DIMENSIONS

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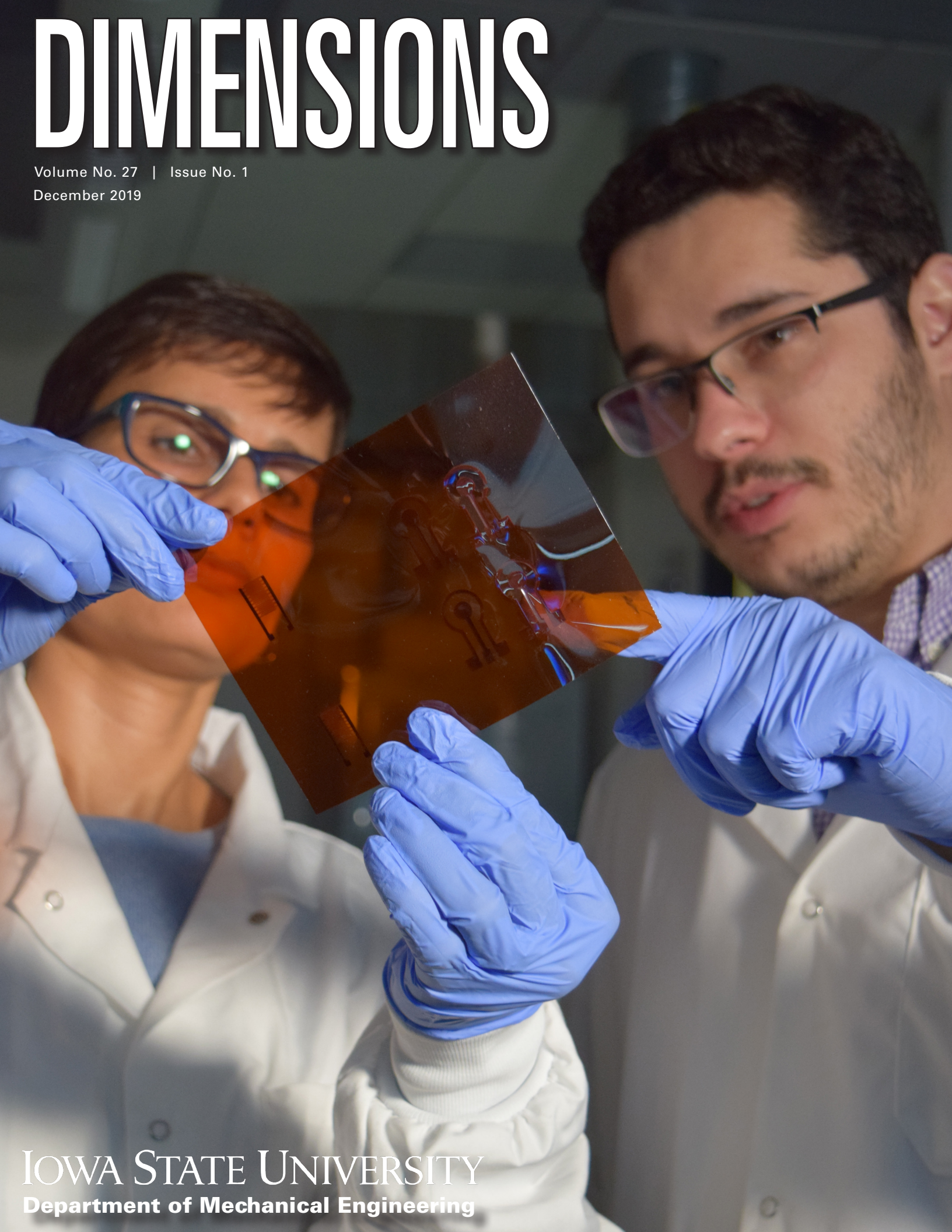

IOWA STATE UNIVERSITY
Department of Mechanical Engineering

Message from the Chair

Dear alumni and friends,

I am pleased to share the stories and achievements of our students, faculty, staff and alumni of the Department of Mechanical Engineering at Iowa State University.

Some highlights in this issue include:

- the introduction of new faculty member and alumnus of the ME department, Steve Zoz;
- associate professor Cary Pint will be joining our faculty in spring 2020 and will bring an energy research program with him;
- Anson Marston distinguished professor and Gary and Donna Hoover Chair Robert Brown is researching ways that slow-release fertilizer can provide crops with the necessary nutrients while also improving water quality;
- professor Xinwei Wang is collaborating with an interdisciplinary team of researchers from across campus to develop protective equipment for firefighters and first responders;
- associate professor Ming-Chen Hsu and assistant professor Adarsh Krishnamurthy are collaborating on a research project that uses computer simulations to develop effective prosthetics for the heart;
- associate professor Xianglan Bai was awarded a patent for a process she has developed that converts lignin into precursors of biofuels and chemicals;
- current students Tim Dorn learned about engineering from a German perspective this summer and Cole Jensen shares his experience interning with Rolls Royce in Indianapolis;
- alums Dylan Neal reflects on the impact that his participation on Team PrISUm has had on his professional development and Tom Duncan tells about his journey to the 2018 Winter Olympics.

This year, 2019, marks the 150th anniversary of the first class of students entering Iowa State, which included ME's first alum Edgar Stanton. To commemorate this event, we are publishing a book on the history of the ME department. For a preview of the book and for info on how to order your copy (available early spring 2020), please visit www.me.iastate.edu/history-book

Our alumni are vital to the growth and success of mechanical engineering and industry in the U.S. and abroad. I enjoy hearing about your accomplishments and encourage you to reach out and share your story. I can be contacted at mealumni@iastate.edu.

Regards,

Caroline Hayes
Department Chair
Lynn Gleason Professor of Interdisciplinary Engineering

On the cover

*ME associate professor **Carmen Gomes** (left) examines a printed biosensor used for monitoring agriculture and food production with ME Ph.D. student **Cicero Cardoso-Pola** in her lab, located inside Sukup Hall.*

For more info about this research, visit:
www.me.iastate.edu/gomes-research-2019/

Photo by Nick Fetty

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Student Team Updates

The **Cardinal Space Mining Club** (CSMC) at Iowa State University is in their 11th consecutive year as a participant in the NASA Robotic Mining Competition. Since 2009, NASA has hosted the competition which allows students of different majors and interests to design, build, and test a robot with the goal of being the most efficient to mine minerals that are found 30 cm (12 in) under the surface of the moon. Each team competes for the Joe Kosmo Award for Excellence. The team awarded this honor has proved the best overall performance including knowledge and execution of systems engineering, community outreach, and overall mining competition runs.

Since the beginning of the competition, CSMC has consistently placed among the top 10 of 50 teams and often in the top 5. In 2018, our team developed our newest generation of robots: the Mobile Autonomous Regolith System (MARS). The team has shown innovation and ingenuity by designing a trenching system that can dig deeper into the ground than most systems. Using the systems engineering approach, our team is working to perfect the robotic mining system both mechanically and electrically through autonomous operation.

In the 2019 – 2020 season, the club is following the design phases outlined by NASA's Systems Engineering Handbook to ensure the team is on track and ready to compete to its fullest ability. The 2020 competition will occur on May 18-22 at the Kennedy Space Center Visitor's Complex (KSCVC). The club leadership is working to ensure continuity throughout the upcoming season as senior members graduate. The team is approved for the upcoming competition year and is on track to successfully meet NASA's deadlines.

Cardinal Space Mining Club

PrISUm Solar Car Team

The **PrISUm Solar Car Team** has been extremely busy these past few school and summer months. As we prepare for the American Solar Challenge in Summer 2020, we have a lot of new regulations to make our car compliant with. Additionally, with a new race route this year, we have a lot of redesigns to consider, like battery pack size, battery pack voltage, and our battery protection system.

After last year's cycle of designing and optimizing all the systems and parts for our car, we're spending this year assembling the whole thing. We've been doing things like attaching the suspension of our car onto our chassis, welding the roll cage onto the structure panels of our car, and working on the surface finish of our car for painting and optimal aerodynamics. Due to a lot of innovation between the last car and this car, we've been learning a lot about how to assemble our new designs, lessons that we're excited to apply to our next car.

According to the most recent race regulations that have been released, the route for the American Solar Challenge 2020 this summer will roughly follow the Oregon Trail. We will compete in this road rayce with our 15th Solar Car Project, Eliana. Additionally, we will be competing in a track rayce to qualify for this road race. This track rayce is known as the Formula Sun Grand Prix. The location for this rayce has not yet been announced.

Faculty and staff honors

Baskar Ganapathysubramanian, Professor
Named to the Joseph C. and Elizabeth A. Anderlik Professorship in the College of Engineering

Ted Heindel, University Professor
Promoted to University Professor

Margaret Mathison, Associate Teaching Professor
Award for Excellence in Foundational Course Teaching

Soumik Sarkar, Associate Professor
Award for Early Achievement in Research

Graduate student honors

Fall 2019 Research Excellence Awards
Aditya Balu
Emily Johnson
Keyvan Mollaeian
Xiaohui Tang

Fall 2019 Teaching Excellence Awards
Viraj Belekar
Arna Ganguly
Humair Nadeem

Undergraduate student honors

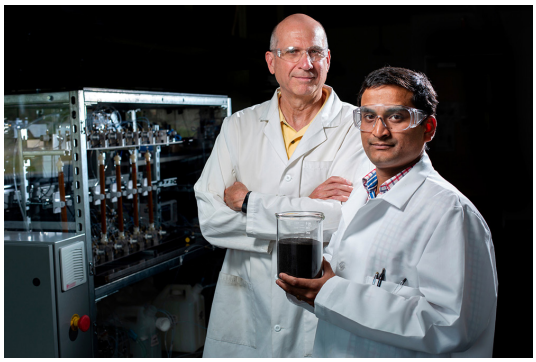
Nikita Kozak, received a Goldwater Scholarship

Courtney Smyth, named Outstanding Senior for Fall 2019 commencement

ME 324L Undergraduate Teaching Assistant CYtation Award
Ethan Hopkey
Jack Loy
Jordan Paone
Austin Powell
Nick Schreck
Alex Weis
Allie Westerlund

Iowa State researchers studying slow-release fertilizer to feed crops, improve water quality

Iowa State University researchers weren't looking for a slow-release fertilizer that could feed crops while protecting water quality, but they may have found one.



Robert C. Brown and Santanu Bakshi, left to right, are part of a team looking for ways to make biochar -- a black powder that's a co-product of bio-oil production -- more useful and valuable. Photo courtesy of Christopher Gannon.

Researchers looking to add value to biochar – a solid, porous co-product of heating corn stalks and other sources of biomass to produce liquid bio-oil in a process called pyrolysis – were studying its physical and chemical properties.

"We've calculated biochar's incredible ability to store carbon in a small package," said Robert C. Brown, director of Iowa State's Bioeconomy Institute. "One day it might be valued at $200 per ton for its ability to remove carbon from the atmosphere, but currently it's only worth about $40 per ton – the energy value of burning it as a coal substitute."

So, what could add value to this black powder, making pyrolysis a more economically attractive biofuel technology?

Maybe biochar could be mixed with biomass to improve the quality of biogas from anaerobic digestion? Or maybe it could help control livestock odors? Or, maybe it could be mixed with composted manure and the fibrous leftovers of anaerobic digestion to produce a fertilizer?

A research team led by Brown – who's also an Anson Marston Distinguished Professor in Engineering and the Gary and Donna Hoover Chair in Mechanical Engineering – won a two-year, $1,469,448 grant to find valuable applications for biochar. The grant is from the Biomass Research and Development Initiative, a joint program of the U.S. Departments of Agriculture and Energy.

The grant put Santanu Bakshi, an assistant scientist at the Bioeconomy Institute, to work on yet another biochar project. He's worked with the material for most of the decade, starting as a doctoral student at the University of Florida looking into how biochar could be used to reduce copper toxicity in the soils supporting citrus groves. In another project, Bakshi showed the effectiveness of biochar in removing arsenic from drinking water.

That led to biochar projects, including arsenic sticking – adsorbing – to the surface of biochar and another that involved capturing phosphorous from wastewater.

As often happens during research, all those projects built on each other to produce a new discovery. Bakshi discovered that biochar produced from biomass pretreated with iron sulfate, an inexpensive byproduct of steel making, can adsorb to its surface up to 12 times the phosphate as biochar from untreated biomass.

The iron sulfate pretreatment developed at Iowa State was designed to increase the yield of sugar from pyrolysis of woody and grassy biomass. Like starch from corn, this sugar can be fermented to produce biofuels.

But the pretreatment also boosted biochar performance in another important way.

Biochar's surface mostly holds negative charges. And so does phosphate – an anion that has more negatively charged electrons than positively charged protons. The two should repel each other. But, when biomass is treated with iron sulfate before pyrolysis, the surface of biochar is modified so it can readily adsorb anions to its surface.

In lab tests, Bakshi has measured 48,000 milligrams of phosphate adsorbed per kilogram of pretreated biochar, compared to 4,000 milligrams adsorbed per kilogram of untreated biochar.

And so, biochar could be mixed with manure to adsorb phosphate – a major plant nutrient – and then applied to soil as a solid fertilizer.

"With this technology, we're trying to improve the recycling of phosphates to the soil," Bakshi said.

The application of nutrients via biochar – unlike some fertilizers used today – is stable in the soil and won't wash away in the rain or leach into groundwater. That could improve the quality of water running off farm fields, decreasing the nutrients that feed algal blooms that take up oxygen in water, helping to create the Gulf of Mexico's "dead zone."

Bakshi also found biochar doesn't release adsorbed phosphate quickly. He's calculated that it releases nearly 18 milligrams of phosphorous per kilogram of soil after three continuous leaching events with water – just about equal to the 22 milligrams of phosphorous per kilogram of soil that's recommended for growing crops.

By oxidizing the iron in the pretreatment process, Bakshi said even more phosphate can be adsorbed and released, nearly 23 milligrams per kilogram of soil after three continuous leaching events with water.

"Phosphate adsorbed on biochar can provide the phosphorous needed by crops," Bakshi said. "But being less soluble in water than conventional fertilizer means the phosphorous will remain in the fields during rainstorms rather than being washed away."

Because they're also negatively charged anions, Bakshi said the process should also work with nitrates, another major plant nutrient associated with water-quality problems. He's planning lab tests to determine if that's the case.

There will also be greenhouse tests with potted crop plants and eventually field tests.

"This might change how farmers apply fertilizer treatments," Brown said.

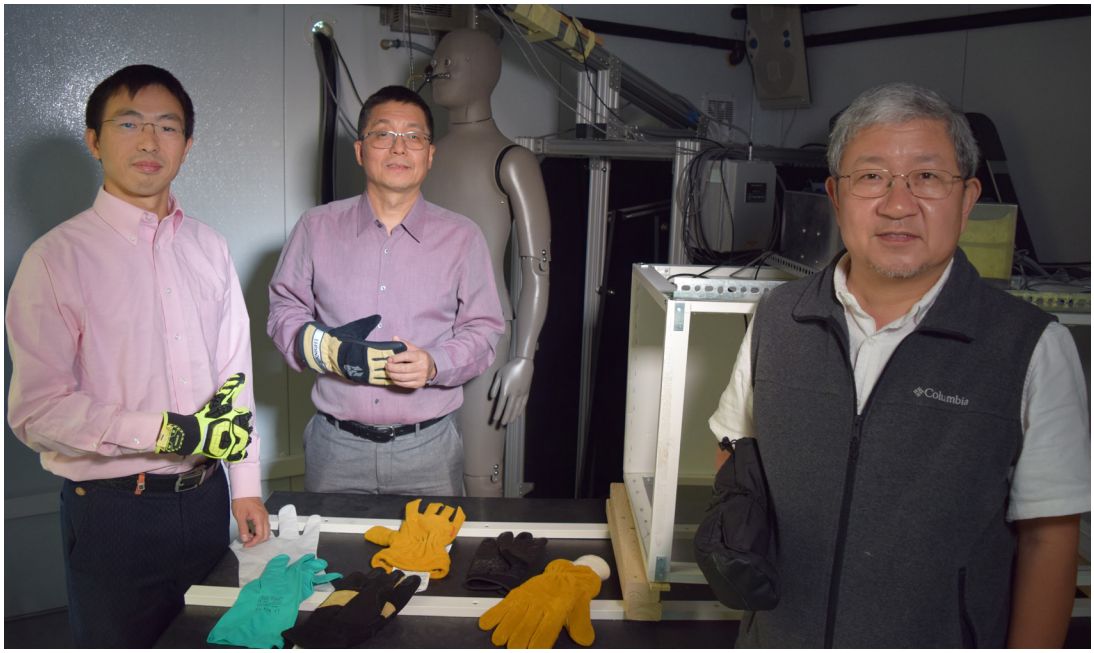
And that idea wasn't even in the researchers' successful grant proposal.

"This is so typical of research," Brown said. "You come up with something you didn't even expect – and here we have a form of charcoal that could be used as slow-release fertilizer."

Contributed by Mike Krapfl/ISU News Service

Engineers contribute to project aimed at improving protective clothing systems for firefighters and first responders

Firefighters and first responders need effective personal protective equipment (PPE) that provides the right combination of functionality, protection and comfort. A project led by a team of Iowa State University researchers aims to develop fundamental knowledge and tools for the next generation of high performance PPE.



From left: Lizhi Wang (industrial and manufacturing systems engineering), Guowen Song (apparel, events, and hospitality management) and Xinwei Wang (mechanical engineering) pose in Song's Laboratories for Functional Textiles and Protective Clothing located inside LeBaron Hall.

Guowen Song, Noma Scott Lloyd Chair in Textiles and Clothing and associate professor of apparel, events and hospitality management, is leading the project titled "Development of hand-specific model and systematic tool (HMST) for next generation gloves used for firefighters and other emergency responders." Funding is provided by the Firefighter Safety Research and Development (R&D) Activity office within the U.S. Department of Homeland Security's Federal Emergency Management Agency. These R&D projects are aimed at improving firefighter safety, health or wellness through research and development that reduces firefighter fatalities and injuries.

Song has assembled a multidisciplinary team of researchers from textile engineering and design, human development and family sciences, industrial and manufacturing systems engineering, kinesiology, mathematics and mechanical engineering.

"This is the nature of multi-science. We really need a team in order to make revolutionary progress," Song said.

Xinwei Wang, professor of mechanical engineering, will bring his expertise in thermal science to the project.

"I'll help to design a new material that provides thermal protection," said Wang. "To do this, I will use some of the techniques that I've developed in my Micro/Nanoscale Thermal Science Laboratory, such as the transient electro-thermal technique for measuring thermophysical properties of micro/nanofibers and the differential laser-heating and infrared imaging, or DLI, technique for measuring the thermal resistance of coatings and cloth."

Wang first connected with Song when Song arrived on campus in 2014, and they have collaborated on projects in 2015 and 2018. The duo said they hope to expand upon their past research with this current project.

Lizhi Wang (no relation to Xinwei), associate professor of industrial and manufacturing systems engineering (IMSE), will contribute his expertise using mathematical modeling, optimization and machine learning.

"I will help develop a hand-specific thermoregulation model and explore the design of next-generation high-performance gloves for firefighters," Lizhi Wang said.

Wang added that the benefits of interdisciplinary research such as this are "bi-directional."

"On the one hand, industrial engineering, or IE, provides advanced modeling and solution techniques to improve the effectiveness and efficiency of decisions. In this case, better design decisions will lead to more protective gloves and fewer injuries for firefighters," said Wang. "On the other hand, challenges from this specific application will also motivate improvements in the IE tools and methods, which will subsequently benefit other application areas."

Song said contributions from engineers help to advance the research within the field of textiles by bringing in aspects of applied science that he could not do by himself.

"When people think of textiles they don't necessarily think science. They think design or art," said Song. "There's a lot of lab simulation, modeling, materials engineering and more. Incorporating these technologies into the textile side is crucial in making the textile system more responsive to the body and hazardous conditions in the environment."

The researchers hope that one day the technology they develop from this research might be applied to other fields such as foundry work, hazmat handling, healthcare and the military.

The Research Team

Warren Franke, kinesiology; James Lang, kinesiology; Ellen McKinney, apparel, events, and hospitality management (AESHM); James Rossmanith, mathematics; Daniel Russell, human development and family sciences and psychology; Chunhui Xiang, AESHM; Lizhi Wang, industrial and manufacturing systems engineering; and Xinwei Wang, mechanical engineering.

Cary Pint bringing his energy research program to Iowa State

During an era before the internet, Cary Pint remembers building ham radio antennae and designing electrical systems that allowed the young broadcaster to communicate with people all over the world.

Pint, who will join the mechanical engineering (ME) faculty at Iowa State University for the spring 2020 semester, said that working on this radio equipment with his father first sparked his interest in STEM when he was growing up outside of Waterloo, Iowa.

"This inspired me at an early age because I could use my knowledge to build a system where I could sit in my room and talk to people across the world, which was so exciting when I was 12 or 13 years old before we had internet," Pint said.

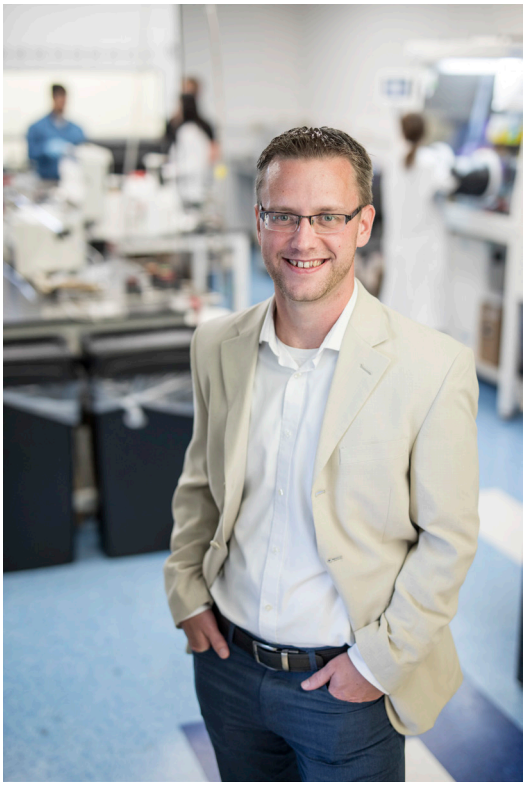


Photo courtesy of John Russell, Vanderbilt University

After graduating from high school, Pint joined the Marines. He completed boot camp and enrolled at the Citadel with intention of becoming a fighter pilot, however a few years later he instead decided to finish his obligation to the Marines and move back home with his family in Iowa. He then completed his undergraduate studies at the University of Northern Iowa and graduated with a B.S. in physics, becoming the first from his immediate family to finish college. He said that it was during the latter part of his undergraduate studies that some of his key mentors helped to guide him down the STEM career path that he is still on today.

"This turning point in my career helped me realize the massive impact a good mentor can have on the career paths and success of others, and this guides my own inspiration as an educator and mentor," he said.

Pint went on to complete an M.S. and Ph.D. in applied physics from Rice University in Houston, Texas, where he conducted research in the laboratory of the late Richard Smalley and under advisement from Robert Hauge and Matteo Pasquali. He completed a postdoctoral fellowship under Ali Javey at the University of California, Berkeley, and then spent a year and a half working as a research scientist at Intel Labs in Santa Clara, California before joining the Vanderbilt University mechanical engineering faculty in 2012. Because of his multidisciplinary background, Pint brings a unique perspective to the field of mechanical engineering.

"What makes me at heart a mechanical engineer is my passion for research in energy and manufacturing that builds directly from core topics in the mechanical engineering discipline," said Pint. "However, my background that brings together diverse experiences through both academia and industry and across many different disciplines allows me to approach these problems in new and unique ways, and this sets my team apart from others."

Much of Pint's research focuses on energy systems, particularly batteries. He and his research team have studied cost, manufacturing and performance in an effort to make batteries a viable option for widespread transportation and electrical grid storage in the future. Among other things, his team has also designed a new class of Li-ion batteries that look and feel like carbon fiber reinforced composites but store energy like conventional batteries. His team is working toward building these integrated structural power systems into drones and robots to break down the walls between the design of systems and their power sources. He said he's excited to get to Ames so he can begin collaborating with researchers in the ME department and perhaps even others across campus.

"There is no other school in the country that balances such diverse and high impact research in energy, nanomaterials and manufacturing relevant to my interests," said Pint. "I also am excited about being at the epicenter of the most talented students in Iowa and surrounding states who are training to be world-class engineers and helping to mentor and teach these students inside the classroom and out."

At Iowa State, Pint will teach M E 345: Engineering Dynamics. He will also hold the title of Charles Schafer (Battelle) Chair in Engineering. Before joining ISU, he advised nine students who have gone on to complete their Ph.D. He said that each student has brought a different skillset to the lab, so he often assembles his research team to balance each student's strengths.

"I believe that one broad trait that is important for success in graduate school is perseverance," said Pint. "It requires perseverance after projects or experiments fail to continue to redesign a hypothesis and keep working toward the end goal."

When he's not busy teaching or in the lab, Pint enjoys spending time outdoors, especially kayaking and fishing. He also enjoys cooking, playing guitar, keyboard or even jazz on his trumpet, and spending time with his wife Rizia and two sons: Elan and Jonah.

"I find one of the most rewarding things that I do outside of the lab these days is to spend time with my kids and inspire them as they grow up so that maybe they can draw the same inspiration from me as I have from my father and other great mentors in my life."

Alumnus Steve Zoz joins ME department

Alumnus Steve Zoz has returned to Iowa State University as a lecturer in the Department of Mechanical Engineering. Zoz received his bachelor's, master's, and doctorate degrees in mechanical engineering from Iowa State University.

Before coming back to Ames, Zoz worked in the mechanical engineering industry, with multiple companies including Ford, GM, Cummins, John Deere, Navistar and Chrysler. Most recently, he was the senior engineer at Caterpillar in Illinois and Indiana.

Zoz

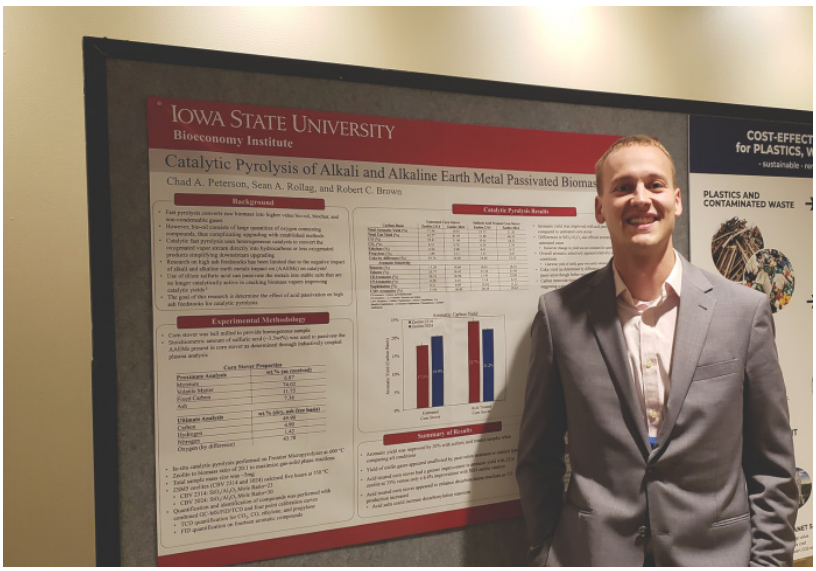
Zoz is credited with four patents and has published several works within his field. He has vehicle and internal combustion engine design and consulting experience involving gasoline engines for automotive applications, natural gas engines for power generation, and heavy-duty diesel engines for construction and mining equipment. His research interests include thermodynamics, energy efficiency, heat transfer, internal combustion engines and heavy duty diesel engine applications.

Contributed by Gillian Mohn/Engineering College Relations

ME grad student takes 2nd place at tcbiomassplus2019 poster competition

Chad Peterson, a Bioeconomy Institute (BEI) research assistant and Ph.D. student in mechanical engineering at Iowa State University, won second place in the Student Poster Challenge at the tcbiomassplus2019 conference held in October 2019 in Rosemont, Illinois. The event is an international conference focusing on the science of thermochemical conversion of biomass and municipal solid waste (MSW) to renewable gas (RNG), liquid fuels, and chemicals.

Peterson won for his poster entitled, "Catalytic Pyrolysis of Alkali and Alkaline Earth Metal Passivated Biomass." His major professor is Robert C. Brown, BEI director and Anson Marston Distinguished Professor in Engineering.



Mechanical engineering grad student Chad Peterson took home second place in the student poster competition at the October 2019 tcbiomassplus2019 conference.

The conference program featured three poster presentations from Iowa State. In addition, Peterson and two other Iowa State researchers gave technical talks, while Brown delivered a keynote address. BEI, along with the BioCentury Research Farm, also had an exhibit at the event to showcase their capabilities.

Contributed by Robert Mills/ Bioeconomy Institute

New project will explore manufacturing in space

A mechanical engineering professor will establish a new research program to study ways for manufacturing polymer-based structures in space for space applications with the help of a new grant from the Iowa Space Grant Consortium.

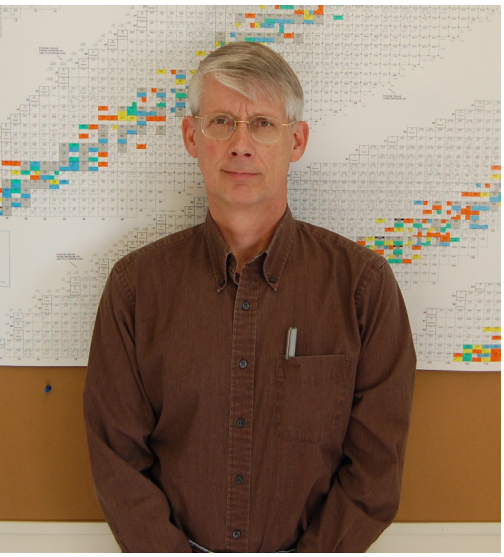
Reza Montazami, associate professor in mechanical engineering (ME), received funding from the Iowa Space Grant Consortium for a project titled "Mechanics and Manufacturing of Polymeric Structures for Harsh Extraterrestrial Environments and Applications."

Montazami will work with his team of student researchers, both undergraduate and graduate, to explore manufacturing of mechanical structures in weak gravity using polymer-based materials. The team will apply materials knowledge along with ME methods such as advanced manufacturing, 3D printing and mechanics of materials. They will also collaborate with colleagues from NASA to realize this goal.

Research on this project will start in January 2020, and funding will continue through June 2020. Montazami said that if the research finds that the concept is feasible, he and the team would collaborate with NASA to explore realization of the concept.

Montazami

Maxwell joins the ranks of emeritus faculty



Maxwell

Greg Maxwell, former associate professor of mechanical engineering, has retired.

Maxwell joined the Iowa State community as an assistant professor in 1985, and he has held various leadership positions since then, including positions at the ISU Research House and the ISU Industrial Assessment Center. He also directed the undergraduate minor in nuclear engineering from 2009 to 2018.

Maxwell received his education at Purdue University, earning his B.S. in physics in 1973, his M.S. in nuclear engineering in 1977, and his Ph.D. in mechanical engineering in 1984. During this time, he worked as an engineer at Oak Ridge National Laboratory in Tennessee and then at Carrier Corporations in New York.

While at Iowa State, Maxwell taught a variety of mechanical engineering courses ranging from 200- to 600-level, as well as a collection of 400-level courses in nuclear engineering. His excellence in the classroom earned him teaching awards from the College of Engineering, ISU Mechanical Engineering students, ISU Engineering Student Council, the ISU Foundation, ISU President Jischke, and most recently, the 2019 Honors Parks Award for outstanding faculty from the ISU University Honors Program.

Maxwell's work has been published in numerous journal articles, and he has contributed to a total of 308 Industrial Assessment Center Reports. He has been a member and held leadership positions in the International Energy Agency, the American Society of Heating, Refrigerating and Air-Conditioning Engineers and the American Nuclear Society.

Maxwell has many fond memories of his career on campus.

"I do not remember the exact year, but a few other engineering faculty members and I were honored by the Engineering Student Council," Maxwell said. "We got to ride in a convertible in the VEISHEA parade. I recall throwing bubble gum to the kids along the parade route."

When asked about what he will miss the most about Iowa State, he said, "the students, my friends and the beautiful campus."

"I remember when I first came to Iowa State and my kids were young, taking them to beautiful Lake Laverne to feed the ducks," Maxwell said.

Contributed by Madison Davies/Engineering College Relations

Engineering from a German perspective

ME student Tim Dorn poses outside of the John Deere facility in Mannheim, Germany.

Learning about engineering in another country is an effective way to become a better-rounded engineer, according to one student.

Tim Dorn, a junior in mechanical engineering, spent his spring 2019 semester and his summer studying abroad at Hochschule Mannheim in southwest Germany. He said that through this experience he noticed the differences in the cultures as well as in the ways that engineering is practiced between the United States and Germany.

"Electricity is relatively expensive in Europe, so many functions in their industry focus on lean production and efficiency with time and energy resources. Thermodynamics is of course another mechanical engineering concept that applies to this conversation," he said.

Dorn, who came to Iowa State University from West Des Moines, Iowa, said he was attracted to mechanical engineering because of its versatility within the workforce. He returned to Ames for the fall 2019 semester and enrolled in a combination of engineering and German language courses. In addition to his course work, he also plays alto saxophone in the Iowa State University Cyclone Football 'Varsity' Marching Band and performs at all of the home football games.

ME student Tim Dorn poses in his marching band uniform inside Jack Trice Stadium.

He will return to Mannheim in spring 2020 to complete a co-op with the John Deere plant there, where he will work on process and material flow optimization. He plans to complete his studies in spring 2022. Dorn said he would encourage others to spend time abroad, whether it be for work, school or leisure.

"Traveling abroad in any capacity affords opportunities for personal and professional growth that I believe are impossible to replicate without leaving one's usual environment," he said. "I'm incredibly grateful for what I learned from my study abroad experience, and I'm looking forward to what I'll learn during my next stay abroad."

ME student rolls in style with summer internship at Rolls-Royce

Cole Jensen was in awe of the jets as they zoomed overhead when he went to air shows as a kid. Now as an adult, he has had the opportunity to work on the jet engines that fascinated him as a child.

Cole Jensen poses outside of the Rolls-Royce facility in Indianapolis, Indiana.

Jensen grew up in Prior Lake, Minnesota and chose to attend Iowa State University because of its strong engineering program and after hearing stories from his uncle, Jason Hoehn, who studied civil engineering at ISU in the early 1990s.

"I knew I wanted to do engineering, so I chose my adventure at Iowa State," said Jensen. "I was originally an aerospace engineering major but realized mechanical engineering better suits my wide variety of interests."

However, his brief time in aerospace engineering was beneficial to his professional development as he said that background helped him to land an internship this past summer when he worked as an engineering project management intern for the Rolls-Royce JSF LiftSystem team in Indianapolis, Indiana.

"My work was a combination of project engineering and program management, both of which I really enjoyed. I led a few different projects and assisted others ranging from component testing coordination to detailed process variable analysis. I was able to put manufacturing engineering and thermodynamics concepts to the test," Jensen said.

While Jensen's interest in airplanes was first sparked when he was a child, that interest was further cultivated through strong faculty and staff at Iowa State. Jensen said former NASA astronaut and current aerospace engineering professor of practice, Clayton Anderson, has been especially influential on him, encouraging him to "aim high" and "persevere through anything." He added that his academic advisor, Aliza MacKenzie, has also been helpful in guiding him through his journey at Iowa State. He said he's been challenged but has enjoyed many of the courses he's taken as part of the ME curriculum.

"My favorite classes are the ones where you get to put your knowledge to the real world test. Classes like M E 170 [Engineering Graphics and Introductory Design], M E 270 [Introduction to Mechanical Engineering Design] and Aer E 160 [Aerospace Engineering Problems with Computer Applications Laboratory] were very influential," said Jensen. "I am looking forward to my senior capstone design course next semester."

In addition to his coursework, Jensen has also gained valuable experience by serving as the project director of the AIAA GoFly student organization on campus and by serving on the Professional Relations Committee for Engineers' Week. His interests also expand outside of engineering as he has participated or currently participates in Ames Flyers (previously The Flying Cyclones), Automotive Enthusiasts, ISU Canoe and Kayak, GENRE Music Club, Entrepreneur Club and ISU Film Club.

Jensen plans to complete his studies in summer 2020 and will likely work for Rolls-Royce after graduation. In addition, he will manage his side company, Jensen Applied Sciences, which he founded with his brother, Dillon, a computer science student at Iowa State.

Bai awarded patent for lignin conversion process

Xianglan Bai, mechanical engineering associate professor, has been awarded a patent for a process she has developed to convert lignin into precursors of biofuels and chemicals.


Bai

U.S. Patent 10,190,053, titled "Pyrolysis of Lignin," is one of the products of her research group in developing biobased chemicals and fuels. Bai was issued the patent in collaboration with Dr. Shuai Zhou, who was a former postdoc of her research group at ISU and currently a scientist at Emory University.

"Lignin is abundantly produced from pulping industries and cellulosic biorefineries as low-cost byproducts," said Bai. "While lignin is mostly incinerated in the plants for heat, it actually is the most importance source of natural aromatics. Our patented process provides a simple and low-cost approach to convert lignin into phenolic oil rich in monomers. Our process also can resolve the technical challenges in pyrolyzing lignin in continuous operation reactors caused by melting and agglomeration of lignin."

This marks the 4,390th patent issued by the Iowa State University Research Foundation.

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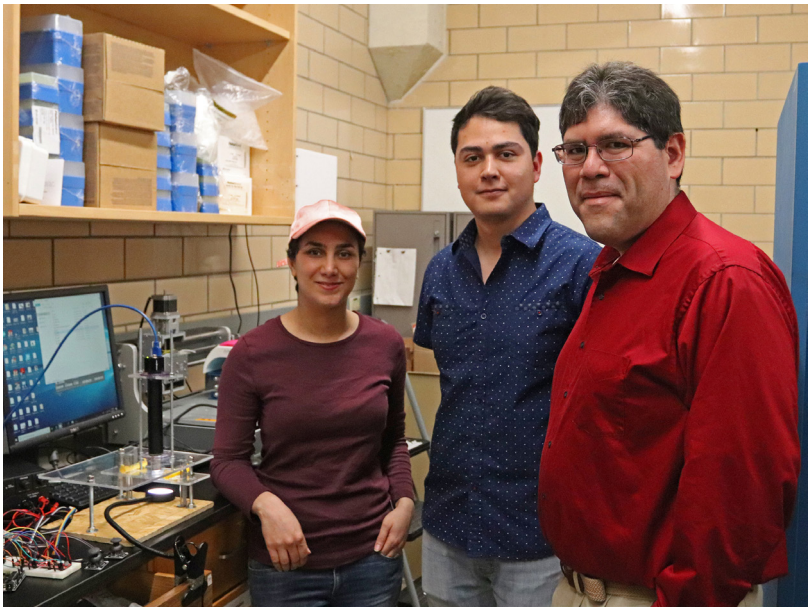
Big undergrad research experience building small device

Mentoring duo creates first-of-its-kind portable viscosity instrument

Jaime Juárez, assistant professor of mechanical engineering and a McNair mentor, had read a multitude of articles about portable optical microscopes that obtain real-time measurements out in the field instead of in a lab. But among these many articles, he did not find any portable means of performing rheology measurements, or how fluids flow under pressure.

Naturally, Juárez decided to look into the possibility himself.



From left: Soheila Shabaniverki, graduate assistant in mechanical engineering, Antonio Alvarez-Valdivia, junior in mechanical engineering and McNair Scholar, and Jaime Juárez, assistant professor of mechanical engineering and a McNair mentor.

With the help of Antonio Alvarez-Valdivia, junior in mechanical engineering and McNair Scholar, and Soheila Shabaniverki, graduate assistant in mechanical engineering, Juárez has been testing a portable system for measuring rheological properties such as fluid viscosity and elastic modulus. The system is based on a technique known as microrheology, where small micro- or nanoparticles are used as probes for measuring these properties. The technique works by measuring the diffusion rate of the probes and inferring the viscosity and elastic modulus of the sample from the data.

"Until now, microrheology has only been demonstrated using research-grade microscopes," Juárez said. "My students built a portable optical microscope to find out if the microrheology could still produce results comparable to those observed in the research grade microscope."

So far, the experiment has been successful. The team performed comparative experiments on both a research-grade microscope and the portable optical microscope to find that the results agree to within a 4-6% range.

Portable, in a variety of fields

During the summer of 2018, Alvarez-Valdivia helped create the portable optical microscope using scraps and spare parts. Unlike viscometers and rheometers that can only be used in a lab, this device is able to travel to location and measure the viscosity of a sample on site. The system works by taking a fluid sample and dispersing microparticles within. The microparticles are tracked with a video camera and their diffusion rates analyzed using codes written by Juárez to determine the sample viscosity.

The practical applications of a portable instrument like the one Juárez's team has developed are extensive, such as in the food industry. Soon, instruments like the one Juárez has developed could be used to monitor material properties to ensure uniform food production. Properties like viscosity and elastic modulus determine how stiff or pliable a food product might be. As a consequence, these properties can determine food texture or quality.

The platform could also be used in the chemical process or energy industry by monitoring the properties of particulate suspensions known as nanofluids, which enhance heat transfer properties from industrial processes to optimize their energy usage and reduce overall cost. This platform could also measure the viscosity of blood samples, which could be used by medical scientists and clinicians to connect these properties to medical disorders that require blood thinners.

Valuable hands-on research experience

Alvarez-Valdivia started working with Juárez over the summer as part of the Multiscale Sensing Actuation and Imaging (MoSAIc) research experience for undergraduates, and they continued working on their research together during the academic year as a McNair Scholar and Mentor duo.

Iowa State's Center for Multiphase Flow Research and Education (CoMFRE) provides resources to educate undergraduate students and connect with programs like the McNair Scholars to provide meaningful research experience to undergrads.

Alvarez-Valdivia said that research allows him to work on something he is interested in outside of the classroom, and he can even earn credits for an independent study in the area of his research. Alvarez-Valdivia feels proud of the instrument he has helped build, and it makes him confident in his own abilities.

"People don't really know how research impacts their lives," Alvarez-Valdivia said. "Sometimes it's underestimated. Little things you see in research presentations are not so meaningful for you at the moment, but they really have an impact on how technology develops."

An article based on Alvarez-Valdivia's work has been accepted for upcoming publication in a journal called Experimental Thermal and Fluid Science.

Contributed by Madison Davies/Engineering College Relations

Engineering shaped nearly every aspect of late ME alum's life

Vernon Mayer passed away in April 2019, but the impact that he has left behind will live on forever.

Vernon Frank Mayer was born on Jan. 9, 1945, on his family's farm in the southwest North Dakota town of Regent. Growing up on the farm he often worked on things with his brother Clifford, which sparked his interest in mechanical engineering at a young age.

The Mayer family, sometime in the 1990s. From left: Peggy, Todd, Vernon, Barbara, Joel, and Allison.

"Growing up on a farm, to stay entertained, he and his brother would build things and work on equipment. The experience of actually building and repairing machinery made him and me better engineers," said Todd Mayer, Vernon's eldest son.

After high school, Vernon hopped on a train with a single suitcase and trekked nearly 900 miles west to Spokane, Washington, where he attended Gonzaga University on a trumpet scholarship. As a collegian, he had the opportunity to participate in various music ensembles with his brother Clifford, a saxophonist and pianist.

Vernon Mayer plays with a toy with his son Todd, sometime in the early 1970s.

Vernon graduated with a degree in mechanical engineering in 1967 and then moved to Ames to pursue graduate studies at Iowa State University. In Ames, he met the love of his life, Barbara Ewald, and the couple wed in 1968. While living Ames, Vernon and Barbara had their first two children: Todd in 1969 and Allison in 1974. Todd would go on to follow in his father's footsteps by completing his B.S. in mechanical engineering from Iowa State in 1992.

"My father inspired me to pursue studies in ME at Iowa State," said Todd Mayer, who currently serves as co-president at Steffes, a lean-operating original equipment manufacturer headquartered in Dickinson, North Dakota. "We would build countless products in our shop. I didn't realize at the time that every farmer did not explain to their kids the metallurgy of welding while they were welding steel together."

Vernon served as a mechanical engineering instructor while also pursuing his studies. He completed his master's in mechanical engineering in 1969 and then his Ph.D. in metallurgy in 1974. As a graduate student, he shared an office with fellow engineering student John Mather in the Metals Development Building and the two would go on to become lifelong friends.

"His integrity and the way that he lived his life are the things that most profoundly impacted me," Mather said.

Mayer was known to have once ridden his bicycle to campus on a day when the university was closed because of snow, following an unseasonable April blizzard. This was just one of many memories that came to mind when Mather reminisced about his days in Ames with Mayer.

"He applied engineering principles in just about everything he touched," said Mather. "His manner of doing things had a discipline to it. He had drive. He was tenacious."

After completing his graduate studies, Mayer was hired by Alcoa Research Laboratory and moved his family to Pittsburgh, Pennsylvania, where son Joel was born in 1975. He worked there for two years before moving back to North Dakota to take over the family farm after his parents retired. He was constantly learning and innovating on the farm and was one of the first farmers in the area to implement no-till to his operation, according to Todd Mayer.

Outside of his responsibilities on the farm, Vernon Mayer was active with St. Henry's Church and he served on advisory boards for various governmental agricultural agencies. His love for music also continued well into his adult life and he even taught himself how to play guitar. He was involved with music ensembles through church and was part of the Dakota Gold band, playing guitar, saxophone, country fiddle and trumpet. During the fall pheasant-hunting season, Vernon and his wife managed a bed and breakfast and often hosted hunters visiting the area. They wanted to share their love of the land with others, even though Vernon had never shot a pheasant.

Mayer retired from farming in 2006 but remained active. He began working as a consulting engineer and rediscovered his passion for cycling, once riding from Bismarck to Richardton.

"Who in their right mind would ride on the interstate edge nearly 80 miles to see their grandchildren," said Mather. "But that was Vern."

Mayer stayed busy watching his grandchildren compete in sports as well as participate in music and dance as they grew up. Ever the competitor, he was known for giving his full effort and not letting his grandchildren win easily.

Vernon Mayer (left) plays trumpet while his son Todd accompanies him on the piano, sometime in the 1990s.

"My dad was like a kid when he was with his grandchildren," said Todd Mayer. "He loved playing games like cards, baseball, frisbee, soccer, and playing music. He did not take it easy on them, but he did it in such a fun way that everyone wanted to be with grandpa."

Vernon Mayer passed away peacefully at his home in Bismarck, North Dakota, on April 24, 2019. He was 74 years old.

"I learned many great lessons from my father: love your family, have faith, be inspired by music, take risks, strive to be the best in whatever you do, be innovative, stay curious, be humble, work hard, don't ask someone to do something you wouldn't do, read, and continuously learn," said Todd Mayer. "He had an amazing life and I miss him."

Strength in numbers: New national chair leading NSBE with purpose

Focus. Focus on what you want and go for it.

These are the first two lines of Jocelyn Jackson's personal mission statement. And as the new national chair for the National Society of Black Engineers (NSBE) as of May 1, focus is Jackson's top priority.

Jackson

When it comes to NSBE, Jackson treats focus as an acronym of values: family, opportunity, commitment, unity, and servant leadership.

According to Jackson, a grad student in engineering education research at the University of Michigan who attended Iowa State for her undergraduate studies in ME, NSBE was founded on servant leadership, which she defines as leading with empathy.

The six NSBE founders and their advisor at Purdue University noticed that while they had found their success, many others had not. Even today, the graduation rate for black engineering students within six years is 36%.

Jackson nearly stopped believing in herself before she found the NSBE chapter at Iowa State, along with the means to succeed.

"I wouldn't be an engineer if it weren't for this organization because I was ready to give up, so I want to give back to the organization and pay it forward," Jackson said.

Jackson's goal as national chair is to promote and make strides to accomplish the current strategic plan of NSBE: 10K by 2025. In other words, to have 10,000 black engineers graduating annually by 2025.

Currently, about 4,500 black engineers are graduating annually nationwide, which is a 28% increase from the start of the strategic plan. Progress has been made, but it is not yet enough.

"It's a complex issue," Jackson said. "It's hard because I don't want to fail. If I fail, I don't lose, but others would, and they are counting on us. I would rather lose than see others lose. I believe engineering is a way of life and a lot of our members are first-generation students or first-generation engineers who need NSBE's support. We change lives!"

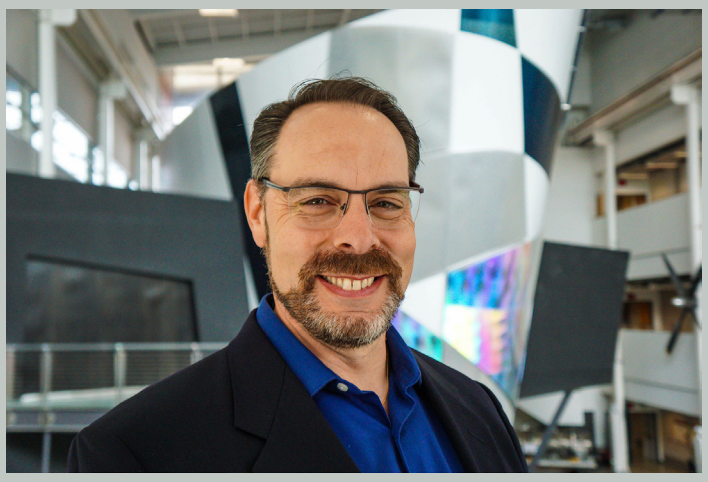
That's why Jackson plans to lead with purpose and to unite the organization.

"Really, I'm the visionary. I put the vision together, work with the team, get feedback and stakeholder engagement, and from there we apply focus and just go for it," Jackson said.

Contributed by Madison Davies/Engineering College Relations

Winer named director of the Virtual Reality Applications Center

Eliot Winer has been named director of the Virtual Reality Applications Center (VRAC) effective July 1. He has served as an associate director of VRAC since 2009, and is a professor in the Department of Mechanical Engineering. Winer replaces James Oliver, who was named director of the Student Innovation Center earlier this year.



In addition to naming a new director, VRAC will now report to the College of Engineering – moving from the Office of the Vice President for Research. The change was recommended to support new strategic areas the center will be exploring in research, education and outreach. This change was also effective July 1.

Winer has more than 20 years of experience working in virtual reality and 3D computer graphics technologies. He received a B.S. in aerospace engineering from The Ohio State University in 1992 and M.S. and Ph.D. degrees in mechanical engineering from the University at Buffalo in 1994 and 1999. Winer teaches courses on mechanical systems design, optimization and professional ethics, and also holds courtesy appointments in the Departments of Aerospace Engineering and Electrical and Computer Engineering.

Winer's research interests include large-scale collaborative design methods; analysis, visualization and interaction with large data sets (i.e. "Big Data"); multidisciplinary design analysis and optimization; computer-aided design and graphics; and virtual reality and augmented reality for use in engineering design and manufacturing. He has had funding from a variety of sources including John Deere, the Boeing Company, the Department of the Army, Air Force Office of Scientific Research, National Science Foundation, Department of Energy, and the National Institute of Food and Agriculture. He is also a co-founder of three startup companies, the latest being BodyViz.com.

VRAC is an interdisciplinary research center focused at the intersection of humans and technology, aimed broadly at enhancing the productivity and creativity of people. The VRAC's world-class research infrastructure supports the research of faculty and students across campus, as well as the interests of collaborators from several federal agencies and numerous industry partners.

ISU researchers to study blockchain technology to improve sustainability in food markets

Food production systems could become more environmentally sustainable and K-12 students could become more educated about it as part of a new research project.

A team of Iowa State University researchers, led by mechanical engineering (ME) associate professor Mark Mba-Wright, recently received a $300,000 grant from the National Science Foundation (NSF) for a research project titled "CNH2-S: Sustainable field-to-market supply chains enabled by blockchain networks." The project will examine the development of blockchain technology to improve traceability and accountability in food markets, according to Mba-Wright.

"Our vision is that blockchain networks will unlock consumers' ability to incentivize sustainable food production practices," said Mba-Wright. "To accomplish this vision, we will be studying ways to integrate blockchain networks with field-to-market food supply chains. Blockchain networks will enable food producers, suppliers and consumers to store, track and monetize sustainable practices."

A blockchain is a system designed to store transactional information in a secure and robust manner. The blockchain network refers to the interconnected computers that store and transmit this information. These networks can be centralized similar to conventional monetary systems. However, a decentralized system allows a large number of participants to save, view and verify transactional information which provides important benefits that have not been extensively studied for food markets, according to Mba-Wright.

"In this project, we will investigate the design of blockchain networks that are suitable for farmers and consumers within a U.S. Midwest context," he said, adding that as a mechanical engineer he will specifically focus on optimizing the system from an energy and resource use perspective. The team will use nitrogen as an agent to link the food production system and the environmental footprint, tracking full-chain nitrogen use efficiency (NUE) from field to consumers.

The research team includes collaborators from a range of different disciplines on campus: Yong Guan (electrical and computer engineering), Chaoqun Lu (ecology, evolution and organismal biology), Lisa Schulte-Moore (natural resource ecology and management), Yu Wang (political science), Nancy Grudens-Schuck (agricultural education and studies) and Alexis Campbell (Science Bound). Additionally, the team hopes to collaborate with Iowa farmers, agricultural cooperatives and food organizations.


Mba-Wright

Education and outreach is another component of this project. The research team is collaborating with Science Bound, Iowa State's premier pre-college program to empower Iowa students of color to pursue degrees and careers in STEM fields, to develop curriculum material for the People in Ecosystems Watershed Integration (PEWI) model. This model aims to educate K-12 students and teachers on the potential of blockchain networks to improve the sustainability of the food supply.

"We believe informing the next generation of consumers on strategies to directly support food production practices that are beneficial to the environment could be a key strategy for supporting our farmers," said Mba-Wright. "Some of our students could also become future farmers who would adopt blockchain technology."

Research on this project began in August 2019 and funding will continue through January 2022. The project is supported by NSF as well as the Bioeconomy Institute at Iowa State University.

Chandra receives ASME award

Mechanical engineering professor Abhijit Chandra has received a prestigious award from a top organization in his field.

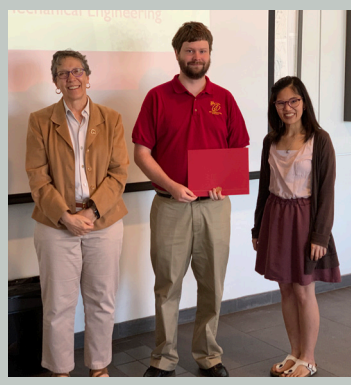

Chandra

In August, Chandra received the Excellence in Mechanics Award from the American Society of Mechanical Engineers' (ASME) Electronic and Photonic Packaging Division. This lifetime achievement award was bestowed upon Chandra because of advancements he has made in the areas of life prediction of devices and in semiconductor manufacturing.

This honor is awarded to just one individual annually. The Excellence in Mechanics Award was established in 1994 and recognizes achievement in the area of engineering and science of Structural Mechanics of electronic systems.

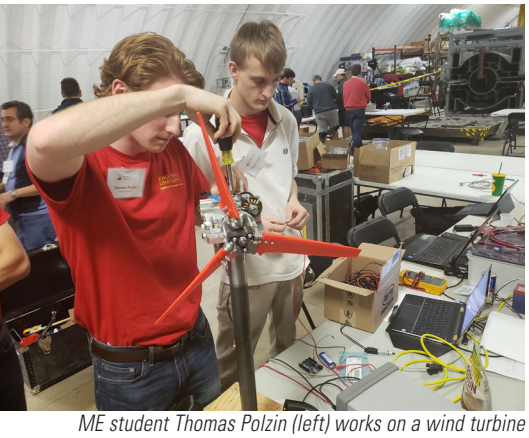
Morgan wins postdoc award

A mechanical engineering postdoctoral associate and department alum is among three from the College of Engineering to win research awards and funding from the Iowa State University PostDoc Association.



Timothy Morgan, postdoc in mechanical engineering (ME), won Postdoctoral Seed Grant funding support. His current project invovles designing and building a one-inch diameter bore RI scanner, specifically for taking non-invasive measurements of multiphase flows. Morgan works in the research group of Ted Heindel, Bergles Professorship in Thermal Science and university professor in the Department of Mechanical Engineering. Morgan holds a Ph.D. in human-computer interaction and ME, a B.S. in mechanical engineering and a MBA, all from Iowa State.

CyWind takes home project development award at Collegiate Wind Competition



ME student Thomas Polzin (left) works on a wind turbine

Iowa State's CyWind team competed in the U.S. Department of Energy's 2019 Collegiate Wind Competition, taking home the top project development award and a fifth place finish overall.

The Collegiate Wind Competition helps prepare students who are interested in the field wind energy by providing them with real-world experience in wind turbine design, construction and siting.

Teams developed a mechanical, electrical and aerodynamic wind turbine and load design that was safe and reliable to be tested in an on-site wind tunnel. Scores were determined by four categories: turbine testing, project development, technical design and knowledge of and adherence to competition rules and regulations.

CyWind members produced a video about their experiences at the competition, which is supported by the DOE, MidAmericanEnergy Co. and M:2:I Make to Innovate sponsored by Boeing. Nicholas David and Mathew Wymore, both graduate assistants in electrical and computer engineering, offered expertise to the team.

A total of 15 students from departments across the college participated in this M:2:I project, with only six students allowed to attend the competition at the National Renewable Energy Laboratory (NREL) Flatirons Campus in Boulder, Colorado. The students that represented Iowa State in the competition on the team were Brian Caskey, senior in aerospace engineering, Cody Hornyak, senior in mechanical engineering, David Jordan, senior in electrical engineering, Kathryn Paszkiewicz, senior in aerospace engineering, Sam Fletcher, senior in mechanical engineering, and Thomas Polzin, senior in mechanical engineering, along with faculty mentor Sri Sritharan, interim associate dean for strategic initiatives, professor of civil, construction and environmental engineering and the Wilkinson Chair in the College of Engineering.

Contributed by Olivia Benjamin/Engineering College Relations

Alum Dylan Neal applies PrISUm experiences to his job at HARMAN

Neal

"Team PrISUm served as the foundation for everything I know today, whether that be collaborating with team members, principles of project management, being comfortable with no clear answer and taking risks," said Cylone Engineer Dylan Neal ('18 mech engr).

While at Iowa State, Neal spent five years involved with team PrISUm. Neal served as project director and was a part of the leadership and competition team for Iowa State's first World Solar Challenge appearance. Neal's team built and raced what they dubbed "the world's first Solar Electric SUV" through the Australian Outback in 2017.

Now Neal applies his experiences from Team PrISUm to his job at HARMAN. As part of HARMAN's rotational program, he has worked in Global product sourcing and in digitalization improvements to global supply chain. Now, he works as a Technical Program Manager with engineers in the product development group and electrical/mechanical validation lab. In 2020, Neal plans to work internationally in Italy where he will work as a technical sales engineer and support the launch of new programs at HARMAN's manufacturing facility in Europe.

"Joining PrISUm was the highlight of my college career. I learned how to be innovative and work hard. The working world is like an over-sized solar car project – every day I learn something new," said Neal.

"Team PrISUm prepared me for my role at HARMAN better than any internship."

Contributed by Olivia Benjamin/Engineering College Relations

Dylan Neal, lower left corner, poses with other members of Team PrISUm at the finish line for the 2017 Bridgestone World Solar Challenge in Adelaide, Australia.

Engineering researchers to develop safer, more reliable machines

Mechanical failures in agricultural and industrial machinery could become easier to predict with the help of a new grant awarded to a team of Iowa State University researchers.


Hu

Chao Hu, an assistant professor of mechanical engineering, and his research team have received a $239,509 award from the NSF Partnerships for Innovation (PFI) program for a two-year project entitled "PFI-TT: Physics-based Deep Transfer Learning for Predictive Maintenance of Industrial and Agricultural Machinery." The aim of this project is to integrate physics-based modeling and data-driven transfer learning for enabling practical and scalable predictive maintenance that makes rotating machines safer and more reliable. This will be the third NSF project that Hu leads as the principal investigator (PI).

If a rotating machine (e.g., motor, pump, or fan) fails unexpectedly, this could lead to unplanned downtime, reduce customer satisfaction, and cause human injuries and fatalities. These consequences not only impact the end user of the rotating machine, but also the machine manufacturer by tarnishing their reputation and potentially putting them at a competitive disadvantage. Thus, according to Hu, it is imperative for companies across industries to have a scalable and practical predictive maintenance solution that will provide advanced warning of failure so that maintenance actions can be scheduled during planned downtime.

"What we want to create is a low-cost, easy-to-implement, massively scalable industrial internet of things (IIoT) platform," said Hu. "This platform allows remotely monitoring hundreds or thousands of machines that operate in the field or on a production floor. With the ability to remotely monitor large quantities of machines, maintenance and reliability engineers will be able to track the health of very large assets and better plan maintenance schedules."

Other Iowa State researchers serving as the Co-PIs on this project include Simon Laflamme, Waldo W. Wegner Professor in Civil Engineering; Carey Novak, Industrial Specialist for Iowa State's Center for Industrial Research and Service; and Matthew Darr, professor of agricultural and biosystems engineering. The project will also involve a consultant and technology commercialization expert – Andy Zimmerman, the CTO of Grace Engineered Products, who has expertise and experience in wireless sensing and communication, and IIoT product development and commercialization.

"The core of our IIoT platform is a new deep learning solution that provides more accurate and robust failure prediction than current solutions and can be easily deployed across multiple types of machines," Hu said. "The solution will be implemented on Grace Engineered Products' existing, industrially hardened IIoT platform, where a network of smart devices monitor machine vibrations and predict machine failures on the edge, and then send prediction results to a web-based Maintenance Hub that provides real-time analytics, dashboards and alert capabilities."

The broader impacts of this project will include (1) enhanced economic competitiveness of the U.S. industrial and agricultural sectors from having more reliable, safer and lower-cost rotating machinery and (2) training of undergraduate and graduate students with innovation and technology translation skills in machine learning, IIoT, and predictive maintenance. The students are expected to receive real-world experience working on a multi-team technology translation project from the idea stage through invention disclosure to licensing.

Funding for this research began on Aug. 1, 2019, and continue through July 31, 2021.

Predicting fuel drop-wall interactions, optimizing engine performance

Modern internal combustion engines power military ground transportation and unmanned air vehicles (UAV). But in certain operating conditions fuel drops can significantly impinge on the engine piston surface of these engines, affecting the fuel mixture distribution and performance – and the success of missions.


Kong

Song-Charng Kong, professor of mechanical engineering, and James Michael, assistant professor of mechanical engineering, are working with the Army Research Laboratory to develop high-fidelity computational models that predict drop-wall interactions. They also conduct experiments to validate the models that they develop.

Currently, researchers struggle to accurately predict the outcomes of drop-wall interactions, particularly when nontraditional fuels, such as those of interest for the military, are used.


Michael

The objective of Kong and Michael's project is to advance the fundamental understanding of the complex spray-wall interaction phenomena by using direct numerical simulation (DNS).

This fundamental knowledge will lead to the creation of an accurate computational tool capable of predicting fundamental details of drop-wall interactions in spray combustion systems. These simulations can then be used to design more effective engines with means of countering the effects of drop-wall interactions.

Not only will the proposed DNS be useful to the U.S. military, the approach will also be applicable to other industrial systems involving sprays, such as gas turbine engines, painting, cooling, fire suppression, and various types of chemical and material processing.

Kong and Michael's work is interdisciplinary in nature because it involves multiphase fluid dynamics and heat transfer occurring in a combustion system, which means this project fits the mission of the Iowa State's new Center for Multiphase Flow Research and Education (CoMFRE).

"CoMFRE provides the opportunity for me and graduate students to interact with other researchers," Kong said. "Such interactions are key to successfully taking on complex multiphase flow challenges like these."

Contributed by Madison Davies/
Engineering College Relations

From mechanical engineering to the Olympic stage: Tom Duncan's path to the 2018 Winter Olympics

Tom Duncan poses with one of the Olympic torches at the PNG House on February 18, 2018, in Pyeongchang-gun, South Korea.

Leading a global multimillion-dollar advertising campaign during the 2018 Winter Olympics required more than a creative marketing strategy. It required problem solving.

After nearly two decades at P&G, that's precisely a skill ME alum Tom Duncan possessed. And he credits the groundwork of his development to Iowa State and the engineering program.

"I had a really nontraditional path to a career in consumer marketing," said Duncan. "But my engineering degree taught me that any big problem is just a handful of small problems."

Duncan said he never planned to stay at one company for so long, but this August he will celebrate 17 years at P&G. Duncan said that the global scale and diversity of opportunities at P&G keep his career challenging and exciting. In just the last three years, Duncan's work has taken him to South Korea, Japan, China, Singapore, the UK, France, Switzerland, Brazil and Panama.

While at P&G, Duncan has worked across a number of brands, including Crest, Oral-B, and Head & Shoulders. Some of his accomplishments consist of the 2018 Olympics campaign "Love Over Bias," creating two new marketing campaigns for Head & Shoulders that returned the brand to growth, as well as developing award-winning advertising with Major League Baseball and the National Football League.

"In school I fixed engineering problems. Now I fix different kinds of problems," said Duncan.

After he graduated in 2001, Duncan started as a manufacturing process engineer at P&G in Iowa City, Iowa, where he designed and installed new equipment and created new training methods that reduced inventory build and lowered expenses. The results were so impressive, Duncan's efforts were globally reapplied by P&G.

Duncan quickly moved into an operations manager role and by 2006 moved to Cincinnati, Ohio, transitioning to brand management, first working on both the Crest and Oral-B oral care brands. Duncan then relocated to Fayetteville, Arkansas, where he led customer marketing efforts for P&G as a brand manager for Walmart. Now the associate brand director for the global P&G brand, Duncan leads digital marketing and content partnerships across P&G globally, as well as the P&G global Olympics program. Duncan has worked with both professional athletes, including Lindsay Vonn and Troy Polamalu, and world-recognized journalists, like Katie Couric and Arianna Huffington.

"Building marketing programs requires extensive teamwork and partnership, both inside P&G and with outside business partners," said Duncan. "I do nothing by myself. I credit the engineering program at Iowa State for demanding teamwork early in my academic career, which is a critical professional skill regardless of where your career takes you."

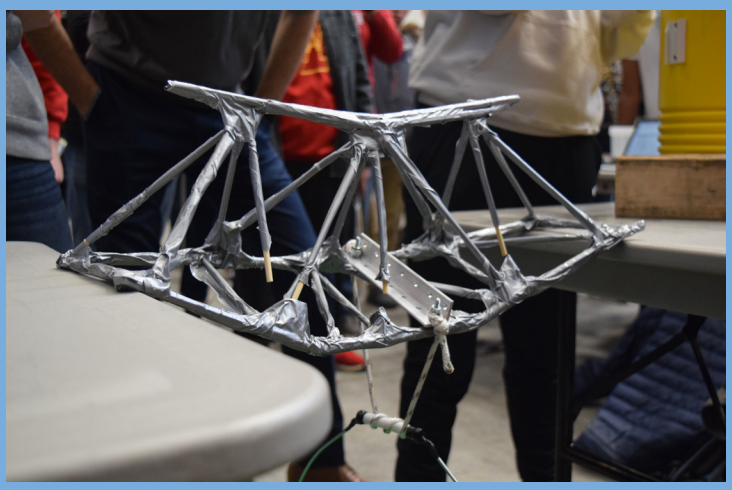
For Duncan, curiosity produces success.

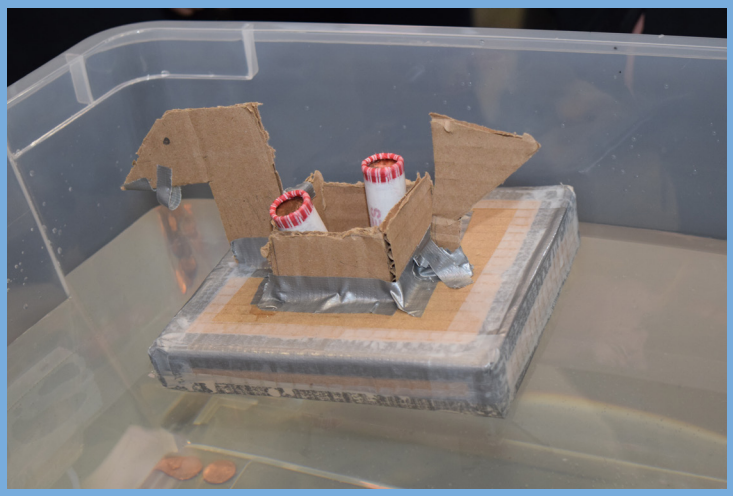
"You spend a lot of your waking hours at work. It's important to be intellectually challenged when you're there," said Duncan. "You don't stop learning after you graduate. Graduation is just the beginning."

Contributed by Liz Jacavino/Engineering College Relations

Mechanical Engineering Learning Teams Design Competition

On Nov. 21, students in the Mechanical Engineering Learning Teams (MELT) competed in the fall 2019 design competition inside the Howe Hall atrium. Groups competed in four different design categories: boat, bridge, catapult and rubber band car. There were lots of innovative ideas and cool designs, and we look forward to seeing what they have in store for next year.





Generating power and leadership: ME alum Cynthia Lord does it all

Armed with a fresh bachelor of science in mechanical engineering, Cynthia Lord headed east, joining Consolidated Edison of New York as a rotational engineer, where she worked with aspects of engineering and operations as well as marketing and finance. An early internship with Iowa Power and Light piqued her interest in the electric generation industry, and she's remained in the field her entire professional career.

Lord

While in New York, she completed an MBA from Baruch College and received her Professional Engineer (PE) license. In 1999 she returned to Iowa, taking a job as plant manager for Alliant Energy's Ottumwa Generating Station. She then served as manager of fuel procurement before taking her current position as manager of a generation engineering group.

Lord attributes much of her success to the skills and knowledge developed in Iowa State's ME curriculum.

"The foundational knowledge has been very important for my career in the power generation business. Nowadays, I don't do much actual engineering but knowing the concepts and vocabulary allows me to lead a very talented group of technical engineers," she said.

It took leaving Ames for Cynthia Lord to realize just how much she loves her hometown – and its university.

Lord grew up in Ames near the present location of Jack Trice Stadium and remembers sledding on the hill where the stadium now stands. Both of her parents graduated from Iowa State, with her mother Jean (Loving) Stout studying home economics education, while her father Ed Stout majored in agricultural engineering. Her father, who worked for Sundstrand (now Danfoss) in Ames, was a significant influence on her when it came time to select a major.

"He was 110 percent engineer, always analyzing things, and that rubbed off onto his two daughters as we both graduated from Iowa State with degrees in mechanical engineering," Lord said.

However, Lord actually attended the University of Iowa her freshman year, with the intention of studying biomedical engineering as a pre-med major. Finding bio-med too specialized after her first year, Lord left those constraints behind and transferred to Iowa State. As a Cyclone Engineer, she discovered mechanical engineering, which she felt provided a level of career versatility that biomedical engineering did not.

As a student, Lord was active with the Society of Women Engineers (SWE) which she saw as "a great place to meet other women engineers, at a time when there weren't very many of us." She was also involved with Iowa State's student chapter of the American Society of Mechanical Engineers (ASME) and served on the engineering council.

"Being involved in those groups broadened my understanding of engineering as a career and showed me that I had interest and ability to be a leader," she said.

Lord felt supported, often times even challenged, by all the ME faculty, but developed particularly close ties with Ted Okiishi and Gale Scandrett, who was also a family friend. She also remembers Bill Bathie and Alex Henkin, who are both still around Ames today. She completed summer internships with John Deere and the aforementioned Iowa Power and Light.

She cites the now-defunct VEISHEA celebration as one of her fondest memories from her time in Ames.

"I enjoyed VEISHEA as a teenager and as a college student," said Lord. "I recall winning the engineering egg drop contest with a very simple design that surprised many."

Outside of work, she trains and competes with her Cardigan Welsh Corgi dogs, Beeper and Neo, in the sport of agility. She also enjoys keeping up with Cyclone athletics, admitting that she follows the team more closely now than she did as a student.

"When I lived in New York City, I had to explain who the Cyclones were," said Lord. "Now, it is fun to have colleagues who are ISU alums and to engage in some friendly banter with colleagues from rival schools."

When reflecting on her time at Iowa State, Lord finds it interesting to think that she was often one of the only female students in a class or on a project team. She said she is encouraged that, in recent years, she's seen many more talented females entering the field.

Neo (left) and Beeper pose with their ribbons from a competition in Wisconsin.

"Finally, after more than 35 years in the business, I am delighted to see more women engineers in the business, and particularly in my company. I'm honored that I was able to hire many of them and watch them as they excel in their careers. Engineering is a great field for women to apply their talents and make a difference in the world."

Medical mechanical engineer: ME alum Emily Alexander has diverse skill set

Emily Alexander credits an Engineering and Beyond summer camp she attended in high school as one of her most influential exposures to engineering and the Iowa State University campus. Having grown up just a half hour away in Des Moines, attending Iowa State was the easy decision when it came time for college, but she needed to find a major that would lead to a career in the medical field.

Alexander

"At the camp, I was attracted to mechanical engineering as a major because of the broad curriculum and greater variety of career options after graduation," said Alexander. "I wanted to enter the medical field in some capacity after graduation and mechanical felt like the best option for my future career."

As a student, Alexander was a teaching assistant for Toying with Technology, a course for early education majors taught by an engineering professor to expose them STEM concepts and implementing them in the classroom. The course taught computer programming using LEGO robots and did community outreach events with K-12 students in the area.

"Helping teach this course pushed me out of my comfort zone and allowed me to improve my communication skills. I was forced to adapt my technical knowledge and learn to customize content for my audience," said Alexander. "This skill has been invaluable in my career as I've worked in cross-functional teams and have needed to explain something I understand in-depth to someone who is not as familiar."

A scene from a Toying with Technology video produced by Iowa State University's College of Engineering

Alexander cites courses like M E 270: Introduction of Mechanical Engineering Design and M E 324: Manufacturing Engineering as having the greatest impact on her path to becoming an engineer.

"I enjoyed M E 270 because it allowed students to explore the entire design process from start to finish in a hands-on manner," she said. "I also really enjoyed M E 324, especially the lab. I loved the course content and felt that the lab was the best of the ME program due to the hands-on projects and variety of manufacturing techniques we had the opportunity to try out after having learned the theory about them in lecture."

It was in M E 270 that Alexander had one of her most memorable experiences during her time at Iowa State when her team's design was nominated as the top project from her section, meaning they would then compete with the top projects from all of the other sections. The night of the department-wide competition happened to be her birthday and she recalls working with her group in the hours leading up to the event to tweak their presentation with the hope of captivating their audience on "why our cashew sheller design for Guinea Bissau would be essential to growing their economy."

"When the votes came in, my team had won and we were ecstatic. To this day, I'm still very proud of that project and it is probably my favorite from my undergraduate experience," she said.

Alexander also fondly remembers some of the relationships she developed with ME faculty and staff during her time as a student. She developed a close relationship with Cindy Bartleson, assistant to the department chair in ME, and cites Gloria Starns, associate teaching professor, as being both a mentor and a friend.

"I would often drop into Gloria's office to discuss anything from a SolidWorks technique to career advice to what we were watching most recently on Netflix," said Alexander. "I found Gloria to be a great professor and an inspiring role model, especially for female ME students like myself who found themselves in the minority every day in class."

In addition to her coursework, she also stayed busy with various engineering related extracurricular activities. She served as advertising co-chair for Engineer's Week and as president of the Women in Mechanical Engineering (WiME).

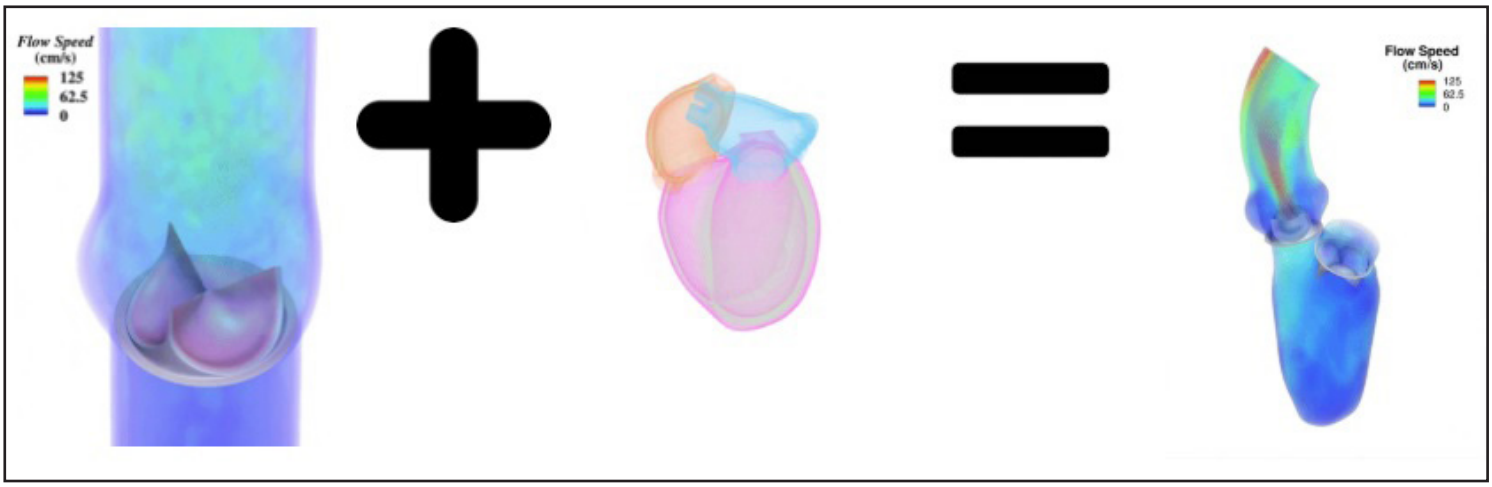
"Both of these appointments taught me the importance of balance and how to prioritize multiple responsibilities. I also gained experience with setting goals and motivating a team to complete projects which are skills I use every day in the workplace," she said.

She also spent a summer in an internship with Conductix Wampfler in Omaha, Nebraska where she developed manufacturing instructions for some of the company's most complicated products.

"This experience taught me a lot about manufacturing quality control and related directly to my operations quality engineer position after graduation," she said.

After completing her B.S. in ME in December 2014, she was hired as a medical device reporter for Medtronic in suburban Minneapolis, Minnesota. She soon moved to a more traditional engineering position as an operations quality engineer for St. Jude Medical. She also enrolled in the Medical Device Innovation program at the University of Minnesota and recently completed her M.S. Earlier this year she was hired as a human factors engineer at Worrell Design, Inc., a small design firm in Minneapolis that provides various services for healthcare companies.

In a heartbeat: Machine learning speeds up heart-valve simulations



Adarsh Krishnamurthy and Ming-Chen Hsu got to talking about their research interests – Krishnamurthy works in simulating cardiac mechanics and Hsu in simulating valve dynamics – when they had an idea.

"He has the heart without the valve, and I have the valve without the heart," Hsu said. "We thought 'why don't we just put them together?'"

Modeling heart-valve replacements

Modeling heart valves and the mechanics of the fluid moving through the heart chambers can be used to predict deformations and diseases that affect the valves. Simulations can also add in a virtual prosthetic replacement valve to examine its effectiveness.

Replacing valves can be a very risky procedure for patients with valvular heart disease, so knowing ahead of time as much as possible about how a prosthetic valve will help a specific patient with specific circumstances will save money and lives.

But, one simulation of heart-valve movement (dynamic closure and opening) takes about four and half hours to complete, and one simulation of fluid movement (with fluid-structure interaction) through a valve takes about one week. In addition, development of a coupled fluid-structure interaction model with accurate movement of the ventricles is complicated, and this can take years.

From years to minutes

So Krishnamurthy, assistant professor of mechanical engineering, and Hsu, associate professor of mechanical engineering, knew who they needed to add to their team: Soumik Sarkar, associate professor of mechanical engineering, and an expert in machine learning. They also enlisted the help of Aditya Balu, graduate research assistant in mechanical engineering.

The team now hopes to teach a machine to predict heart valve simulations, and eventually fluid-structure interaction simulations of heart valves by providing enough data and simulations to learn from. Their initial tests of the machine learning have produced predictions that are 95% accurate according to the actual physics simulations that are run.

The potential with machine learning is simulations that normally take hours or days could be predicted by a machine within a matter of seconds. The long-term goal is to design custom-created heart valves unique to patients' anatomy and health problems.

Combining expertise, solving problems

This combined research project falls under the umbrella of the Center for Multiphase Flow Research and Education (CoMFRE).


Hsu

"CoMFRE is about the fluids," Krishnamurthy said. "But with our expertise, we can also look at how the fluids interact with other physics. So, we are really working closely with the Multiphysics part of CoMFRE in this project."


Krishnamurthy

The team's work is different from what people typically think of as mechanical engineering, but they are able to do this work because Iowa State encourages creative new lines of research that apply engineering across traditional discipline lines.

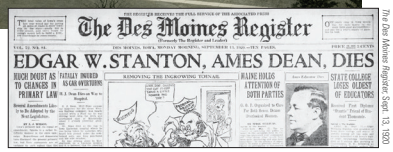
"A lot of people think, 'Oh, you guys are doing biology.'" Hsu said. "No, it's a very mechanical problem. At its core, a heart is a pump and it has four valves. They should open, and they should close – and that's what we are doing here!"

Contributed by Madison Davies/
Engineering College Relations

New book celebrates 150 years of Mechanical Engineering at Iowa State


The engineering campus, circa 1919.


A scene from a class focused on the care and repair of automobiles, around 1920.


The Des Moines Register, Sept. 13, 1920.

The Des Moines Register

EDGAR W. STANTON, AMES DEAN, DIES


Ames Daily Tribune, Jan. 23, 1923.

Madison Case Settled

Proprietor of New London Pays Local Plumber $100.

W. G. Madison, local plumber, claiming that he had been damaged in the amount of $500 thru humiliation, mental suffering, and exposure to public contempt and ridicule, because he had been denied service at the New London restaurant here, brought an action in district court to recover.


The Ames Daily Tribune, July 13, 1918.

TRAINING THE ENLISTED MEN CARE OF AUTOS

Five Hundred at the Technical School at State College.

Ames, Ia., April 19.—(Special.)—Five hundred enlisted men are on the campus at Iowa State college for two months' technical training along the lines of repairing and caring for automobiles and motor trucks. These men are from Missouri; they are a fine lot, having been picked because of their previous training or fitness to take up such work. They will use the shops and laboratories of the mechanical engineering department of the college, and will also require additional equipment which is being installed in tents and buildings on the campus.

April 1918
The training program begins for military auto mechanics, blacksmiths and machinists as 500 soldiers come to campus. Though completely separate from the college's academic program, the training is led by ME professor Warren Meeker. During World War I "[t]he work of every department was reorganized to render maximum service to the nation. Courses not directly connected with the war effort were dropped." To contribute to the war effort, courses were added in radio communications, signal corps practice, telegraph and buzzer signaling, military reconnaissance, gas engines, machine shop and more. Professor Meeker taught an eight-week course that provided roughly 500 enlisted men with "extensive training" in machine shop, auto mechanics and repair processes. During this time ME alum Edgar Stanton was serving his fourth term as acting president (1917-18), filling in for President Raymond A. Pearson, who took a leave of absence to serve in the U.S. Department of Agriculture as part of the war effort.

***Circa* 1920**
By 1920, Iowa State's engineering school had grown "from one small Department of Mechanic Arts with two instructors, a workshop and less than a score of students, into one of the largest engineering schools west of the Mississippi River, with over one hundred instructors, eleven engineering buildings and over one thousand students of collegiate grade," according to department historical records. Following World War I, ME enrollment hit 430, more than double the enrollment of the previous year.

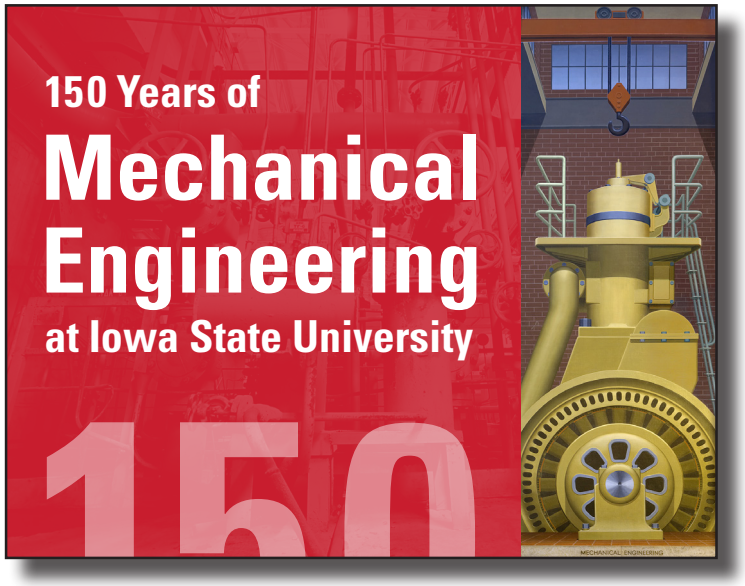
Sept. 12, 1920
Edgar Stanton, who served his alma mater for nearly half a century, dies. His death was attributed to a combination of the Spanish flu - which he contracted during the 1918 epidemic - and diabetes.

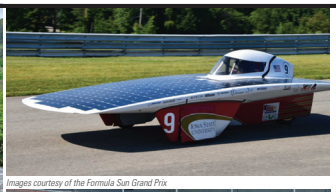
Feb. 1, 1922
ME alum Walter Madison, the department's first African American alumnus, is denied service when he attempts to order lunch at the now-defunct New London restaurant in downtown Ames. Madison, who owned a heating and plumbing business in Ames, filed a lawsuit in Story County District Court against the restaurant's owner for the humiliation and mental anguish he experienced. The case was settled out of court in January 1923, and Madison was awarded $100. State law at the time forbade restaurants, hotels and other establishments open to the public to deny service based on race or color.

Twenty-nineteen (2019) marks the 150th anniversary of the first class of students enrolling at Iowa State. In commemoration of this historic event we will publish a book about 150 years of mechanical engineering history at Iowa State. Mechanic Arts, which included mechanical engineering, was one of the original majors offered to students. The other was agriculture. Today our department has the largest undergraduate enrollment of any department on campus.

The book will be available early spring 2020. To order your copy, please visit:

www.me.iastate.edu/history-book




Images courtesy of the Formula Sun Grand Prix

Above: *A shot from the 2015 trip to Nicaragua.*

Right: *Team PrISUm's Phaëton races down the front straight of the Circuit of the Americas in Austin, Texas.*


COURTESY OF IOWA STATE UNIVERSITY ATHLETICS


Willer

Above: *In addition to her 2015 Big 12 Scholar-Athlete of the Year honors, Koree Willer was a three- time Academic All-Big 12 First Team selection (2014, 2015, 2016), All-Big 12 First Team selection (2015) and a Team Offensive MVP (2014).*


Sundararajan

Summer 2014
Students in the Human Centered Design service learning course, taught by ME associate teaching professor Gloria Starns, travel to Nicaragua where they work with locals to collect information and then design products based on the needs of the individuals and the resources available. The students collaborate with the Nicaragua-based non-profit Emerging Opportunities for Sustainability, which was founded by ME alum Wes Meier.

December 2014
ME professor Jonathan Wickert, who also serves as the ISU's Senior Vice President and Provost, becomes the first Iowa State faculty member inducted into the National Academy of Inventors.

July 31, 2015
Iowa State's Team PrISUm car Phaëton takes first place at the 2015 Formula Sun Grand Prix in Austin, Texas. Phaëton racked up 223 laps for a total of 764 miles, well ahead of the second place team from École Polytechnique de Montréal with 192 laps for 658 miles. Phaëton also recorded the fastest lap time on the 3.426-mile, 20-turn track clocking in at 4:30.444, roughly 14 seconds ahead of the next closest team.

December 2015
ME student Koree Willer is the first Cyclone soccer player named a Big 12 Scholar-Athlete of the Year. The forward from Ft. Collins, Colorado was recognized for her 3.90 GPA in the classroom and her six goals and three assists on the field.

April 2016
Iowa State SAE (Society of Automotive Engineers) Baja team takes first place in endurance for the third time during a competition in Cookeville, Tennessee.

July 1, 2016
ME professor Sriram Sundararajan begins his term as the College of Engineering's associate dean for academic affairs.

Fall 2016
Iowa State University becomes the largest undergraduate ME program in the nation.

Department of Mechanical Engineering
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2529 Union Dr.
Iowa State University
Ames, IA 50011-2030

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- Awarding seed money for new projects
- Funding access to state-of-the-art technology through new equipment purchases and laboratory renovations
- Attracting top-caliber faculty to Iowa State

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