DIMENSIONS

Volume No. 25 | Issue No. 2
July 2018

IOWA STATE UNIVERSITY
Department of Mechanical Engineering

Message from the Chair

Dear alumni and friends,

We are proud to share the stories and achievements of our students, faculty, staff and alumni after yet another busy semester in the Department of Mechanical Engineering at Iowa State University. We are particularly proud of our three assistant professors (Shan Hu, Adarsh Krishnamurthy and Juan Ren) who received CAREER awards from the National Science Foundation. This was especially impressive considering just eight assistant professors across the entire university – and seven from the College of Engineering – received this award.

The department added one new faculty member for the spring 2018 semester: Paul Schafbuch joined the ME department as a senior lecturer after serving as an associate professor of practice for Iowa State's Department of Aerospace Engineering. Administrative specialist Katie Lott shifted positions within the department to assume an active role in the Capstone and administrative areas.

Our faculty have had a busy and productive semester. Read about ME researchers who are collaborating with their counterparts in the Department of Agronomy to develop a smartphone-based app that can help farmers diagnose stresses in soybeans as well as research by ME's Robert C. Brown and Alberto Passalacqua that aims to scale up autothermal production of bio-oil. You can also read about ME assistant professor Jonathan Claussen and his research on flexible, water-repellent graphene circuits for washable electronics as well as a project with other Engineering researchers that aims to develop bio-based carbon fiber.

Our students have had a busy and productive semester. Read about four ME impact-makers from Iowa State's chapter of the National Society of Black Engineers, an ME student who competed in the 2018 Boston Marathon finishing 29th out of a field of more than 14,000 runners, and a student group that is touring Iowa high schools to teach students about automotive engineering opportunities available at Iowa State.

This issue also highlights the achievements of few past alumni. Read about the lives of ME's first female faculty member Elmina Wilson (1895), ME's first female graduate Florence Kimball (1908), and ME's first African American graduate Walter Madison (1914). Also highlighted is an ME alum who recently published a book that he hopes will make high school students interested in engineering, as well as an alum who does outreach to expose underprivileged elementary school students to the STEM field.

Our alumni are vital to the growth and success of mechanical engineering and industry in the U.S. and abroad. We enjoy hearing about your accomplishments. Please feel free to reach out and share your story. You can contact us at mealumni@iastate.edu.

Regards,

Caroline Hayes
Department Chair
Lynn Gleason Professor of Interdisciplinary Engineering

On the cover

Joshua Meeks of Ohio-based Meeks, Watson and Co. pours molten bronze into a bell mold inside Black Engineering Building on April 10. The bell is part of the Campanile Carillon Model Project which has been a multi-semester project by studuents in the ME senior capstone course. Photo by Christopher Gannon of ISU News Service

Volume No. 25 | Issue No. 2

Published by the Department of Mechanical Engineering, College of Engineering, 2043 Black Engineering, 2529 Union Drive, Iowa State University, Ames, IA 50011-2030; *www.me.iastate.edu; isume@iastate.edu*

Prepared by Nick Fetty, Engineering College Relations Communications Specialist, *nrfetty@iastate.edu*

Three ME faculty receive prestigious NSF CAREER awards

Seven Iowa State University College of Engineering faculty - three of whom are from mechanical engineering: Shan Hu, Adarsh Kirshnamurthy, Juan Ren - have been selected for 2018 National Science Foundation's Faculty Early Career Development Program (CAREER).

CAREER awards are the NSF's most prestigious awards given to early-career faculty. The support aims to build a firm foundation for leadership in integrating research and education.

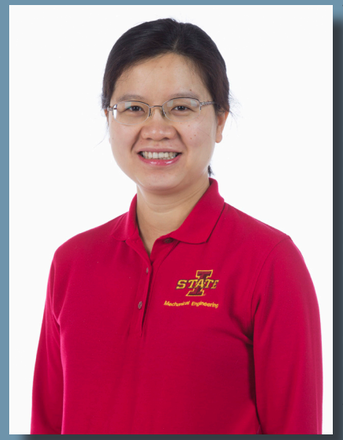
The five-year awards total nearly $3.3 million and represent the first time that Iowa State's College of Engineering has received seven CAREER awards in one year.

"CAREER awards are very competitive, so receiving just two or three in a year is excellent. Receiving seven in a year is simply outstanding," says Arun Somani, associate dean for research. "These CAREER awards are a clear testament to both the early achievement and high potential of our engineering faculty."

"I congratulate our seven CAREER award winners and I'm impressed by the high-impact research and educational activities they have planned," says Sarah Rajala, dean of the College of Engineering. "The CAREER awards are evidence of the exceptional quality and creativity of our faculty. Iowa State University students are learning from the best of the best in engineering."

Hu aims to improve solar panels, batteries for wind energy storage

An ongoing research project by a mechanical engineering faculty member could lead to improved solar cells and better batteries for wind energy storage.



Hu

Shan Hu, an assistant professor of ME, recently received a CAREER award from the National Science Foundation (NSF). Hu is one of three ME researchers at Iowa State to receive the award this year, and is one of seven in the entire College of Engineering. The award will provide her with $500,000 over the next five years for her project entitled "Scalable Manufacturing of Hierarchical Nanostructures by Acoustically Modulated Emulsion Technique for Next Generation Renewable Energy Applications."

"I will investigate how the acoustic field can move and assemble droplets of an emulsion, a multi-phase fluid system consisting of two or more immiscible liquids. And apply this knowledge to develop a new nanomanufacturing strategy for the scalable assembly of nano-sized building blocks into functional hierarchical structures," said Hu. "The resulting hierarchical structures hold the promise of boosting the performance of solar cells, batteries, catalysts, and more."

Hu, who joined the Iowa State faculty in 2014 after completing her PhD in mechanical engineering from the University of Minnesota-Twin Cities, said that winning this award has been a major accomplishment in her professional life.

"I am thrilled and grateful to receive this NSF CAREER award. Since I have been thinking and working on the proposed research idea behind the CAREER proposal for a long time, this award is a dream-come-true to me. This award is also very important for me to develop my career as a researcher and educator," she said, adding that she's thankful for efforts by her fellow faculty members as well as the pre-award support team.

Hu's research will mostly focus on the mechanical engineering principles of acoustics and fluid mechanics. Specifically, she'll look at the dynamics of emulsion droplets when they are subjected acoustic radiation forces and drag forces in a standing acoustic field.

The findings of her research can have various applications, some of which relate directly to Iowa.

"The knowledge gained from this research project will enable the scalable manufacturing of designer materials, which hold the promise of boosting the performance batteries, which is an important component for wind energy storage, and catalysts, which enable faster and more efficient production of biofuels, both of which are major industries here in Iowa," said Hu.

"I want to show that although mechanical engineering is one of the oldest branches of engineering, knowledge from a mechanical engineering degree is essential for solve emerging technical challenges in advanced materials and manufacturing, renewable energy, and more."

Hu's research will also aim to bring in students from underrepresented minority groups as well as students from community colleges to Iowa State to complete four-year degrees and potentially advanced degrees.

Hu plans to again serve as a mentor for the Microscale Sensing Actuation and Imaging (MoSAIC) Research Experience for Undergraduates (REU) program, which brings undergraduate students to Ames to participate in a summer-long research project. In the past the MoSAIC REU has brought in students who finish their associate's degree at Des Moines Area Community College to complete a four-year degree from Iowa State. In addition to focusing on junior college students, Hu's research will also attempt to recruit students from underrepresented minority groups.

"Engaging underrepresented minority groups is a good investment of time and effort," said Hu. "My research group will benefit from increased diversity, because I believe a diversified group brings new perspectives and nurtures creativity to solve research problems."

Hu is currently building the proposed nanomanufacturing platform with a team of both graduate and undergraduate students. In the next step, they will establish a multi-physics and multi-scale computational model of the setup to speed up the material design and manufacturing process.

Krishnamurthy will use computational modeling to improve treatment of cardiovascular diseases

An upcoming research project by a mechanical engineering faculty member will use computational modeling to improve treatment processes for various cardiovascular diseases.

Adarsh Krishnamurthy, an assistant professor of mechanical engineering, recently received a CAREER award from the National Science Foundation (NSF). Krishnamurthy is one of three ME researchers at Iowa State to receive the award this year, and is one of seven in the entire College of Engineering. The award will provide him with $500,000 over the next five years for his project entitled "GPU-Accelerated Framework for Integrated Modeling and Biomechanics Simulations of Cardiac Systems."

"The overarching goal of this research is to advance the state-of-the-art technology in translational medicine with the help of computational modeling and interactive analysis tools that will improve the basic understanding of the cardiac muscle and facilitate personalized treatment of cardiovascular diseases in patients," Krishnamurthy said.

The research will focus on creating novel computational methods and tools to automate simulation and analysis of patient-specific cardiac systems resulting in optimized cardiac therapies and developing advanced multiscale methods to model muscle contraction and growth that will help in advancing knowledge about disease and therapeutic mechanisms.

According to data from the Centers for Disease Control and Prevention (CDC), heart failure affects 5.7 million Americans which poses a severe burden on the healthcare system. Current treatment for heart failure is mainly based on the patients' severity of their symptoms. However, identifying patients who will best respond to a particular therapeutic intervention is difficult, and there is an urgent need for clinical decision support tools that help cardiologists optimize patient response.

Krishnamurthy said that computational models, developed from patient-specific clinical data, can help refine the diagnosis. His proposed research project will focus on developing predictive computational models that can be used to explain the different mechanisms of heart failure.

"One of the main challenges in developing patient-specific models are the lack of tools to systematically generate the patient-specific geometry and tune the parameters of the model to match baseline cardiac characteristics of the patient," said Krishnamurthy. "As part of this research we will build computational tools that facilitate the generation of patient-specific cardiac models from clinical data – such as CT or MR images and pressure measurements – with minimal user intervention that can replicate the baseline characteristics of the patient and can ultimately be used to personalize heart failure intervention therapies."

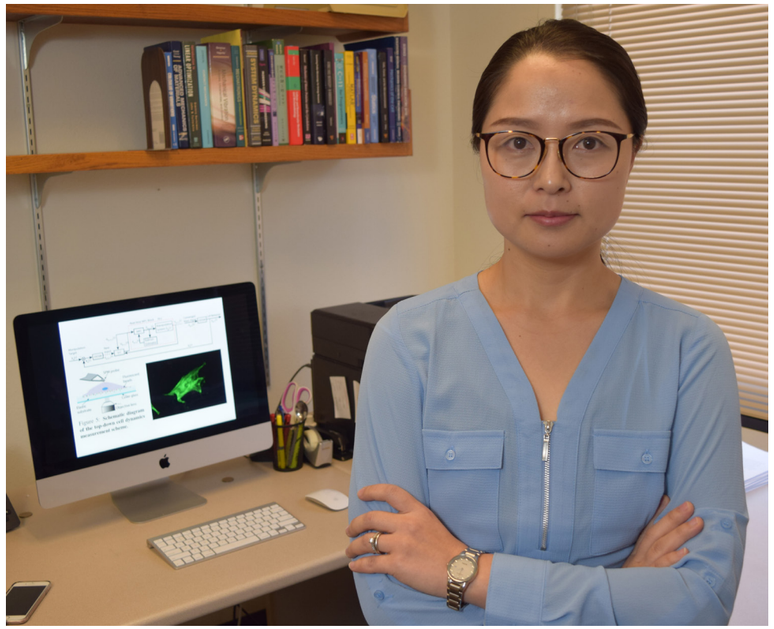
Krishnamurthy's research also aims to bridge GPU-accelerated modeling and simulations with biomedical engineering. Through subject-specific modeling and the resulting data, bioengineers and other medical professionals will be able to better understand complex heart diseases in humans as well as in different species.

While this research has applications that extend nationally and even internationally, it can also have a direct impact in Iowa where heart disease has been the state's leading cause of death since 1920, according to data from the Iowa Department of Public Health. Through this research Krishnamurthy said he would like to better pinpoint the regional differences that lead to higher rates of heart disease in Iowa.

In addition to its application within the fields of engineering and medicine, the computational models developed from this research can serve as educational tools. For example, an animation of a beating heart can be used to explain concepts such as the different stages of the heart cycle, pressure volume loops, and other concepts both to engineering as well as medical students.

"The broader impacts of the proposed work can be divided into educational tools for students and for the general public," said Krishnamurthy. "The outcomes of this project will bear significant impact on numerous applications in mechanical engineering, and will benefit researchers in both academia and industry."

Ren examines mechanical behavior of cells



An upcoming research project by a mechanical engineering faculty member will study the dynamic mechanical behavior of live cells which might someday be used to help treat cancer.

Juan Ren, an assistant professor of mechanical engineering, recently received a CAREER award from the National Science Foundation (NSF). Ren was one of three ME researchers at Iowa State to receive this award, and was one of seven in the entire College of Engineering. The award will provide her with $500,000 over the next five years for her project entitled "Modeling and Control of Cellular Response to Dynamic Mechanical Manipulation Using a Dual-Input Platform."

"The aim of this research is to develop a hardware as well as a control algorithm to study the dynamics of cell mechanical response, or what we call mechanotransduction," said Ren. "The first step we need to do is invent a platform which can excite or disturb the cells using forces on both the top of the cells as well as the bottom where they grow. With this platform, which we call the dual-direction platform, we can observe if we excite the live cells from different directions, and how the structure of the cytoskeleton, which is the internal skeleton of the cells, will change in order to affect the cell's mechanical response."

Once Ren and her research team study this, the next step will be to use control approaches to manipulate the mechanical properties of cells to make them behave in a way mechanically that is good for tissue generation or other biomedical applications.

"This is an interesting topic and no one has looked at it extensively from the mechanical and controls point of view," said Ren. "I'm junior faculty here and this was the first time I submitted an NSF CAREER proposal so I was pretty excited when I heard I won it."

The primary application area for his project is for biomedical uses. From the medical point of view, Ren and her research team can use the outcome of this research to improve a medicine's effectiveness. For example, they can study the most effective and efficient ways for cells to absorb the active components of a drug or protein.

Another direct product of this is that because they are studying the mechanical reorganization of the cytoskeleton and its dynamics, they can use the data and the model they build for biosynthesis approaches to build materials or structures which can synthesize the behavior or simulate the behavior of true cells or even at the tissue level.

More effective cancer treatment would be one potential outcome of this research. In general cancer cells are softer than normal cells, and because they are soft they are more flexible to migrate to affect other healthy tissues. Once Ren and her research team can control the growth of the cell or tissue they can target and eliminate the bad cells or tissues.

Ren added that this research extends beyond just biomedical applications for humans.

"With some modifications it can also be applied to veterinary medicine as well as plant cells, plant tissues, and soil to enhance the growth of an agriculture product," Ren said.

While Ren's research focus is on mechanical measurements and controls, she has worked with researchers in other areas who have provided their specific expertise. Meng Lu, who has dual appointments in ME as well as electrical and computer engineering and won the NSF CAREER award last year, penned a letter of support which Ren submitted along with her other application materials. She will also be working with colleagues from chemical and biological engineering as well as physics on this research, adding that this interdisciplinary collaboration will be "important to the success of the project."

"For all of the biological phenomena, there are mechanical forces involved," said Ren. "Typically, when people think about cells they think about the biological and chemical aspects, however, the mechanical forces generated during these processes are also a key factor, so that's why as a mechanical engineering I was able to look at this issue."

She added that the modeling she will use on this project will be similar to how mechanical engineers model other structures and forces like fluid and solid mechanics.

"Mechanical engineering is a framework and serves as a tool for us to solve problems that usually show up in other areas," she said.

Eventually she said she hopes this project can also help to introduce the topic of nanomechanics or nanoscience to undergraduate students, even K-12 students through workshops, lab tours, mini seminars, and other outreach events.

Faculty honors

Baskar Ganapathysubramanian
Promoted to Professor

Nicole N. Hashemi
Promoted to Associate Professor

Ted Heindel, Bergles Professor of Thermal Science
2018 Regents Award for Faculty Excellence

Valery Levitas, Vance D. Coffman Faculty Chair
Named Anson Marston Distinguished Professor of Engineering

Mark Mba-Wright
Promoted to Associate Professor

Reza Montazami
Promoted to Associate Professor
2018 University Honors Committee Award for Excellence in Honors Mentoring

Michael Olsen, Professor
2018 ME Professor of the Year

Alberto Passalacqua
Promoted to Associate Professor

Xinwei Wang, Professor
2018 Award for Outstanding Achievement in Research

ME student-athletes to watch in 2018-19

Chase Allen - **Football,** *Tight End*

Greyson Dolezal - **Track & Field,** *Middle Distance*

Bryn Ericksen - **Swimming,** *Sprint Freestyle/Backstroke*

Carson Epps - **Football,** *Wide Receiver*

Demichael Franklin - **Wrestling,** *174 pounds*

Alex Kleinow - **Football,** *Offensive Line*

Charlie Kolar - **Football,** *Tight End*

Edwin Kurgat - **Track & Field,** *Distance*

Tanner Lundgren - **Wrestling,** *149 pounds*

Alec McDowell - **Wrestling,** *184 pounds*

Kene Nwangwu - **Football,** *Running Back*

Vlad Pavlenko - **Track & Field,** *Throws*

Jessi Storer - **Swimming,** *Distance/Fly*

Graduate student honors

Spring 2018 Research Excellence Awards
Austin Downey
Aayush Sharma
Fei Xu

Spring 2018 Teaching Excellence Awards
Yasaman Esfandiari
Emmanuel Hitimana
Reihaneh Jamshidi
Raghav Ram

Hossein Taheri
National Science Foundation (NSF) student grant for the POWDERMET2018 and AMPM2018 conferences
R. Bruce Thompson Graduate Fellowship award from Iowa State's Center for Nondestructive Evaluation

Undergraduate student honors

Steven De Alwis, 2018 Dean's Student Leadership Award

ME 324L Undergraduate Teaching Assistant CYtation Award
Brian Dentlinger
Kyle Fossey
Alex Kin
Camryn Linster
Roy Molina
Gwen Nelson
Olivia Vogel
Emma Zeman

In Memoriam: Alfred "Al" Joensen

Alfred "Al" Joensen, a former associate professor of mechanical engineering at Iowa State University, passed away at Mary Greeley Medical Center in Ames on May 10, 2018. He was 87.

Joensen was born on July 24, 1930 and grew up in the Bronx, New York. He graduated from Stuyvestant High School and attended City College of New York where he played on the varsity football and lacrosse teams. In 1951, he joined the Air Force as a navigator and flew in missions all around the world. Following his active duty, Joensen served in the Air Force Reserve for 28 years, retiring with the rank of Lieutenant Colonel.

After an honorable discharge, Joensen studied mechanical engineering at Iowa State, graduating with his bachelor of science in 1957. He then enrolled in graduate school at Iowa State, simultaneously working as a part-time instructor, and graduated in 1965 with his master of science in mechanical engineering. He then served on the mechanical engineering faculty until his retirement in 1999 at which time he was granted the title of Associate Professor Emeritus in Mechanical Engineering.

Joesen's research and teaching focused on power plant design, thermodynamics, and alternative fuels. He was involved with Iowa State's partnership with the City of Ames to study the effects of burning landfill items to generate electricity.

Outside of his responsibilities with the university, Joensen was active with area Cub Scout and Boy Scout troops. He was also a member of St. Thomas Aquinas Parish (1959-1976) and St. Cecilia Parish (1976-2018). He served as a minister to the sick and homebound for St. Cecilia. He was a member of the Knights of Columbus and was also a big supporter of athletics at both Iowa State and Ames High, often serving as a timer at ISU track meets. Along with his family, he also enjoyed traveling around the United States and Europe.

On August 17, 1959 Joensen married Marilyn Simington in Waterloo, Iowa. The couple lived in Ames during their 58-year marriage and raised four sons and a daughter. Joensen is survived by his wife, five children, and seven grandchildren.

facebook.com/ISUMechanicalEngineering

Q&A with nondestructive testing award-winner Hossein Taheri

Hossein Taheri will complete his PhD in mechanical engineering at the end of the summer. He is also a recent recipient of the 2018 Young NDT (Nondestructive Testing) Professional Recognition award from the American Society of Nondestructive Testing (ASNT). Taheri, who was co-advised by Timothy Bigelow and Leonard Bond, will work as a nondestructive evaluation (NDE) research engineer for Molex in Chicago after graduation.

Tell us a bit about your background: where are you from and when did you first begin developing an interest in engineering?

I was always interested in physics and engineering problems. I graduated with a BS in mechanical engineering from Shahid Beheshti University in Tehran, Iran. After working in industry for a few years, I decided to pursue my graduate degrees in engineering and attended South Dakota State University for a master of science degree in mechanical engineering.

Why did you choose to attend Iowa State? Why did you choose to study mechanical engineering?

Mechanical engineering is very diverse in research topics and has many connections with other fields of research. My field of research in quality assurance and evaluation needs knowledge in multidisciplinary research. The Center for Nondestructive Evaluation (CNDE) at Iowa State University is the pioneer in NDE research and education in the world and it was always my goal to join this group.

Your research seems to touch on electrical engineering along with mechanical engineering. In what ways do you observe overlap between these two fields?

Concepts in mechanical engineering provide the physical background of NDE, however extracting more information from the testing results requires the advanced signal and data processing techniques and concepts from electrical engineering.

How has your membership in the American Society For Nondestructive Testing advanced your professional goals?

Membership in professional societies is a very beneficial way to get involved in the advanced techniques and research in each field. Membership and activities in ASNT helped me to expand my knowledge in NDE and learn from other people in the field.

Tell us a bit about what your research involves.

My research work with Iowa State's CNDE is about using NDE techniques for in-line quality monitoring for 3D printed metal parts. The goal of my research was to evaluate the quality of the 3D printed parts during the manufacturing process.

Based on your experience, what advice would you have for an incoming college student who is interested in engineering?

Try to explore your interests in the engineering field. At the end of the day what matters most is skills that you need to acquire. Specifically: problem solving, the ability to analyze, good communication skills – both written and verbal, punctuality, the ability to work in teams, initiative, determination, and resilience.

Members of Iowa State's chapter of National Society of Black Engineers making national impact

Daoud

Abdelwadood Daoud, senior in mechanical engineering, serves as the NSBE Region V finance chair.

In this position, Daoud is considered a corporate liaison, promoting events by company request to NSBE students, raising funds through communication with corporate human resources leaders and coordinating the regional career fair of over 1,000 students.

"My goal is to negate the thought of money when the region is talking about professional development opportunities or other parts of the NSBE mission," Daoud said. "With my work, we're able to fund the conferences that provide students with the best experiences at NSBE."

After joining NSBE and becoming the finance chair for the chapter his sophomore year, Daoud wanted to show other members why he is so passionate about the organization, so he ran for vice president of the Iowa State chapter during his junior year.

Daoud took Jocelyn Jackson's recommendation to run for Region V finance chair during his senior year, and he was elected.

"I'm in contact with the heads of HR at most companies in the United States. I can help connect anyone in the organization with these companies through these opportunities," Daoud said. "With the help of NSBE, a student from Iowa State can be talking to a vice president of engineering at Google and director of HR at Texas Instruments."

Daoud says that his time with NSBE has helped him to develop his skills in leadership, speaking, finances and understanding the corporate structure, and that he has learned the most from the people involved.

"It's all about developing connections with as many people as possible to see where it might lead," Daoud said.

Hudgins

Aaron Hudgins, a senior in mechanical engineering, serves as the NSBE Missouri Zone Chair for Region V. In this position, he communicates between the regional board and the chapters within North Dakota, South Dakota, Iowa, Missouri and part of Nebraska.

Hudgins listens to concerns from the chapters to inform the regional board, keeps chapters on track and ensures recruitment and retention efforts are continual at the chapter levels.

Hudgins first learned about NSBE through NSBE Junior, a program that now starts at the middle school level, teaching students about STEM fields and engineering.

"The main reason that NSBE exists, in my eyes, in to make engineering a household name in black communities," Hudgins said.

As a native of Kansas City, Missouri, Hudgins saw, firsthand, the lack of opportunities for professional development in his community. For that reason, he is passionate about NSBE's visits to middle schools and high schools to influence kids in the community and teach them about STEM fields.

"It's not common for a young black male in Kansas City to become an engineer, or even go to college," Hudgins said.

After learning about NSBE in high school, Hudgins sought leaders of NSBE during his second semester at Iowa State, when he became a member and attended the National Convention in Nashville, Tennessee.

"It's a very professional organization, and the people that you get to work with are phenomenal," Hudgins said.

Since his first convention, Hudgins has served as finance chair, treasurer, vice chairperson and now Missouri Zone Chair.

Hudgins urges students to participate in NSBE and push the mission, from elementary students to lifetime members.

"As long as you're committed to the organization, you can go a long way," Hudgins said.

Jackson

For **Jocelyn Jackson** NSBE has become more than just a club.

"I definitely would not have made it in engineering without NSBE," Jackson said.

As the representative at the national level for over 3,500 constituents in Region V, Jackson sets goals and directives at the regional and chapter levels in order to help the organization remain successful.

Jackson's position allows her to take ownership of a budget of over $120,000 to push the NSBE mission.

"It's like we've already had the equivalent leadership as a manager of a company, and we're allowed to make mistakes and learn from them," Jackson said.

Because NSBE is a student-run organization, the students are "the CEOs" of the organization, according to Jackson. Professional staff are hired for day-to-day operations, but students are the ones who call the shots.

The society's current vision, NSBE 2025, has a goal to graduate 10,000 black engineers annually by the year 2025 in Region V. The nation is currently at a bit over 3,000 per year, according to Jackson.

In order to achieve NSBE 2025, the organization offers STEM promotion and education programs, including NSBE Day at NASA in Houston, Texas and educational visits to middle schools and high schools across the region.

The ISU chapter also currently coordinates a program called "Engineering the Future" at the local Ames Middle School.

When Jackson discovered NSBE when she first came to campus, she jumped at the opportunity to get involved. NSBE provided her with the family and home feeling that she'd been missing.

Jackson decided to run for a position to fundraise for the chapter, and did so well that she continued for another semester. Jackson then became a regional board member, so she could better help affect positive change in the organization.

Jackson urges other students to get involved in NSBE by becoming a chapter member, then advancing as far as they'd like to in NSBE leadership from chapter officers to national executive board members.

With support from, not only chapter members, but over 12,000 members at the national conventions, NSBE could become like home.

"NSBE is not only going to get you to where you need to be, but they'll love you while they do it," Jackson said.

Ahmad Shehata, a senior in mechanical engineering, is the Technical Outreach and Community Help (TORCH) chair for NSBE's Region V.

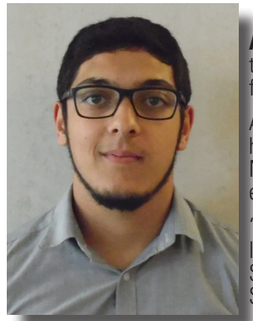
As the TORCH chair, Shehata promotes STEM events and holds workshops and events to let people know more about NSBE. He is particularly passionate about NSBE events that encourage kids to pursue STEM fields.

"It feels really good to impact kids in a positive way. A lot of parents express interest in NSBE events related to STEM-fields because their kids enjoy our events so much," Shehata said.

Shehata also serves as an example that NSBE also helps people get their first internship through NSBE career fairs. After attending a single NSBE career fair, Shehata got interviews with Honeywell, Cummins and Boeing.

Not only does NSBE help students get a strong professional start, but the organization supports its members throughout their lifetime, according to Shehata.

"NSBE professionals also help fellow NSBE members find news positions or paths," Shehata said. "NSBE is a network of people in the same majors with an inclusive family vibe, all working to support and reach the same goal. Being involved has definitely connected me with a lot of great individuals. We all come from different backgrounds, schools and states, and that lets you expand your mind."



Shehata

Ahmad Shehata, a senior in mechanical engineering, is the Technical Outreach and Community Help (TORCH) chair for NSBE's Region V.

As the TORCH chair, Shehata promotes STEM events and holds workshops and events to let people know more about NSBE. He is particularly passionate about NSBE events that encourage kids to pursue STEM fields.

"It feels really good to impact kids in a positive way. A lot of parents express interest in NSBE events related to STEM-fields because their kids enjoy our events so much," Shehata said.

Shehata also serves as an example that NSBE also helps people get their first internship through NSBE career fairs. After attending a single NSBE career fair, Shehata got interviews with Honeywell, Cummins and Boeing.

Not only does NSBE help students get a strong professional start, but the organization supports its members throughout their lifetime, according to Shehata.

"NSBE professionals also help fellow NSBE members find news positions or paths," Shehata said. "NSBE is a network of people in the same majors with an inclusive family vibe, all working to support and reach the same goal. Being involved has definitely connected me with a lot of great individuals. We all come from different backgrounds, schools and states, and that lets you expand your mind."

Contributed by Alli Waver/
Engineering College Relations

Juárez studying best materials for 3D printing in space

Juárez

ME assistant professor Jaime Juárez recently received funding from the Iowa Space Grant Consortium's Early Career Investigator Research Program to study materials than can effectively be manufactured on a 3D printer in outer space.

Juárez's research project – *Acoustically-Mediated Multi-Material 3D Printing for Polymer-Microparticle Composites* – aims to "develop an acoustic-based 3D printing platform as an effective approach for fabricating polymer-microparticle composite materials." By having the ability to manufacture crucial components and other materials in space, it would lessen the need to stockpile parts that take up crucial cargo space in space crafts. This could have a significant financial impact as current costs for sending materials to the International Space Station is estimated at $27,000 per pound

This project includes three main research tasks: mounting the existing acoustic device to a 3D printer, extruding polymer fibers with internally ordered microparticles, and testing the effect of particle order on mechanical properties. Juárez will assemble a team of undergraduate and graduate student researchers and will also work with officials from the Marshall Space Flight Center in Huntsville, Alabama on the project.

The results of the study "will be used to evaluate and improve acoustofluidic-mediated assembly as a pathway towards 3D multi-material printing of polymer-particle composites." Within the next five years Juárez hopes "to establish the foundation for a high-impact research program that enables high-throughput additive manufacturing of soft materials."

Work on this project will began in January and is expected to be completed by June 2018.

Chris Hill (left), Technology Assistance Program (TAP) Director for Iowa State's Center of Industrial Research and Service (CIRAS), holds a 3D-printed full size tooling section for a cheerstand, while Emmanuel Agba, senior lecturer in mechanical engineering, poses with his certification in the 3D printing lab in the basement of Sukup Hall on Feb. 7, 2018. *Photos by Nick Fetty*

Iowa State instructors receive certification for 3D printing

A mechanical engineering faculty member recently received certification as a trainer in additive manufacturing.

ME senior lecturer Emmanuel Agba completed a certification program offered by Stratasys, a Minnesota-based manufacturer of 3D printers and 3D production systems. The certification program is part of Stratasys's effort to enhance workforce development and bridge the industry skill gap in 3D printing operations. The development of the certification program is being supported by several educational institutions, including Iowa State through the Center of Industrial Research and Service (CIRAS). This is in response to an increased demand for skills in 3D printing (also known as additive manufacturing) within industry.

The certification indicates Agba's understanding of the basics of 3D printing technology, software, design, materials, applications, and benefits. The material was presented as a 40-hour online course that concluded with a two-hour exam. The first class – which included two faculty members, four students, and two P&S staff members – was taught by Chris Hill, CIRAS' Technology Assistance Program (TAP) Director. CIRAS and the ME department started Iowa State's metal 3D powder bed printing collaboration in 2015. The program since has produced millions of dollars in economic impact involving Iowa's manufacturers.

Agba said 3D printing has existed since the 1970s but has evolved rapidly because of the digital revolution over the past couple of decades. This revolution was characterized by the widespread adoption of digital computers for 3D modeling and visualization, coupled with the extensive use and interconnectedness of networked devices. In addition to being used for direct manufacturing, 3D-printed parts can also be used as aides for production processes. For example, 3D-printed mold inserts and make guides can be created to assist with drilling and cutting.

"My first interaction with additive manufacturing was in the early nineties at NASA's Marshall Space Flight Center where I used a Liquid Vat photopolymerisation – or VAT – to make a model of my high speed spindle design concept. That model is still in my office today," Agba said.

Agba said the content covered in the certification program can be applied to ME courses like Engineering Graphics and Introductory Design (ME 170), Introduction to Mechanical Engineering Design (ME 270), and Mechanical Systems Design (ME 415).

In addition to being covered in the curriculum, additive manufacturing has been used by various student groups on campus. PrISUm solar car, for instance, 3D printed more than 50 parts on their latest model Penumbra which they took to Australia and raced across the outback for the 2017 Bridgestone World Solar Challenge. Agba serves as a faculty adviser for PrISUm as well as for Iowa State's 3D Printing and Design club which was started in 2015.

Hill worked with Stratasys to develop the material for this first of three planned certifications. Through CIRAS, Hill works to educate Iowa industry and complete company-specific projects that promote the adoption of technologies, including 3D printing. He also provides quarterly industry tours of the metal printer, which is located in the basement of Sukup Hall. Hill, who has over 25 years of 3D printing experience, says the certification is a step towards providing industry with systematic training materials to ensure a foundational understanding of various 3D printing technologies and how they could be applied to create value.

ME senior lecturer Emmanuel Agba holds a 3D printed model of his high speed spindle design concept inside of his office on January 22, 2018.

Chris Hill, Technology Assistance Program (TAP) Director for Iowa State's Center of Industrial Research and Service (CIRAS), explains a 3D-printed part to students in the summer 2017 section of ME 324L. Behind Hill is a 3D printer located in the basement of Sukup Hall.

"The program not only provides information on the various systems, but it also does a good job of covering the available materials and applications. This focus will continue to be expanded in future certification material," Hill said.

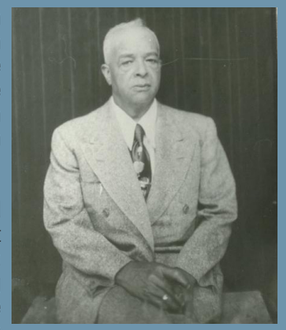
Echoing Agba, Hill said described an increased focus on 3D printing and additive manufacturing by a wide variety of industries across the globe. This in turn, he said, is driving interest through the educational system from elementary schools to universities. Lowering equipment and material costs along with increased capabilities will continue to drive interest in 3D printing. This global interest was demonstrated through this program, as Stratasys' had the support of higher educational institutions from across the US and Europe.

Earlier this semester the ME department opened its Additive Manufacturing Lab in Black Engineering Building. The lab will offer its additive manufacturing services to other departments on campus and to Iowa industry through CIRAS. Student workers also will learn firsthand how to operate 3D printers and other relevant equipment. Agba hopes that eventually the ME department will be able to offer a course fully devoted to additive manufacturing.

"As the demand for 3D printed parts grows, the fundamental question that people will be asking is 'how will I change my design process to take full advantage of the technology?' It is no longer a question of how 3D printing will impact manufacturing. It is becoming increasingly obvious that it will," said Agba. "People are seeing that the limitations of manufacturing are shrinking and you can 3D print complex shapes that would be impossible or very costly to make by traditional manufacturing methods, and you can 3D print an assembly. We are essentially talking about design freedom now. The question to ask ourselves as instructors is, 'How can we design for additive manufacturing?'"

CIRAS communications manager Jeff Eckhoff contributed to this article

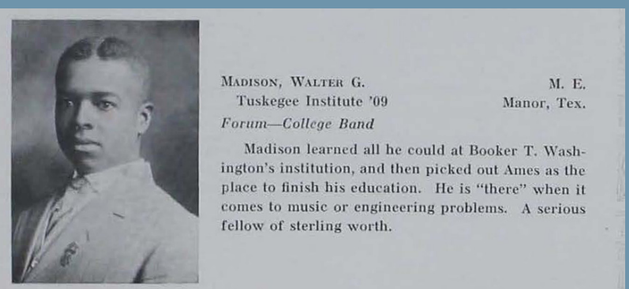
Walter G. Madison – Early African American pioneer from Iowa State



Walter Garfield Madison was one of the first African American students to graduate from Iowa State and was the first to receive a degree in mechanical engineering when he graduated in 1914.

Madison was born and raised in Manor, Texas, just northeast of Austin. He graduated with a diploma in steam engineering from Alabama's Tuskegee Institute in 1906. Madison filed a patent for a "flying machine" in 1910 and in 1912 he was granted the patent.

Perhaps influenced by George Washington Carver, an Iowa State alum on the faculty at Tuskegee, Madison moved to Ames so he could continue his studies at Iowa State College (as it was called at that time). Madison's time at Iowa State briefly overlapped with Henry Agard Wallace, who would go on to serve as agriculture secretary, commerce secretary, and vice president under Franklin D. Roosevelt.



MADISON, WALTER G. M. E.
Tuskegee Institute '09 Manor, Tex.
Forum—College Band

Madison learned all he could at Booker T. Washington's institution, and then picked out Ames as the place to finish his education. He is "there" when it comes to music or engineering problems. A serious fellow of sterling worth.

Madison's senior photo in

As a student at Iowa State, Madison was a member of the Forum literary society and also played first clarinet in the Iowa State College Military Band. In the fall of 1912 Madison lived in "The Maples", which was the home of Edgar Stanton who was then dean of the junior college and part of ME's first graduating class in 1872.

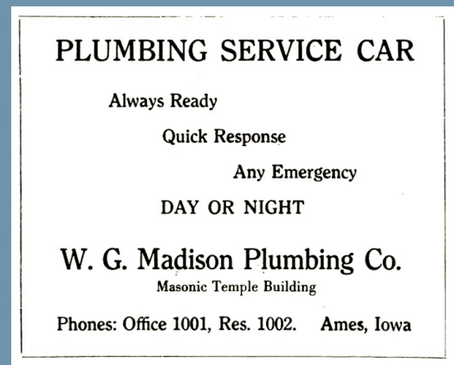
After graduating with his ME degree in 1914, Madison stuck around Ames for the next two and half decades working as a heating and plumbing contractor. His business was initially in the Masonic Building (southwest corner of Douglas Avenue and 5th Street) but later moved to the Olsan Building (southwest corner of Main Street and Burnett Avenue).

During his time in Ames he helped in the construction of sections of the city's sewer system as part of a major public works project in 1916 and 1917. He is also credited with writing part of the first Iowa Plumbing Code.

Despite these contributions he made to the community, Madison was subjected to unfair treatment because of his race when he and a client were denied service at a downtown Ames restaurant on Feb. 1, 1922. Madison filed a lawsuit in the Story County District Court against the restaurant's owner for the humiliation and mental anguish he experienced because of being denied service. 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.

In 1917, Madison participated in a reception and banquet "in honor of the colored officers training camps at Fort Des Moines." ME alum Edgar Stanton also attended the event. Then during World War II the Army purchased Madison's patent for "a radiator bracket designed to support radiators from walls rather than floors" which were installed in various Army camps.

Madison's son Horace, a Private First Class, was killed in action in Italy in 1945 while serving in World War II. Just three years later Madison's son Archie, a First Lieutenant in the Army engineers, died while serving in Korea. Archie studied mechanical engineering at Iowa State and served in the Pacific theater during World War II.



PLUMBING SERVICE CAR

Always Ready
Quick Response
Any Emergency
DAY OR NIGHT

W. G. Madison Plumbing Co.
Masonic Temple Building

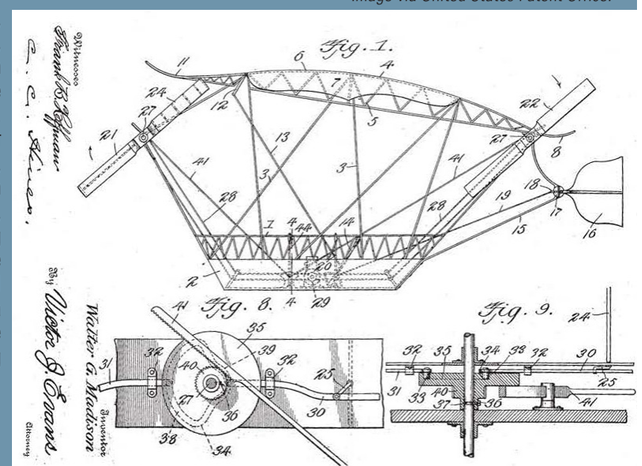
Phones: Office 1001, Res. 1002. Ames, Iowa

An advert for Madison's Ames business published in the 1920 edition of *The Ames Forrester*

Walter Madison left Ames in 1938 to serve as chief engineer at Fisk University, a historically black university in Memphis, Tennessee. In this position he was in "charge of all engineering aspects of the operation of the university's plant, which includes 40 buildings." From 1942 to 1944 he served as a professor of mechanical engineering at Howard University, a historically black university in Washington D.C.

Walter Madison Sr. passed away at Freedmen's Hospital on the Howard University campus on Feb. 28, 1964. He was 76.

Madison was survived by two of his sons who both also pursued careers in engineering. His oldest, Walter Jr., studied general engineering at Iowa State in the late 1930s, worked as a mechanical engineer in Washington D.C., and passed away in 1985. Ira, his youngest, was a civil engineer in Los Angeles and passed away in 2000.



A blueprint for Madison's "Flying Machine."
Image via United States Patent Office.

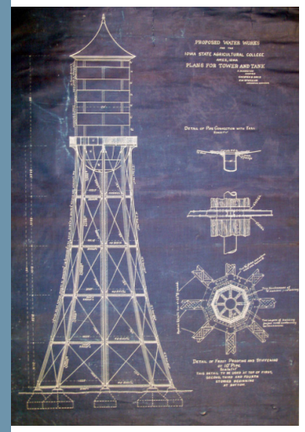
Elmina Wilson – pioneering engineer and women's suffrage leader

Elmina Tessa Wilson became the first female graduate of Iowa State's civil engineering department when she completed her bachelor's degree in 1892.

Wilson

Wilson was born in Harper, Iowa on Sept. 29, 1870. She became the first female engineering graduate at Iowa State when she completed her BS in civil engineering in 1892. In 1894, she earned her MS in civil engineering, making her the first female in the United States to receive a master's degree in the field. Elmina completed her master's degree the same year that her sister, Alda, completed her BS in civil engineering. As collegians, both Elmina and Alda were members of the Phileleutheroi Literary Society, a collegiate debate team that Elmina helped to establish in 1890, and Pi Beta Phi, which was the first fraternity for women established at Iowa State.

During summers as a student, Elmina Wilson worked for architectural and engineering companies in Chicago and took advanced coursework from the Massachusetts Institute of Technology and Cornell University, the alma mater of her mentor Anson Marston who served as ISU's engineering dean from 1904 to 1932. Wilson actually worked closely with Marston on the design and construction of a 168-foot-tall water tower on the west side of the Iowa State campus which was completed in 1897. The tower, known today as the Marston Water Tower, was the first steel water tower built west of the Mississippi River and currently stands as one of the tallest structures on the Iowa State campus, dwarfing the iconic Campanile by nearly six stories.



Blueprints for the Marston Water Tower.

In 1895, Wilson was hired as an instructor at Iowa State to teach drawing courses for both civil and mechanical engineering. She was promoted to assistant professor of civil engineering in 1902, making her the nation's fist full-time female professor of civil engineering. Elmina took a leave of absence in 1903 when she – along with Alda – traveled to Europe "to study noteworthy architecture and engineering works." Upon returning to the United States Elmina had to make a decision on whether to remain on the faculty at Iowa State. Dean Marston encouraged Elmina to return to Ames in a letter dated May 21, 1904.

"I am still reluctant to yield to the idea of your not being with us next year. I would not for a moment insist on your coming back against your wish and you must decide the matter from the standpoint of what you think to be best for yourself. I can assure you that myself and the other people here would very much like to have you with us. We often think and speak of you and the department misses you greatly," Marston wrote.

Ultimately Wilson decided to resign her position at Iowa State and instead went into consulting engineering in New York and other cities on the East Coast. She worked for the James E. Brooks Company and Purdy & Hendersen (P&H), which was "the country's leading engineering designer of skyscrapers" around the turn of the 20th century. While with P&H Elmina worked on the Metropolitan Life Tower, which was the tallest building in the world from 1909 to 1913; the Whitehall Annex, the tallest office building in New York at the time of its completion in 1910; and the Manhattan Municipal Complex, which was added to the National Register of Historic Places in 1972.

Outside of her accomplishments in the field of engineering, she was also a strong supporter of women's rights. Elmina served as president of the Woman Suffrage Club of the 23rd Assembly District, Manhattan Borough and was also involved with the College Equal Suffrage League, the Woman Suffrage Party, and the Woman's Political Union. During this time both Wilson sisters worked closely with prominent women's suffrage leaders such as Carrie Chapman Catt (a fellow alumna of Iowa State), Susan B. Anthony, and Eleanor Roosevelt.

Elmina Wilson passed away on June 2, 1918 after an extended illness. Two years after her death the 19th amendment was ratified, granting women the right to vote.

In an article in The Arrow of Pi Beta Phi (the organization's official publication) co-authored by Elmina and Alda and published in 1919, the sisters encouraged other young women to pursue careers in architecture and engineering.

The Metropolitan Life Building in 1911.
Photo via the U.S. Library of Congress.

"Even though disagreeable incidents such as running up against policies like 'neither minorities or women will be considered for certain technical positions' in certain offices are likely to occur, we all know that a stone much knocked about gets its sharp angles worn off and besides they are more than offset by the unselfish willingness of many to lend a helping hand. There is no door at which the hand of woman has knocked for admission into a new field of toil but there have been found on the other side of the hands of strong and generous men eager to turn it for her, almost before she knocks. So her standing will depend greatly upon herself; upon her ability to concentrate her thoughts on the subject at hand, and to gather up afresh the products of the classic past and mold them into something specifically modern; upon her devotion, tact, ingenuity and self-sacrifice, the qualities required of her sisters in whatever occupation they follow."

~from The Arrow of Pi Beta Phi, January 1919

Florence Kimball – first female graduate of ME at Iowa State

Florence Kimball became the first female graduate of Iowa State's mechanical engineering department when she completed her degree in 1908.

Kimball was born in Anamosa, Iowa in 1885. Her father, Charles, taught "practical shop mechanics" at Iowa State (then called Iowa Agricultural College) prior to 1892 when the family business moved its foundry and machine shop to Council Bluffs and also shifted its focus to manufacturing freight elevators.

Kimball enrolled at Iowa State in 1904 after completing her junior year of high school and chose to study mechanical engineering. Her father actually encouraged her to pursue ME, though his reason was less than flattering: "because she would probably never get married." As a student at Iowa State, Kimball played right guard on the varsity field hockey team, was a board member for The Bomb yearbook, and also served as the first president of the Gamma Gamma chapter of Kappa Delta sorority.

Much to her father's dismay, she married Donald B. Stoufer in 1911 and became Florence Kimball Stoufer. Donald Stoufer was a fellow mechanical engineering graduate from Iowa State, was captain on the 1905 football team, and was also a member of the track team.

Following their marriage, the couple moved to Council Bluffs to work for Florence's family business, Kimball Elevator Co. Florence managed the company's real estate properties, including the historic Ogden House hotel.

Florence and Donald had three children, all of whom went on to graduate from Iowa State: Richard (General Engineering '35), William (Mechanical Engineering '38), and Lucy Beall (Home Economics '46). Three of their seven grandchildren also attended Iowa State.

In 1976 she was awarded the Alumni Key by the Omaha-Council Bluffs chapter of the ISU Alumni Association.

Florence Kimball Stoufer passed away in 1977 at the age of 91. The Florence Kimball Stoufer Recognition Award was established in 1978 to honor the achievements of female students in ISU's mechanical engineering department. The award was discontinued in 2001.

In 1995 she was posthumously honored with a brick on the Plaza of Heroines memorial outside of Carrie Chapman Catt Hall on the Iowa State campus. Her brick reads:

Florence Kimball Stoufer
1885-1977

First woman to graduate from
Iowa State College
with degree of bachelor of
mechanical engineering
conferred on her
the fourth of June 1908
also
first president
of Sigma Sigma chapter
Kappa Delta sorority

Florence Kimball Stoufer poses with then-ME department chair Arthur Bergles (left) and longtime ME professor Henry Black (right) outside of the Mechanical Engineering Laboratory building during a visit to the Iowa State campus in November 1974.
Photo via mechanical engineering department records

ME student finishes 29th in the Boston Marathon

William Graham, a student concurrently pursuing a MBA and BS in mechanical engineering, ran in the 122nd Boston Marathon on Monday. The 23-year old finished 29th out of 14,142 males who completed the 26.2-mile race.

"My teammates and I from the Iowa State Running Club, trained for the Boston Marathon all through the winter," said Graham. "Seeing our hard work pay off on race day was an extremely rewarding feeling. It was awesome to represent Iowa State in Boston."

He completed his degrees at Iowa State in May.

Engineers develop flexible, water-repellent graphene circuits for washable electronics

New graphene printing technology can produce electronic circuits that are low-cost, flexible, highly conductive and water repellent.

The nanotechnology "would lend enormous value to self-cleaning wearable/washable electronics that are resistant to stains, or ice and biofilm formation," according to a recent paper describing the discovery.

"We're taking low-cost, inkjet-printed graphene and tuning it with a laser to make functional materials," said Jonathan Claussen, an Iowa State University assistant professor of mechanical engineering, an associate of the U.S. Department of Energy's Ames Laboratory and the corresponding author of the paper recently featured on the cover of the journal Nanoscale.

Jonathan Claussen and his research group are printing and processing graphene ink to make functional materials.
Photo by Christopher Gannon.

The paper describes how Claussen and the nanoengineers in his research group use inkjet printing technology to create electric circuits on flexible materials. In this case, the ink is flakes of graphene – the wonder material can be a great conductor of electricity and heat, plus it's strong, stable and biocompatible.

The printed flakes, however, aren't highly conductive and have to be processed to remove non-conductive binders and weld the flakes together, boosting conductivity and making them useful for electronics or sensors.

That post-print process typically involves heat or chemicals. But Claussen and his research group developed a rapid-pulse laser process that treats the graphene without damaging the printing surface – even if it's paper.

And now they've found another application of their laser processing technology: taking graphene-printed circuits that can hold water droplets (they're hydrophilic) and turning them into circuits that repel water (they're superhydrophobic).

"We're micro-patterning the surface of the inkjet-printed graphene," Claussen said. "The laser aligns the graphene flakes vertically – like little pyramids stacking up. And that's what induces the hydrophobicity."

Claussen said the energy density of the laser processing can be adjusted to tune the degree of hydrophobicity and conductivity of the printed graphene circuits.

And that opens up all kinds of possibilities for new electronics and sensors, according to the paper.

"One of the things we'd be interested in developing is anti-biofouling materials," said Loreen Stromberg, a paper co-author and an Iowa State postdoctoral research associate in mechanical engineering and for the Virtual Reality Applications Center. "This could eliminate the buildup of biological materials on the surface that would inhibit the optimal performance of devices such as chemical or biological sensors."

The technology could also have applications in flexible electronics, washable sensors in textiles, microfluidic technologies, drag reduction, de-icing, electrochemical sensors and technology that uses graphene structures and electrical simulation to produce stem cells for nerve regeneration.

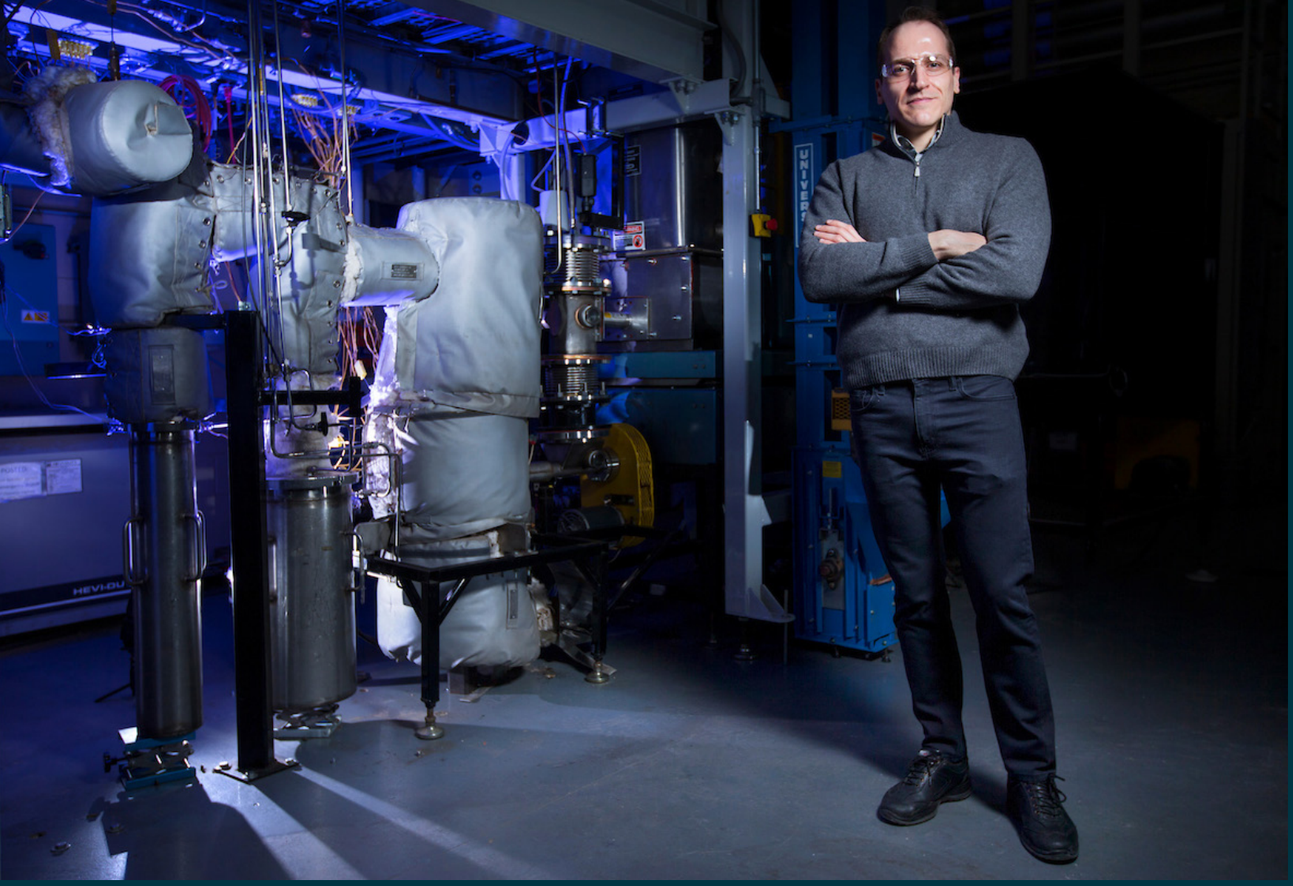
The researchers wrote that further studies should be done to better understand how the nano- and microsurfaces of the printed graphene creates the water-repelling capabilities.

The current studies have been supported by grants from the National Science Foundation, the U.S. Department of Agriculture's National Institute of Food and Agriculture, the Roy J. Carver Charitable Trust plus Iowa State's College of Engineering and department of mechanical engineering.

The Iowa State University Research Foundation is working to patent the technology and has optioned it to an Ames-based startup, NanoSpy Inc., for possible commercialization. NanoSpy, located at the Iowa State University Research Park, is developing sensors to detect salmonella and other pathogens in food processing plants. Claussen and Stromberg are part of the company.

The graphene printing, processing and tuning technology is turning out to be very useful, Stromberg said. After all, "electronics are being incorporated into everything."

Contributed by Mike Krapfl/ISU News Service



Alberto Passalacqua will lead an Iowa State research team that will study, model and develop design tools for autothermal pyrolysis, a new way to break down corn stalks, wood chips and other biomass to produce a liquid bio-oil for energy and a biochar for fertilizer. Passalacqua is pictured with the pyrolysis pilot plant at Iowa State's BioCentury Research Farm. *Photo by Christopher Gannon.*

Engineers developing tools to understand, scale up autothermal production of bio-oil

On a whim, Iowa State University's Robert C. Brown asked students to crank up the oxygen.

Brown and the engineers in his research group had worked for years to develop a thermochemical process called fast pyrolysis to produce biorenewable products. The process uses heat in the absence of oxygen to break down corn stalks, wood chips and other biomass to produce a liquid bio-oil for energy and a biochar for fertilizer.

The engineers had explored adding a little oxygen to the reactor. Brown suggested adding more and more. And that started to change everything. Now, rather than trying to improve pyrolysis by pushing more heat from outside the reactor, the engineers discovered burning a small amount of biomass inside the reactor could more efficiently provide the energy to drive pyrolysis.

Importantly, this partial combustion didn't hurt the yield of bio-oil, said Brown, the director of Iowa State's Bioeconomy Institute, an Anson Marston Distinguished Professor in Engineering and the Gary and Donna Hoover Chair in Mechanical Engineering.

Iowa State engineers call this process "autothermal pyrolysis." The Iowa State University Research Foundation has applied for patent protection on the technology and has licensed it to Easy Energy Systems of Mankato, Minnesota, for commercial use.

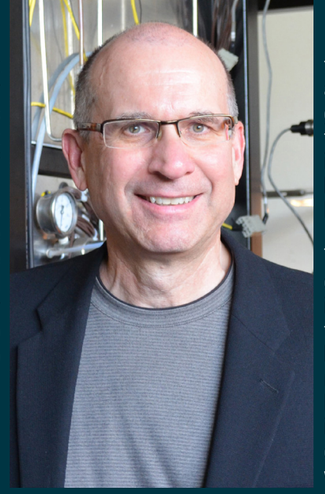
Hitting the throttle

Others have experimented with adding oxygen to their pyrolyzers, but Brown said a review of the scientific literature didn't find much success. In many cases, researchers dramatically reduced their yields of bio-oil.

As the Iowa State engineers continued to study autothermal pyrolysis, graduate student Joseph Polin decided to substitute inexpensive air for the pure oxygen used in earlier tests.

Polin found that to keep air-fuel ratios similar to the experiments with pure oxygen, he needed to feed biomass into the reactor five times faster. Brown was initially skeptical the reactor was big enough to handle so much more biomass. But it did.

"The epiphany was that biomass throughput for a pyrolysis reactor was limited by our ability to get heat through the walls of the reactor," Brown said. "By burning the biomass internally to generate the energy needed to drive pyrolysis, we eliminated the heat transfer bottleneck, allowing us to open up the throttle, so to speak, on our reactor."



Brown

Understanding and modeling

Iowa State engineers know their autothermal process works. But they're still not sure exactly how.

Brown thought carbon monoxide and methane known to exit a conventional pyrolyzer might be burning during autothermal pyrolysis. Iowa State graduate student Chad Peterson proved him wrong using a simple computer model that demonstrated pyrolysis temperatures are too low to ignite these gases.

A new research grant should help find some answers.

The U.S. Department of Energy recently announced it has awarded Iowa State engineers a two-year, $854,039 grant to study autothermal pyrolysis and develop software tools to help design other kinds of autothermal processes. The grant from the department's Advanced Manufacturing Office is part of $35 million awarded to 24 research projects across the country. Final details of the Iowa State project are being negotiated.

Alberto Passalacqua, an Iowa State assistant professor of mechanical engineering, will lead the Iowa State project.

"First we want to figure the chemical reactions and mechanisms that make autothermal pyrolysis work," said Passalacqua. "Then we want to develop models of the process and compare them to experiments. The final goal is to develop simplified design tools to design bigger reactors."

Scaling up biorefineries

This isn't the first time Iowa State researchers have been involved with an Energy Department grant related to autothermal pyrolysis. In December 2016, the department awarded a five-year, $70 million grant that helped launch the Rapid Advancement in Process Intensification Deployment Institute, known as RAPID.

The American Institute of Chemical Engineers in New York City leads the RAPID Institute. Iowa State's role is to manage the institute's biorefinery efforts, including demonstrations of autothermal pyrolysis with the university's commercialization partner, Easy Energy Systems.

"What we have achieved is process intensification – multi-fold increases in biomass throughput for a given size reactor – while preserving oil yield," Brown said.

Passalacqua, who has expertise in multiphase flows and computational fluid dynamics, said he's hoping to develop design tools that will help manufacturers maintain that intensification at larger scales.

"We want to help develop designs for production plants," he said. "We want to study and understand what happens in large-scale production."

The Iowa State engineers expect their design tools will be added to an open-source toolbox that is freely available to use. That could help reduce the risk of scaling up the technology for commercial use. And it could help apply the autothermal principle to other chemical processes.

As plans move ahead to build two autothermal demonstration plants capable of processing 50 tons of biomass per day, Brown said it would be useful "to have a model that predicts the performance of these big reactors."

The engineers think the reactors' performance could ultimately do a lot for the bioeconomy's bottom line – a research summary for the latest grant says the jump in biomass feed rates made possible by autothermal pyrolysis could reduce the estimated cost of producing fuel from $3.27 per gallon to $2.58 per gallon.

Contributed by Mike Krapfl/
ISU News Service

ME student named Academic All-Big 12 for swimming

A mechanical engineering student has been named to the 2018 Academic All-Big 12 Women's Swimming & Diving Team.

Storer

Jessi Storer, a sophomore distance/fly swimmer, was a 2018 Academic All-Big 12 Women's Swimming & Diving first team selection, the conference announced last month. The Lincoln, Neb.-native finished 10th in the mile swim during the finals of the Big 12 Championship last month in Austin, Texas. She notched seven points to help the Cyclones to a fourth place overall finish.

Storer is among 14 Cyclone swimmers and divers named to the first team for having a grade-point average (GPA) of 3.20 or higher. Two Cyclones were also named to the second team with GPAs between 3.00 and 3.19. The 16 Cyclone honorees was Iowa State's highest number since 2015 when 16 Cyclones were also recognized.

School outreach is one part of ME alum's volunteer efforts

One mechanical engineering alum hopes to inspire the next generation of engineers through his outreach efforts.

Daniel Diaz graduated from Iowa State with his BS in ME in 2013 and his MEng in ME in 2015. After graduation, Diaz was hired as a Mechanical Engineer at Lennox International Inc., manufacturer of heating, ventilation, and air conditioning (HVAC) systems, at their Product Development and Research Center (PD&R) in suburban Dallas, Texas. Diaz said his education at Iowa State helped to prepare him for his wide array of job responsibilities.

"There are periods of time when I'm a research test engineer so you'll see me out on the lab floor, in a psychrometric test room looking at the performance of a unit in terms of efficiency and capacity," he said, adding their products need to meet various customer needs and regulatory requirements.

"Sometimes you'll find me at my computer doing design work. Other times you'll see me at our factory in Arkansas supporting the release of new products and finding ways to meet our manufacturing needs. And some days you'll see me involved with the community," he said.

Part of that community involvement happens through an employee engagement initiative that he and others at LII participate in called "Let's Connect!"

"Because of the needs in our community, primarily in education, I felt like that was where I needed to focus my attention," Diaz said.

LII officials identified an elementary school near their PD&R facility as their partner for the outreach program. This particular school is comprised of low-income students with standardized testing performance below state averages, and few of them know much about careers outside of what their parents do.

"We really wanted to bridge that gap between the knowledge they gain in the classroom and the possibilities that are out there for them. That is why my focus has been on STEM activities," Diaz said, adding that he worked with Iowa State Engineering Kids (ISEK) for advice on engaging pupils and providing them with something they will retain afterward.

Diaz

Diaz said that over the years he's received several thank you cards from students and teachers which currently adorn the walls of his cubicle. Students have even told their teachers that they will now consider engineering as an option for their future.

"Just having one person think this way, makes the whole effort worth it," said Diaz. "It's been very rewarding to see students engage in the activities."

It was while growing up in Cartagena, Colombia that Diaz first developed his interest in engineering.

"I became interested in mechanical engineering as a kid. I had a passion for taking things apart and sometimes putting them back together correctly," he said with a smirk.

He specifically remembers disassembling an old radio that his dad had and enjoyed learning about how all of the different parts worked. During a science fair in high school, Diaz said he was able to learn about physics through a potato launcher. Under his dad's supervision he experimented with using different quantities of alcohol which served as the potato launcher's fuel source.

"Since that time I developed passion for converting energy from one form to another more useful form," he said.

When it came time for college, Diaz looked at various schools with strong engineering programs and ultimately choose Iowa State because of its strong reputation in the thermal sciences as well as the fact that his father, Luis, earned a MS in chemical engineering and environmental engineering in 1982 and 1983, respectively, and his brother, Hermes, earned a BS in mechanical engineering and construction engineering in 2003 and 2009, respectively. Choosing Iowa State also meant that Daniel got to be closer to his brother who lived in Ankeny.

Diaz said he has more of a traditional approach to things and therefore felt mechanical engineering would be a nice fit as his major. He said that he considered materials science and engineering, but ultimately chose ME because of its broad applicability.

Outside of the classroom, Diaz stayed busy with various campus groups and other activities. He was part of the student ministry at Grand Avenue Baptist Church and said he really misses the Sunday luncheons with fellow students, some of whom were engineers. He was a community advisor (CA) in Linden Hall and served as backup for his floor's intramural soccer team. Additionally, Diaz said he enjoyed renting kayaks and canoes from Rec Services and taking them out to Ada Hayden Lake on the north side of Ames.

"I lived in Iowa for seven years so Iowa definitely has a big part of my heart," he said.

Diaz also developed his own personal tradition as a student.

"Every semester I would check out a camera for a week and go around campus taking pictures. That was my own personal tradition," he said, adding that he thought it was cool to see difference in scenery as the seasons changed.

Lastly, Diaz said his participation in Iowa State's chapter of the American Society of Mechanical Engineers (ASME) was one of the most valuable parts of his college experience. He served one year as the organization's vice president which he said helped him to develop various non-technical skills such as effective leadership, communication, and outreach, all of which he has applied to his work at LII. He said he would encourage incoming and current students to find time for these activities and groups.

"But just remember, it's a complement to – not a replacement of – the things you learn in the classroom."

Bell cast for Campanile model

Campanologists from Ohio-based Meeks, Watson and Co. were on campus on April 10 to cast the first bell for the Campanile Carillon Model Project inside the metal casting lab in Black Engineering Building. Joshua Meeks - from Meeks, Watson and Co. - believes that this was the first time that a carillon bell was cast on a college campus. Once the project is complete, the mobile 1:5 scale replica of the campanile and a 27-bell carillon will travel around to bring the music of the campanile/carillon to Iowans all across the state and abroad.

Above: Joshua Meeks puts a layer of mold wash on the bell mold.

Below: A shot with the finished bell. From left: Caroline Hayes (ME department chair), Jim Shelledy (ME teaching lab coordinator), Joshua Meeks (Campanologist), Tin-Shi Tam (University Carillonneur), and Bill Meeks (Campanologist).

New ISU research could help farmers diagnose soybean stresses with a smartphone

New technology developed by an interdisciplinary team of scientists at Iowa State University could allow anyone with a smartphone to see crops much the same way trained plant breeders and scientists do.

The researchers' findings, published recently in the peer-reviewed journal Proceedings of the National Academy of Sciences, demonstrate how artificial intelligence can identify a range of common stresses in soybeans. The technology can improve efficiency for plant breeders and farmers, and it demonstrates the growing value of automation in agriculture.

ISU agronomists and engineers started by collecting a large dataset of around 25,000 images of soybean stresses taken in Iowa, said Arti Singh, an adjunct assistant professor of agronomy and co-corresponding author of the article. The team developed an automated machine-learning framework to find patterns in the soybean leaf images that correlated with eight common sources of stress, such as diseases, nutrient deficiency and herbicide injury. The result is a computer application that can diagnose and quantify the amount of various foliar stresses by analyzing digital images of soybeans.

Singh said scouting crops and conducting visual measurements for stress is a time-consuming and often inconsistent process both for plant breeders and farmers. Introducing an automated tool can save time and produce more standardized results.

"We want this technology to allow machines to see with the eyes of an experienced plant breeder," she said.

Sarkar

Soumik Sarkar, an assistant professor of mechanical engineering and co-corresponding author, said the researchers compared the performance of their program with actual diagnoses from trained plant scientists, and the results showed excellent correlation. In addition, Sarkar said the program qualifies its diagnosis by providing the specific visual symptoms it noted to reach its conclusions.

While the program is currently available only for academic communities, the researchers said they intend to deploy the application on smartphones to make the product available widely. The technology also has the potential for use in unmanned aerial vehicles and ground robots.

"This is a prime example of how artificial intelligence can be applied to agriculture," Sarkar said. "It can provide more automation and more efficiency than the traditional way of diagnosing these stresses."

Ganapathysubramanian

The interdisciplinary research team also included Asheesh Singh, an associate professor of agronomy; and Baskar Ganapathysubramanian, an associate professor of mechanical engineering. Two Ph.D. students, Sambuddha Ghosal in mechanical engineering and David Blystone in agronomy, also contributed. The research was supported by funding from the Iowa Soybean Association, the ISU Plant Sciences Institute, the ISU Presidential Initiative for Interdisciplinary Research, the U.S. Department of Agriculture, and the National Science Foundation.

Contributed by Fred Love/ISU News Service

Engineering research project aims to develop bio-based carbon fiber

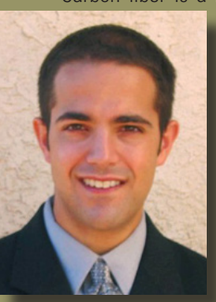
A research project by a group of College of Engineering researchers aims to develop a bio-based carbon fiber that could be used in anything from cars to wind turbines.

Bai

The project was first started two years ago when the College of Engineering's Exploratory Research Project provided seed funding for the preliminary studies. Findings from those studies proved to be promising, so the research group – which consists of three mechanical engineering researchers and one from chemical and biological engineering – recently received a $500,000 grant from the U.S. Department of Agriculture's National Institute of Food and Agriculture.

"We are trying to make bio-based carbon fiber," said Xianglan Bai, an assistant professor of mechanical engineering who serves as the project's primary investigator (PI).

Carbon fiber is a high-tensile strength, high performance material that can serve as a lighter alternative for certain metal alloys. However, carbon fiber is currently produced using petroleum-derived materials which increases its cost.



Cochran

"Thus, if we can make carbon fiber using bio-based feedstock at a lower cost, more green carbon fibers will be applicable in broader areas." said Bai. "However, the problem is that it's difficult to produce high-performance carbon fiber using bio-based alternative sources."

Efforts to produce carbon fiber using sustainable sources have seen limited success in recent decades, according to Bai. Not only could her team's research find a new way for producing carbon fiber but it would also serve as a new way to increase the value of lignin byproducts, which are currently burned in pulp/paper industries and biorefineries for heat.

Bai describes that the major problem with using lignin to make carbon fiber is the intrinsic lack of molecular orientation in lignin structure. Thus, she will first break down lignin into smaller molecular units using thermochemical conversion techniques, such as pyrolysis and solvent liquefaction. Eric W. Cochran, associate professor of chemical and biological engineering who will also serve as a co-PI on this project, will rebuild these depolymerized lignin into new polymers with better molecular linearity.

"Synthetic polymers change their orientation in the fiber drawing process to point along the fiber direction—they derive much of their strength from this phenomenon. We're working to reconstruct lignin into analogous structures so that they will be flow-orientable as well," Cochran said.

Mba Wright

Bai and her student will then further fabricate the newly synthesized polymers into carbon fibers.

This new carbon fiber can have wide-ranging applications including being used for wind turbines, which is a major industry in Iowa. In addition to being lighter weight than their metal counterparts, turbines and other components manufactured from carbon fiber are resistant to corrosion and other effects caused by weather.

Other Co-PIs of this project also include Mark Mba Wright, an assistant professor of mechanical engineering, and Robert C. Brown, Anson Marston Distinguished Professor in Engineering and Gary and Donna Hoover Chair in Mechanical Engineering. Mba Wright will be studying the economic aspects of the new carbon fiber: the cost of the polymer, its industry applications, and how the manufacturing process will affect the final cost.

Brown

Robert Brown and his research staff will assist Bai and her student to break down lignin using both the pilot scale pyrolysis reactor in the BioCentury Research Farm and the lab-scale fluidized bed located in the Biorenewable Research Lab on campus.

Projects such as this serve as a nice example of the interdisciplinary research that takes place within Iowa State's College of Engineering.

"This project is exciting because the whole team is needed to get it done: breaking down the biomass, turning the biomass into polymer, turning the polymer into carbon fibers and then understanding if it will ever be profitable to do so all require different skill sets," Cochran said.

Keep up with the latest ME department news

www.me.iastate.edu/news

Engineering group teaches high school students about automotive engineering

Jason Whited, left, presents to students at Marshalltown High School on April 12. *Photo by Andrew Potter, Marshalltown District Communications Director*

A College of Engineering student group is currently on a tour of Iowa high schools to teach teenagers about automotive engineering opportunities at Iowa State.

Iowa State's chapter of the Society of Automotive Engineers (SAE) recently traveled to Marshalltown High School where they brought a few of their vehicles and told the students about opportunities available to them if they study engineering at Iowa State.

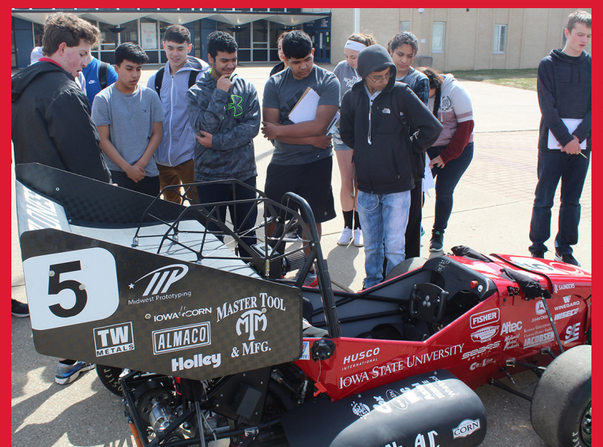
SAE is one of the largest engineering student organizations on campus with more than 200 students spread across five competition teams: Aero, Baja, Clean Snowmobile, Formula and Supermileage. Aero builds a 12-foot wingspan RC airplane from the ground up to compete in a weight lifting and maneuverability competition. Baja designs and builds a single-seat, off-road racing vehicle which competes in more than five yearly competitions. Clean Snowmobile Challenge modifies a stock snowmobile to meet more stringent emissions and noise standards, while increasing performance. Formula designs a high-performance open-wheel race car, and is currently ranked 4th in the United States. Supermileage builds a high mileage vehicle from scratch, with a goal of reaching 800 mpg.

"Iowa State SAE's objective is to develop leadership, engineering, and communication skills in college students from a variety of disciplines, and promote STEM in the surrounding community," said SAE vice president Jason Whited, a senior in mechanical engineering. "The core function of each team is to design, build, and compete with their respective vehicle in yearly international competitions."

SAE students are able to take material they learn in the classroom and apply it to their work on the various SAE vehicles and are also able to take the skills they develop through SAE and apply it to the classroom. Involvement in SAE also teaches the students about industry standards and best practices in the automotive field.

"SAE-rated oil, bolts, design practices, and testing plans can be found in nearly every machine that moves people. The engineering done at the Iowa State SAE chapter is much more focused. We are here as a chapter to help the next generation of engineers learn by getting their hands dirty with something that moves and interacts with the world," said Baja's Project Director Derick Whited, a senior in mechanical engineering. "Every part on every vehicle we build is picked or designed with purpose behind it, so we operate similar to a large vehicle manufacturer – like Polaris, General Motors and Caterpillar – when they go to design and build a prototype. This effort requires a concert of different disciplines and specializations to bring it all together, so we do a lot of structural design, dynamic system analysis, ergonomic studies, combustion engineering, and operations research."

Jimmy Rolansky presents to students at Marshalltown High School on April 12. *Photo by Andrew Potter, Marshalltown District Communications*



During their trip to Marshalltown on April 12, the team brought with them their Baja and Formula cars as well as their snowmobile. The team was invited by Mike Lazere, a PLTW and biology teacher at the high school. They talked to roughly three hundred students and staff members from PLTW classes, physical science, metals, business law, and sports marketing and entrepreneurship.

"The four members who went spoke on everything from our backgrounds at Iowa State and our future plans to the vehicles and competitions in which each of us participate," said SAE Fundraising Mangaer Erin Mitchell, senior in Industrial Engineering and in the concurrent MBA program. "Specifically, the focus on was the iteration and documentation that went into each vehicle, pressing the point that the vehicle is not just the final product but also the documentation and presentation of it."

Jimmy Roslansky, Formula's Aero lead and a sophomore in aerospace engineering, said outreach events like this are important for not only recruiting students to Iowa State and SAE but also for exposing pre-college students to the STEM and automotive fields more broadly.

"Talking to kids at Marshalltown High School and other outreach events has allowed me to see how many kids are interested in STEM. While a lot are interested, most don't really understand how STEM fields apply to the real world. Getting to see our vehicles gives them a visual representation of how their education will be used in the future," Roslansky said, adding that he first got introduced to SAE by attending Iowa State's ClubFest as a freshman.

The team also visited three schools in the month of May: Mount Vernon High School on 9th, Carlisle High School/Middle School on the 10th, and Ankeny Centennial High School on the 11th.

Pittoni joins SAE as faculty adviser

ME lecturer Paola Pittoni has joined Iowa State's SAE International chapter as its new faculty adviser. Pittoni came to Iowa State in fall 2017 and holds a PhD in chemical engineering from National Taiwan University of Science and Technology, Taipei. She also serves as an adviser for the Women in Mechanical Engineering (WiME) student group.

Pittoni

Alum publishes novel: 'Spirit of Engineering'

A novel penned by a mechanical engineering alum tells the story of two freshmen college students and their journey to discover what engineering is.

Kuzhiyil

Najeeb Kuzhiyil, who graduated with a PhD in ME in 2013, recently published his first novel: Spirit of Engineering: The Journey of Two College Freshmen and the Soul of Engineering. The idea to write the book, which was published in December 2017, first came to Kuzhiyil while he was a student at Iowa State.

"So I thought before you begin your undergrad studies, you should understand what engineering is in simple terms," said Kuzhiyil. "I really wanted to write a book that was simple enough for high school students."

The book took about a year and a half to write and started out as separate essays covering four pillars of engineering: methodical approach, practical skills, abstraction, and creativity.

"One morning I was lying in my bed and I thought why don't I tell this as a story. I can include all of these concepts and wind them into a nice plot," Kuzhiyil said.

The target audience for the book is high school students or perhaps even freshmen in college. The plot is set in modern times and follows around two main characters who are both first year engineering students at an unnamed Midwestern college: Matt from northern Iowa and Maya from India.

Matt and Maya come across a presentation about the Wright Brothers which piques their interest to the point that they decide to travel to the Wright Brothers museum in Dayton, Ohio in an attempt to better understand what engineering really is. During their travels they meet an experienced, middle-aged engineer who helps them understand how math, physics, and other natural phenomena apply to engineering.

Kuzhiyil said that his PhD adviser Robert C. Brown, Anson Marston Distinguished Professor in Engineering, was a major influence on him personally and with his writing style specifically.

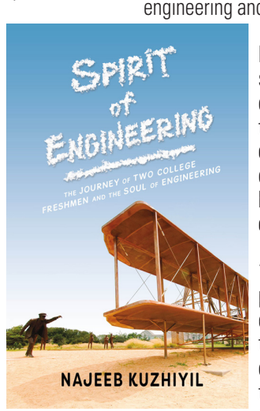
"He's a wonderful engineer and he's a great writer because we as engineers aren't always great writers," said Kuzhiyil. "Before coming to Iowa State I never paid attention to my English but Dr. Brown told us 'You might be great engineers but you also have to learn how to write well. It's very important to be able to express your ideas.'"

Brown, who also serves as director of the Bioeconomy Institute at Iowa State, wrote the foreword of the book. He said he thinks the book can be helpful for the next generation of engineers.

"I would have benefited from this book when I was in high school, at the time having no clear idea of the engineering profession. Even today despite the emphasis on STEM education, engineers are rarely portrayed in popular culture except for the occasional less than flattering role of bumbling technocrat. Najeeb's book helps to overcome this stereotype," Brown said.

Kuzhiyil cited Brown, whose research focuses on biorenewable resources, as a major reason why he chose Iowa State to pursue his PhD. Kuzhiyil is originally from the state of Kerala in southern India. He attended school in the city of Kochi and began developing an interest in chemical engineering in high school. He attributed his interest in engineering to his older brother, Dr. Abdul Kader, who studied chemistry and worked at a fertilizer manufacturing company.

"I didn't know anything about chemical engineering, but as a kid I thought it would be cool to learn about it," he said, adding there was a large petroleum refinery close to home that always fascinated him.



Kuzhiyil graduated with a bachelor of technology in chemical engineering from the University of Calicut and went on to work as a tech service engineer for Indian Oil Corporation.

After a decade in industry, Kuzhiyil decided to pursue an advanced degree. In graduate school his interest shifted from chemical engineering to renewable energy. He graduated with a MS in Combustion and Energy from the University of Leeds in England in 2005.

Kuzhiyil came to Iowa State in 2008 and was involved in various groups outside of his engineering studies, including serving as president of the Indian Students Association from 2009 to 2010. Despite spending just three years in Ames, Kuzhiyil said he made friends and memories that will last a lifetime.

"There were so many moments I really enjoyed at Iowa State," said Kuzhiyil. "Our research group was so big we had people from all over the world. We had people from India, China, Europe, Africa, from all over and we had discussions on science, on politics, on life, on love, on everything. They were all great for me because different viewpoints and perspectives on different things were really insightful. I really had a blast and enjoyed every moment of my PhD."

Kuzhiyil added that he loved the beauty of Iowa State's campus, especially during the spring bloom, and that he enjoyed participating in the International Food Festival during the annual VEISHEA celebration.

After completing his PhD, he worked as a fuels and lubricants technologist at General Electric for six years. In November 2017, he was hired as a staff engineer in synthetic lubricants at ExxonMobil Corporation. His current work focuses on engine oils and gear oils and how it relates to fuel economy.

"By using synthetic lubricants we can improve fuel and the energy efficiency. Synthetics are more of a move toward a sustainable future," Kuzhiyil said, adding that the job has been a nice marriage between his interests in chemical engineering and renewable energy.

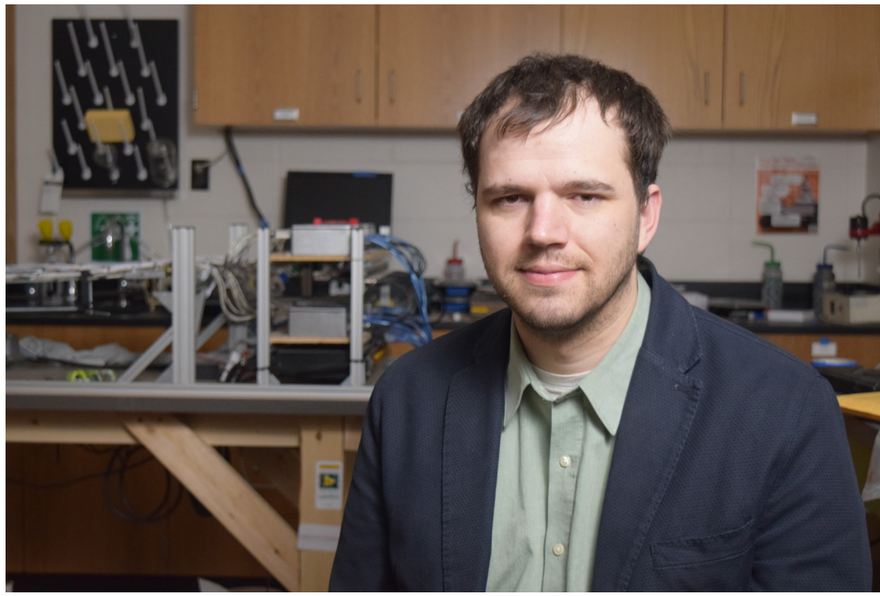
During his career, Kuzhiyil has studied or worked on three different continents. He said that these diverse experiences have contributed to his professional development and have been helpful when approaching challenges.

"In engineering most of the problems we deal with are open-ended. There's no single answer to many of the problems. You can design things in different ways so the engineer's job is to design a product or a process or whatever, within the constraints of resources, environment, culture and weather. All of those factors play into the engineering," said Kuzhiyil.

"Because I come from India, and I lived in Europe and the U.S., all of these places are different if you look at the available resources, the weather, the philosophy, etcetera. I really got a lot of examples of how the same product can be different on these three different continents and I think that's been helpful in getting me to where I am today."

Q&A with Zaffranfo Award honorable mention Austin Downey

Austin Downey is currently pursuing a PhD in Wind Energy Science Engineering and Policy administered by the mechanical engineering department. He was recently named an honorable mention for Iowa State's Zaffarano Award which recognizes excellence in graduate research. This marks the fourth year in a row that a ME student has won the award or been named honorable mention. Downey plans to complete his degree requirements this summer.



Austin Downey poses in his office in Town Engineering Building on April 19, 2018. *Photos by Nick Fetty*

Tell us a bit about yourself: Where are you from and when did you first begin developing an interest in engineering?

I grew up in northern Iowa and I have always enjoyed building and fixing things for other people. Earning a formal engineering degree has allowed me to work on projects that are important to a broader society, this is one of the reasons I have decided to focus my research on enhancing the safety and reliability of infrastructure.

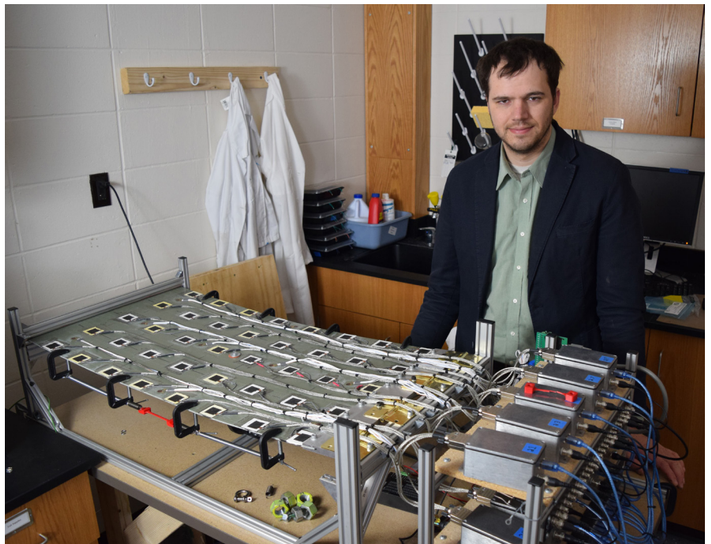
What did you study as an undergraduate here at Iowa State?

I have a BS in Civil Engineering and was very involved in undergraduate research during my time here. This allowed me to easily transition into a research-heavy graduate school experience.

In what ways do you see overlap between civil engineering and mechanical engineering?

Successful engineering is all based on problem solving. Working on a research problem that requires knowledge of both fields allows me to approach and solve problems in a unique way. The hardest problems in engineering lie on the edges of traditional declines, therefore, working between two disciplines provides me with a unique perspective.

Austin Downey stands next to a dense sensor array of low-cost sensors intended for the monitoring of large-scale structures. The test-bench allows researchers to validate algorithms and methods before the deployment of sensors networks onto full-scale structures.



Tell us a bit about what your research involves.

My research is focused on developing a low-cost sensing skin for the structural health monitoring of infrastructures, including bridges, civil structures, aircraft, and wind turbines. The sensing skin consists of a novel and inexpensive large area electronic, termed the soft elastomeric capacitor (SEC), that when deployed in a network configuration is analogous to a biological skin where local changes (i.e. strain or damage) in a structure can be monitored over the structure's global area. The real-time tracking of damages in structures will allow for more detailed infrastructure inspections and repairs, therefore, enhancing the safety and reliability of infrastructure.

What advice would you have for incoming college student who is interested in engineering?

My advice to students is to get involved in engineering-based clubs, activities, or research early on. These experience can really help students to understand what they enjoy and where their interests lie. In particular, undergraduate research can be helpful if you are considering grad school as it will introduce you to solving real problems in a research setting.

Nickname signifies rarity of skill set for ME alum

Carlson

Earning a nickname can be a rite of passage for any freshman, rookie, or other newcomer, and for one mechanical engineering alum that rite of passage occurred within the first week of his new job.

Adam "The Purple Squirrel" Carlson landed a job with Ford in January 2014, after finishing a dual degree in mechanical engineering and industrial design from Iowa State. It was during his first week at the new job that he acquired his unique nickname.

"I walked in like my first day and one of the supervisors in the other group said 'Oh, so you're the purple squirrel.' Then I thought 'Oh great I already have a nickname,'" said Carlson. "That's the nickname I carry and it's kind of fun within the group. The nickname is starting to spread to other departments as well and people are beginning to recognize it which is really cool."

Carlson said the nickname refers to the rareness and uniqueness of someone in his position which combines mechanical engineering with industrial design. He found out just how coveted his skill set was in the workplace when he applied for the job on a Sunday and within a day Ford contacted him for an interview. Due to a lack of qualified candidates, Ford actually considered pulling the position which had been open for a full year before Carlson came along.

Carlson works in the wind tunnel with full-scale clay models. He focuses on "wind noise" which is also known as aero-acoustics.

"My job is to go between the engineering team and the design studio to sell new ideas and to try to invoke shape changes that make the car quieter," he said. "It's kind of a crazy thing to think about but the exterior shape of the car is what generates the noise. It's the aerodynamic effects. So the idea is that if you can reduce the sound coming off the car from the shape, you need fewer items to absorb or reflect that noise to the interior cabin. So that reduces weight, it reduces costs, it reduces complexity, which is a pretty nice business case."

Carlson added that many automobiles consist of between 3,500 and 5,000 components so lessening the number of necessary parts is a great opportunity to save costs. For Carlson, the job is the best of both worlds: being able to combine his logic and engineering skills with his creative, design side.

"I get to propose aesthetic changes, the design side, but yet influence the functions and really try to make the vehicle the best we can for the customer, and as quiet as we can for the customer, the engineering side."

Carlson's interest in mechanical engineering can be traced back to his youth when he helped his father, Curt, and grandfather, Duane, work on cars in his hometown of Ankeny. Adam said around the time he was in junior high school he remembers helping his grandfather to rebuild a Ford Model-T touring car.

"That was bit of the Ford influence early on. I was probably bred to bleed blue a little bit," he said.

Engineering is a family matter for the Carlsons as Curt graduated with his BSME in 1981 while Duane – a farm kid from Boxholm – studied Farm Operation at Iowa State in the early 1950s but left before graduation to care for his ill father and to eventually serve in the Korean War. Adam's uncle, Dan, also studied chemical engineering at ISU.

In addition to being from a family of ISU alumni, Adam said that the proximity to home, the strength of the engineering and design programs, and his loyalty to the Cyclones – "win or lose" – were also factors that influenced his decision to attend ISU.

Carlson arrived in Ames in the fall of 2009 and spent five and a half years on campus pursuing his dual degree. As a freshman he served as a Cyclone Aide, assisting in student recruiting efforts on campus, and he joined the Iowa State University Cyclone Football "Varsity" Marching Band his sophomore year. He said both of these experiences helped him to develop a large network of friends that he describes as "a family in a lot of ways."

Adam Carlson (right) sporting an Iowa State Cyclones Starter jacket poses with his father Curt (left) and his grandfather Duane (center) with their Ford Model T. *Photo courtesy of Adam Carlson*

"The comradery of going to the same university, having a lot of the same connections, going through the same things is always awesome, it's huge," he said. "I was in Chicago over Christmas break. Chicago O'Hare is a huge airport and I'm walking along and somebody yells out my name and sure enough it's one of my fellow trumpet players that I played right beside in band. That comradery is an incredible connection."

Not only did Carlson develop lasting relationships with his peers but he also worked closely with some faculty members including ME professor Judy Vance, Joseph C. and Elizabeth A. Anderlik Professor of Engineering. Carlson spent a couple of semesters and summers working in Vance's virtual reality (VR) lab. Vance said that when she first met Carlson, he provided her with a sketch of a bottle shape that he was working on, which she said was not the typical work example she would get from a ME student.

"My research in virtual reality focused on how to use this technology to improve the design process. I've always been cognizant of the need for engineers to appreciate and work closely with designers and vice versa," said Vance. "Adam's skill set and interest areas were just what I needed in my research group. Adam joined the group and often contributed ideas that had us looking at problems from a different perspective."

Vance, who played flute in Iowa State's marching and symphonic bands in the late 1970s, said that she thinks participation in the band can be a nice break from ME coursework while also providing students with an outlet to express their creativity and also meet people.

"Band provides a means to meet new people outside of your major and expand your network. It often becomes a place that people call their second home at ISU. It's a place to fit in. Band is a place where you can have fun, meet people and do something constructive that provides a break from all the hard work that goes into completing an ME degree," she said.

With all of the relationships he has developed and memories he has, Carlson said one of the biggest things he misses about Iowa State is being able to hang out on central campus.

"I've been a few different campuses all over the country I can tell you that there are far and few between that are as nice and beautiful as Iowa State with the green space that is there. I live in Ann Arbor now and [the University of] Michigan has a really nice campus but I would say that it does not have the green space that Iowa State does."

As he reminisced about his college years, Carlson offered three pieces of advice for current and incoming students. In high school, Carlson said he always excelled at math but struggled a bit with the two semesters of calculus he was required to take in college.

"One of the best things that I did was I got a tutor," he said, adding that the tutor helped to keep him from falling behind which ultimately helped him to succeed in other classes and stay on track to graduate in time.

Carlson's second piece of advice was to "get involved," as he had done being a Cyclone Aide and a trumpet player in the marching band.

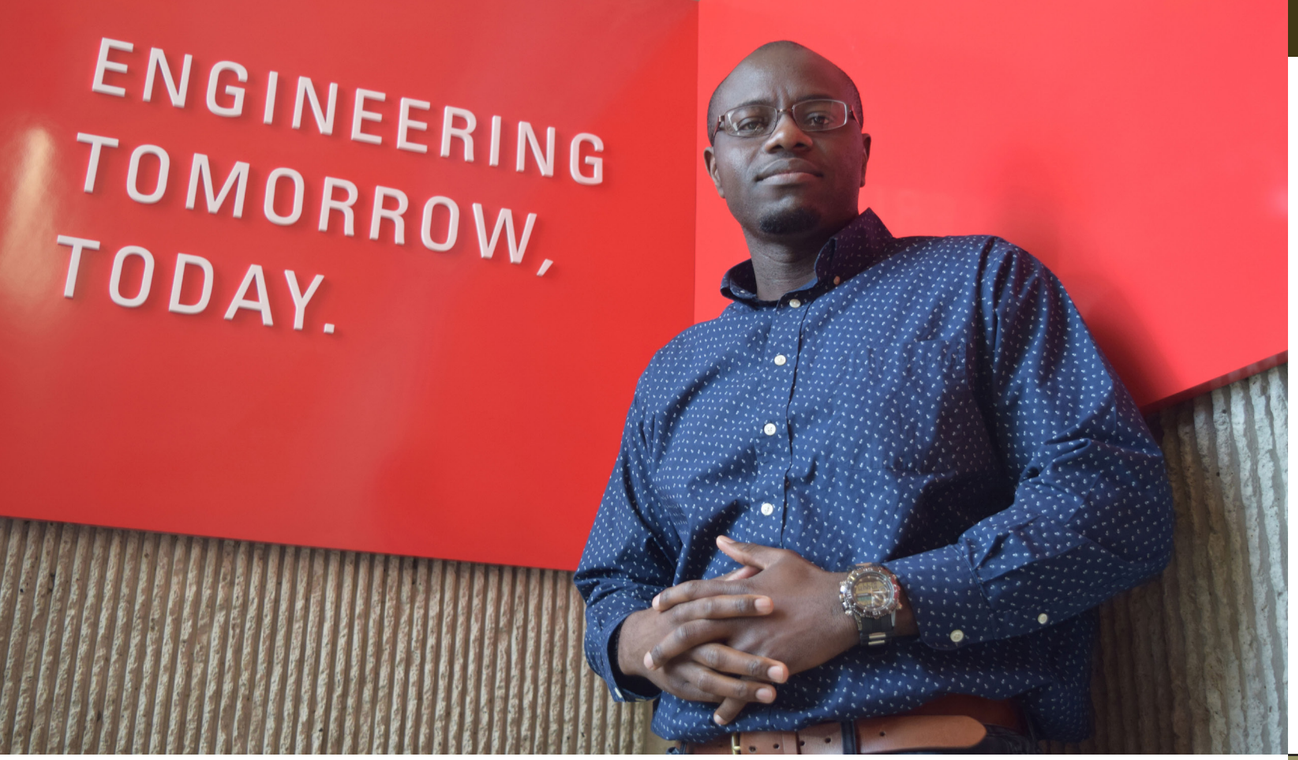
"It's such a cool university to be at with 36,000, 37,000 students that the ability to connect with so many people your age at such a special time in your life, there's no better time to create friendships and have fun and enjoy what you're doing."

Lastly, Carlson encouraged students to take a class in a department outside of their major.

"While mechanical engineering is really, really good at Iowa State, being multi-disciplinary and being able to think in different ways and being able to relate to other people that have experience in other areas will only open up doors for you."

Even though he is now four years and more than 500 miles removed from Ames, Carlson said he will continue to hold his time at Iowa State close to his heart.

"What Iowa State gave me was really incredible in terms of a skill set and I'm only continuing to appreciate what that did for me. It takes a while to truly grasp what four or five years of school will do but I think I will only continue to look back fondly at the memories I have."



Hitimana wins teaching award

A mechanical engineering graduate student is the most recent recipient of Iowa State's Graduate and Professional Student Senate's Teaching Award.

Emmanuel Hitimana, a PhD student, was among five candidates selected this semester for the honor. He currently serves a teaching assistant for the lab component of ME 421: System Dynamics and Control.

"When I got notified about the award, I was very excited. It feels great to be recognized for your hard work," said Hitimana. "Being one of the few to be chosen for such a competitive award is also humbling."

Hitimana, who has also taught ME 335: Fluid Mechanics and engineering thermodynamics, said that conducting experiments and explaining them to students is his favorite part of teaching. He grew up in the East African nation of Rwanda and developed an interest in mechanical engineering while in high school.

"I always wanted to apply mathematical and scientific theory to solve real world problems," he said.

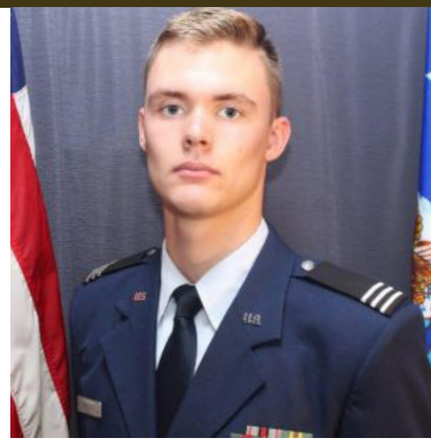
He attended William Penn University in Oskaloosa, Iowa for his undergraduate studies, majoring in Industrial Technology with an emphasis in engineering technology and a minor in mathematics. He then earned his MS in mechanical engineering with a thermo-fluid since emphasis from the University of North Dakota.

He first came into Iowa State in spring 2015 and plans to graduate with his PhD in mechanical engineering with a thermos-fluid emphasis by 2019. He said Iowa State and ME were easy decisions for him because of the reputation of the university's engineering program and the versatility that the ME field offers.

"I like the way mechanical engineering is very diverse and eases collaboration across different disciplines," said Hitimana. "Most importantly, mechanical engineering opens path to many research and career opportunities."

After graduation, he hopes to continue to do research either in industry or for a large research institution. Someday he hopes to become a university professor or even pursue entrepreneurial opportunities.

Carpenter named student marshal



Zachary Carpenter has been selected as the 2018 spring commencement student marshal representing the College of Engineering at the University Graduation Ceremony on Saturday, May 5.

Carpenter has been on the Dean's List every semester at Iowa State, obtaining a 4.0 GPA in mechanical engineering courses and being named a Cardinal Key Honor Society member.

Outside his success in the classroom, Carpenter has served as a peer mentor for the Mech E Learning Community, a teaching assistant for ME 370 and ENV S 342, as an Air Force ROTC cadet and has volunteered with children at various Ames organizations, such as St. Jude Up till dawn Fundraiser, Relay for Life and Ames Community and Youth Club.

"Because of his integrity, Zach is the type of person in which we can place a high level of trust. Zach went above and beyond by reaching out to his learning community students outside of the classroom via weekly emails, eating together and connecting students with his own network to help them succeed," said Jessica Van Winkle, academic advisor in mechanical engineering. "One of Zach's greatest skills is his ability to balance authority and care with the students he leads."

Carpenter participated in the National Reconnaissance Office summer research program in Washington D.C. and has received over eight honors and awards during his time at Iowa State.

Serving in four different leadership positions in the Air Force ROTC and as the leadership development chair for TKE, Carpenter has led many students at Iowa State.

"Zach has acted with independence, reliability and excellent communication skills in this role. Feedback from the students in his learning community section was overwhelmingly positive with students highlighting his leadership skills, his ability to present information and his down to earth personality, which made students feel comfortable," Van Winkle said.

In addition, Carpenter had two internships with Medtronic, as a manufacturing intern, and in the National Reconnaissance Office in Virginia.

Carpenter will be a U.S. Air Force Officer upon graduation.

Sarkar named Plant Science Institute Faculty Scholar

Funding from Iowa State's Plant Science Institute will allow a mechanical engineering researcher to study ways to assist farmers in Iowa and across the globe in growing food.

Soumik Sarkar, an assistant professor in mechanical engineering, will receive $75,000 in funding per year over the next three years for his research project. This project combines computing and other digital tools with traditional farming techniques.

"This grant will be an excellent support to explore my high-risk, high-gain ideas at the juncture of machine learning, artificial intelligence and plant science or agriculture," said Sarkar. "Specifically, I would like to develop advanced spatiotemporal data analytics and information fusion techniques to solve problems in plant pathology, plant breeding and enable smart farming practices."

Sarkar's research leverages the Predictive Plant Phenomics (P3) Program, which combines plant sciences with computational sciences and engineering to examine ways that sensors and data analysis techniques can be used to improve crop productivity. The P3 Program is part of the National Science Foundation's Research Traineeship program.

"My research focus is on data analytics, machine learning and applying such concepts to cyber-physical systems," said Sarkar. "Today, precise and cost-effective sensors as well as high performance computing technologies are looking to transform traditional agriculture into an efficient cyber-physical system. In this context, engineers and computer scientists have a major role to play and I see myself as one such enabler who can contribute to this critical societal need – growing sufficient food for the world."

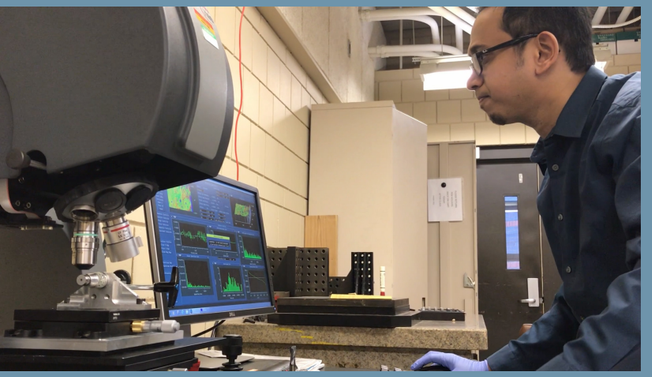
This year's Plant Science Institute Faculty Scholars cohort consists of researchers from agronomy; genetics, development and cell biology; industrial and manufacturing systems engineering; mechanical engineering; plant pathology and microbiology; and statistics.

"The PSI scholar award is a great honor for me and I am excited to join an amazing group of scientists, get opportunity to work with them, and learn from them," Sarkar said.

Do you have story ideas for the next issues of *Dimensions*?

Send them to mecommunications@iastate.edu

Roy receives tribology research award



Sougata Roy conducts research in the Metrology Lab in Black Engineering Building on February 28, 2018. *Photo by Nick Fetty*

A mechanical engineering graduate student looks to advance the field of tribology and lubrication engineering with an award he received from that field's largest technical society.

Sougata Roy, a PhD candidate in ME, recently received the Society of Tribologists and Lubrication Engineers' (STLE) Early Career Award in the student category. Tribology is the study of two interacting surfaces that are in relative motion. Engineers and researchers in these fields generally study problems related to friction, wear, and lubrication from the macro to nano scale.

Roy said he was honored to receive the award which will cover his expenses to attend the 2018 STLE Annual Meeting and Exhibition this May in Minneapolis. Additionally he'll be able to publish an early career-focused article in TLT (Tribology and Lubrication Technology), a magazine dedicated to current research trends in the field of tribology.

"STLE is the largest technical society in my field of research. Hence, receiving such a prestigious recognition from this specific society certainly made me very ecstatic," said Roy. "This kind of achievement gives me more encouragement and confidence to continue working in such a wonderful and exciting field of science and engineering."

Roy received the award in part because of his past accomplishments and publications, and also in part because of the impact of his current research project in which he has collaborated with Argonne National Lab in Illinois as well as PCS Instruments and Wallwork, both based in the United Kingdom.

"In a nutshell, my research is mainly focused on studying the effect of the specific phase in steel called retained austenite on crucial failure modes observed in gears and bearings," said Roy. "The findings from my research will provide the gear and bearing industries an insight on how to enhance the life of those components by changing the material microstructure. The direct application area of my research findings ranges from the wind turbine industry to agricultural machineries."

This is yet another award that Roy has earned in recent years. He was named a 2016 National Science Foundation (NSF) Trinect fellow, received an Iowa State University Teaching Excellence Award in spring 2015, and earned the "Best Individual Project" award in 2012 from the Indian Institute of Technology Madras.

Roy grew up in Bishnupur, India and in middle school began developing an interest in engineering. In high school he excelled at math and physics and chose to pursue both his BS and MS in mechanical engineering from the Jalpaiguri Government Engineering College and the Indian Institute of Technology Madras, respectively. Roy said he chose mechanical engineering because of "the global opportunities and wide range of application areas" it offers.

After working at Cummins Fuel Systems, India for a year, Roy chose to pursue his PhD in mechanical engineering at Iowa State because of both the research opportunities available and faculty members with whom he wanted to collaborate.

"I was always passionate about working on experimental research that might have some industrial application," said Roy. "After getting an offer letter from ISU, I discussed some potential research opportunities with Dr. Sundararajan since there was a great match between his research focus and my research interest. He mentioned about the research opportunity on gear tribology, which was funded by John Deere and we agreed on working on that specific project."

Sriram Sundararajan, Roy's PhD adviser who also serves as Associate Dean for Academic Affairs in the College of Engineering as well as a professor of mechanical engineering, said he has been impressed with the work he's seen from his pupil.

"His background I think has been fantastic. He brings a materials science-type mindset to this problem and he's an excellent mentor to students," said Sundararajan. "He has a good focus on understanding the implications of what the problems are, what is a good systematic way to approach it, and gather excellent data and do the analysis required to convert it into very high-quality scholarship so it's been an excellent experience and he's an up and coming scientist in this area of tribology."

Sundararajan added that the implications of Roy's research can have a major impact in Iowa where agriculture and wind energy are two of the state's major industries.

"This [research] has implications for both agriculture equipment and earth-moving equipment as well as wind turbines because all of these things share a gear drive that operate at a high load and relatively low speeds. His research can have wide-based impact," Sundararajan said.

Roy plans to complete his PhD in the summer of 2018. Upon graduation he hopes to find a postdoctoral position at a research university or a national laboratory. He said he would encourage younger students to pursue studies and careers in the field of tribology.

"I would say that the field of tribology is an interdisciplinary research area, which is both technologically relevant and scientifically fascinating. There exists a wide range of application areas starting from the energy sector to biomedical fields. I think young, aspiring engineers from different disciplines can come forward to investigate more about this field. It is definitely an exciting time to be a tribologist."

ME grad students combine skills in engineering, entrepreneurship

Two mechanical engineering graduate students recently received awards for their paper at the United States Association for Small Business and Entrepreneurship (USASBE) national conference in Los Angeles last January.

Sanvisna Kogelen (MS, Mechanical Engineering) and Alex Wrede (PhD, Mechanical Engineering) along with Patrick Kreiser (Bob and Kay Smith Fellow in Entrepreneurship and Associate Professor of Management) and Younggeun Lee (PhD, Entrepreneurship) co-authored a paper entitled, "The Influence of University based Entrepreneurship Education on the Formation of Entrepreneurial Capabilities". Their paper won the 2018 USASBE Entrepreneurship Education Research Paper Award sponsored by the journal Entrepreneurship Education and Pedagogy (EE&P) as well as the 2018 Best Overall Paper Award sponsored by Ohio University. The Best Overall Paper Award had more than 400 submissions from 254 universities across 24 countries.

Wrede said he was encouraged that his team's submission took the Best Overall Paper Award among so many other qualified entries.

"I am overly encouraged that the entrepreneurial society has recognized our work with such high regard," said Wrede. "Winning this award has motivated me to encourage other students to broaden their education. This paper and award all started from going outside of my major department and using elective credits toward a class that looked interesting to me."

Kogelen said he was surprised to receive the award.

"I had confidence that our study was quite impactful, but I expected researchers from other institutions to win this award given their experience in this field," said Kogelen. "That being said, receiving this award was a very pleasant surprise. Knowing that work we conducted will contribute to the field of scholarly entrepreneurship positively is very rewarding."

Wrede plans to complete his PhD in May 2019 and hopes to pursue entrepreneurial and mechanical engineering opportunities simultaneously after that. He said that having knowledge of both engineering and business/entrepreneurship has been beneficial to his professional development.

"I think business and entrepreneurship intellect is important to incorporate with all fields of study. This opportunity has allowed me to develop entrepreneurial skills and in the future I think this will be extremely beneficial as I try to advance society in a practical manner with engineering designs," Wrede said.

Kogelen plans to complete his MS this May and hopes to pursue a career in research and development in industry after that. He said that having knowledge of both engineering and business has contributed to his professional development.

"Scholarly entrepreneurship is a broad field currently comprised of theories from several distinct fields, ranging from psychology and communication to business management. Being trained in engineering, I have a strong theoretical background in the hard sciences. By taking MGMT606X and subsequently conducting this study I garnered some idea into how people think and behave, how cultural influence affects how business is conducted across borders, and the advantages younger, smaller companies have over large multinational corporations," said Kogelen.

Wrede

Kogelen

"Having knowledge like this allows me to understand how to work better in teams, conduct work being actively conscious of cultural boundaries and the inner workings of companies I might someday join. Skills like these that I picked up through my journey with entrepreneurship research together with my strong theoretical understanding in the harder sciences I believe has made me a more all-rounded student, and given me a unique skill set that I can bring into my future career," Kogelen added.

Levitas receives Khan International Award

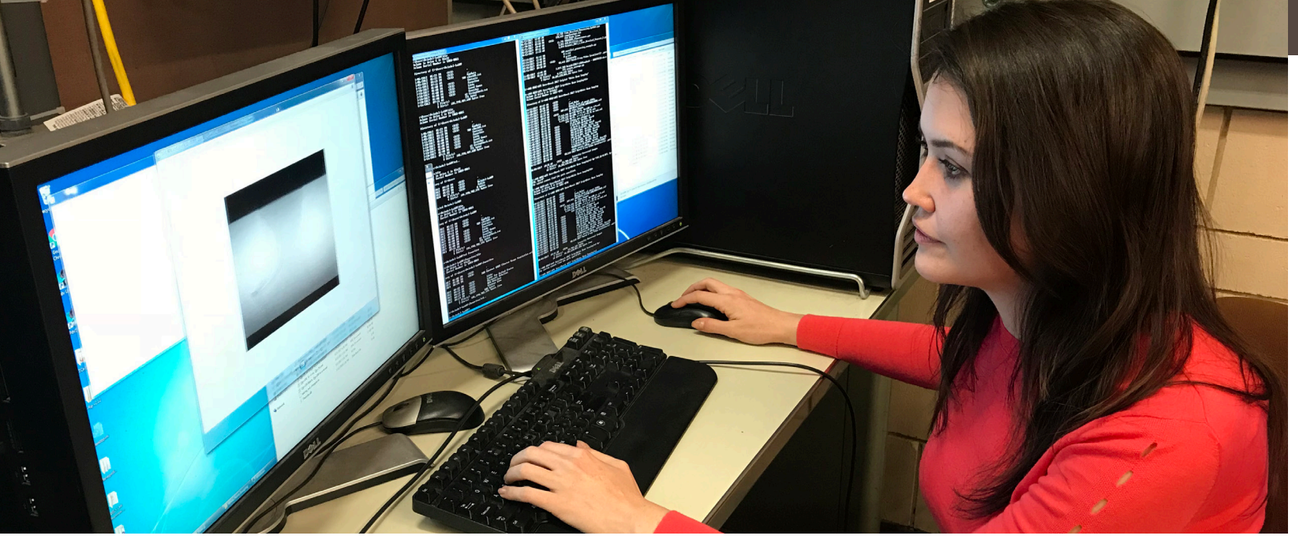
Dr. Valery Levitas, Vance Coffman Faculty Chair Professor of Aerospace Engineering and Mechanical Engineering, and faculty scientist with the U.S. Department of Energy Ames Lab, has been named the 2018 recipient of the Khan International Award, also known as the Khan Plasticity Award.

Levitas, who has a courtesy appointment with materials science engineering, was noted for outstanding contributions to the field of plasticity over a period of 24 years (1993-2017), and especially for pioneering works on interaction between phase transformations and plasticity in materials under high pressure at multiple scales.

This award was presented to Levitas at the recent 24thInternational Conference on Plasticity, Damage & Fracture in San Juan, Puerto Rico. Levitas also delivered a 50-minute plenary lecture as part of the conference.

The Khan International Award is named after the International Journal of Plasticity Founding Editor-In-Chief Akhtar Khan. The award committee consisted of five former recipients of the award from the U.S., France, Belgium, and South Korea. The selection criteria included general quality, quantity, and standing of research contributions to the field of plasticity and quantitative parameters of citations of all plasticity-related papers; papers published in the International Journal of Plasticity; and papers that have more than 50 citations, excluding self-citations.

The award also includes a mini-symposium on phase transformations and other structural changes in materials, which will be organized in Levitas' honor at the 25th International Conference on Plasticity, Damage & Fracture in January 2019. A special issue of the journal will include the symposium presentations.



Bothell receives funding for multiphase X-ray radiography research

Mechanical engineering graduate student Julie Bothell recently received $2500 from the Iowa Space Grant Consortium for her research related to multiphase X-ray radiography.

Her current project is entitled "X-Ray Imaging of the Spray from a Coaxial Air Blast Atomizer" and is a collaborative effort between Iowa State and four other universities: Cornell University, University of Florida, University of Illinois – Champaign-Urbana, and University of Washington. Bothell said the main goal of the research is to "actively control a spray."

"One of the main places that we see a use for this is in the fuel injection system of jet engines," said Bothell. "Right now, the fuel injection systems are optimized for cruise conditions. But, if it were possible to actively control the spray inside of the engine, it would be possible to optimize for take-off, landing, and any other condition that the jet has to go through. Because this research is fundamental research of sprays, our findings could also be useful in paints, coatings, in industrial systems, or anything else that uses sprays."

However, Bothell said that they need to learn more about spray fundaments before figuring out how to control them. To learn more about this, they are focusing on the spray that is close to the nozzle. Specifically, she's looking at the part of the nozzle where the spray begins to take its shape.

"To study this, we use X-ray imaging because X-rays can penetrate the liquid even when visible light can't," said Bothell. "We take the X-ray images with a high-speed camera and can then go back and play them in slow motion. By doing this we are able to see the way that the liquid breaks up and becomes droplets and then more droplets and more droplets until there is a spray. This characterization provides us with the information necessary to start controlling the spray."

Bothell works in the lab of Ted Heindel, Bergles Professor of Thermal Science in mechanical engineering. Heindel said Bothell's current research project fits in nicely with the focus of his Experimental Multiphase Flow Laboratory in Black Engineering Building.

"Sprays are a very complex multiphase flow, and Julie is part of a large team working to increase our understanding of the spray formation process," Heindel said.

Bothell began developing an interest in science and engineering when she was in elementary school.

"I knew that I wanted to be in science after participating in the science fair in fourth grade. Then, I decided to pursue engineering when I was in high school. The idea of combining science and math to create new products and technology really appealed to me," she said.

She earned her BS in aerospace engineering from Iowa State but decided to switch to mechanical engineering for her graduate studies because she thought it offered her more flexibility with her research and career possibilities. She said that she thinks there is a lot of overlap between the two fields.

"The research I am doing now is in fluid flow which is a prevalent topic in both fields," said Bothell. "In aerospace a lot of the research is dealing with air so they study things like the boundary layer of air as it's flowing around a wing. In mechanical engineering there are studies that primarily focus on air flow but there are also a lot of studies in fluid flow that deal with liquids or even solids that are entrained in liquids. Mechanical really is just a broader field."

Heindel also said that he think's Bothell's undergraduate background in aerospace engineering has contributed positively to her coursework and research as a graduate student in mechanical engineering.

"The study of fluid mechanics is common to both aerospace engineering and mechanical engineering, and Julie's understanding of this area has certainly helped with her spray research," he said.

Bothell hopes to complete her PhD in spring 2020 and said she would like to continue to do impactful research when she pursues a career after graduation.

"I'd really like to work at a National Lab or another large lab. When I chose to do a PhD, I did it because I really enjoy doing research. It appeals to me because the discoveries that are made in research form our understanding of how the natural world works. That understanding is what forms our knowledge as a species and it's also what makes new innovations possible. So, my real career aspiration is to make discoveries that will lead us all to a better future," she said.

Lynch gets funding to study microwave interaction with energetic material flames

Mechanical engineering graduate student Joel Lynch recently received a $2500 grant from the Iowa Space Grant Consortium to study the coupling of microwave fields with solid rocket propellant combustion.

His current project is entitled "Modeling of Flames Seeded with Alkali Compounds under the Presence of Alternating Electric Fields." The research is taking place within the Nanoscale Energetics Lab overseen by Travis Sippel, an assistant professor of mechanical engineering.

"Dr. Sippel's research group seeks to understand and utilize coupling between alternating electric fields and solid rocket propellant combustion," said Lynch, who is pursuing a PhD. "The combination of the two creates a plasma environment that can be extremely useful in enhancing and controlling propellant combustion. There are a number of uses of this coupling, such as providing dynamic control of rocket motors and enhancing rocket motor efficiency."

Through this research, Lynch will develop computational models

"My portion of this effort is to develop computational models that can capture the plasma kinetics and transport phenomenon observed in our experiments. We hope these models can provide insight into how to further improve this enhancement technique," he said.

One of the thrusts of the Nanoscale Energetics Lab is to develop energetic materials and energetic material additives that can improve energetic material combustion (e.g. the combustion of a rocket propellant, pyrotechnic, or an explosive).

"Much of the lab's research is experimental and while experimentation is useful and demonstrative, the experimental diagnostic measurement of energetic material flames is quite difficult because of the fast timescales of combustion events, the varying sizes of ingredients and flame features, and the multiphase – solid, liquid, and gas – nature of the combustion environment. In dynamically controlling an energetic material with an electromagnetic field and/or plasma, we have added additional layers of complexity to this already difficult problem," said Sippel.

"Joel's research is computational, and aims to develop simulations of microwave-plasma interaction with flames in order to gain valuable insight that would not be possible experimentally. The end-goal environments Joel aims to simulate are extremely complex. However, the simulations Joel is conducting are able to simplify many of the complexities of an experiment, enabling a wealth of insight that is relevant to experiments. He is approaching his research from a fundamental perspective and continues to build into his simulations additional physics and chemistry to make them more realistic."

Sippel added that these efforts are benefited by his co-mentor, Shankar Subramaniam, an ME professor who has expertise in simulation of chemically reacting and multiphase flows.

Lynch said his interest in engineering began as a kid playing with LEGOs.

"I've been an engineer in some form for most of life," he said.

He worked with robotics in high school and with rockets as an undergraduate studying aerospace engineering at Iowa State.

"I've been rather surprised by the degree of overlap between ME and Aero E," said Lynch. "Both are excellent in teaching core concepts like fluid mechanics, though the different applications create noticeably different approaches. For example, ME tends to focus on the thermodynamic applications of working fluids, whereas Aero E emphasizes the effect of flow-fields on aerodynamic vehicles."

Sippel said that he also thinks Lynch's background in aerospace engineering has helped to prepare him for his current research and his graduate studies.

"Joel's undergraduate training in aerospace engineering has been beneficial to his particular research topic," said Sippel. "As an undergraduate in aero, Joel took several courses in thermofluid simulation and high-performance computing. These courses have helped Joel to excel in his research."

Lynch first started working in Sippel's lab as an undergrad and this experience, coupled with Sippel's mentoring, encouraged him to pursue mechanical engineering for his PhD.

"I'd like to thank Dr. Sippel, both for taking me on as an undergraduate researcher and as a graduate student. I wouldn't be here without his support, and that means a great deal to me," said Lynch. "I'd also like to thank my fellow students in Dr. Sippel's lab, who are wonderful coworkers and even better scientists."

Lynch is currently focused on completing his graduate studies and said he hopes to continue to do research when he pursues a career after graduation.

Do you have ideas for the ME department history project?

Send them to mecommunications@iastate.edu

Steve Koenck and Joe Musil: Cyclone engineers and patent powerhouses

Steve Koenck (right) and Joe Musil (left) got a unique hands-on experience at Iowa State that helped propel them to into the Iowa patent hall of fame.
Photo by Breehan Gerleman

Two Cyclone engineers. More than 200 patents. A hands-on Iowa State learning experience that started it all.

Steve Koenck (elec engr '73, MS '74) and Joe Musil (mech engr '72) met as Iowa State engineering students in 1970 when they both were working in the College of Engineering's fabrication machine shop.

"Pretty much every hour I wasn't in class, I was in the shop in Coover Hall," said Koenck. "We got to help every step of the way as the shop technicians created one-of-a-kind research equipment for faculty members – anything from custom instruments to setting up whole new labs."

Along the way, Koenck, Musil and the other student workers got unique practice in the design and build cycle from beginning to end.

"Researchers would come in with an idea brilliantly in their minds, and we learned how to take those idea and turn them into a design on paper," said Musil. "Then we'd set to fabricating using lathes, milling and welding, so we could come up with a prototype for the researcher to test."

Both Koenck and Musil grew up working on Iowa farms, building early hands-on problem solving skills. And both say working in Iowa State's fabrication shop gave them further experience that set them apart from other engineers.

"We knew how to run every machine in the shop, and we got to see what we learned in class come to life," said Musil, "When I got a job, they were astounded to learn how much I knew about how to design, machine, and weld."

Beyond technical skills, working in the shop instilled a powerful spirit of innovation and problem solving.

"The shop manager, Terry McConnell, had a motto of 'we can do anything.' Didn't matter what it was, we can engineer and create it," said Koenck. "So, we went into the work world with that idea in our heads."

Industry impact

From Iowa State, Musil joined Iowa Manufacturing Company, a Raytheon owned company, in Cedar Rapids, engineering heavy machinery.

"With my experience at Iowa State, I was able to go in and start solving problems right away," said Musil.

Over the years, he's designed and created huge, complex heavy machines from "one end to the other." He developed rock crushing equipment, asphalt plants and pavers, air filtration equipment and more.

"I had the luck to start working in heavy equipment in 1972, the year the Environmental Protection Agency was formed. Our industry worked hand-in-hand with the EPA on a large varities of issues on regulations, test protocols, tests and controls," said Musil. "Changing regulatory conditions meant an opportunity to create a lot of new ideas and technologies."

And create he certainly did: He holds 64 patents for new technologies and processes he's invented (with more applications in progress). And he's a member of the Iowa Intellectual Property Law Association's Iowa Inventors Hall of Fame.

Koenck made an equally large innovation impact during his career in the electronics and aerospace industry. He worked most of his career at Norand Corporation and Rockwell Collins, where he engineered components for commercial, aerospace and defense systems.

"The work was consistently between interesting and fascinating," said Koenck. "I had real opportunities to attack significant problems that changed the industry."

One of those industry-changers is at the top of your cell phone or laptop display right now: the highly accurate fuel gauge that tells us just how much battery charge remains. At Norand Corporation, Koenck created this "smart battery" technology that combines batteries and computer chips to monitor and regulate battery conditions.

And that's just one of his 150 patents (so far). Koenck is also a member of Iowa's Inventors Hall of Fame.

Inventive education

Koenck recently retired and moved to Ankeny, Iowa. Musil farms 240 acres near Ely, Iowa, and continues to work "in town."

They have kept in touch over the years, meeting up to talk about their work and reminisce about their time at Iowa State.

"It's interesting that both Joe and I have made a lot of inventions in our professional life, and I always wonder what the common thread is," said Koenck. "Was it being in the shop? Was it the technical knowledge in our classes?"

Musil would say that both were key to their success.

"I always say Steve and I came out of the College of Engineering with two degrees. One in our technical engineering area. And one in how everything else really works in the engineering world: how run everything in the shop, how to make anything, how to talk to people and come up with designs," he said.

Koenk agrees. "Part of being an inventor is just really wanting to invent, but the other parts are technical know-how and hands-on experience. I credit Iowa State as the place that delivered a high quality education that made it possible for me to invent and make an impact as an engineer."

Contributed by Breehan Gerleman/Engineering College Relations

Department of Mechanical Engineering
2043 Black Engineering
2529 Union Dr.
Iowa State University
Ames, IA 50011-2030

Your support makes a difference

Generous gifts from our alumni, corporate sponsors, and other partners enable the mechanical engineering department to continue its tradition of academic excellence. Your contributions to the Black-Hilstrom Excellence Fund make a lasting impact on our program and the success of our students through initiatives that include

- Providing scholarships and fellowships for recruiting and retaining students
- Supporting student leadership groups
- 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

Please use this form to contribute or contact our development officer, Ryan Harms, at 515 294-0743 or rharms@iastate.edu to learn about other ways you can support the mechanical engineering department.

Black-Hilstrom Excellence Fund

☐ I would like to contribute to the department in the amount of
☐ $50 ☐ $100 ☐ $250
☐ $500 ☐ $1,000 ☐ Other $_____
☐ I am interested in information on establishing a scholarship, naming a laboratory, or creating a named faculty position.
☐ I would like information on planned giving.
☐ I have included the Department of Mechanical Engineering in my estate plan.

Name _____ Date _____

Degree(s) _____ Year(s) granted _____

Address _____

City _____ State _____ Zip _____

E-mail _____ Phone _____

My gift ☐ does ☐ does not qualify for a company matching gift.

Payment Type

☐ Check enclosed (payable to the ISU Foundation)
☐ Credit card Select type: ☐ Visa ☐ MasterCard ☐ Discover ☐ AmEx

Credit card number _____ Expiration date _____

Name as shown on credit card _____

Cardholder signature _____

Please return form and payment to: **The ISU Foundation**
2505 University Boulevard
Ames, Iowa 50010-7164

We appreciate your support!