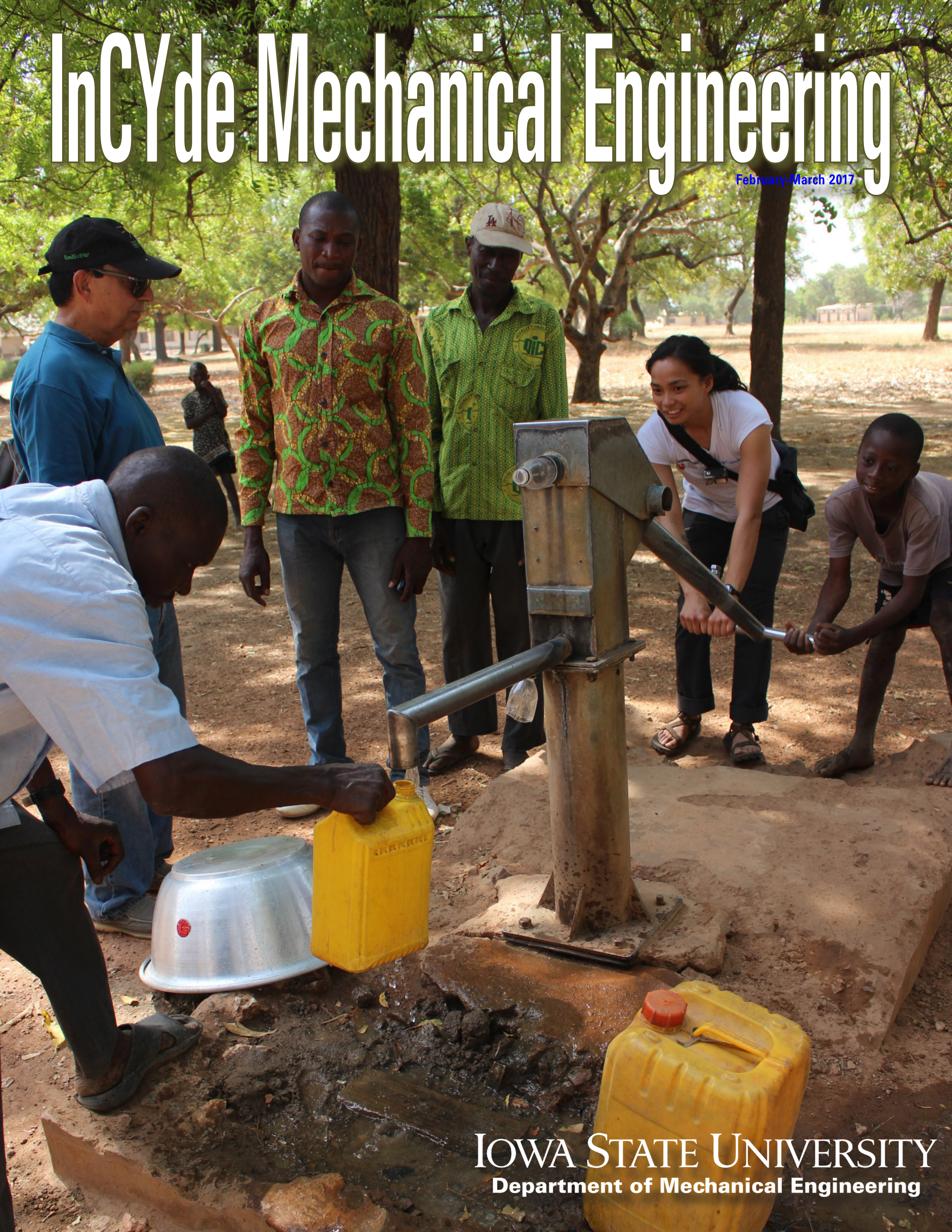
InCYde Mechanical Engineering

February-March 2017



IOWA STATE UNIVERSITY

Department of Mechanical Engineering

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On the cover

Students in the Iowa State Univesity chapter of Engineers Without Borders have spent the past couple of years working with Ullo residents to ease water procurement in the West African village. Photo courtesy of Engineers Without Borders-Iowa State University.

InCYde Mechanical Engineering | February-March 2017

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Prepared by Nick Fetty, ME Communications Specialist, 515-294-5065, *nrfetty@iastate.edu*

Mechanical engineering has largest undergrad enrollment on campus

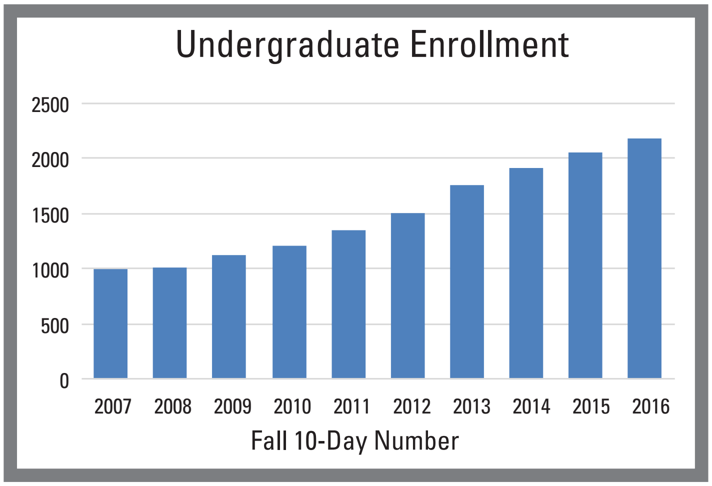
ME senior lecturer Jim Heise teaches an undergraduate class. Photo by Dan McClanahan.

Enrollment in the mechanical engineering undergraduate program at Iowa State for the spring 2017 semester is nearly twice the size of the next biggest major, according to data from the Office of the Registrar.

ME's spring 2017 enrollment comes in at 2,054, ahead of second-place kinesiology and health with 1,119 students. Though not a degree-granting program, there are 1,750 undergraduates this spring on the "pre-business" track. Roughly one-third of this spring's undergraduate student body are concentrated in 10 majors: mechanical engineering, kinesiology and health, animal science, elementary education, aerospace engineering, chemical engineering, psychology, computer engineering, biology (AGLS and LAS), and civil engineering .

"I am honored that all these students and their parents have chosen to entrust us with their education," said ME Department Chair Caroline Hayes. "It is my aim to give the the best educational experience possible. Mechanical Engineers make the world a better place."

In the fall, Iowa State surpassed Georgia Tech University to become the nation's largest undergraduate ME program.



Data from the 2016-17 ME Annual Report.

Did you know?

In fall 2016, Iowa State University surpassed Georgia Tech University to becomes the nation's largest ME undergraduate program?

ME, ECpE professor promoted to AIUM Fellow

Bigelow

This past October, the American Institute of Ultrasound in Medicine (AIUM) recognized individuals who have contributed to the field of medical, scientific or engineering work-related ultrasound. Iowa State University Associate Professor Timothy Bigelow was honored by being promoted to an AIUM Fellow. Bigelow was nominated by existing fellow members and has been a senior member of AIUM for over six years.

AIUM is a professional society that brings together both basic scientists and clinicians. Bigelow first got involved in 2006 after his advisor, who was also a part of AIUM, sparked his interest. Bigelow said he wanted to be able to work in an area that would impact human health.

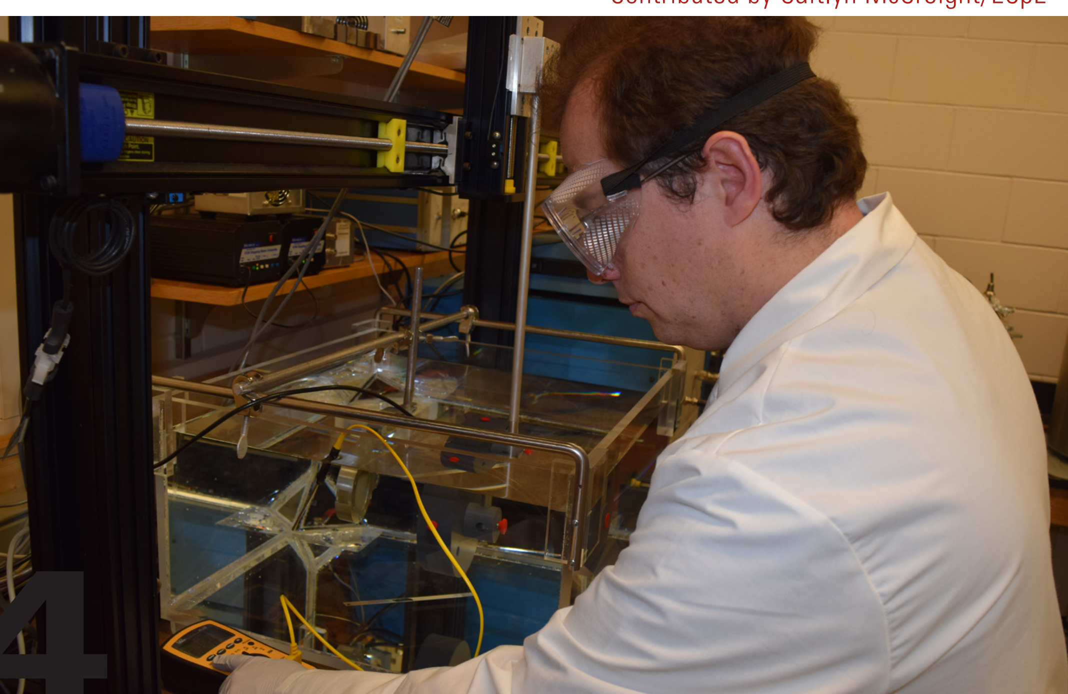
“I have developed new ways to diagnose disease from ultrasound images and have helped pioneer a new type of therapy, called histotripsy, based on ultrasound,” Bigelow said. “Histotripsy was originally developed at the University of Michigan, but I have worked as one of the few other groups to understand the therapy and apply it to new problems, such as the treatment of infections on medical implants.”

Prior to coming to Iowa State, Bigelow received his undergraduate degree in electrical engineering from Colorado State University in 1998. He later received both his master’s and doctorate degrees in electrical engineering from the University of Illinois at Urbana-Champaign in 2001 and 2004, respectively.

In the future, Bigelow – who has joint appointments in Electrical and Computer Engineering and Mechanical Engineering – plans to stay involved in the various committees and communities of ultrasound practice and research.

“As a faculty member, I always have future plans related to my research, and I do plan to continue to be involved in the society,” Bigelow said.

Contributed by Caitlyn McCreight/ECpE



CoE researchers awarded Miller Faculty Fellowship

Chen

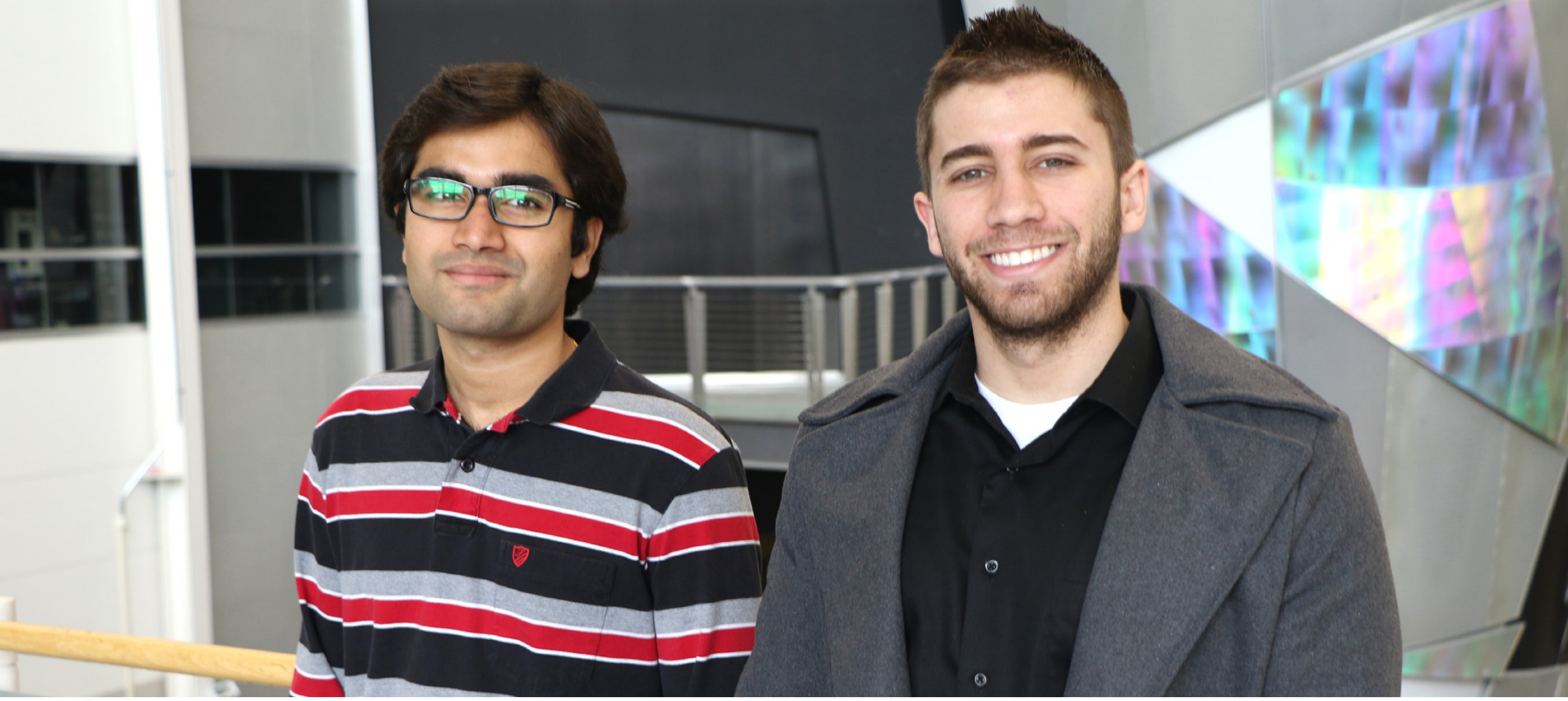
Three College of Engineering researchers have been granted funding to study the use of augmented reality applications when teaching structural analysis.

The reserach team of An Chen (assistant professor in civil, construction, and environmental engineering [CCEE]) Rafael Radkowski (assistant professor in mechanical engineering) and Aliye Karabulut-Ilgu (lecturer in CCEE) were awarded a Miller Faculty Fellowship for their proposal entitled “Exploring the potential of augmented reality applications to teach structural analysis.” The group will be funded in the amount of $14,971 beginning July 1, 2017.

Karabulut-Ilgu

The Miller Faculty Fellowship provides “faculty with opportunities to enhance their scholarly work in the undergraduate academic programs of the university and to develop innovative approaches to enhance student learning.” The fellowship is named for F. Wendell Miller, a graduate of Grinnell College and Harvard Law School who practiced law in Des Moines and Chicago. Upon his death in 1995, Miller left his entire estate jointly to Iowa State University and the University of Iowa. The Miller Faculty Fellowship is a program of Iowa State’s Center for Excellence in Learning and Teaching.

Radkowski



After meeting in a math class in 2014, Akash Vidyadharan and Tyler Carter are the co-founders of InfraDrone. Photo by Clay Paciorek/AeroE

Graduate students' startup makes a strong first impression

Akash Vidyadharan and Tyler Carter spent the first part of last summer applying for jobs in anticipation of receiving their master's degree in the spring of 2017. For the second half of the summer, they worked on a project that has caught the attention of investors, corporations, as well government officials.

"One year ago, this idea didn't even exist," Vidyadharan said. "We were applying for jobs, both of us online, clicking through job applications."

"We didn't like the ones we got though so we thought, let's do something that stimulates us, something fun," Carter added.

Vidyadharan and Carter, who received a B.S. in aerospace engineering and mechanical engineering respectively, from Iowa State in 2016, started InfraDrone, a company that does structural health monitoring for agriculture and infrastructure using UAV's. The two construct the UAV's, fitted with monitoring equipment including high resolution cameras and laser equipment such as LiDAR, thermography, and ultrasonics, and pilot them to inspect bridges, fields, wind turbines, and power lines.

"We have a big non-destructive evaluation center at Iowa State where I worked for a while," Vidyadharan, who is a student of Dr. Bloebaum's, said. "We decided instead of having this NDE equipment in the lab and bringing in samples, why don't we get this outside and make it more mobile, such as on drones?"

UAV's offer many benefits to inspecting structures that could change the way the practice is conducted.

"Say you're inspecting power lines," Vidyadharan said. "Currently they do inspections one of three ways. The first one is having a person climbing up the pole and physically look at the line, the second way is flying a helicopter over the lines with a thermal camera, and the third way is leaving sensors embedded on the line to collect the data."

All three of those options can be expensive, time consuming, and in some cases, dangerous. Flying a UAV around the powerline as it collects data is a quick and inexpensive way of analyzing the structure without putting lives at risk.

Recently, InfraDrone has caught the attention of many people, including the next governor of Iowa, Lt. Governor Kim Reynolds. Carter and Vidyadharan spent almost a half an hour with Lt. Governor Reynolds during a fundraising event, showcasing the technology and how it could help the state of Iowa.

"We gave her a bunch of our stuff," Vidyadharan said. "We showed her what we are doing and how it could benefit Iowa both economically and also for improving our infrastructure by detecting issues. We are hoping to pursue more projects with the state in the future."

In addition to government officials, the two engineers have also managed to impress investors, as well as some larger companies and potential clients. The combination of the drone market taking off recently and looser FAA regulations regarding drones has presented a golden opportunity for the entrepreneurs.

Carter admits that while the timing of the drone market is good, the key for InfraDrone is not actually the drone, but the way the analytics are presented.

"The UAV is just the part that collects the data," Carter says. "People can collect data, UAVs can collect data, satellites can collect data. UAVs are just the fastest and most accurate way. The real money comes in during the processing and the analytics of the data and the NDE testing. That's where the value is."

After a UAV scan is completed, Carter and Vidyadharan have figured out how to package the information in a way that is helpful for clients. Analyzing the data, deciphering the NDE results, and presenting it in a way the client can understand is just as important as the initial scan.

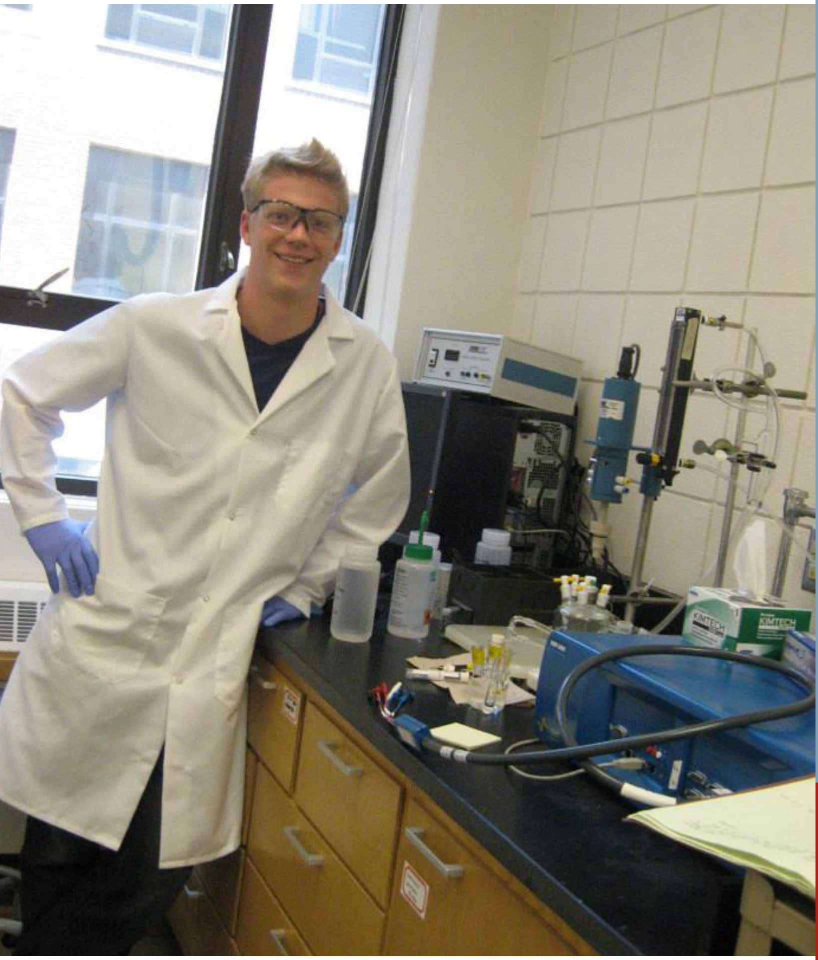
InfraDrone recently opened offices in West Des Moines and have started hiring employees.

While they're still being cautious and making sure all the bugs have been worked out in beta testing, Carter and Vidyadharan are hopeful their sacrifices will be worth it.

"Instead of getting full-time jobs, we thought there was a small chance this could take off," Vidyadharan said. "So we took the big leap."

Contributed by Clay Paciorek/AeroE

ME alum awarded National Science Foundation Graduate Research Fellowship



Goodrich

Mechanical engineering alumnus Payton Goodrich was among four Iowa State students or alumni recently awarded graduate research fellowships from the National Science Foundation.

Goodrich (BSME'15) studied microbial fuel cells and microfluidics in ME assistant professor Nastaran Hashemi's lab as an undergraduate at Iowa State. He also participated in the Science Undergraduate Laboratory Internship program, working under Wenyu Huang, an assistant professor in chemistry at ISU. The Minneapolis native is currently pursuing a PhD from the University of California-Berkeley.

Goodrich was among 2,000 students and researchers nationwide selected for the Graduate Research Fellowship Program (GRFP) from a pool of more than 13,000 applicants. GRFP provides three years of financial support within a five-year fellowship period: $34,000 annual stipend and $12,000 cost-of-education allowance to the graduate institution.

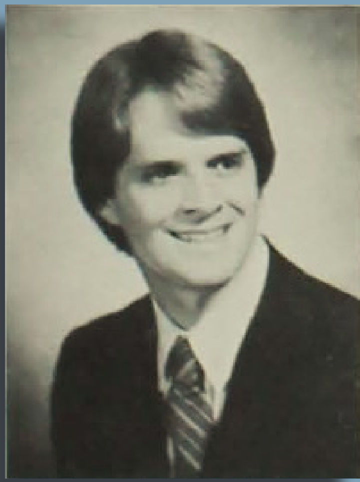
Other ISU students and alumni to receive this honor include Deon Ploessl (Chemical and Biological Engineering) and Jacob Sporrer (Electrical and Computer Engineering). A researcher from ISU's biology program was also recognized.

A full list of 2017 recipients is available on *FastLane*.

ME alum named "2016 Attorney of the Year"

Mechanical engineering alumnus Michael Kane, along with two other principals from the Twin Cities office of the law firm Fish & Richardson, have been named "2016 Attorneys of the Year" in the team category by the independent newspaper *Minnesota Lawyer*.

Kane and his colleagues – John Dragseth and William Woodford – were recognized for their June 2016 U.S. Supreme Court win while representing Halo Electronics, Inc. The case was the capstone of a nine-year patent litigation between Pulse Electronics, Inc. and Halo Electronics, Inc.



Kane's senior photo from the 1982 ISU Yearbook.

Kane graduated from Iowa State in 1981 with honors in mechanical engineering. He then received his J.D., magna cum laude, from the University of Minnesota Law School in 1994. Kane specializes in patent and trademark litigation, particularly in the areas of pharmaceuticals, biotechnology, and electrical and medical devices.

In addition to each holding a J.D. from the University of Minnesota Law School, Dragseth and Woodford also have degrees in mechanical engineering and electrical engineering, respectively.

Did you know?

The original ten bells on Iowa State's iconic campanile were donated by Edgar Stanton, an ME alum who was part of the Iowa State's first graduating class in 1872. Staton spent more than half a century on the Iowa State campus, including four terms as acting president. The bells were donated in memory of Stanton's first wife, Margaret McDonald Stanton, the university's first dean of women.

Brown

Two ME professors awarded patents

Mechanical Engineering professors Robert C. Brown and Atul Kelkar were recently each awarded patents.

Brown was co-inventor with R. Christopher Williams, a professor in Civil, Construction, and Environmental Engineering at Iowa State, and Mohamed Abdel Raouf Mohamed Metwally of Cairo, Egypt on U.S. Patent No. 9,546,276 entitled “Bio-oil Formulation as an Asphalt Substitute.” The patent was issued on January 17, 2017.

Kelkar was co-inventor with Thomas C. Waite of Des Moines on U.S. Patent No. 9,558,732 entitled “Active Noise Control System.” The patent was issued on January 31, 2017.

Kelkar

Valery Levitas honored at international conference

Valery Levitas, a Schafer 2050 Challenge Professor of aerospace engineering was honored at a symposium at the 23rd International Conference on Plasticity, Damage & Fracture on January 3-9 in Puerto Vallarta, Mexico. The symposium, “Structural Changes in Materials,” was organized by aerospace engineering faculty Dr. Liming Xiong and his colleagues.

The International Conference on Plasticity, Damage & Fracture is a prime forum for material plasticity research bringing 300-400 scientists from around the world. The symposium in honor of Dr. Levitas brought together world-wide distinguished researchers from multiple disciplines for a vibrant discussion of the research frontiers in the respective fields of phase transformations and plasticity in materials.

Throughout his distinguished career, Dr. Levitas has been a much-admired teacher, a mentor, a colleague, and a friend to all who worked with him. The symposium was very successful, and turned out to be a great occasion for Valery’s world-wide collaborators and friends to get together to celebrate Dr. Levitas’ contributions and their association with him.

Contributed by Clay Paciorek/AeroE

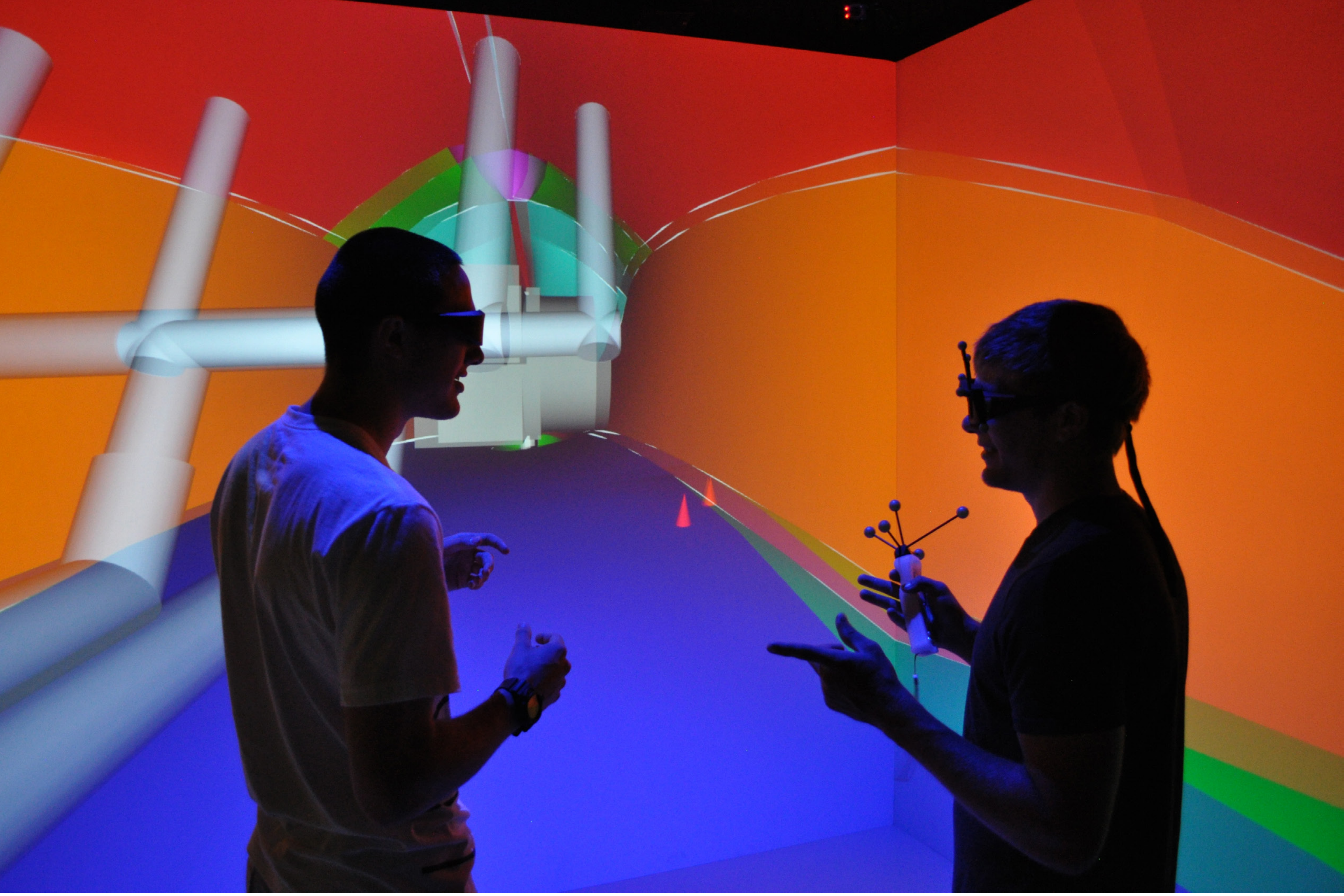
Levitas

Brown Moves Up to 44th in Top 100 in Bioeconomy Listing

Robert C. Brown, BEI director and an Anson Marston Distinguished Professor in Engineering and the Gary and Donna Hoover Chair in Mechanical Engineering at Iowa State University, is tied for number 44 in the “Top 100 People in the Advanced Bioeconomy” for 2017, as nominated and voted by the readers of The Biofuels Digest and the publication’s editorial board.

Contributed by Robert Mills/
Bioeconomy Institute

Iowa State's Robert C. Brown, left, explains new pyrolysis technology to Karen Fletcher, leader of the RAPID Institute for manufacturing; and Mark Gaalswyk, leader of Easy Energy Systems in Emmetsburg; during a recent tour of the BioCentury Research Farm. Photo by Christopher Gannon.



Two students in Supermileage use augmented reality to view a 3D model of their fuel-efficient vehicle in METal, the Multimodal Experience Testbed and Laboratory in Black Engineering building. Photo by Sean Russell.

Racing to the future: Students collaborate to design vehicles using augmented reality

When most of us drive our cars, we're busy thinking about what's on the radio, what we're making for dinner and, hopefully, the other drivers and pedestrians around us. Most likely, we aren't thinking about the elaborate computer systems keeping our vehicles running smoothly and safely. And thankfully, we don't have to think about the computers, because they do their jobs well enough that we don't notice. But some students at Iowa State University take great interest in the systems running vehicles behind the scenes.

SAE International, or the Society of Automobile Engineers, was started in 1905 in New York City in response to a growing demand: Automobile manufacturing was on the rise, and engineers wanted and needed a resource for communicating knowledge and expertise, as well as sharing ideas about and solutions to technical issues. As technology progressed, electronics and computers became increasingly important to the automobile industry, and SAE changed with the times.

Flash forward 112 years later to Ames, Iowa, where SAE International is a thriving student organization on Iowa State's campus, with 418 total collegiate clubs and branches around the world. At ISU, SAE International is comprised of five teams of approximately 320 students working on designing and building different vehicles, including cars, snowmobiles and airplanes. Their mission is "to expand upon the ISU classroom education through participation, leadership, outreach, design and fabrication," and the club members spend many nights and weekends together to achieve this goal and to win competitions across the country and even around the world.

Within these five teams, Formula, Baja, Supermileage, Clean Snowmobile and Aero, students use electronics and computer systems to improve the speed, safety and efficiency of the vehicles. SAE puts no requirements on academic majors of their members, though many come from the College of Engineering, and some are future electrical, computer and software engineers.

One of those students, Mitchell Kerr, a junior software engineering major, is Project Director for Supermileage, whose members design and build a fuel-efficient vehicle and make it as aerodynamic and lightweight as possible with a goal of achieving 200 miles per gallon.

"Unlike many other clubs, we have built our car completely on our own with almost no outsourcing [help from another company]," Kerr said. "I enjoy problem solving, and with a ground-up build process, there is a lot of that."

The challenge of building an extremely fuel-efficient vehicle is what led senior mechanical engineering major Ian Baumgartner to start ISU's Supermileage chapter two years ago when he and a few friends, who later became club members, were just sophomores.

"We started researching [other Supermileage chapters across the country], and the amount of miles per gallon that these cars were getting was absolutely crazy," Baumgartner said. "Some of the better teams are getting 3,000-plus miles per gallon, depending on what type of power train they're using, whether it's electric or gasoline. The electric ones are getting up to 10,000 miles per gallon equivalent. That absolutely blew our mind."

Because SAE International allows students from any major to join, Baumgartner knew he would need students with different skills. Just like the original founders of SAE in 1905, he wanted to build a place for students to communicate expertise and new ideas.

"The greatest part is the shared collective knowledge," he said. "There are people who are really knowledgeable in one area but may not be knowledgeable in another, whereas someone else on the team may be knowledgeable in that one area. And so you're sharing all this knowledge, and everyone's learning a lot. I know I've taught people SOLIDWORKS as my expertise, and there are other people who are really good with mechanics, and they've taught me a lot. There are people who are really good with engines, really good with carbon fiber, and so it's all just this collective learning about all these different areas."

Supermileage members use carbon fiber, which both Kerr and Baumgartner say they knew almost nothing about before joining, to make their vehicle lightweight and as fuel efficient as possible.

"Every ounce you can shave off the car could potentially get you another five miles per gallon. Our car is 10 feet long, 40 inches wide and close to three feet tall. But for a car of that size, it probably only weighs 50 pounds at most, just by itself, so it's really lightweight," Baumgartner said. With a driver in the car, the total weight will not pass 200 pounds.

Originally, members worked with pre-impregnated carbon fiber, which uses a hardener and resin to bond and create a hard surface.

Ian Baumgartner demonstrates how he views the Supermileage car in 3D on his phone, using an app and augmented reality. Photo by Mitchell Kerr.

Computer systems, including Electronic Fuel Injection kits, play an important role in helping Supermileage club members design and build their car. Photo by Ian Baumgartner.

But to achieve that hardness, students had to lay the fiber in multiple directions and then apply heat to the vehicle's shell.

The problem? Baking a ten-foot-long car in one shot.

"We actually had to build our own oven," Baumgartner said. "It was four feet by 12 feet to fit the whole entire car in, because we couldn't find a place that had an oven large enough. We used foam installation plywood. I know it's crazy to make an oven out of wood, but the combustion temperature of wood is 460 degrees, and we didn't need it to get that high. So we actually tore up a microwave oven and used the heating element for that and an old computer fan with some ducting to blow the air around. We were able to get the oven up to 150 degrees and get the car into there and bake it."

Besides having the ability to work with carbon fiber and build an oven from scratch, other technical knowledge required to build Supermileage's vehicle includes working with an EFI kit, or Electronic Fuel Injection kit, as well as the team's use of augmented reality.

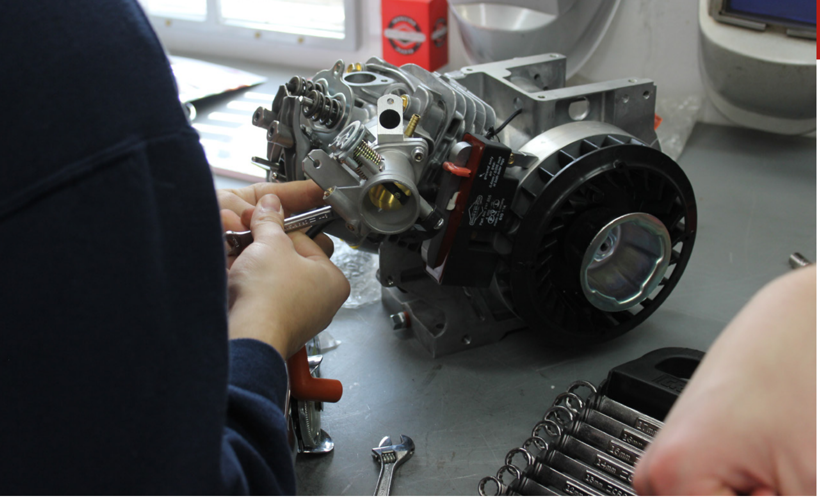
"We use an EFI kit, which uses a computer that has software to determine the best air-to-fuel ratio for the engine," Kerr said. "It has sensors for temperature, pressure, O2 and so on."

Baumgartner echoed Kerr's thoughts on benefits of using the kit.

"The EFI kit will definitely help us get a lot better fuel mileage because we're able to actually control the fuel in and out more precisely. We're able to tune the engine now a lot quicker with a laptop versus having to adjust the throttle body," he said. "We have actually thought about having a small Raspberry Pi computer and having it continuously tune the engine as the car's running, so to adjust the air-to-fuel ratio mixture."

Baumgartner also got the idea to use augmented reality to help design and build the vehicle after taking a course with Mechanical Engineering Professor Judy Vance.

"The big problem with designing in CAD [computer-aided design] is that you can't really tell the scale of the car in real life. You're just stuck with this 3D image transformed onto a 2D plane. And you do have these set lengths and distances that you're dealing with, but you don't get a good idea about depth perception, and the size perception is really skewed," Baumgartner said.



The team disassembles the engine to install a new head gasket. Photo by Ian Baumgartner.

Vance allowed students taking her course to look at their own 3D CAD models in the Multimodal Experience Testbed and Laboratory (METal) in the Black Engineering building, which houses the Department of Mechanical Engineering. METal is a three-projection screen immersive room, which supports development of products and processes through computer-based simulation. Baumgartner worked with a graduate student to program their car into augmented reality.

"We were able to see it in that one-to-one scale, and it was immensely helpful," he said. "We actually had our driver come in and sort of virtual-reality-like sit in the car to see if the window that we had originally designed [on the vehicle] was enough for him to see out through it, and we discovered that it actually wasn't. So that was a huge thing we were able to discover."

Baumgartner uses an application on his phone to view a 3D model of the car, which is uploaded to the program. When he points the camera of his phone at a cylinder, recognized by the app, an image of the car appears on the screen of his phone.

"Anyone can do it that has a smartphone," he said. "Now we don't have to reserve a time [to work] at a spot. We can just have it on our phone, look at a marker and then see the car there. It's way more applicable and easy to use for everyone."

This ingenuity makes Supermileage successful, which in turn will help these students be successful in their futures.

"My dream job is to work in the automobile industry as a software engineer, helping to progress the industry toward more automation, higher safety ratings and cleaner energy consumption," Kerr said. "Supermileage will help me in my future because I've learned how to tackle problems that I have little to no background in. I do this by reaching out to people more knowledgeable than me, conducting my own research, brainstorming with team members and testing ideas."

This is where being not just club members but teammates comes in – these students get more out of their SAE International memberships than experience on a resume.

"We're almost like a family by the time the year's done," said Jason Whited, president of SAE International and mechanical engineering senior. "The leaders and all the core members that stick around through the entire year really learn a lot about each other and learn how to work together a lot more, so it's a more personal experience than just being in a very, very large organization where everybody's doing the same thing. [In SAE International], everybody has their goals and their own jobs, and you work together to accomplish that. That's a lot more unique in terms of a college experience."

While being in SAE requires long hours and lots of hard work, members say making the most of that time is beneficial.

"You become invested if you put the time into it," Whited said. "You have very strong feelings about building this car. You become attached to it in a different way than just designing something on SOLIDWORKS in your free time. Because now, you're involved in a whole group of people building this together."

Contributed by Kristin Clague/ECpE

The team creates a fiberglass mold layup. Photo by Mitchell Kerr.

Daniela Faas, second from left, poses with her Bucknell Alumni Achievement Award on Feb. 25, 2017. Photo courtesy of Bucknell Athletics.

ME PhD alum receives Bucknell Alumni Achievement Award

Dr. Daniela Faas – a 2010 PhD alumna in mechanical engineering and human-computer interaction at Iowa State University – recently received the Bucknell Alumni Achievement Award.

Faas holds an M.S. and B.S. in mechanical engineering and a B.A. in International Relations from Bucknell University in Lewisburg, Pennsylvania. The Ludwigshafen, Germany-native also competed on the water polo and swimming and diving teams for the Bison. She was a three-year letter winner in each sport, an academic All-American in swimming, and set school records in the 500-yard (4:56.93), 1000-yard (10:18.78) and 1650-yard (17:02.07) freestyle events.

Fass currently serves a senior lecturer in mechanical engineering and director of design and fabrication operations at the Olin College of Engineering in Needham, Massachusetts. Prior to that she served as senior preceptor in design-based instruction at the John A. Paulson School of Engineering and Applied Science at Harvard University and as a postdoctoral associate and research associate at the Massachusetts Institute of Technology (MIT).

Faas's PhD advisor was Dr. Judy Vance and her dissertation was entitled "A Hybrid Method of Haptic Feedback to Support Virtual Product Assembly."

ME-ECpE professor studies non-invasive treatment for medical implant infections

Dr. Timothy Bigelow – who has joint appointments in Mechanical Engineering as well as Electrical and Computer Engineering – is currently working on a research project in which he uses high-intensity ultrasounds as a non-invasive way to treat infections caused by medical implants.

Check out the video:
www.youtube.com/user/ISUengineering/videos

Iowa State engineer addresses need for scientists, engineers to engage the public


Sundararajan

AMES, Iowa – It's no longer enough for scientists and engineers to communicate their work by publishing in technical journals, says an associate dean for Iowa State University's College of Engineering.

Today's scientists and engineers need to communicate the potential impacts of their work to the public, said Sriram Sundararajan, Iowa State engineering's associate dean for academic affairs and a professor of mechanical engineering. They also need to find ways to use their expertise to advance societal goals such as developing a stronger workforce in technical fields.

Sundararajan will present his ideas during a seminar at the annual meeting of the American Association for the Advancement of Science (AAAS) Feb. 16-20 in Boston. The theme of the meeting is "Serving Society Through Science Policy."

Sundararajan will be one of three speakers for a seminar called, "Scientist Motivations, Support and Challenges for Public Engagement." The seminar will be 11 a.m. to 12:30 p.m. Thursday, Feb. 16, in Ballroom A of Boston's Hynes Convention Center.

Sundararajan will explain how Iowa State is working to help researchers succeed in broader impacts activities, including public engagement.

"Being able to communicate effectively to multiple audiences is important to scientists and engineers," Sundararajan said. "And so we want to help faculty and graduate students develop a broader impacts portfolio."

An individual's portfolio could include outreach to high school students, communicating the value of campus research, mentoring young engineers or nurturing diversity in technical fields.

Iowa State has several programs devoted to helping faculty and graduate students develop ideas and programs for engaging the public. Here are two examples, both supported by the National Science Foundation:

Iowa State's Strengthening the Professoriate initiative provides resources and support for faculty members, postdoctoral research associates and advanced graduate students who are developing broader impacts programs for their grant proposals and research projects. The initiative offers events, programs, resources and consulting to help researchers develop effective engagement activities.

- Iowa State offers a graduate course to engineering students that's taught by Sundararajan and is designed to help students apply their technical work to benefit society. As part of the course, students design a broader impacts project. One student, for example, developed LEGO-based activities to help high school students learn about industrial engineering.

- Iowa State offers a graduate course to engineering students that's taught by Sundararajan and is designed to help students apply their technical work to benefit society. As part of the course, students design a broader impacts project. One student, for example, developed LEGO-based activities to help high school students learn about industrial engineering.

Describing those and other Iowa State programs will help Sundararajan deliver his main point to the seminar audience:

"You need to encourage individual faculty and graduate students to develop broader impacts and public engagement," he said. "You need to develop a structure to provide them with the tools they need to be successful."

In addition to Sundararajan, the seminar will feature talks by Tracey Holloway, a professor of civil and environmental engineering at the University of Wisconsin-Madison; and Ezra Markowitz, an assistant professor of environmental conservation at the University of Massachusetts Amherst.

The AAAS was founded in 1848 and is the world's largest general scientific society. The association publishes the journal Science and several other scientific journals.

Contributed by Mike Krapfl/ISU News Service

Soybean field near Seymour, Illinois. Photo by Kevin Dooley/Flickr

ME, agronomy researchers team up to study robotics in agriculture

A team of Iowa State researchers has been awarded funding to study the use of robotics in agriculture.

The project is led by mechanical engineering assistant professor Sourabh Bhattacharya, with co-PIs Baskar Ganapathysubramanian (associate professor, ME), Soumik Sarkar (assistant professor, ME), Asheesh Singh (assistant professor, Agronomy), and Arti Singh (adjunct assistant professor, Agronomy). The project is entitled "National Robotics Initiative: Saliency driven Robotic Network for Spatio-temporal Plant Phenotyping" and funding is provided by the U.S. Department of Agriculture's National Institute of Food and Agriculture and the National Robotics Initiative.

Bhattacharya

Ganapathysubramanian

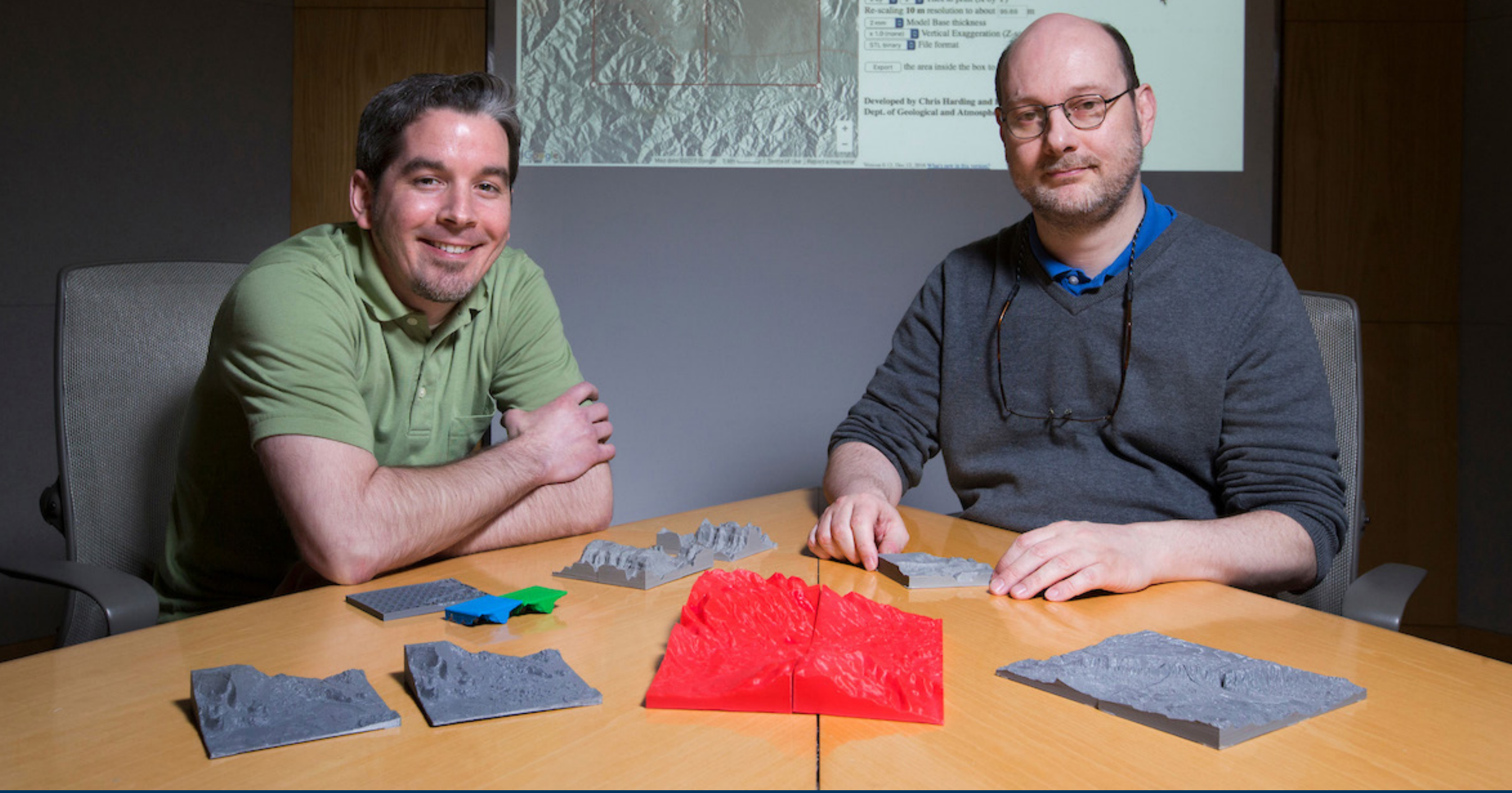
Sarkar

Bhattacharya said the project aims to assist farmers by utilizing robotic components in the field.

"The project involves developing a holistic framework for communication, control and motion planning for robotic swarms deployed in agricultural fields for gathering data," said Bhattacharya. "Guided by advanced learning and inference techniques, the robots will compete with each other in the field to acquire the most salient data relevant to plant phenotyping. In the long run, this data will help breeders to identify the characteristic traits of several diseases in soybean plants."

Arti Singh

Asheesh Singh



Alex Renner, left, and Chris Harding, two of the developers of TouchTerrain, with the web application that makes it quick and easy to print 3-D terrain models. Photo by Christopher Gannon.

Iowa State geologists develop app to print 3-D terrain models of any place on Earth

AMES, Iowa – Today's geology lesson is all about anticlines.

Students can read all they want about geological folds, axial planes, hinge lines, antiformal synclines and synformal anticlines. But it can still be a challenge to visualize just what geologists are talking about.

A better option is putting boots on the ground – such as a trip to Iowa State University's Carl F. Vondra Geology Field Station near Shell, Wyoming. The field station is in the north-central part of the state, on the western flank of the Bighorn Mountains. Nearby is Sheep Mountain, a well-known and typical anticline.

The Bighorn River has cut a canyon through the mountain and students can hike along the river to get a good look at a natural cross section of the exposed geological fold.

But most students aren't able to make a trip to Sheep Mountain.

So Iowa State researchers have come up with a new option – TouchTerrain.

The web application is open source and free for private use through Iowa State's GeoFabLab. It allows anybody with a 3-D printer to easily and quickly print terrain models of any place on the planet, including the ocean floor.

To demonstrate, Franek Hasiuk, an Iowa State assistant professor of geology and David Morehouse Faculty Fellow, placed four tiles of 3-D-printed plastic, each about 4 inches square, on the desk in front of him. Put them together, and there's a scale model of Sheep Mountain and its central ridge rising out of the Bighorn Basin.

That's a teaching tool that can help students see and touch an anticline – potentially a more powerful experience than studying a flat map or computer screen.

"This could be a key element in improving how geoscience students connect with the surface structure of the Earth," said Chris Harding, an associate professor of geology and a member of Iowa State's program in human computer interaction.

But, said Hasiuk, to be really useful, there had to be a fast, easy and reliable way for people to make the terrain models.

A technology challenge

It's challenging to make 3-D terrain models that consistently print well on any commercial 3-D printer.

It requires an understanding of geographic information systems, computational geometry, design and manufacturing software and 3-D printing technology.

The TouchTerrrain development team includes Harding, with expertise in geographic information systems; Hasiuk, with expertise in 3-D printing of geological samples; Alex Renner, a doctoral student in mechanical engineering with expertise in simulations for 3-D printing; and Levi Baber, a College of Liberal Arts and Sciences information technology manager with expertise in server technology.

Even if a teacher had experience with geographic information systems, computer aided design software and 3-D printing, Harding said it can be a lengthy and complex process to generate a good digital terrain model that can be 3-D printed.

It's an even bigger challenge to create models large enough for the classroom by making several tiles of, say, the Grand Canyon and seamlessly fitting them all together.

"Our application makes it very easy to create physically large models by dividing the desired area into multiple tiles that can then be 3-D printed separately and glued together to form a much larger 3-D map," Harding said.

Models for everybody

Visit the TouchTerrain website and you see a terrain map with Wyoming's Sheep Mountain inside a red box.

You can zoom in and out of that map, moving the red box anywhere in the world. When you settle on an area to print, you can adjust a few simple settings to match your 3-D printer, hit export and you'll get a file for your 3-D printer. And, if you want, the terrain can be exaggerated to accentuate subtle details.

Adjusting the application's digital models to a specific 3-D printer can be a big advantage for users.

"Why create a very large, high resolution model that takes a long time to process when a 3-D printer can only print out at a much lower resolution?" Harding said.

The cost of the resulting terrain models?

Operating a 3-D printer (now available for less than $2,000) costs about $1 per hour. Printing out a square, 4-inch terrain model typically costs about $2, Harding said.

The Iowa State researchers hope the ease and low cost of TouchTerrrain models will enable more geoscience teachers to use 3-D printed materials in their classes. The researchers' next steps include enhancing the application's capabilities and creating a way for teachers to connect specific locations with specific geologic concepts.

Hasiuk picked up a red plastic terrain model of north-central Iowa, a rolling landform known as the Des Moines Lobe. He said that model showed the effects of glacial activity and also represented one of the best things about TouchTerrain.

"You can't buy this anywhere," he said. "No one would ever make a terrain model of central Iowa, but this is very useful if you want to talk about your environment."

Contributed by Mike Krapfl/ISU News Service

ME alum's company focuses on sustainability, helping people

One Iowa State alum has turned his passions for mechanical engineering and helping people into a career. Wesley Meier (BSME'08) took his degree and went on to be the co-founder and CEO of Emerging Opportunities for Sustainability, or EOS International.

Along with fellow ME classmates Chris Deal, Greg McGrath and Lee Beck, Meier set off to use his engineering skills to give back to communities around the world.

"EOS International was founded with a simple mission: bring life-changing technology to the developing world, improving health, generating income, and preserving the environment," says Meier.

During the fall of 2008, Meier set off on a Peace Corps mission to a rural town in Nicaragua. During his time there, he realized that his engineering skills could make a significant impact on homes and agriculture in villages throughout the country. "With support from the EOS engineers back home, I started redesigning and installing technologies such as drip irrigation systems for smallholder farmers," says Meier.

This passion began long before college. Since childhood, Meier has been interested in mechanical engineering. However, during his sophomore year of college, a mechanical engineering class sparked his interest for working in developing countries. "The purpose of the class was to design an energy source to power a laptop, which would be used in Africa-all for under $100. This was my introduction into designing for the developing world. What really excited me about the whole project was the opportunity to use my limited engineering skills to potentially have a larger impact."

After this class, Meier went on to study emerging market-focused classes, such as Sustainable Engineering. In one class, he even designed a water valve for a rural community in Mali, Africa—a design that was actually put into place upon his graduation.

"I was fortunate enough to travel to Nana Kenieba, Mali with EOS co-founder Greg McGrath to implement our design. Traveling to Mali was very exciting, but we were quickly

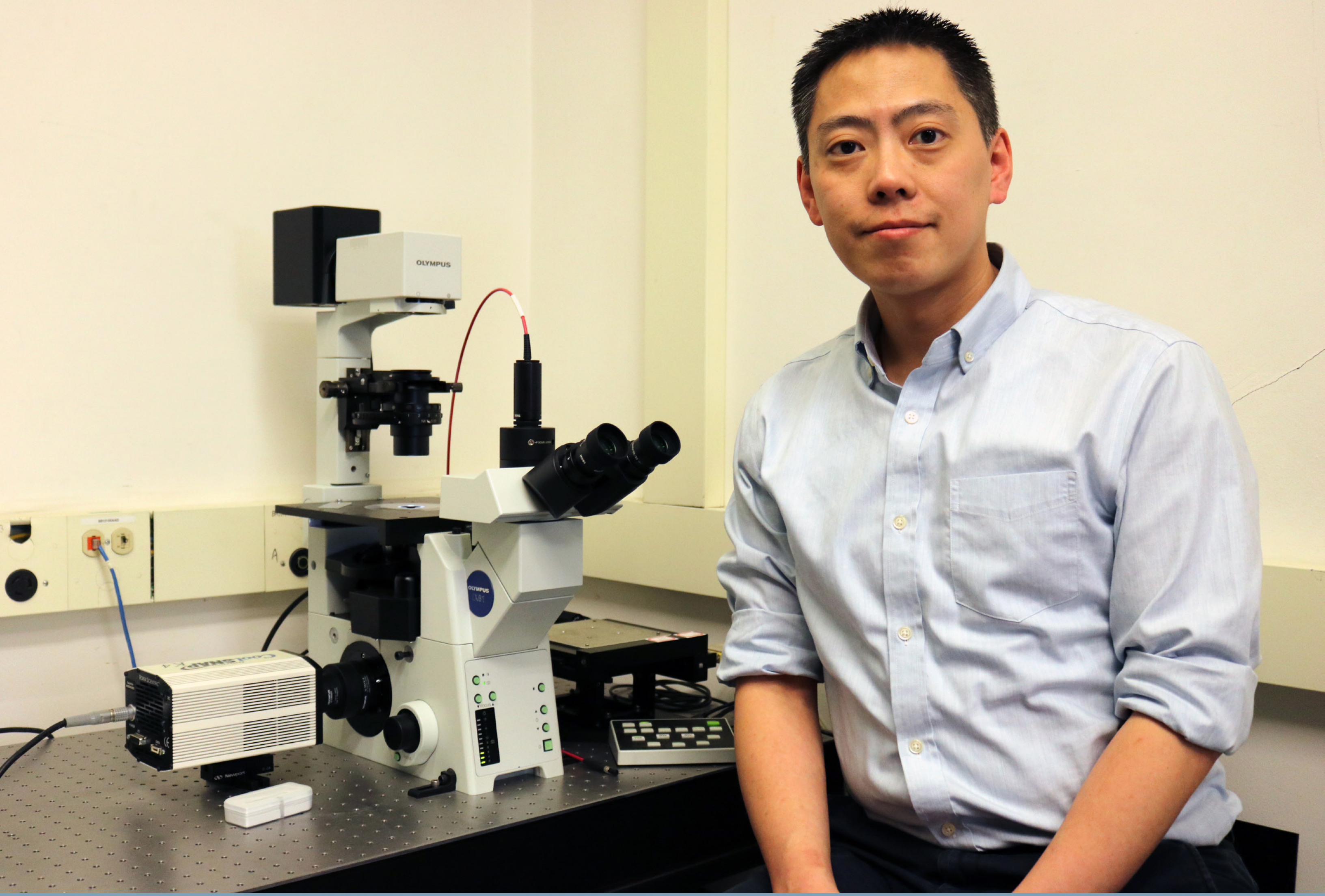
Meier

humbled by the experience," remarks Meier. "We realized the unexpected complexities within the rural village such as our inability to communicate efficiently, limited tools and resources, and the practicality of taking a technology designed in a lab and installing it halfway across the world. This trip sparked an interest and passion to continue this work, and has carried with us throughout the creation and growth of EOS."

Today, current engineering students can participate in this mission. "Four years ago, EOS started hosting ISU engineering students in Nicaragua and facilitating their skills to have a broader impact as well as provide an educational, cultural experience," says Meier. "This quickly grew into an accredited class led by Dr. Gloria Starns. With Dr. Starn's leadership, the class grew to a month-long experience where students designed products in collaboration with Nicaraguans. This summer will mark the fifth year of engineering students in Nicaragua."

Meier encourages today's engineering students to find their niche and discover what they're passionate about. "I am fortunate to be able to use my engineering degree in a unique way to have an impact abroad," says Meier. "There is nothing more satisfying than finding or creating that dream job that matches your passion. It is worth the wait and you would be surprised how, with persistence, your work in various industries will eventually yield well-rounded career experiences."

Contributed by Emily Boyd/ Engineering College Relations



Meng Lu, Assistant Professor of Electrical and Computer Engineering and Mechanical Engineering.

ME's Lu receives prestigious NSF CAREER award

Meng Lu, assistant professor with Iowa State University's Mechanical Engineering (ME) and Electrical and Computer Engineering (ECpE) Departments, has received the National Science Foundation's CAREER award for a project that aims at developing the next generation diagnostic technology using an engineered paper strip. The technology has the potential to drive down the cost of the health care system. The five-year award will fund Lu's group to pursue the interdisciplinary research through 2022.

The National Science Foundation (NSF) grants CAREER awards, some of the most competitive honors from the organization, once a year to standout junior faculty members who positively represent the mission of their department through their teaching and research. According to the NSF website, "Such activities should build a firm foundation for a lifetime of integrated contributions to research and education."

With his award-winning proposal, "We will establish a low-cost, high sensitivity, multiplexed, rapid sensor paradigm, in conjunction with a new readout modality that can perform biomarker analysis for clinical disease diagnostics," Lu said. In other words, he and his students hope to bring state-of-the-art diagnostic technology to patients' homes and help physicians collect the healthcare information more efficiently in times of need. "We make the special paper, so-called photonic paper, that integrates photonics and microfluidics on a porous material found in most papers," Lu said. "It allows point-of-care or bedside detection so the patient doesn't have to go to a hospital. The procedure can be performed by the patient at home."

The photonic paper-based biosensors would detect multiple disease biomarkers found in human body fluids to provide timely warnings and would work especially well for people with limited access to resources, such as deployed members of the military, astronauts or those living in developing countries. The sensor is disposable and low in cost, which also makes it practical for use anywhere, and it can be modified for detecting hepatitis, tuberculosis, HIV and cancer.

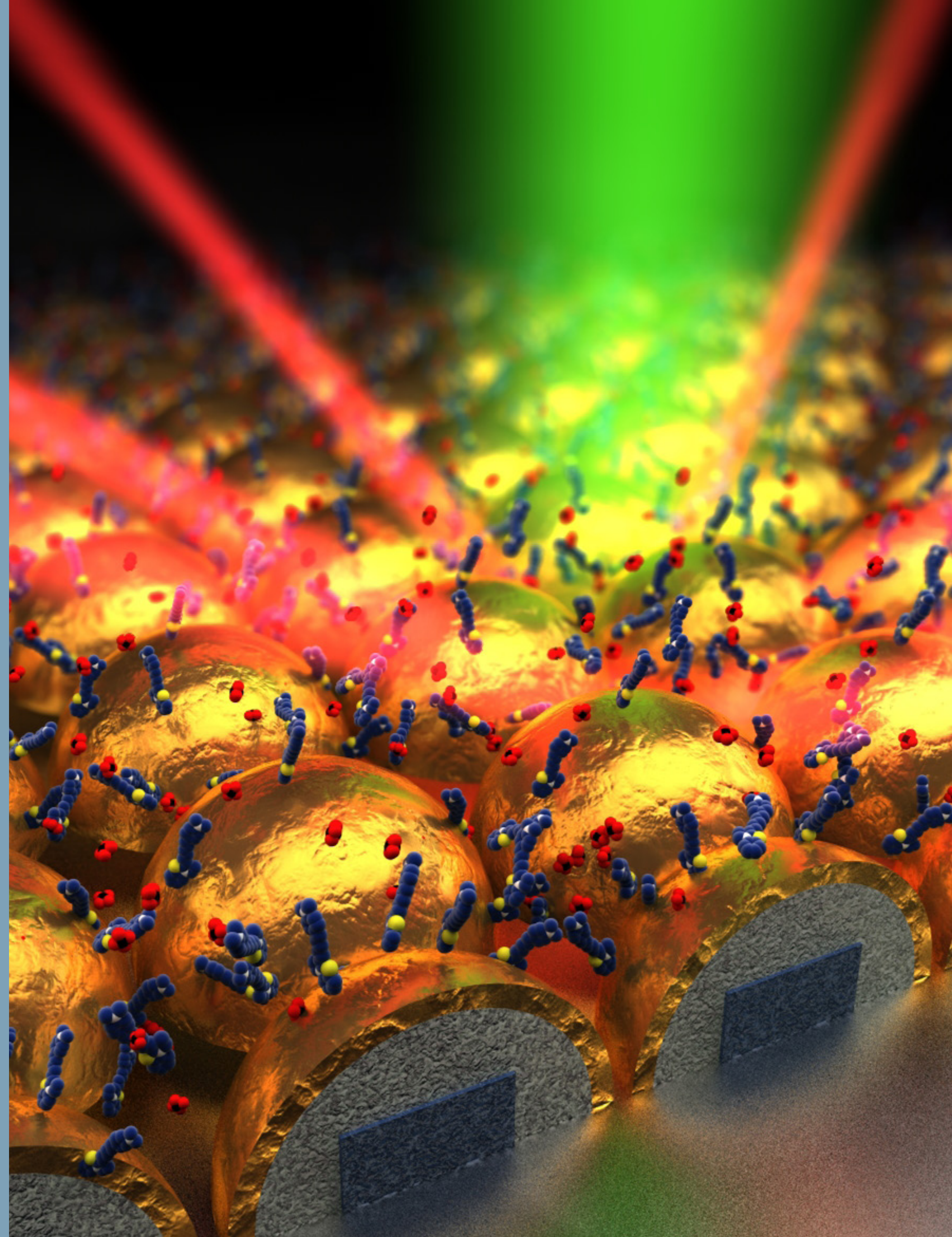
According to Lu, "To date, the poor sensitivity and high cost are still the key challenges prohibiting a practical point-of-care diagnostic test based on quantifying low-abundance disease biomarkers." Lu's group is working with Douglas Jones, professor of Iowa State's College of Veterinary Medicine, and John McClelland of MTEC Photoacoustics, Inc., to address these challenges. Lu hopes to work with doctors and physicians in clinics. "We are working with MTEC Photoacoustics to pursue the new biosensing mechanism. We collaborate with Professor Jones — they send us their sample, and we do the test," Lu said. "So far, we are not allowed to do the patient test. That's why we will do more collaborations, which is funded in part by NSF, to optimize the photonic paper."

Because this is a CAREER award, Lu is honored not only for his current proposal but also for the entirety of his time spent at Iowa State. He began working at ISU in January 2013, teaching Electrical Engineering 332: Semiconductor Materials and Devices and Electrical Engineering 432/532: Microelectronics Fabrication Techniques. He then took on the Mechanical Engineering course ME 370: Engineering Measurements and Instrumentation. Now, Lu is developing a course for Electrical and Biomedical Engineering, called EE/BME 450: Biosensing, which relates to his research; the course teaches students how to design, evaluate and commercialize biosensors.

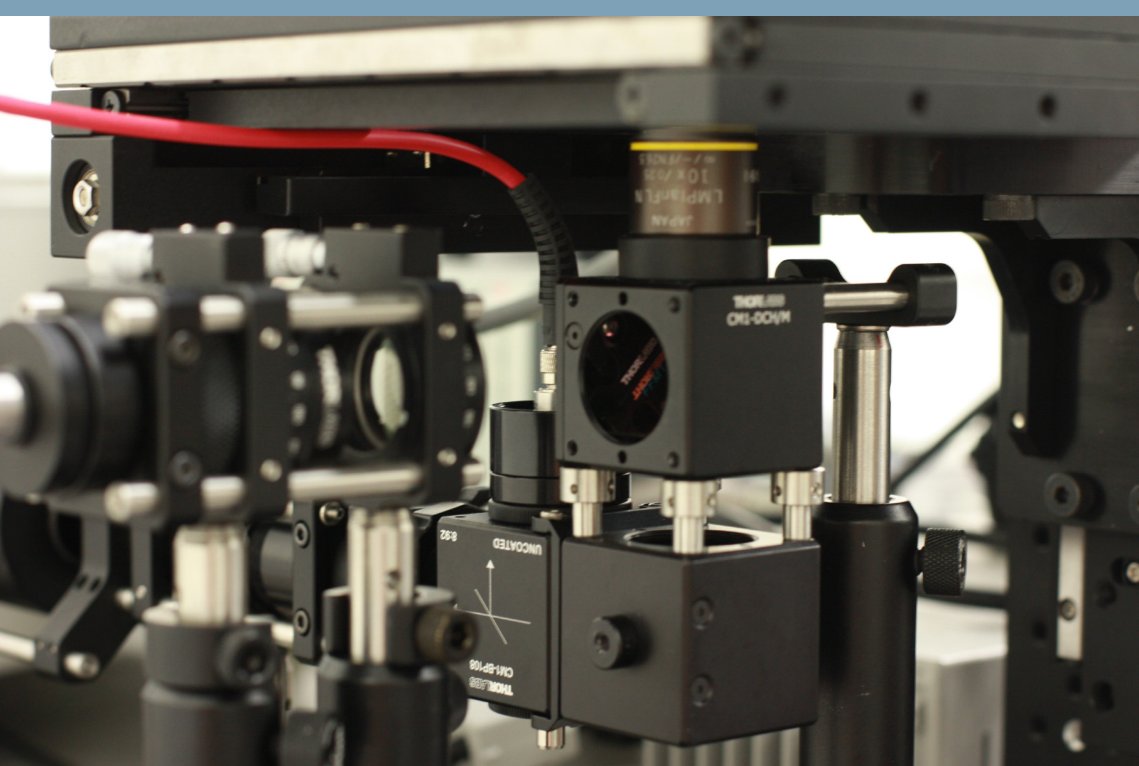
Outside of the classroom, Lu is the principal investigator for ISU's Laboratory of Integrated Optical Sensors (LIOS), which sponsors research for undergraduate and graduate students from electrical engineering, mechanical engineering and material science. These researchers work with Lu on projects in the field of photonics, nanofabrication and biosensors. The funding from the CAREER award will go toward more research opportunities for Lu and his graduate students, as well as toward education and outreach for K-12 and undergraduate students and those in Midwestern agricultural communities and of underrepresented minorities.

Lu has authored and co-authored more than 80 journal and conference papers, as compiled on the LIOS website. He credits his graduate students for their help, too, with the research and with the recognition from NSF. "My students are fantastic, and they work pretty hard," Lu said. "I feel very lucky to have them in the group. The results of their works helped me secure the CAREER award."

Contributed by Kristin Clague/ECpE



Schematic diagram of a plasmonic nanolaser. The nanolaser can be exploited to detect small molecules.



Did you know?

Three ME faculty members have joint appointments with another department on campus: Timothy Bigelow (ME and ECpE), Valery Levitas (ME and AeroE), and Meng Lu (ME and ECpE).

Detection setup used for the study of a nanofluidic high-Q resonator biosensor.

ISU's Engineers Without Borders aims to ease water procurement in West African village

By easing access to clean water, Ullo villagers will need to spend less time pumping and transporting water.
Photo courtesy of Engineers Without Borders-Iowa State University

One Iowa State University student group aims to use its engineering expertise to provide a safe and reliable source of water for a drought-stricken, agriculture-dependent region in West Africa.

The ISU chapter of Engineers Without Borders (EWB) has worked with officials in the village of Ullo – in northwest Ghana – to provide its roughly 1100 permanent residents with easy access to water. Current practices can require more than three hours of labor to procure water which is problematic in a village that relies on agriculture and where the daily average income per person is about 75 cents.

Climate conditions in the region make it so that villagers experience about eight months of drought, while the other four months are considered the wet season. This is where EWB comes in.

"We have partnered with their village to help extend their storage of water during the dry season," said Will Parr, a member of EWB. "They have asked us to come up with a plan that will help them have water throughout their dry season. Upon our assessment trip in December of 2016, we decided that a small town water supply project is going to be the best option for this community."

Ullo villagers utilize wells such as this one to access groundwater.
Photo courtesy of Engineers Without Borders-Iowa State University

EWB plans to drill a borehole in the village which will provide inhabitants with access to well water and which will save them time and labor when compared to the current techniques for procuring water. These current techniques often involve using hand pumps, storing the water in containers, and transporting it back to the village. Villagers also have access to some wells but those sources dry up quickly.

ISU's chapter of EWB is working with its parent organization, EWB-USA, on this project. The ISU chapter has an ambitious goal of raising $40,000 for the project and EWB-USA requires that 5 percent of the total cost of the project comes from the village of Ullo.

In addition to funding, EWB has relied on officials in Ullo provide local expertise.

"They can help find people to help us with getting things done such as bacteria testing or procuring construction materials," Parr said.

EWB also organized an on-campus soccer tournament fundraiser in early March and hosts weekly pizza sales (every Thursday at the south entrance of Black Engineering Building from 11 a.m. to 1 p.m.) to help support the project. The group also raises funds through off-campus initiatives by reaching out to companies, rotaries, and other groups. Small individual donations also provide a "great amount" of funding, according to Parr.

Parr, a junior studying software engineer, said that while "Engineers" is in the group's title, it's actually open to students of all disciplines.

Pumps such as this one allow Ullo villagers easy access to clean water. Photo courtesy of Engineers Without Borders-Iowa State University

"We have anything from designing water pumps to managing social media for marketing to reaching out to companies," he said.

He added that the engineers in the group are often able to take what they learn in the classroom and apply it to real-world situations.

"We apply physics, optimization, and a lot of design to the project," he said. "For example, we will need to know the best way to distribute the water to key areas through piping, so we apply optimization and estimate water volumes as well to see if we lose any water while pumping. If you have not taken any engineering classes, or only basics, there is definitely a role for you as well."

EWB first visited Ullo in the summer of 2014 and then made a return trip in December 2016. Parr said the group aims to raise its money and begin rolling out the project over the next two years.

"December of 2017, we will start the first half of our implementation trip and depending on the wet season, we may implement the second half over the summer of 2018. We are also looking to open another project soon as well."

One key to the success of this project is EWB's active engagement with the Ullo community, according to Levi Nauman, a senior studying mechanical engineering.

"We are working with Ullo to find an appropriate solution that they will take ownership in and continue to maintain for many years," said Nauman. "Through this committed partnership we believe that Engineers Without Borders will empower the people of Ullo to a more sustainable lifestyle, and create a lasting impact on the community."

Nauman also credits Iowa State University for providing the resources to make projects like this possible.

"We're a group of students that see a need in the world for improved infrastructure and we want to address that with our engineering education. Iowa State offers us the training and networks necessary to positively impact the quality of life for entire villages. This impact is rooted in the long-term partnerships that EWB creates with developing communities."

To learn more about EWB and to donate to their cause, visit www.ewb.stuorg.iastate.edu/

Members of the Iowa State chapter of EWB pose with Ullo villagers during their winter 2016 assessment trip. Photo courtesy of Engineers Without Borders-Iowa State University

Janice Marquardt poses with her degree after the spring 2007 commencement ceremony in Hilton Coliseum. She is flanked by her grandfather John E. Guastafson to the left and father John L. Gustafson (PhD, Applied Mathematics, '82). Photo courtesy of Janice Marquardt.

Alum combines her studies in mechanical engineering, communications, and business

Iowa State alum Janice Marquardt knew that she wanted to study mechanical engineering in college but but she didn't think that it would lead her to the career path she's taken.

Marquardt was born in Portland, Ore. but moved to Ames at the age of five when her father, John Gustafson, took a job at the Ames Laboratory where he studied high-performance computing. Marquardt said that from a young age her family provided a strong support system that not only encouraged her to pursue higher education but that also pushed her to specifically pursue studies in the STEM (Science, Technology, Engineering, and Mathematics) field.

Attending Iowa State was an easy choice for Marquardt since not only was the campus right in her backyard but also because her parents were ISU alumni. Her father earned his PhD in applied mathematics in 1982 and that same year her mother, Denise, earned a B.S. in ceramic engineering. Marquardt said that her mother was particularly supportive in encouraging her to pursue studies in engineering.

"She used to tell me when I was a very small girl, she'd say 'You can do whatever you want in your life. You can get whatever degree you want as long as you also have an engineering degree,'" Janice Marquardt said.

Janice Marquardt wanted to be an interior designer and her mother encouraged her but also said she should get an engineering degree as her primary major but by the time Janice got to college she was genuinely interested in studying engineering.

"When you have role models like that in your life it's not a stretch to think of yourself as a female going into engineering. It's not an issue. It just felt natural," she said.

Marquardt came into college as an undeclared major but ending up selecting mechanical engineering because she liked to work with both "microscopes and big machines." She also went with mechanical because of her dislike of chemistry at the time, which she said was ironic since biochemistry was a large part of her emphasis in graduate school. During her master's studies she worked under ME professor Pranav Shrotriya and Marit Nilsen-Hamilton, a professor in the Roy J. Carver Department of Biochemistry, Biophysics and Molecular

Phi Beta Kappa induction ceremony. From left, Janice Marquardt, her husband Ryan Marquardt (B.S., Community and Regional Planning, '05, M.S., Sustainable Agriculture, '08), her stepfather Dr. Michael Carter (PhD, Computer Engineering, '93), her mother Denise Hayward (B.S. Ceramic Engineering, '82), and her grandparents Betty and Richard Hayward. Photo courtesy of Janice Marquardt.

Biology. Her thesis was entitled "Force interaction characterization between thrombin and DNA aptamers" and it focused on atomic force microscopy and RNA strands.

When she was still an undergraduate, Marquardt was looking for a minor to accompany her ME degree. After talking to recruiters at an engineering career fair she found that there was demand for effective communicators within the engineering field, so she decided to pursue a minor in communication studies. She eventually declared communication studies as a second major since budget cuts her sophomore year forced the department to restrict many of its introductory-level courses to majors-only.

She said that while her communication studies classes weren't quite as challenging as her engineering courses, she learned a lot about people from her communication studies coursework. She has applied many of these communication skills when dealing with not only engineers but also human relations (HR), marketing, and other non-engineers.

"Being in the double major really taught be how to speak both languages," she said.

Marquardt graduated with her B.S. in mechanical engineering and B.S. in communication studies (both Summa Cum Laude and with Honors) in 2007 and her M.S. in ME in 2008. She started her job as a design engineer with Vermeer the Monday after her commencement ceremony and spent about five years there before joining MidAmerican Energy as a senior buyer in July 2013.

"I found that I was a decent design engineer but I was never a very good design engineer, at least by Vermeer's standards. But I'm great at procurement. I like to negotiate with people. I learned great negotiation skills through my MBA and a little bit through my communication studies as well," she said, adding that conflict management was another skill that she learned in her studies and still uses today.

In addition to her bachelor's and master's degrees, she earned a master's of business administration (MBA) from the University of Northern Iowa in 2014. Marquardt said that she feels that having these advanced degrees helped to raise her career ceiling. She also thinks that these advanced degrees helped her land an inline promotion to Procurement Manager in August 2016. Then earlier this month she was promoted to Director of Strategic Procurement at MidAmerican Energy.

"Procurement's job is to bridge the gap between supplier and an engineer so you have to be able to speak both languages and that really started with my double major," she said.

While Marquardt's skill set ranges from engineering to communications to business, she said she thinks that an engineering degree is especially important for those in managerial positions because of the pragmatic mindset that many engineers have.

"There's a very high value placed on an engineering degree at the senior level at many companies," she said, adding that it helps to establish a base level of technical competence. "What engineering teaches you is a very structured way to restate the problem and lay out what your assumptions are, which is the step that people usually miss."

"Let me layout how I'm going to solve the problem, then I'll solve the problem. Then I look at my answer and ask 'Is this a reasonable answer given this question?' I think that's really what engineering teaches and why engineers are so valuable," she said.

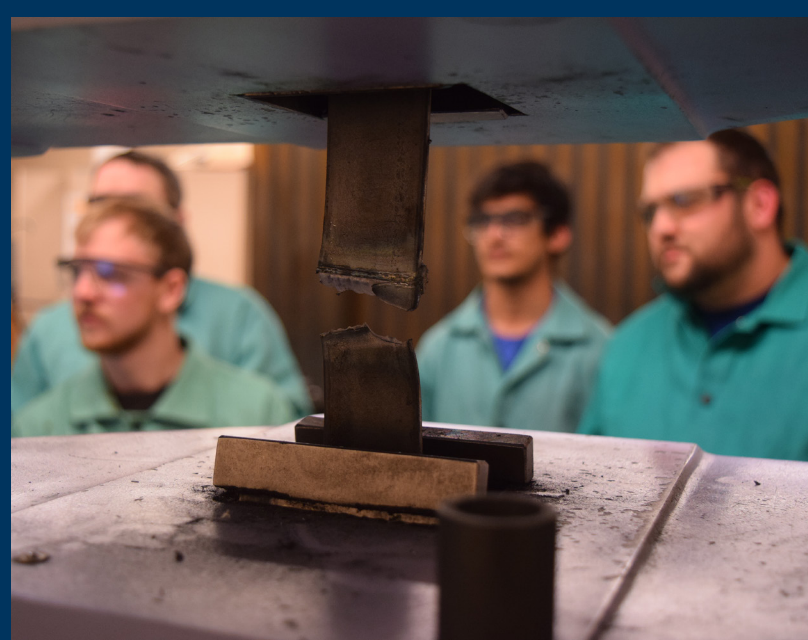
In graduate school, Marquardt worked as an academic adviser and part of the advice she'd have for her students, particularly females, was for them to just be themselves. She said she would echo this advice to any young women considering STEM fields today.

"Be you," she said. "Don't be afraid to be the girl. Don't feel like you have to be one of the guys. I didn't really start growing in my career and in my life until I stopped trying to be one of the guys, and trying to be something I wasn't. My career really took off when I stopped doing that."

In addition to her day job, Marquardt and her husband own and operate Wild Rose Pastures, a chemical-free and antibiotic-free livestock farm near Van Meter. Photo courtesy of Janice Marquardt.

Boyd Lab on March 22

ME 324L on March 28



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