL provides a partial immersive environment with less equipment and a simpler configuration.

"We have three projectors and two walls and a floor," Vance said. "With one projector per surface, that makes it pretty simple."

Even so, projector technology has advanced rapidly in the last few years and can provide bright displays with adequate resolution. Take a closer look whenever text is displayed in METaL, Vance said. The letters are crisp and readable and the 3-D resolution is high enough to create an effective virtual reality environment.

"One of the reasons I like to work in this space is the ability to walk up to a virtual image of a 3-D object and explore it from many different angles," Vance said. "The physical sensation of moving your body provides you with additional spatial information about the products you are examining. The aspect of moving in the space makes it more real than standing here and flying towards it."

Vance said the lab will be used to study and develop the integration of 3-D visual display technology, audio effects and force feedback. The goal is to create natural interaction techniques in virtual reality. That could be used by industry to design new parts, explore design functionality or develop better assembly methods.

Another goal for the lab is to make virtual reality more accessible on campus. Vance said METaL will be a tool used by undergraduate researchers and one that reaches out to young students and prospective engineers. About 40 middle school and high school girls, for example, recently visited the lab to learn about virtual reality and engineering.

The lab was built with support from Iowa State, the College of Engineering, Iowa State's Institute for Physical Research and Technology and the department of mechanical engineering. The lab was built by Mechdyne Corp., a Marshalltown-based company founded by graduates of Iowa State and former graduate research assistants in Iowa State's Virtual Reality Applications Center.

Working with Vance to advance research in the lab are students in mechanical engineering, human computer interaction, computer science, and electrical and computer engineering. Graduate students in the lab include Berg, Patrick Carlson, Isaac Garlington, Tim Morgan and Pavlik. Undergraduates include Adam Carlson, Andrew Moore, Jane Peters and Meisha Rosenberg.

Those students are a key to one of Vance's long-term goals: to spread the use of virtual reality to industry.

"All these students see the value of virtual reality," she said. "And when they get jobs in industry, they'll say, 'We need to do virtual reality.'"

Contributed by News Service

Female students from local middle and high schools experience METaL

A biannual conference called "Taking the Road Less Traveled: A Career Conference for Girls" brings middle and high school female students to Iowa State to explore careers and research in math, science and computer-related fields. This year, the students were introduced to virtual reality technology by **Meisha Rosenberg**, graduate student in mechanical engineering, and Jane Peters, senior in electrical engineering, *(below, left)*, undergraduate students working with **Judy Vance**, the Joseph C. and Elizabeth A. Anderlik Professor of Engineering. The guests had a chance to explore and interact with different environments, including a simulated version of Hogwarts Castle from the *Harry Potter* book series *(far below)*. The conference is organized by the Program for Women in Science and Engineering.

Hashemi receives NRC/ASEE research publication award for optofluidic approach

Nastaran Hashemi, William March Scholar in Mechanical Engineering, was chosen to receive the 2011 Naval Research Laboratory NRC/ASEE Research Publication Award for her paper "Optofluidic characterization of marine algae using a microflow cytometer."

Hashemi, an American Society for Engineering Education (ASEE) Postdoctoral Fellow at the time, worked on the publication with Jeffrey Erickson, Joel Golden, and Frances Ligler from the Center for Bio/Molecular Science and Engineering at Naval Research Laboratory in Washington D.C.

The group demonstrated the design and fabrication of a flow cytometer, a device used to study microscopic particles, in a microfluidic platform, to characterize phytoplankton. Within the flow cytometer, streams of sheath fluid guided by grooves on a microchannel wrap around a central sample stream and hydrodynamically focus the sample stream in the center of the channel. Lasers provide excitation light close to the maximum absorbance wavelengths for the intrinsic chlorophyll and phycoerythrin within the phytoplankton, resulting in fluorescence and light scatter that are collected using optical fibers.

The team was able to detect and characterize picoplankton with diameter approximately 1 micrometer and larger phytoplankton of up to 80 micrometers in length. The wide range in size discrimination coupled with detection of intrinsic fluorescent pigments suggests that this microflow cytometer will be able to distinguish different populations of phytoplankton on unmanned underwater vehicles.

Nastaran Hashemi and Reza Montazami at the ceremony in Washington, DC in March.

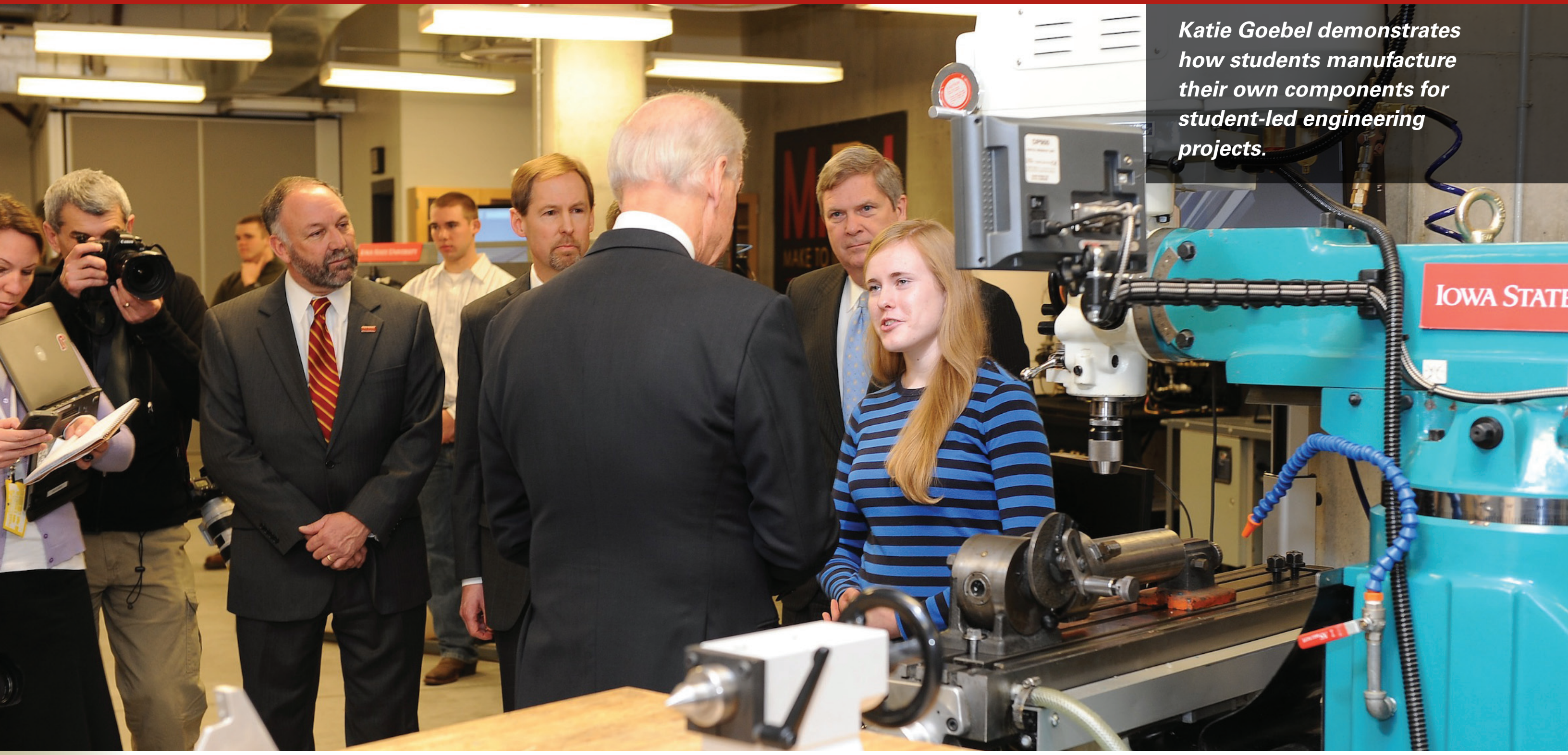
Hashemi receives a certificate to recognize her NRC/ASEE research publication award.

Their approach can be classified as optofluidics, a fast-growing field that complements microfluidic systems with optical functionality to construct highly integrated and compact "lab-on-a-chip" devices. "Optofluidic chips are more sensitive and provide higher throughput in a compact and cost-effective platform in comparison to conventional optical instruments," Hashemi explained. "Optofluidic platforms such as sensors and flow cytometers can be used for environmental monitoring, medical diagnostics, and chemical-weapon detection."

The work was published in Biomicrofluidics, and is one of a series of works published in Biosensors and Bioelectronics and Analytical Chemistry. It was also

- Selected for Publication in Virtual Journal of Nanoscale Science and Technology
- In the top 20 most read articles published in Biomicrofluidics for three months
- Resulted in more than 8 Invited Presentations and Talks
- Presented in Gordon Research Conferences – Microfluidics, Physics & Chemistry

The research publication award from NRL and ASEE honors bright, highly motivated, recent doctoral graduates for superior scientific accomplishments in areas of interest to the Navy. The award was given at the NRL Alan Berman Research Publication and Edison Patent Awards Ceremony in Washington, DC on March 16, 2012. Hashemi and **Reza Montazami**, assistant professor of mechanical engineering, were invited to the ceremony as guests of ASEE.



Katie Goebel demonstrates how students manufacture their own components for student-led engineering projects.

Vice President Biden visits ISU College of Engineering

During his visit to Iowa State's campus on March 1, Vice President Joe Biden highlighted the role engineering will play in the country's future economic growth, which relies on keeping jobs and innovation in the United States.

Before he took the stage at the town hall forum, Biden met with students working on manufacturing projects in the College of Engineering. During his talk, he noted the projects served as a good example of collaboration across different disciplines and partnerships between academia and industry.

Katie Goebel, senior in mechanical engineering, and **Thomas Naert**, senior in mechanical engineering and agricultural engineering, both presented a mechanical engineering project to Biden.

Goebel demonstrated how students use tooling machinery to create components for conveyors and other belted systems. She also uses her engineering skills with Iowa State's Lunabotics club, where students create a lunar rover to mine materials from the surface of the moon.

Naert talked about his senior design project with Ames-based Ag Leader, a manufacturer of agricultural sprayers, to improve fluid flow through the sprayer system. Naert and his mechanical engineering colleagues are helping ensure that only the minimum amount of chemicals are used on crops.

As the Vice President commended the projects going on at Iowa State, he emphasized that lessons like these will help reshape the American economy. The students appreciated his encouraging words that promoted both manufacturing and education within the country.

Goebel says that manufacturing and new technology go hand-in-hand. "When more new technology is created, more jobs are created to manufacture and sell it," she explains. "As long as there is demand for technology and engineers to create it, the economy will be significantly helped along."

She also says that Biden's discussion about bringing jobs back to the U.S. must be carried out. "When more of the manufacturing is in the U.S., it is easier to create better manufacturing processes, which makes companies more efficient," Goebel explains.

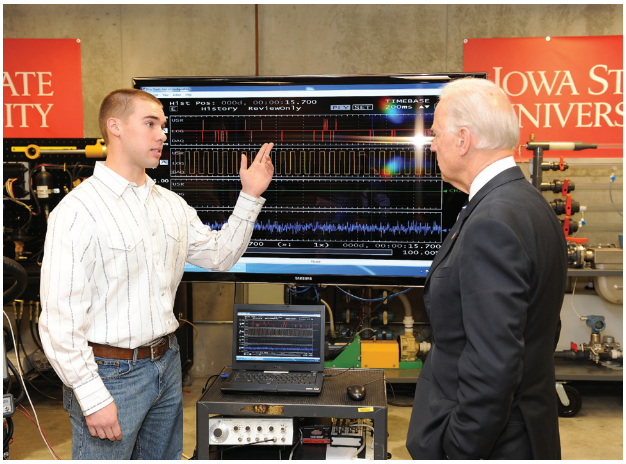
Biden also talked about how the U.S. is unique in that it offers the freedom to think creatively.

"He put freedom into a whole new context that I had never thought of before," Goebel says. "Everyone cherishes the freedom to gather and to speak freely, but no one usually thinks to cherish the freedom to create. His point that freedom is directly correlated to America's innovation and ingenuity makes me appreciate this country's values."

With an understanding of the influence engineering can have both locally and globally, these students are excited about what their future holds. From creating new technologies to solving important problems, they will be using their skills and way of thinking to make an impact on the world around them.

"We have to keep envisioning and creating solutions to problems like always," Goebel says. "When more people are involved with generating breakthroughs, we will have access to more advanced science and technology."

Contributed by ECR



Thomas Naert discusses a capstone design project with Vice President Joe Biden.

Dedic recognized for her abundant accomplishments

The College of Engineering advances many successful engineers into industry each year, and they all have unique experiences and accomplishments from their time at Iowa State. Mechanical engineering senior and Mason City native **Chloe Dedic** is no exception.

In Dedic's nearly four years at Iowa State, she has upheld a 3.99 GPA, participated in groundbreaking research, and participated in extracurricular programs. These activities ultimately led to her selection for prestigious honors such as the Barry M. Goldwater Scholarship, the Wallace E. Barron All-University Senior Award, and the Spring 2012 College of Engineering Student Marshal.

As a freshman, Dedic arrived on campus undecided as to what career path she wanted to take. Interested in science and math as a high school student, Dedic knew she wanted to pursue engineering but was stuck between the choice of the chemical and mechanical engineering disciplines.

"I initially considered chemistry as a major, but I was afraid that if I were to major in chemistry I would be doing something extremely theoretical, and I'm the type of person who really likes to know how my work applies to the real world," explains Dedic.

She began working with the freshman Honors Program to find a research project that would give her that real-world application. When Dedic was selected to work in the Department of Mechanical Engineering's Multiphase Reacting Flow Laboratory with assistant professor **Terry Meyer**, she found the work suited her interests. She subsequently selected ME as her major, pairing it with a minor in physics.

Dedic credits much of her ME success to her early involvement with the Honors Program.

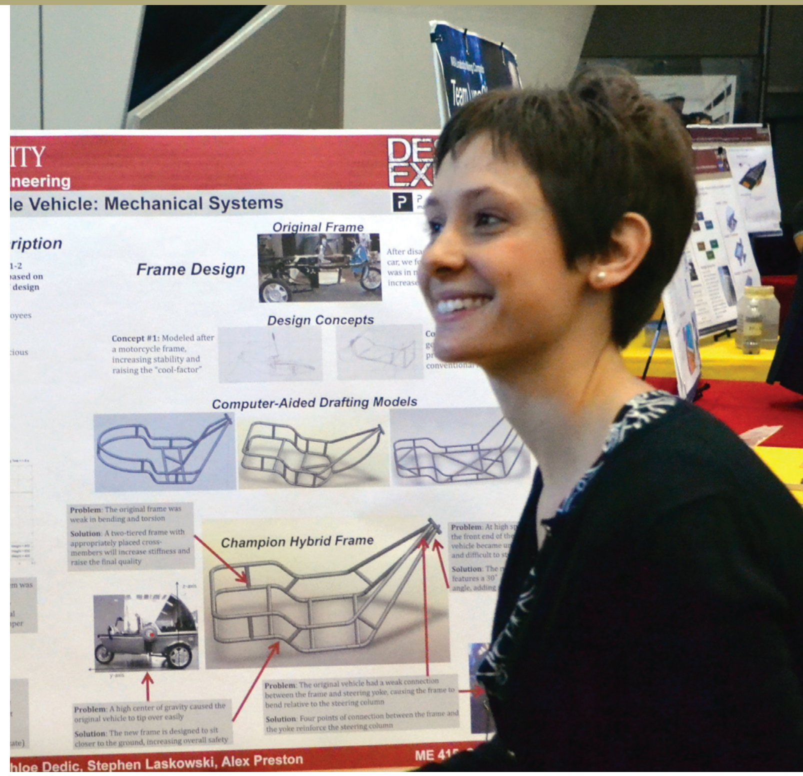
"I learned how to apply for national scholarships through the Honors Program, which really paid off when applying for the Goldwater Scholarship," she says. "Without the Honors Program, I would not have become as involved in research, and may not have found something I enjoyed so much."

Dedic has enjoyed her position in the ME lab so much that she continues to work there today. She's evaluating diagnostics for combustion processes with a hybrid femtosecond/picosecond coherent anti-Stokes Raman scattering spectroscopy technique. The research relates to ongoing efforts aimed at producing and utilizing clean, renewable energy sources. In order to fully understand the chemical reactions governing clean energy processes, measurements of temperature and molecular concentration can help reduce or even eliminate the formation of pollutants such as carbon monoxide or nitrogen oxides.

"My favorite part about research is having the opportunity to be the first person to try something," she explains. "There is no way to know without a doubt whether or not your experiment will work, giving you the chance to either be completely wrong or discover something new."

Dedic furthered her engineering skills last summer as an intern at Kiewit Power Engineers in Lenexa, Kansas, where she assisted in several aspects of designing a combined cycle power plant.

"My internship provided me with a very realistic snapshot of engineering within an industrial setting. I enjoyed the projects I was assigned to, and I am glad I had the opportunity to experience engineering away from an academic setting," she says.



Chloe Dedic has received multiple honors and awards recognizing her achievements during her ongoing student work in mechanical engineering. Above, Dedic presents a class project at the 2011 Mechanical Engineering Design Expo.

In addition to her commitment to research and education, Dedic has made it a priority to participate and hold leadership positions in several organizations in the Iowa State community. These activities have included ISU Engineers Without Borders, Tau Beta Pi Engineering Honor Society, ISU Wind Ensemble, ISU Water Polo Club, ISU Student Alumni Leadership Council, Dance Marathon, and several community service projects for which she has received the Silver Cord Volunteerism Award.

Dedic has also been honored with the ISU President's Award for Competitive Excellence Scholarship; received ISU Scholars and Leaders recognition; won the Galen F. Smith Design Competition; was a semi-finalist for the Science, Mathematics, and Research for Transformation Scholarship, and won a Woman of Innovation Award.

Of all her activities, she is most enthusiastic about the opportunity to mentor others. Dedic is particularly proud of her involvement with Engineers Without Borders, peer mentoring for Women in Science and Engineering, and coaching the local children's swimming club because they have allowed her to push others to succeed.

"I am so proud of the success of each of the swimmers I have coached in the past three years," explains Dedic. "Motivating these children to push their personal boundaries and discover how much they can accomplish was a rewarding experience, and I look forward to finding other opportunities in the future to mentor and inspire individuals to succeed."

While Dedic's undergraduate studies at Iowa State are coming to a close, her excitement for learning will continue. She is currently working on a concurrent master's in ME, and was recently awarded a National Science Foundation Graduate Fellowship to support her graduate work. Following her master's degree, she hopes to pursue a PhD at another institution.

Looking even further down the road, Dedic hopes to pursue a doctoral degree, and is considering a career in academia to continue her passions for research and mentoring.

Contributed by ECR

Spotlight: ME student organizations reach out to K-12 students

Lunabotics team members visit Fellows Elementary in Ames

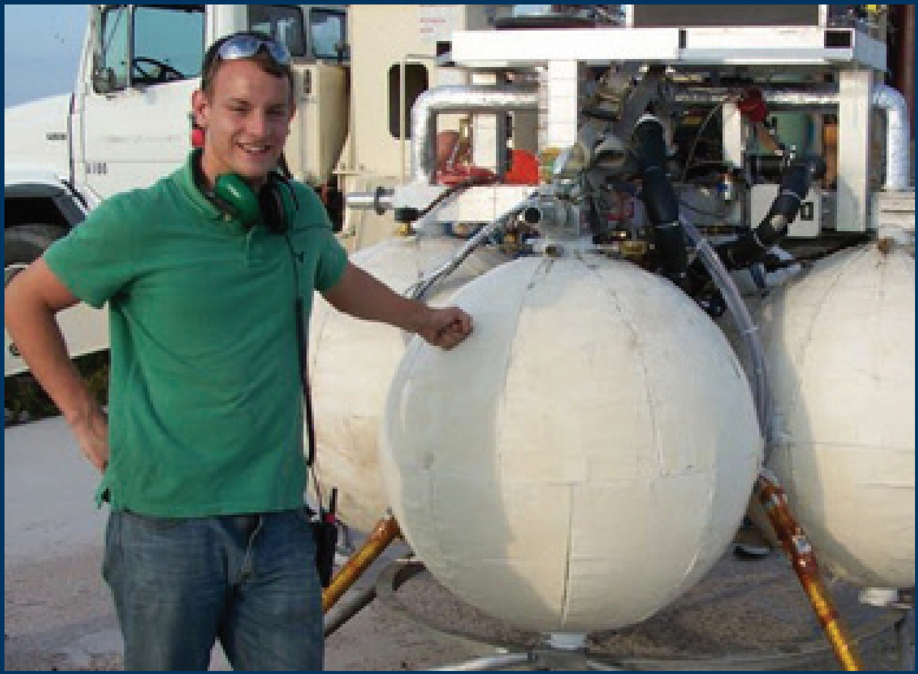
The ISU Lunabotics Mining student team sent three members to Fellows Elementary School in Ames on November 8 to speak with an Extended Learning Program (ELP) class about the Lunabotics team and to demonstrate the robot they created for the May 2011 competition at the Kennedy Space Center. Ashley Pitkin, senior in IE; **Garrett Schieber**, freshman in ME; and Bryan Sullivan, sophomore in AE, explained how the robot was made with students bringing expertise from different areas of engineering, and how they are working on improving the robot for next year's competition in Florida. The ELP students then took turns controlling the robot, and the Lunabotics team members demonstrated how the robot mines mood dirt. The Ames Extended Learning Program at Fellows Elementary is designed to support the high ability and gifted students through enhanced curriculum activities and peer group opportunities. The ISU Lunabotics Mining Team, a multi-disciplinary design team, is advised by **Jim Heise**, lecturer in mechanical engineering.

ASME and WiME students mentor Des Moines high school students

Students from the American Society of Mechanical Engineers (ASME) and Women in Mechanical Engineering (WiME) traveled to Des Moines district's East High School and Hoover High School on November 10 to mentor high school students in the topics of wind energy and wind turbines. The ASME and WiME students aimed to inspire the next generation of engineering students, teaching them about the advantages and challenges associated with wind energy technologies. ISU students also developed networks with high school teachers and three high school visits were planned for Spring 2012. This project was made possible by the support of the Iowa Office of Energy Independence and the ISU Department of Mechanical Engineering. ASME is advised by **Xinwei Wang**, associate professor of mechanical engineering, and WiME is advised by **Baskar Ganapathysubramaniam**, assistant professor of mechanical engineering.

Radke designs rocket engines for NASA

Chris Radke, a concurrent MS/BS student in mechanical engineering, is helping NASA in its quest to send robots to the moon. After landing an internship at the College of Engineering career fair, he has successfully designed and tested six rocket engines. Radke is part of Project Morpheus, a concept to use vertical launch systems to send robonauts to the moon. The propulsion system is fueled by methane and liquid oxygen. Methane is a waste gas of the International Space Station and could also conceivably be harvested from ice in lunar craters. Radke also had the opportunity to brief the White House staff on this project. This fall, Radke will join NASA full time.



Wind energy powers up alum's career

When **Brian Lapcewich** enrolled at Iowa State in 2005 as an undeclared engineering major, he didn't know his passion for engineering would lead him to a career where an ordinary day at the office would mean standing atop an 80-meter high wind turbine.

After one semester at Iowa State, he declared mechanical engineering as his major. He participated in two internships, first with BNSF Railway in 2008, and then with Caterpillar in 2009. At Caterpillar, he worked with technicians to tear apart faulty drive train units to locate and replace problem components and conduct failure analyses, gaining insight that would eventually help him settle on a direction for his career.

In his fifth and final year, he added a nondestructive evaluation minor and began to focus on wind energy aspects that correlated with his studies in mechanical engineering.

"When I came back to ISU [from Caterpillar], the job market was starting to shift and shrink up," he says. That was when a fortuitous letter from his mother arrived, with an article about the skyrocketing market for renewable energy professionals. He immediately saw a connection between what he was studying and his future plans.

"A wind turbine is just a large drive train," he explains. "It has a gearbox, bearings, and a generator, just on a larger scale."

With this new goal in mind, Lapcewich researched wind energy and signed up for an introduction to wind class that had just been introduced at Iowa State. His enthusiasm grew until he was fully engulfed in wind.

Under the supervision of Lisa Brasche, associate director of the Center for Nondestructive Evaluation, Lapcewich participated in a semester-long independent study focused on failure modes for wind turbines, drive trains, and fiberglass blades. With the Clipper Windpower turbine factory in Cedar Rapids, Iowa, Lapcewich used nondestructive methods and equipment such as borescopes and infrared cameras to inspect wind components and observe turbine elements.

"Brian was very committed to understanding wind," Brasche says, adding that during his time with Clipper, Lapcewich "gained a deeper understanding of the complexity of turbine construction, from transportation of components to building them up."

Armed with hands-on experience with machinery and nondestructive evaluation techniques, Lapcewich focused his career search on the wind energy market. He says the wind industry has enormous potential for engineers in almost any program.

Besides the mechanical and electrical aspects of turbines, computer and software engineers design the control systems which turn the turbines into the wind, shut them down, and collect data and send it back to remote-operations centers. Aerospace engineers are working on blade design, trying to balance lift versus resistance, as in any propeller or wing of a plane. Civil and construction engineers develop foundations, construct wind farm layouts, and consider the needs of people who live and work around the farms who are concerned with noise, or the impact of water runoff in local areas. Industrial and manufacturing systems engineers work on projects like improving the efficiency of producing turbine blades.

Among the companies Lapcewich applied to during his job search was Availon Inc., previously SSB Service, a company founded in Germany that has expanded to the United States and established its headquarters in Grimes, Iowa. He was excited by the prospect of staying in Iowa, and the opportunity to travel abroad for training at the company's parent firm in Germany. He had an offer from Availon before he graduated, and stared work with the company soon after commencement.

Lapcewich knew little about Availon before beginning his job search, but the company's involvement in the wind industry began over 20 years ago, with the design of electrical motors and control systems for some of the first modern wind turbines in Germany.

Modern turbine technology is still relatively young, spurred by the 1970's oil crisis and NASA wind turbines, which pioneered today's turbine designs. However, many of the first modern turbines were cobbled together from components that weren't designed for the high strain of wind, such as cooling systems taken from the automotive industry or large bearings found in construction cranes. Over time, these components fail, but unlike a car, a wind turbine can't simply be towed to a repair shop. This is where Availon steps in.

"We focus on providing service on normal operations and maintenance, troubleshooting, designing and installing upgrades, and performing end-of-warranty inspections," Lapcewich says.

ME alum Brian Lapcewich's work takes him to the top of 80-meter high wind turbines.

By studying the life cycles of 20-year-old turbines in Germany, Availon can predict when malfunctions will most likely occur in newer, stateside turbines as they age.

In his role as a mechanical product support engineer, Lapcewich has aided teams in the field by conducting troubleshooting and diagnostic testing to find solutions for recurring problems. He has also designed upgrades for the wind industry to maintain the life and output of the older, more slap-dash turbines.

Whether his day includes scaling a turbine or staying in the office, Lapcewich greets the winds of challenge head-on.

"I absolutely love my job," Lapcewich says. "I wake up in the morning excited to go to work. There's something about the view from the top of a turbine that just can't be replicated."

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EOS: Improving the lives of Nicaraguans with technology

Two ME alums have already helped more than 20,000 Nicaraguans through the organization they built on the idea of implementing simple, helpful technologies in the developing world.

Wes Meier (BSME'08) and **Greg McGrath** (BSME'08) created a not-for-profit organization called Emerging Opportunities for Sustainability (EOS) International in 2008 to promote appropriate technology in the developing world.

Meier and McGrath became friends at Iowa State while working on class projects together, including a project for ME 389, Applied Methods in Sustainable Engineering. For the class, they tested and implemented a water valve using local materials during a month-long stay in a rural village in Mali, Africa.

"Our experiences at Iowa State taught us that we had the power to create social change in the developing world," McGrath says.

After graduating in 2008, Meier joined the Peace Corps and was placed in Nicaragua, where he and McGrath started EOS International.

"Working with Wes has been amazing," McGrath says. "We each have strengths in different areas, and it worked out perfectly to have him on the ground developing technology and building a network in Nicaragua, while I was developing the structure of the organization and building a base of followers in the U.S."

EOS is a growing organization of five full-time Nicaraguan engineers and more than 30 volunteers from the United States. Last year, EOS spent a little under $40,000 and helped more than 20,000 Nicaraguans by implementing helpful and appropriate technologies such as drip irrigation systems, biodigesters and fuel-efficient barrel ovens.

"The best part of EOS is working with the people of Nicaragua. My favorite memory was when a woman told us that she is able to sleep in later each day since we installed her biodigester," McGrath says. "This technology creates a renewable source of gas for cooking, eliminating the tedious task of finding wood and preparing a fire each morning."

Through their efforts, EOS has brought electricity, clean drinking water, and renewable energy to communities across Nicaragua using many different technologies. In one village, the engineers installed two ovens for a women's baking co-op that gathers to bake twice a week and now has a social outlet and provides income for their families.

Left to right: Wes Meier, Greg McGrath, a Nicaraguan farmer and a Peace Corps volunteer.

"We have worked with schools, installing drip irrigation systems with elementary students in their school garden, providing an agricultural learning experience and vegetables for lunch," McGrath says.

EOS also implemented solar panels in schools and co-ops, providing much-needed light and the opportunity for the people to continue working or studying after the sun goes down.

A constant challenge for the organization is running a business in foreign countries with language barriers and cultural differences. EOS has utilized engineers from Iowa State to help design new or gather information from existing technologies that would serve the needs and resources available in Nicaragua.

"Now that we are fully staffed in Nicaragua with Nicaraguan engineers, it is really neat to serve as the communication board from the Nicaraguan engineers to the ISU students on new ideas and designs," Meier says.

Meier and McGrath have high hopes for what EOS can accomplish in the future as it continues to grow and reach more people in the developing world.

"Within just the past three years we have gone from a crazy little idea to a fast-paced organization. We have seen how simple technologies can change the lives of Nicaraguans," Meier says. "We are now limited on our small operating budget to increase our reach of people. The longer we work, the more efficient we become and are able to reach more people with less expense."

As advice to anyone who might think it is impossible to make a positive difference in the world, Meier would remind them of how something very small can create big change.

"We have learned how providing light to family's home literally changes their life," Meier says. "Something so simple that we take for granted every day can make a huge impact on someone else. There are so many opportunities to make even a small difference."

The Nicaragua EOS Team: Top row, from left: Lester Peralta, EOS technician; David Hernandez, EOS technician; Evelyn Soza, EOS Financial Administrator (Nicaragua); Alvaro Rodriguez, EOS Nicaragua Country Director; Wes Meier, EOS International Director; Joe Dunlay, EOS Board Member; Greg McGrath, EOS Executive Director. Bottom row, from left: Sergio Romero, Compatible Technology International (CTI); Marlon Castro, CTI; Salvador Espinoza, EOS technician.

Bergles Professors meet with Art Bergles at IMECE

The Bergles Professorship of Thermal Science is named for **Art Bergles,** who was the chair of the Mechanical Engineering Department from 1972 to 1983. **Ted Heindel**, the current Bergles Professor of Thermal Science and interim ME department chair and **Robert Brown**, Anson Marston Distinguished Professor of Engineering and Gary and Donna Hoover Chair in Mechanical Engineering and the former Bergles Professor of Thermal Science, had the opportunity to have dinner with Dr. Bergles while all three were attending the 2011 ASME International Mechanical Engineering Congress & Exposition in Denver, CO, November 11-17, 2011.

Teaching beyond the classroom: ME course integrates web conferencing software

Michael Olsen

Michael Olsen, associate professor of mechanical engineering, is bringing web conferencing software into the classroom, creating virtual help sessions where students interact, ask questions, and get answers.

Initially, Olsen used the technology, Adobe Connect, to manage increasing class sizes. What resulted was a new space for learning that students are quick to embrace.

The mechanical engineering department has grown into the most popular major at Iowa State in recent years, and class sizes have grown to match. Olsen, who teaches fluid mechanics at the undergraduate and graduate level as well as undergraduate thermodynamics, has seen his classes more than double in size.

While the department is working to hire more faculty, the need for an intermediate solution was growing apparent.

"I've tried to be as accessible as I was when my class sizes were smaller so students have the same quality of education as before," Olsen says, noting previous approaches weren't as effective with greater numbers of students.

When his department acquired several licenses for Connect to reduce travel time and facilitate effective communication in extension and collaborative research projects across the country, Olsen tinkered with the software and then asked to try it in his classes.

"A light bulb went off in my head, and I thought, this software might be a way to make myself more accessible to my students," Olsen says.

CoE Dean Jonathan Wickert, who was the department chair at the time, offered Olsen a license to integrate the software into his class as supplemental instruction.

In addition to his regular office hours, Olsen began hosting online help sessions a few nights before homework was due and twice before tests. He says the transition was quick and painless. He introduced the software briefly in class and students fine-tuned their use of it as the semester progressed.

"It's similar to Skype," Olsen explains. "Students are familiar with this technology and pick it up really quickly. Actually, they pick it up faster than me."

He says the number of students physically walking into his office has dwindled as they've taken advantage of the convenience of an online contact with all the benefits of one-on-one counseling.

Connect allows him to project audio and video of himself in real time, as well as a whiteboard he can write examples on via a tablet. To ask questions, students sign on via a built-in chat feature.

"It's very anonymous," Olsen says. "Anyone can access the help sessions, including students from other sessions. They have to type in a username, but it doesn't have to be their NetID."

As a result, sessions are regularly attended by Chuck Norris, and occasionally Mr. T.

Students who are uncomfortable asking questions in class may feel more comfortable asking through the chat box. Olsen finds students are more willing to ask even simple questions, which inadvertently helps their classmates.

"I used to get a line of students outside my door all asking the same question. I'm happy to see them individually, but with over 140 students, that becomes unmanageable. Through the online help sessions, one student asks the question, I answer it, everyone gets the answer," Olsen says.

Olsen records the help sessions and posts links online for students who either missed the session or want to watch it again. By the end of the semester, the compiled recordings become an archive for students to refer to while studying for the final exam.

"I had a student tell me, 'Dr. Olsen, take all the engineering professors, lock them in a room, and don't let them out until they agree to have online help sessions'," Olsen says, adding that student responses have been overwhelmingly positive in his semester evaluations.

"This is a change that's not only good for students but also for faculty. It's mutually beneficial. It makes my job easier, and my students are a lot happier," Olsen says.

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