

NEWSLETTER | FEBRUARY 2017

MIE

MECHANICAL & INDUSTRIAL
ENGINEERING DEPARTMENT

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 THE UNIVERSITY OF IOWA

College of Engineering

NADS Thinks Big...

NADS Thinks Big...

NADS sets its sights on becoming a multi-faceted driving research institute



NADS research includes: advanced vehicle safety technologies and automated vehicles

the world of driver performance and vehicle safety research is changing rapidly and, intent on progressing right along with it, is the UI College of Engineering's National Advanced Driving Simulator (NADS). With new leadership from MIE Professor Daniel McGehee, a broader, more holistic approach toward automotive safety research is emerging to grow the center's reputation internationally.

As the nation's largest and first simulator of its kind anywhere in the world, NADS has made the UI a global leader in vehicle research. For more than 20 years, researchers at NADS have studied the connection between humans and vehicles through

driving simulation. Development and research at NADS, sponsored by government, military, and industry partners, strives to save lives, improve the quality of life for motorists, and improve efficiency and productivity of the automotive and supporting industries.

But while simulation is an essential research tool for studies that are infeasible, too costly, or unsafe to be investigated in the real world, a more diversified approach is necessary as industry and government funding for automated vehicle research and testing of on-road technologies is rising dramatically. Enter Professor Daniel McGehee, the newly appointed director of NADS.

[For more information on Daniel McGehee, please see the New Faculty page](#)

Interdisciplinary research is a hallmark of Professor McGehee's work. Professor McGehee's innovative collaborations is evident in his leadership on the TraumaHawk project, a smartphone app that allows first responders to quickly collect specific photos and vital collision information of a crashed vehicle. This information is sent instantly to emergency room personnel, providing time to prepare for the arrival of trauma patients. TraumaHawk joins faculty and staff from across multiple areas of expertise at the UI, including public policy, medicine, public health, and computer science.

Professor McGehee also conducts research for the United States Department of Transportation (US DOT), National Institute of Health (NIH), and the automotive industry. He has logged more than a million miles of naturalistic on-road human factors data and driver behavior. McGehee's research helps policy makers improve government safety standards as well as develop new laws on driver distraction and teen driving. As the principal investigator of the MyCarDoesWhat.org project, a national, multi-year campaign in partnership with the National Safety Council, Professor McGehee leads efforts to educate drivers on new safety technologies designed to help prevent vehicle crashes. With McGehee as director, NADS is now the most interdisciplinary research unit



at the UI, partnering with nearly every college on campus. To further expand this work and remain at the forefront of the vehicle research field, Professor McGehee and staff intend to shift NADS to a more broad-based automotive safety research institute over the next 12 to 18 months. Leadership aims to expand NADS with new multi-use facilities, including more general garage and shop space for the next generation of cars and trucks, experimental laboratories, new clinical capabilities for increased pharmaceutical research, and office space for faculty, staff, students, and industry partners to foster innovation, creativity, and discussion of ideas.



MIE Advisory Board Members inside the simulator during a tour of NADS – Fall 2016

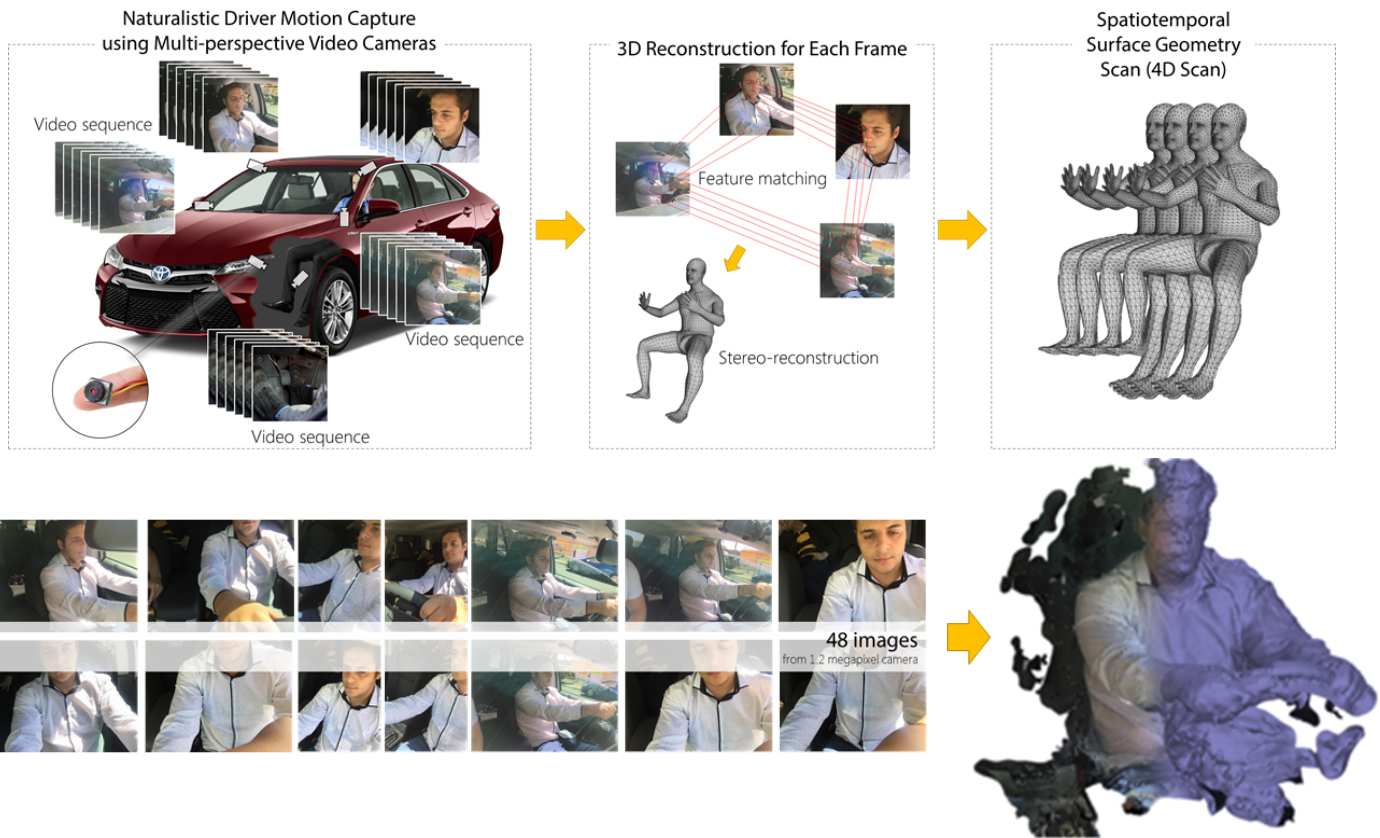
Autonomous vehicles will be a defining technology of the 21st century and a diverse automotive safety research institute would bring NADS on pace with regional economic development and automated vehicle design and development. In partnership with the Iowa DOT, Professor McGehee and staff are creating real-time, three dimensional (3-D) maps of interstate 380 that will be accurate down to the centimeter. These detailed maps will be available to researchers and car-makers in future testing advanced automated vehicles.

NADS is always searching for new partnerships, including collaborations with faculty in Mechanical and Industrial Engineering.

For example, MIE Professor **Stephen Baek** has been creating an algorithm and hard drive system for NADS research. Baek's research focuses on measuring movement of humans using 3-D scanning. In collaboration with NADS, Baek has created and installed his own system, of cameras and sensors in vehicles in hopes of understanding what is happening inside. Baek explains that to be able to bridge the gap between manual and driverless vehicles, "we need to develop the technologies to enable cars with the technology to understand what is happening with the driver's physical and emotional state." The goal for this system is to detect driver distraction by analyzing the driver's movements and eye patterns, and when detected the technology takes control of the vehicle. Baek identified driver privacy as an issue with this technology. "We will get there, but right now we are focusing on detection." He anticipates that minor tweaks in this technology will eliminate the issues. Although this technology is very specific for NADS, it could revolutionize the safety of the way driverless vehicles operate.

"We (NADS) are creating the technologies to revolutionize the way automated vehicle systems operate."

–Assistant Professor Stephen Baek



For more on NADS please visit: <https://www.nads-sc.uiowa.edu>

New Faculty



Daniel McGehee

Associate Professor

Although he isn't new to the University of Iowa, new faculty member Daniel McGehee has recently been appointed as an Associate Professor in Mechanical and Industrial Engineering and Director of NADS. McGehee also holds a secondary faculty appointment in Occupational and Environmental Health and Emergency Medicine. He earned his PhD in Human Factors from the University of Leeds, England. For more than 20 years, Professor McGehee has been a leading expert in studying vehicle crashes and how to prevent them with technology. He has conducted developmental research on a number of crash avoidance systems.

Professor McGehee began his career in 1993 when he joined the original Center for Computer-Aided Design (CCAD) Iowa Driving Simulator and did some of the first crash avoidance system and worked on early crash avoidance systems and on-road research. He later joined the UI Public Policy Center where he founded a new interdisciplinary research program in human factors and vehicle safety research. He continued to conduct high-fidelity driving research for, and also added to the UI's expertise by moving into, instrumented road vehicles and naturalistic driving research. Professor McGehee's research has been funded by the US DOT, NIH, and the automotive industry and includes real-time, very detailed 3-D maps of Interstate 380. These detailed maps will aid future testing of highly automated vehicles. As director of NADS, McGehee leads a group of faculty, staff, and graduate and undergraduate students in an interdisciplinary transportation research program that is funded by government and industry partners. His research helps improve government safety standards, and driving laws.

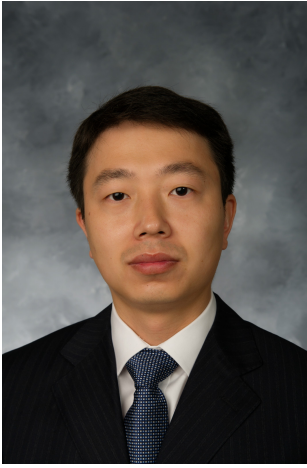
Professor McGehee is teaching a graduate course he developed on Automated Vehicle Systems. He teaches the class like a start-up company where the students develop the specifications for a highly automated vehicle. Students consider safety regulation and policy changes every step of the way.



Daniel McGehee presenting the NADS research vehicle to members of the Iowa State Patrol during a tour of the facility



Students in the UI College of Engineering's Automated Vehicle Systems class ride along with Daniel McGehee to test the automatic brakes of a car equipped with automatic emergency braking



Zhen Kan

Assistant Professor

Professor Zhen Kan received his PhD degree in 2011 from the Department of Mechanical and Aerospace Engineering at the University of Florida. After completing his doctoral studies, he was a postdoctoral research fellow with the Air Force Research Laboratory (AFRL) at Eglin Air Force Base (AFB) and the University of Florida Research and Engineering Faculty (REEF). In 2016, he joined the University of Iowa in the Department of Mechanical and Industrial Engineering as an Assistant Professor. He currently serves as an Associate Editor on Conference Editorial Board in Institute of Electrical and Electronics Engineering (IEEE) Control Systems Society and technical committee for several

internationally recognized scientific and engineering conferences.

Professor Kan's group, **Networked Systems and Robotics (NSR)**, focus is on the design and analysis of control algorithms for networked dynamic systems to realize intelligence, efficiency and safety in uncertain and dynamic environments, which integrate advanced control theory with the science of networks, communication, optimization, and graph theory. In particular, NSR's research efforts are focused on:

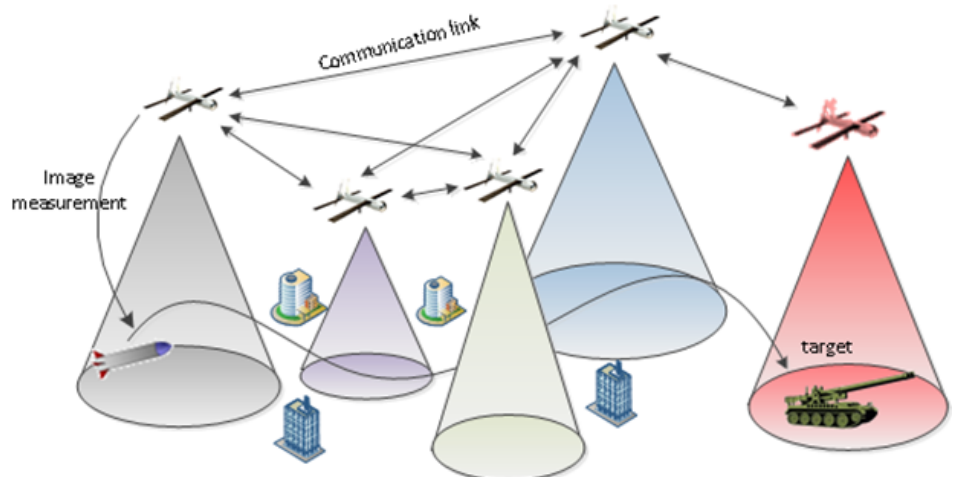
- Distributed estimation and control of networked autonomous systems
- Adaptive, robust, and learning control designs for nonlinear systems with uncertain nonlinear dynamics and limited sensing/communication information
- Control and analysis of networked complex systems (e.g., social networks, cyber-physical systems)
- Human-assisted estimation, planning, and decision-making in human-robot systems



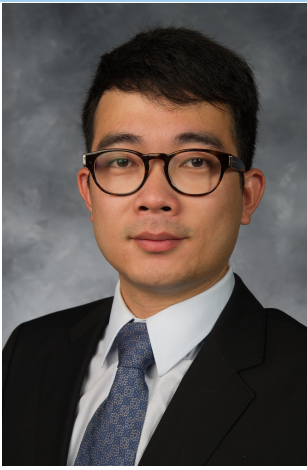
Connectivity maintenance of networked systems

Strong emphasis is placed on both theoretic research and experimentation for addressing fundamental and open real-world technological problems. The goal is to make life better by significantly advancing the technologies on controls and training science-based engineers and professionals to shape the future of our society.

In addition to research, Professor Kan will instruct mechanical engineering courses. Professor Kan eagerly dove right into the classroom setting instructing Engineering Instrumentation in the Fall of 2016. Engineering Instrumentation is a class discussing the basic elements of circuits, laboratory instrumentation, frequency response principles, data acquisition, and much more. He will continue instructing intermediate level mechanical engineering courses.



Navigation and path planning for network Unmanned Autonomous Vehicles (UVAs) to cooperatively track a mobile ground target

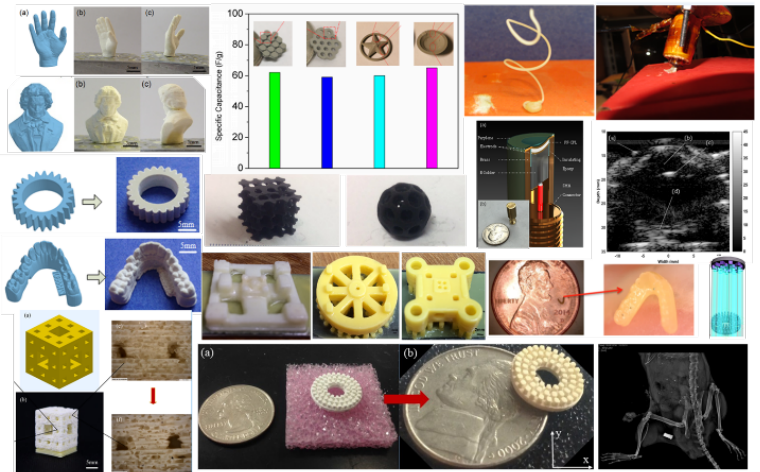


Xuan Song

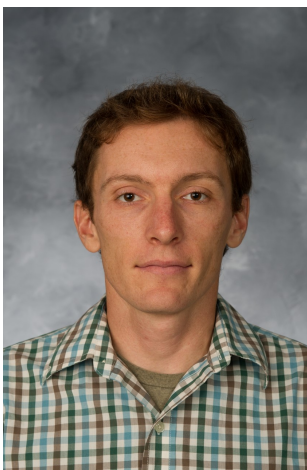
Assistant Professor

New to the Industrial Engineering faculty, Dr. Xuan Song. He obtained his PhD in Industrial and Systems Engineering from the University of Southern California in 2016. Dr. Song's research focuses on additive manufacturing (AM, also known as 3-D printing) process development and optimization, especially for polymer, ceramics and composites. He is also interested in novel applications of AM technologies in various areas, such as biomedical imaging, tissue engineering, energy harvest, and robotics.

Dr. Song joined the MIE department as an Assistant Professor in the fall of 2016. At UI, Professor Song's research focuses on the development of next generation additive manufacturing processes, including multi-material, multi-scale and multi-directional printing. In addition to conducting research, he will be instructing industrial engineering courses. Since starting, Dr. Song established the **Additive Manufacturing-Integrated Product Realization Laboratory (AMPRL)**, which focuses on his research. Current research includes: new process development for next generation AM technologies, such as multi-material, multi-scale and multi-directional printing. The goal is to print polymers, ceramics, metals or composites at different scales; process modeling, quality control and optimization for AM. Research is carried out to improve fabrication accuracy by identifying the process-structure-property relationships for different materials and geometries; and to study novel design and applications using AM technologies, such as 4D printing, tissue engineering, microfluidics, robots, biologically inspired structures, etc.



Example components fabricated by new additive manufacturing processes developed in Dr.Song's lab



Matias Perret

Lecturer

New Lecturer Matias Perret is no stranger to the MIE department. In 2005, Matias began his journey at the UI, pursuing his undergraduate degree in Mechanical Engineering. In 2016, Matias received his PhD in Mechanical Engineering. During his doctoral studies, Matias researched multi-phase fluid dynamics, and optical phase detection probes. His research analyzed behavior of bubbles in a turbulent boundary layer. In Fall 2016 Matias joined the Department as a lecturer. Matias is now instructing the Design for Manufacturing (DFM) course and the capstone design courses in MIE. These courses teach students the fundamentals of design, engineering graphics, and manufacturing processing. Matias is also collaborating with other faculty members on establishing Science Technology Engineering and Math (STEM) curriculum for the Office for Naval Research (ONR). In addition, Matias is the faculty advisor for the UI student chapter of the **American Society of Mechanical Engineers (ASME)**. He is working on revitalizing and growing the student organization. Currently, ASME members are teaming up with others on campus to construct both solar powered and human powered vehicles.

Student Organization

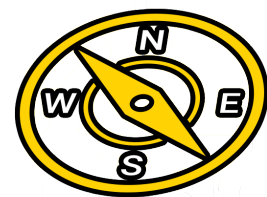
Iowa Marine Autonomous Racing Club



The Iowa Marine Autonomous Racing Club (IMARC), is an exciting new club in the Department of Mechanical and Industrial Engineering at the University of Iowa. This highly multidisciplinary club is designing and building an autonomous boat to present at the **RoboBoat 2017** competition which will be held in Daytona Beach, Florida, this summer. The RoboBoat competition is sponsored by the Association for Unmanned Vehicle Systems International and is an annual event that began in 2007. IMARC has more than twenty members attending weekly whole group and technical subgroup meetings. Group meetings this Spring 2017 are Wednesday evenings at 5:30 pm in 4505 SC. By participating in this club, members gain valuable experience in embedded systems, systems integration, sensors, mechanical design, manufacturing, project management and communication. IMARC was developed to give students an opportunity to gain hands on experience with the Iowa Institute of Hydraulic Research's Fluids Workshop and the MIE Department's new certificate program in Naval Hydrodynamics. Current leaders of IMARC are Mike Watkins (michael-watkins@uiowa.edu), President; Brian Von Arb (brian-vonarb@uiowa.edu), Vice President; Caleb Mann (caleb-mann@uiowa.edu), Secretary; and the Faculty Advisor is Professor **James Buchholz** (james-h-buchholz@uiowa.edu).

For more information, on sponsorship or membership
contact President Michael Watkins:

michael-watkins@uiowa.edu



IMARC
ROBOTICS

Alumni



Andrew Lambert, an alumnus of the BSMS program in Mechanical Engineering, earned his BSE in Fall 2007 and MS in Spring 2010. He reflects on his time in CoE: *“I really enjoyed my time as a research assistant under Professor Ching-Long Lin, as well as being a teaching assistant for Thermodynamics. The teaching experience was very fun, I found that you quickly learn how well you understand (or misunderstand) a concept once you have to explain it to someone else. Getting the opportunity to do research as an undergraduate and graduate student was very valuable as it taught me how to approach and solve complex problems. Also, the smaller program size at UI Engineering made it easier to talk to professors and learn from them.”*

For the past 5 years, Andrew has been working for Lawrence Berkeley National Laboratory, primarily working on scientific instruments for high-energy physics projects supported by the U.S. Department of Energy. He has worked with both particle accelerator systems and ground-based observatory telescopes, and is frequently involved in design and analysis as well as supervising part fabrication and assembly work. Andrew is currently working on the **Muon Ionization and Cooling Experiment (MICE)** and the **Dark Energy Spectroscopic Instrument (DESI)**.

“I like that I am challenged by my work on a daily basis and have the opportunity to work on interesting problems.” Throughout his academic career, the only thing he would have done differently was taking advantage of the valuable knowledge an internship in industry can give.

Advice to students: *“Work hard and ask questions. Do not be afraid to admit when you do not understand something. Being a successful engineer means a commitment to continual learning and development.”*



New Advisory Board Members



Jeff DeGrange

Impossible Objects LLC – Chief Operating Officer

BSE Industrial Engineering – 1986

Looking back, two things CoE provided that were extremely beneficial and applicable to the work force, were courses in manufacturing and materials, and courses in information technology. UI has constantly been in the forefront of new things. For example, when I attended, students were able to interact with emerging technologies that are now considered normal, like computer-aided design applications. I see this trend continuing into the future." Jeff has worked for mega corporations (Bowling), mid-sized tech companies, and most recently, a startup tech company (Impossible Objects LLC). Working with a range of companies provides a diverse background. Jeff is involved in several professional organizations, and sits on multiple boards for national labs, education, and science. Jeff has access to new technology before others, which enables him to present these recent innovations and advanced technologies to the MIE Advisory Board. Jeff hopes this insight helps the Board recommend new courses and enhancements to current courses so students excel in the workforce. Jeff believes he has the skills and tools needed to, "evolve an idea and make it a reality." As new disruptive technology continues to evolve, Jeff believes the use and adaptation of additive manufacturing, especially in the medical field, robotics, drones, and driverless cars, will change the world we live in, a lot like smart phones did. He has no doubt we will see these technologies perfected in our lifetime and encourages MIE to keep the curriculum current with these emerging technologies.

-Advice for students- "Students should focus on electives that are applied science. Strengthen verbal and written communication skills, especially public speaking skills." Jeff went on to explain that success is, "taking complex engineering concepts and boiling them down to terms that an audience without an engineering background would understand."

**IMPOSSIBLE
OBJECTS**



Gregg Machetta

John Deere – Internal Material Logistics

BSE Mechanical Engineering – 1988

MS Industrial and Management Engineering – 1990

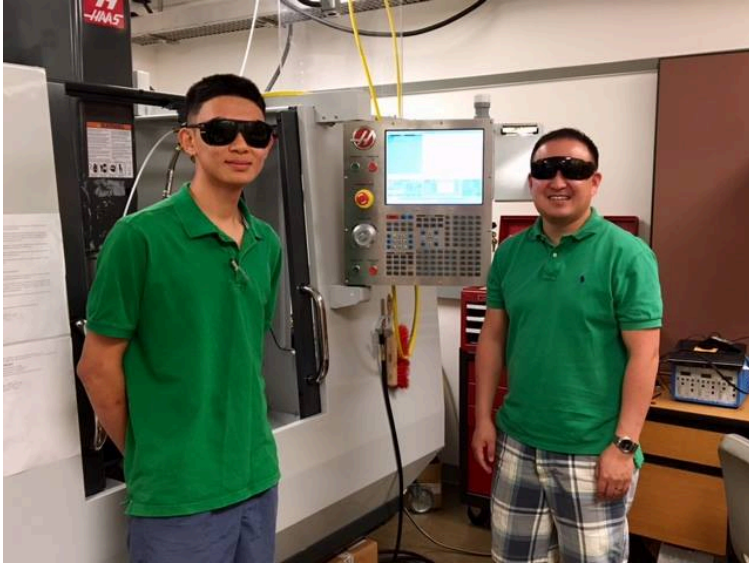
UI CoE created the opportunity for lifelong learning. “The College has really driven that.” During his time at Iowa, Gregg was involved with several student organizations. The two he enjoyed most were American Society of Mechanical Engineers (ASME) and Institute of Industrial and Systems Engineers (IISE formerly IIE). Being involved in these clubs made him, “realize the (hands-on) opportunity being an engineer has. You are able to create your own avenue and find the niche you enjoy.” Gregg distinctly remembers one of his mentors, Professor Andrew Kusiak, as being one of the people that made a positive, lasting impact on his educational experience. Soon after graduating, Gregg found his way to John Deere (Deere), and has been with Deere for 18 years. For the past 15 years, he has been actively participating in MIE’s Senior Design Night activities as a judge for student projects. He decided to become a member of the MIE Advisory Board because it was time to give back to the institution that, “gave him so much.” On the Board, Gregg will draw on his knowledge and lengthy involvement with CoE as he recommends ideas regarding courses offered, enhancing student experiences, and making sure students are prepared to meet industry in the real world. Gregg would like to see entrepreneurship, unmanned vehicle, robotics, water technology, and information technology courses. Gregg thinks these diversified classes will give students a well-rounded experience that employers are looking for more and more.

-Advice for students- Gregg encourages students to get involved and hold leadership positions so that they strengthen their powerful soft skills. Although core knowledge is important to being a successful engineer, there are complementary skills engineers need in order to differentiate themselves in industry. “The downfalls of some of the smartest individuals I’ve worked with were their lack of communication and leadership skills, and generally not being an ethical person.” Gregg went on to explain, “A person needs the engineering knowledge, analytical expertise, and the ability to work globally, in addition to soft skills, that make you more personable and easier to collaborate with.”



JOHN DEERE

Faculty Excellence



High school student Lien (left) with Professor Ding (right) in a lab during MIE sponsored Work Place Learning's internship over Summer 2016

Iowa City West High School student, Lien Zhu, applied for a summer internship looking for an authentic experience in the field of Engineering. He got that while interning with Assistant Professor **Hongtao Ding** at the UI in the Department of Mechanical and Industrial Engineering. Lien shared, "This experience provided me with many valuable new contacts and communication skills. Interning through the Workplace Learning Connection was a great opportunity to gain insight into a potential career and create lifelong connections with people whom I likely would not have met. The experience has greatly influenced my future goals in a positive way."



Fred Stern giving a tour of IHR's research facility, wave basin

Frederick Stern, George D. Ashton Professor of Hydrosience and Engineering, professor of mechanical and industrial engineering, and faculty research engineer at IHR-Hydrosience & Engineering, has been selected to receive the **Panel Excellence Award** from the Applied Vehicle Technology (AVT) Panel, part of the North Atlantic Treaty Organization (NATO) Science & Technology Organization (STO). The STO is a NATO subsidiary body, created within the framework of the North Atlantic Treaty signed in Washington DC in 1949. It was established to meet the best advantage of the collective needs of NATO, NATO nations, and partner nations in the fields of science and technology.



Hiroyuki Sugiyama, Associate Professor in the Department of Mechanical and Industrial Engineering, has received a **SAE Excellence in Oral Presentation Award** for his presentation, "Tire Dynamics Simulation for Transient Braking and Cornering," at the SAE 2016 World Congress. The presentation, delivered as a technical keynote, focused on a high-fidelity physics-based flexible tire model that he developed for predicting the transient tire dynamics under hard braking and cornering maneuvers. The work was accomplished with his PhD student Hiroki Yamashita and in collaboration with the US Army TARDEC and Yokohama Rubber.

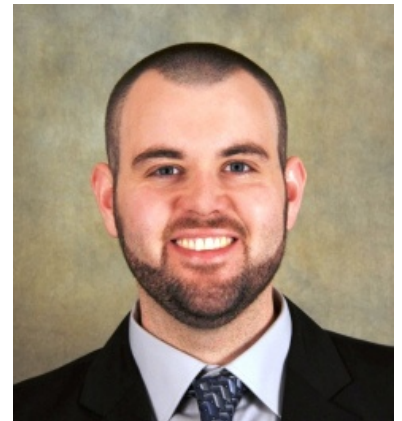
Student Success



Huaxia Li, graduate research assistant in the Department of Mechanical and Industrial Engineering, received first place in the student poster competition at the EPSCoR Annual Meeting in Cedar Rapids, IA. The poster, titled "Reliability-Based Design Optimization of Wind Turbine Drivetrain under Wind Load and Gear Manufacturing Uncertainties," was co-authored by Hiroyuki Sugiyama, Associate Professor of Mechanical and Industrial Engineering, Li's primary advisor; K. K. Choi, Carver Professor of Mechanical Engineering and Professor of Mechanical and Industrial Engineering; Hyunkyoo Cho, Postdoctoral Scholar in Mechanical Engineering; and Nicholas Gaul, Adjunct Assistant Professor in Mechanical and Industrial Engineering. The Experimental Program to Stimulate

Competitive Research (EPSCoR) is a federal program designed to improve the research capacity of eligible states or regions, making them nationally competitive for future grants. EPSCoR is aimed at building research capacity and increasing competitiveness for the State of Iowa through investments in infrastructure and human capital. EPSCoR provides support for key research areas at Iowa's Regents Institutions, while establishing partnerships with the state's community colleges, private colleges, school districts, government agencies and industries. The ultimate goal is to stimulate lasting research infrastructure improvements for the State of Iowa.

Robert Hart, doctoral student in Mechanical Engineering, has received two prestigious scholarships. Hart is studying under Olesya Zhupanska, professor of Aerospace and Mechanical Engineering at the University of Arizona and a formerly Associate Professor in MIE. Hart's first award is the Dr. Jackie Rehkopf Scholarship, presented by the SPE® Automotive Composites Conference & Exhibition (ACCE). Hart's second scholarship is the 2016 American Society for Composites PhD Research Scholarship. Hart won his Rehkopf scholarship with the topic: Multi-Physics Effects in Carbon Fiber Polymer Matrix Composites. In addition to being a doctoral candidate at the CoE, Hart also is a U.S. Department of Defense SMART Scholar and works in collaboration with the U.S. Army Tank and Automotive Research and Development Engineering Center (TARDEC). He also served as a guest lecturer when the primary instructor was traveling. He holds both B.S. and M.S. degrees from UI. After graduating with his doctorate in 2017, Hart will work at TARDEC full time and continue to advance composites research in the ground-vehicle sector.



Ratner presents on Research at EPSCOR Iowa Capital Visit

Front row, left to right: **Dr. Albert Ratner University of Iowa**, Iowa Governor Terry Branstad, Pat O'Rourke Ag Bio Power Board member, Joseph Powell IEC Executive Director of North America.

Back row, left to right: Randy Reichs Vice President of Business Development Simonson Ironworks, Ryan Jensen CEO Simonson Ironworks, Todd Olson IEC Sales and Business Development Director, Adrian Lanser IEC CEO, Trevor Malecha IEC Executive Vice President, Layton Jensen Chairman of the Board Simonson Ironworks.



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MIE Advisory Board Members – Fall 2016 meeting

Important Dates:

Engineering Career Fair: Tuesday, February 14th

Spring 2017 Senior Design Night: Thursday, May 4th

Spring Advisory Board Meeting: Friday, May 5th

Spring 2017 Commencement Ceremony: Sunday, May 14th

Want to be featured?

Contact: alexis-busch@uiowa.edu

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Contributions made by: College of Engineering, National Advanced Driving Simulator, Work Place Learning Connection, Jeff DeGrange, Gregg Machetta, Stephen Baek, Dan McGehee, Xuan Song, Zhen Kan, Matias Perret, Andrew Lambert, Michael Watkins, Anna Dizack