2016

ME-EM 2015-16 Annual Report

Department of Mechanical Engineering-Engineering Mechanics, Michigan Technological University

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ME-EM

MECHANICAL ENGINEERING — ENGINEERING MECHANICS

Human-Centered ENGINEERING

STRENGTHENING OUR CURRICULUM WITH SIMULATION

Michigan Technological University
1885

2015-16
ANNUAL REPORT

Human-Centered **ENGINEERING**

In this Annual Report, we present the impact of our alumni and faculty on the world of simulation: the tools, technologies, and software that have revolutionized product development. This journey begins with our influence on the rise of simulation, its incremental acceptance as algorithms become more mechanistically aligned with physics, and finally, the revision of our curriculum to include simulation as a core engineering process.

Our alumni have both created modeling tools and brought simulation full circle to help make state-of-the-art software available to our students. To maintain our position as a national leader in engineering education, our faculty have revised our curriculum and incorporated simulation-driven design into the traditional stages of design, build, and test. Through the use of industry-standard simulation software, we are better able to engage our students' creativity and expand their range of solutions for complex design challenges, improving their success in any industry.

Validation and verification through simulation has become a standard practice for our graduates working in industries ranging from automotive to aerospace and military. Our graduates have built nanosatellites and full-scale military vehicle equipment and emphasize that simulation is critical when developing technologies at both the very small and large scales, for building prototype models is often financially or logistically unfeasible. Their stories collectively illustrate our Department's contribution to this shifting landscape.

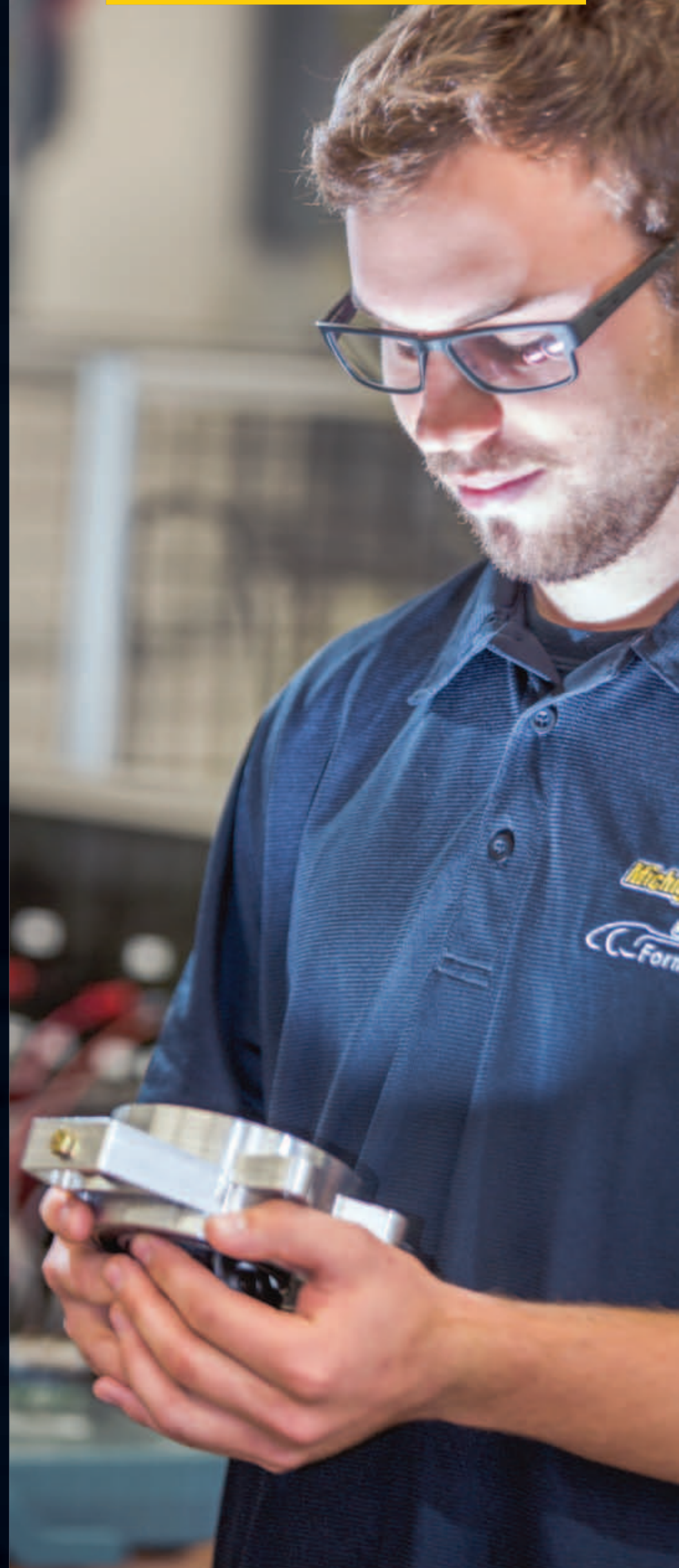
In this report I am equally proud to feature the awards and nominations received by our ME-EM faculty and staff, and the new faculty and staff members welcomed to our human-centered endeavors. Maintaining our effective leadership in all facets of engineering requires ongoing support, yet offers ongoing dividends in societal improvement. Alumni, individuals, and corporate donors continue to ensure our efforts are well supported, and we respond with a vigor equal to their faith in us. To these many partners, I would like to express the gratitude felt by our students, faculty, and staff, and I look forward to sharing the innovations developed by our past, present, and future engineers.

William W. Predebon

William W. Predebon, PhD
J.S. Endowed Department Chair & Professor • wwpredeb@mtu.edu

ON THE COVER

Undergraduate Brett Michaud holds an axle bushing, a part he simulated using Altair HyperMesh software. Simulation is now pervasive through all four years of our curriculum. Practice courses follow a simulate, design, build, test workflow to mirror that of engineers working in industry. See page 22.



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ME-EM **RESEARCH**

The ME-EM Department continues to hold its position as a prominent leader in research across a spectrum of industries, federal labs, and government agencies as our faculty members secure research funding opportunities and bring in qualified graduate students. Our research expenditures have increased over the course of the year, enabling us to continue our plans for future expansion and center development.

Several large research projects have been awarded to faculty within the Department, including Dr. Greg Odegard who, in conjunction with REL, Inc., was awarded $2.1 Million from Southwestern Energy for the design, fabrication, and testing of a compressed natural gas tank for use in light-duty trucks. Dr. Jeff Allen is expanding research in the area of novel ionomers and electrode structures with funding from the Department of Energy.

Our faculty continue to work across departments on the development of agile microgrid systems with research lead by Dr. Gordon Parker, Dr. Rush Robinett, and Dr. Ossama Abdelkhalik in collaboration with Dr. Wayne Weaver in the Department of Electrical and Computer Engineering and Dr. Laura Brown in Computer Science under the Center for Agile Interconnected Microgrids (AIM). Dr. Nina Mahmoudian is furthering her research on underwater gliders through the exploration of autonomous power distribution systems for continuous operation. Testing of these systems is pictured on the back cover. The Advanced Power Systems Labs (APS LABS) continues to make strides through research in diesel engine aftertreatment lead by Dr. John Johnson, in collaboration with Dr. Jeff Naber and Dr. Gordon Parker. Additional research is being funded by the Department of Energy on high brake mean effective pressure and high efficiency ignition in natural gas engines.

The continual development of our research programs has allowed for the expansion of two centers, AIM and APS LABS, with plans for development of several more. The growth of these centers and research has allowed our Department to attract both new faculty members and highly qualified graduate students. We look forward to maintaining these trends and to strengthening our collaborative ties to industry.

RANKINGS

American Society for Engineering Education

- 20th in BSME degrees awarded, 7th in BSME enrollment
- 10th in MSME degrees awarded, 6th in MSME enrollment
- 30th in PhD degrees awarded, 30th in PhD enrollment

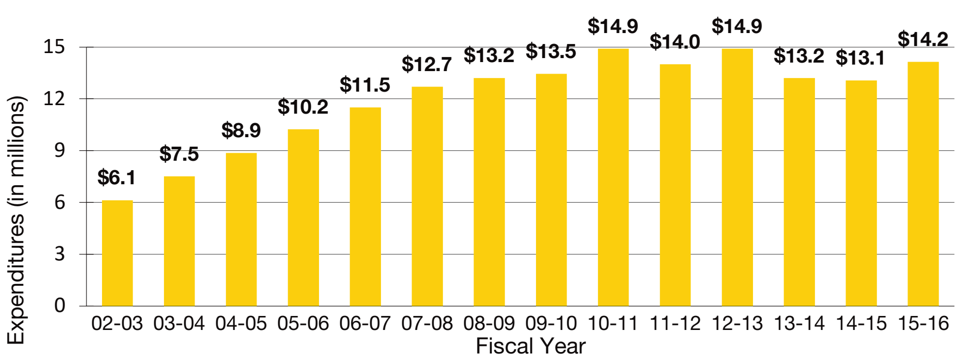
National Science Foundation

19th in research expenditures ($14.15 million) among all mechanical research in the US.

US News & World Report America's Best Graduate Schools

51st among the top 177 (top 29%) doctoral-granting ME departments.

ME-EM RESEARCH EXPENDITURES: 2002-2016



Note: Research expenditures are an estimate at publication time and are corrected in the next annual report.

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MISSION

Prepare engineering students for successful careers.

VISION

Be a nationally recognized mechanical engineering department that attracts, rewards, and retains outstanding students, faculty, and staff—be a department of choice nationally.

EXECUTIVE COMMITTEE

Dr. Jason R. Blough
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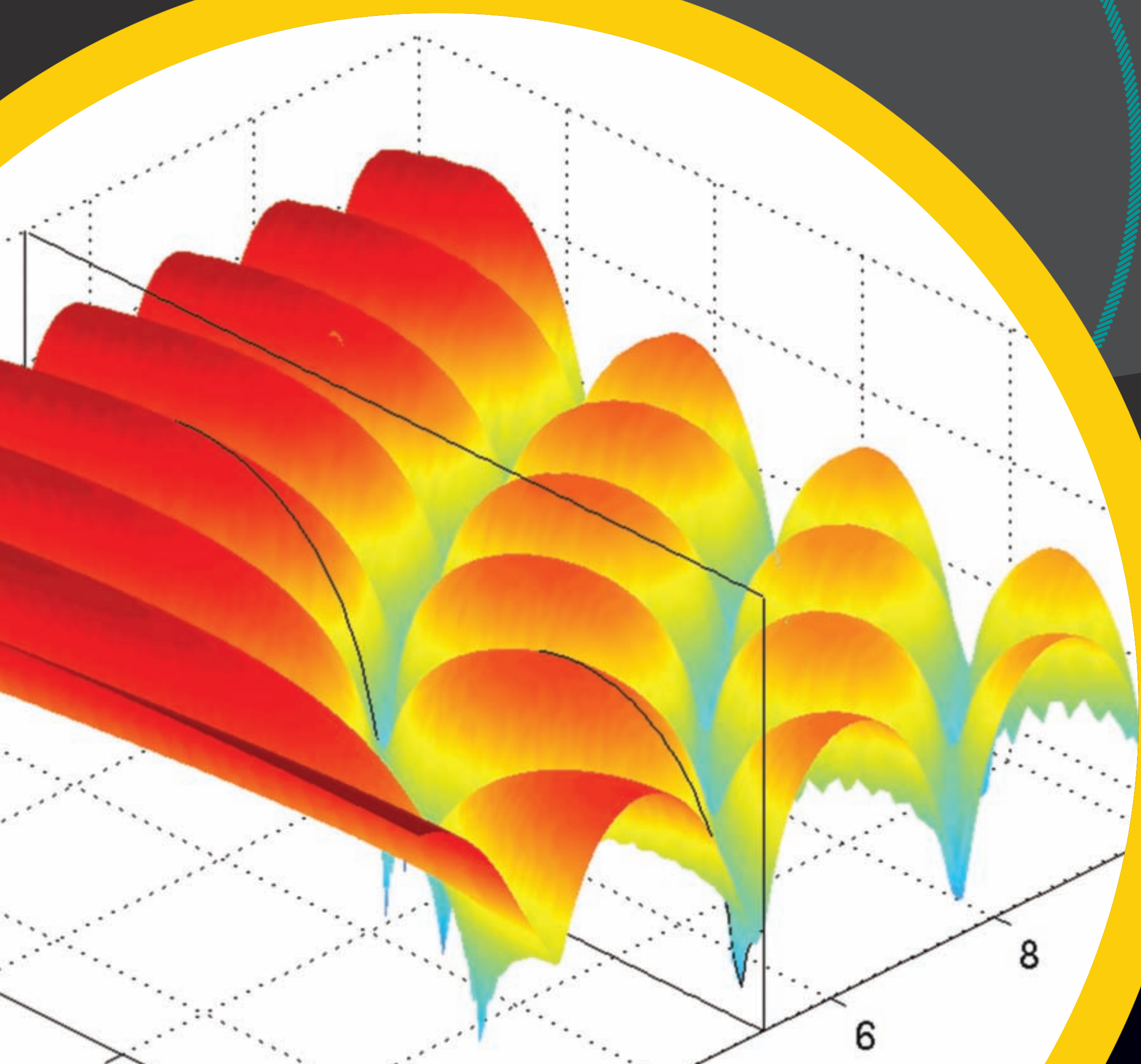
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SIMULATION

Alumni

LEADING WITH SIMULATION

The market demands that companies develop products that perform at their optimum. Consumers expect their mobile devices to have a long battery life, airplanes to provide a high level of cabin comfort, and automobiles to be both safe and fuel efficient.

Because of the tremendous amount of time it takes to physically build, verify, and validate, manufacturers increasingly leverage simulation to bring safe new products to market.

ME-EM alumni and faculty create, modify, and utilize simulation technologies—impacting everything from the health of humans on Earth to the health of rovers on Mars.

FEATURED ALUMNI

- John Hallquist '72, '74
- Xinhai Zhu '98
- David Wallerstein '61, '69
- Brett Chouinard '88
- Mike Agostini '97, '99
- Becky Petteys '03
- Doug Hull '98
- John Baker '71
- Sin Min Yap '93
- Tim Thomas '81
- Terry Woychowski '78
- Melissa Marszalek '01
- Robin Cash '15
- John Scott '10

ALUMNI

BY ENHANCING SIMULATION TOOLS, ME-EM ALUMNI ARE SHAPING THE EFFICIENCY OF PRODUCT DEVELOPMENT LIFECYCLES WHILE MAINTAINING SAFETY AND RELIABILITY.

"It has been a wonderful experience working with Dr. Hallquist. He is a role model to me and other engineers here at LSTC. He works seven days a week, ten hours a day, and is dedicated to our software and our customers."

—DR. XINHAI ZHU, SPEAKING OF DR. JOHN HALLQUIST

Simulation Transformation

DR. JOHN O. HALLQUIST '72, '74, LIVERMORE SOFTWARE TECHNOLOGY CORPORATION

Simulation software has had a major impact not only on the virtual crash-testing of vehicles to meet government regulations, but also in the metal forming industry where engineers simulate vehicle manufacturing.

Simulation software enables engineers to refine their designs throughout the analysis process, saving time and improving results. Tools such as LS-DYNA® are widely used by the automotive industry to analyze vehicle designs and evaluate prototypes, while also providing accurate predictions of the effects of vehicle crashes on the occupants. These features save the automotive industry billions of dollars by reducing the number of prototype crash tests required during the design and development phase.

While the LS-DYNA software is used by over 2,500 customers worldwide, the code actually began more than 40 years ago at Lawrence Livermore National Laboratory (LLNL), under the direction of John O. Hallquist ('72, '74), as a way to analyze bombs dropped by US Air Force jets and other structures subjected to impact loading. The first user's manual was published in August of 1976. Two years later DYNA3D was released into the public domain and was freely distributed worldwide to everyone from university researchers to industrial users. As its industrial uses grew, especially within the automotive sector due to government crashworthiness regulations, the demand for additional capabilities and support also increased dramatically. Because the commercial use of the DYNA3D software did not fit with the mission of the lab, Hallquist left LLNL in 1989 to work full time at Livermore Software Technology Corporation, which he founded in 1987, to further develop the simulation tools of DYNA3D under the name LS-DYNA.

Today LS-DYNA is highly scalable for cloud computing with state-of-the-art capabilities to solve fully coupled problems in structures combined with acoustics, electromagnetics, compressible fluids, incompressible fluids, heat transfer, and most recently, control systems. The majority of automotive and aerospace manufacturers worldwide use LS-DYNA for crashworthiness design, manufacturing simulations, such as sheet metal stamping, and countless other transient engineering simulations. In automotive applications in crash, NVH, and durability, LS-DYNA makes it a simple process to include the results of the prior manufacturing simulations in the full vehicle models to account for thickness variations, initial plastic strains, and material orientation for anisotropic composite materials.

Software Strength

DR. XINHAI ZHU, '98, LIVERMORE SOFTWARE TECHNOLOGY CORPORATION

By the mid-1990s, LS-DYNA® software from Livermore Software Technology Corporation (LSTC) had become an auto industry-standard for crash analysis, but a market remained open for simulation of metal forming processes in manufacturing. Predicting the way a material will behave in a stamping die became a strategic goal to bring LS-DYNA out of product design and into manufacturing teams.

As parts were formed, trimmed, and removed from the stamping die, engineers discovered that many of the parts had deviated from their design shape due to residual stress, and this spring back behavior becomes a more serious problem for high-strength steel and aluminum alloys. Dr. Xinhai Zhu ('98) joined LSTC to develop a means to obtain consistent and accurate solutions on the spring back predictions, with an emphasis on advanced sheet metals.

"High-strength steel properties are different. You can't use traditional material models. For example, the Bauschinger effect is more pronounced, so a more advanced kinematic hardening model must be used," says Zhu. "Other technologies are necessary, too, including smooth contact—to be more accurate in calculating contact force—and a more robust convergence behavior for implicit calculation."

As a PhD student at Michigan Tech, Zhu focused his research efforts on formability predictions for sheet metal forming processes. The software enhancements tied directly into his PhD studies, improving sheet metal failure prediction by implementing a more advanced criteria for non-linear strain path, which helped raise LS-DYNA's reputation as the most accurate code.

"We are fortunate to have opportunities to work with the best engineers and researchers in related fields, and we take great pride in every new technology we developed that has been accepted by industry users worldwide."

—DR. XINHAI ZHU

"It has been a perfect match for my work and studies at LSTC," says Zhu. "When I was in school, I never dreamed the work I developed through school and my professional career to be used by so many people worldwide, and to be so quickly accepted by industrial users."

To maintain their footprint as a leader in software technologies, LSTC is working to create more sophisticated models for stamping simulation. One of the most significant developments is automated spring back compensation for stamping dies. By analyzing the output of a die, the software can morph the die shape to produce a correctly formed part. This achievement is significant because it eliminates many die recuts, which cost hundreds of thousands of dollars per cut. The eliminated die recuts in turn contribute to a much shorter stamping die design, engineering, and build cycle.

To lower vehicle weight and reduce carbon emission, industry is utilizing a new generation of steels and aluminum alloys, the material properties of which are different from those of the past. Researchers like Zhu and colleagues are constantly adapting additional advanced material models and failure criteria in the LS-DYNA software.

ALUMNI

"Accuracy is important. NASA has that game with telescopes, looking at stresses down to the ninth decimal place, and they get worried if the results change between releases. Simulation can be used to explain why a solution changed."

—DR. DAVID WALLERSTEIN

Degrees of Freedom

DAVID WALLERSTEIN '61, '69, MSC SOFTWARE / NASTRAN

Working on telescopes that will be launched into orbit, accuracy is king because it is nearly impossible to implement a fix in a million mile orbit. The stresses and degrees of freedom are inspected, verified, and validated far beyond the decimal, and any changes in the numbers between simulations are carefully evaluated. Through the use of simulation, software engineers are able to examine the inputs and determine why a solution changed, rather than wondering what changed between physical test runs in the internal or external environment of the prototype model.

Dr. David Wallerstein ('61, '69) has been pushing the limits of innovation in the world of simulation since graduation, and his early models had 30,000 degrees of freedom, maxing out the computers of the day. Fast forward to today, and his automobile models have 30 to 40 million degrees of freedom. Initially beginning his simulation career working with ADAMS code for rigid body mechanics, he soon transitioned to NASTRAN's nonlinear flexible body code. Wallerstein's initial forte with NASTRAN was with the famed Skunkworks SR71 project at Lockheed Martin for NASA. In 1982 he joined MSC Software to further develop the NASTRAN code base that included, under Ford Motor Company contract, the first commercially viable design sensitivity and design optimization methods. To keep pace with newer simulation tools, Wallerstein rewrote the NASTRAN operating system in the 1990s and has also worked to improve design optimization features and model sensitivity.

Simulation with NASTRAN has played an increasing role in automotive design, with automotive engineers exploring the vehicle interior and tires, seeking to suppress road noise and keep vehicles quiet. Crash analysis is also involved in the simulation process to quantify energy absorption and acceleration rates on vehicle impact. NASTRAN's recent releases have coupled non-linear analysis for noise and vibration with a focus on automobiles to enable engineers to examine how the body-frame structure responds to inputs from the road through the vehicle's suspension system.

"In today's simulation environment, everything becomes a coupled analysis. The aerospace engine designers are happy to rev their engines up and ensure the blades won't come off; however, the customer wants to know what is happening as they perceive the noise entering the passenger compartment," says Wallerstein. "Passenger perception and passenger safety both need to be considered before a design is validated and market-ready."

Having led development at MSC Software for many years, Wallerstein's impact on the simulation industry is, ironically, incalculable. With countless models running daily at client locations worldwide, each producing better, safer designs, untold failures are avoided and product value is realized. Never accepting the status quo, he continues to move NASTRAN forward, assuring his engineering peers that the software will remain at the vanguard of simulation well into the future.

Building Efficient Structures

BRETT CHOUINARD '88, ALTAIR

For Brett Chouinard ('88), simulation was the lightbulb moment for his career in engineering, first illuminated when he was in Dr. Grimm's FEA class during his third year at Michigan Tech. "I was a student of theory, and simulation gave me a counterweight with the most practical way to evaluate a design," says Chouinard.

Upon graduation he left for Cincinnati, Ohio, where he began his career as a design engineer with GE Aviation. Running countless simulations, he was responsible for the development of structural components for hardware that goes into aircraft engines, creating the design concept and the verification plan for simulation, testing, and manufacturing of the hardware and its structural performance.

Chouinard sought to directly help people through his abilities, so while at GE Aviation he began studies in biomechanics at the University of Cincinnati, using finite element analysis to test and replicate empirical observations of the load distribution and strain in human bone structures. After completing his master's degree, he left GE Aviation to continue his biomedical research at the University of Michigan. There his graduate student colleagues introduced him to software under development at Altair Engineering in Troy, Michigan. Compelled once again by the interweaving of theory and practice, he approached Altair's founder and expressed his interest. He began work immediately, ultimately finding his home at Altair with the launch of their new product focused on creating efficient structures. Since 1995, he has risen to the position of COO and guided the introduction of numerous innovative tools for hundreds of Altair customers.

Products like Altair OptiStruct were put on the market to help engineers shorten product release timelines, while continuing to develop lightweight and structurally efficient designs in a rapid development cycle. Automotive OEM Ferrari recently worked with Altair's product design team to optimize their next generation modular vehicle platform, achieving a 15 percent weight reduction. Despite removing mass, the resulting design's crash, noise, vibration, and harshness attributes were improved by more than 20 percent.

"Everyone can innovate, but we are allowing companies to innovate much faster and more radically, while minimizing risk."

—BRETT CHOUINARD

Optimization centers have become a part of the technology transfer between Altair and OEM partners like Boeing, Airbus, and Ferrari. These centers combine Altair and client experts to ensure weight, structural, and performance optimization are achieved earlier in the process. This avoids future emergency revisions, which often add significant time and cost.

"Everyone can innovate, but we are allowing companies to innovate much faster and more radically, while minimizing risk," says Chouinard. "Today, everyone talks about simulation driving design—something Altair has been advocating for more than 20 years—so we are seeing simulation move earlier in the design cycle, which means we are going to see our tools utilized far more extensively than we do today."

ALUMNI

"When you are a manager or leader helping others, it is not about how long of a shadow you personally cast because you are helping everyone you work with become a little taller and helping them increase the lengths of their shadows, their influence, their impact."

—MIKE AGOSTINI

Coding Cleanly

MIKE AGOSTINI '97, '99, MATHWORKS®

Simulation provides the tools to visualize what is behind the calculations in each scenario, but understanding the fundamentals is critical to succeeding in industry. Through a solid foundation in the fundamentals, engineers are able to parse the key relationships and identify the important factors governing a system.

Alumnus Mike Agostini ('99) garnered this understanding of the fundamentals through his coursework at Michigan Tech, as well as his hunger to learn various computer languages, ranging from C to MATLAB and Simulink. Initially using the VI text editor, Agostini taught himself to code fast, with keystroke shortcuts in VI and fast typing speeds enabling his fingers to keep pace with his mind. After completing his degree, he was hired by Analex where he was validating rocket and space vehicle designs, identifying problems with launch codes, and digging deep to resolve bugs. While coding was exciting, Agostini eventually left Analex because the engineering challenges were narrowly focused, and he sought a position helping others solve a diverse array of problems.

"When I joined MathWorks on the MATLAB team in the applications engineering role, I saw a new world where I didn't have to go deep, but I got to help hundreds or thousands of people solve their problems—get them pointed in the right direction," says Agostini.

Following a philosophy learned from Adil Shafi, a mentor, he strived to keep his code easy to read. By lining up equal signs, semicolons, and commas the code can be viewed a block at a time, rather than line-by-line. Those who inherit the code can absorb it more quickly, making it easier to understand, fix, or improve with less energy and fewer errors.

When Agostini moved into his new role, he was able to extend this philosophy from code to other forms of communication: slides and presentations. "The idea is to be able to communicate as cleanly and efficiently as you can. It's not just about what you know—it's how well you can use what you know to help others. If you confuse people, the best you can hope for is no action, no impact, just wasted time. At worst, if people are confused and take the wrong action—you've just led them astray," says Agostini.

Now a manager directing a team of 27 application engineers, Agostini fosters an environment where trust and openness are the social currency, something he learned as a member of the Troupe theater ensemble at Michigan Tech. By keeping users in central focus, and focusing on these same principles, Agostini and his team provide solutions that enable businesses and researchers to move forward in their endeavors.

Control through Simulation

BECKY PETTEYS '03, MATHWORKS®

Selecting the ideal platform for developing tools for the simulation process is a critical step for any product development engineer. The key aspect is integration of all of the pieces from the aerodynamics to the control and the flexibility or rigidness of the models. While one tool may have been ideal for past scenarios, with the ever-changing market, engineers must exercise their adaptability and deliver innovative thinking.

After finishing a master's degree with a focus on controls using simulation, Becky Petteys ('03) continued to build her experience base at Analex Corporation, later acquired by QinetiQ, working on independent verification and validation of launch vehicles using an older software product. Although the software worked, Petteys realized there were better solutions available. She and the other junior engineers proposed the simulation platform Simulink® and to build out the new launch vehicle simulation using an array of tools. She spent the next 18 months integrating the system model from the aerodynamics to the actuators, only to realize her remaining time would be spent writing reports and running routine analysis.

Looking to make a lasting impact on simulation, she left Analex and began her career at MathWorks® as an application engineer focusing on the aerospace and defense industries using Simulink.

"As an application engineer, we are customer-facing, so we go out and discover what they are doing, what their problems are, what tools they are using, what tools work, and what fails at a technical level, and then we determine how to help them," says Petteys.

She has been working with a team on the Simulink software for verification and validation of models and from a controls aspect, using dynamic simulations to build, design, and access controllers. Petteys' role as an application engineer with MathWorks has allowed her to make a mark in the aerospace and defense industries by ensuring the results of each simulation are calculated meticulously for the NASA and commercial and defense aircraft engineers that utilize the tools for aircraft development, satellite and vehicle launches, and helicopter designs.

One of the numerous ways Petteys and the engineers at MathWorks help their customers is through verification, validation, and testing of the software to the FAA standards for DO-178 certification to keep passengers and pilots safe on the ground and in the air. Harkening back to her time at Michigan Tech, Petteys never loses sight of those most impacted by her work—the passengers and crew that ultimately put their faith in her work.

"One of the big things we do is show our customers how to automate the simulation process, which frees up the engineer to work on getting the product designed right and fully tested—to ensure a safe product makes it to market."

—BECKY PETTEYS

ALUMNI

"In the field of artificial intelligence (AI), poker is one big area of research and while AI is close to solving chess, poker has an element of randomness and hidden information that challenges the research," says Hull. "At its base, poker is a math problem and the face of poker is changing to reflect that."

—DOUG HULL

Know When to Hold Them

DOUG HULL '98, REDCHIPPOKER.COM

Through comprehensive testing and analysis, simulation software provides a powerful tool for psychologists, financers, and engineers in aerospace, automotive, electrical, and chemical industries. No simulation is complete without a test of the data to confirm the system is behaving as expected, which requires knowledge of the simulation output and how changes in the parameters will impact the system's response—including data visualization.

Data visualization is about the engineers and end users being able to quickly understand trends in their data. As a student, alumnus Doug Hull ('98) learned the importance of visualization of results while working on a research project with Dr. Michele Miller to simulate chatter while milling. Because of his experience and at the recommendation of faculty member Dr. KVC Rao, Hull took the extraordinary step of writing a textbook while still an undergraduate—Mastering Mechanics I, Using MATLAB: A Guide to Statistics and Strength of Materials.

After pursuing a master's degree in robotic programming and algorithms, Hull moved to the applications engineering team at MathWorks® to rapidly prototype simulation code to demonstrate for end users that MATLAB could effectively solve their problems. Developing video blogs each week for seven years and coaching hundreds of users at conferences, on phone calls, and through support tickets, Hull found the heart of each user's problem and helped them find a way to use MATLAB not only to compute a solution, but also to effectively display the data.

With a focus on the customer's needs and digging deep to find out the "why" behind it, Hull quickly became a MATLAB evangelist, finding a solution to bring NASA's wind tunnel simulation run time from seven minutes to four minutes, saving millions on the testing time, and reprogramming an equation from Microsoft Excel into MATLAB to display the data in half the time. Promoting the use of MATLAB to solve every problem is what led Hull to his career in the gaming industry.

"What I have done is bring my skills in data visualization to the world of poker," says Hull. "There are online calculators for poker, but those only provide one data point and lack the explanation of the phenomena, which is something I knew MATLAB had the power to do."

While many in the poker industry were thinking about the function of two variables to get a result, the bigger picture wasn't being realized. By developing a topographic map, Hull could show all the possible Xs and Ys that would lead to the same Z; something he published in Red Chip Poker: Late Position in 2014. After the success of his book, he partnered with another engineer-turned-poker-expert to found RedChipPoker.com. Through his engineering background, Hull discovered he could take poker concepts, simulate them, and generate representations of them to give the audience a better understanding of the stochastic landscape they face.

Predicting Behavior – Reliable Models

JOHN R. BAKER '71, SIEMENS PLM SOFTWARE

Engineers inform the research and development process of software simulation companies through partnerships and communication. Simulation software is utilized to ensure the machine or part is built for the correct purpose, so companies like Siemens PLM Software (previously Unigraphics Solutions) take care to aid engineers in procuring reliable results in the simulation process.

As a subject matter expert and customer evangelist in software R&D at Siemens PLM Software, alumnus John R. Baker ('71) interfaced directly with customers to ensure the software was fit for intended use and to have an understanding of the aspects most important to their success. Through all of the complicated lines of code, Baker's role was to work with customers to add new features and better meet their needs.

"Engineers need to find the software to be trustworthy, and my job was to help them understand what tools were available and what they were capable of doing," says Baker. "We communicated with customers and our research and development team so we could best understand what areas our users needed us to invest in. Sometimes technology leads the users and other times the users lead the technology."

The rapid development process, commonplace in today's engineering industry, has come about largely as a result of the younger generation of engineers who are producing 3D-printed prototypes for the manufacturing production line, along with more powerful computers and the development of distributed computing.

"It is refreshing to stand in front of students to see how they use the software and how creative they can be with it," says Baker. "I deal with students all the way up to commercial users and entrepreneurs and it is interesting to watch their interaction with the tools."

"Everything will fail; our job is to find out where the failure will occur and control that."

—JOHN R. BAKER

To continue on the path toward technology advancement, Siemens is also working on solutions for Manufacturing 4.0. Traditional build-and-break cycles in manufacturing introduce large trial and error costs with four to five build cycles to create the optimal final product—eliminating even one build-and-break cycle could bring a huge savings.

Through the use of simulation, design engineers are able to do more work and solve problems unimaginable only a decade ago. Mechanical engineers at Michigan Tech are continually influencing simulation through their roles in CAD and CAE software development.

"These simulation codes solve problems that are too difficult by hand and eliminate experimentation, allowing us to break it virtually and keep engineers and consumers safe," says Baker. "Simulation also captures tribal knowledge, taking trial and error and automating the process early on in the cycle."

Results from simulation allow new engineers to see what did and did not work in the past to get a unified look at the predicted behavior—resulting in a more reliable and better performing model.

ALUMNI

"I have never worked in a place that has as much whitespace in terms of growth as simulation, and that opportunity excites me."

—DR. SIN MIN YAP

Simulation for Everyone

SIN MIN YAP '93, ANSYS

Products have to perform in the physical world, and simulation provides engineers with the ability to predict how a product will react under specific conditions, which creates opportunities for shorter product development cycles. Simulation enables engineers to delay or forgo the build phase of products until the model has been verified and validated, which is ideal for large-scale projects like those of SpaceX and NASA. Testing a lander on Mars before launch without simulation is an impossibility.

These simulation challenges are why organizations like NASA and SpaceX turn to engineering simulation software companies such as ANSYS for reliable simulation. Dr. Sin Min Yap ('93), vice president of Global Corporate Strategic Initiatives at ANSYS, guides students and engineers in the use of simulation to understand the physical world and how to apply it intelligently to each new circumstance.

"It's one thing to study physics, chemistry, and mathematics, and another to apply it in the real world to predict how products will perform," says Yap.

Simulation is heavily relied upon to verify and validate products before production because of the complexities of each part, especially in integrated circuit computer chips, which boast over 20 billion transistors. Testing each transistor is not a feasible option, but using simulation, companies are able to optimize their designs to minimize thermal dissipation and maximize efficiency, yielding lower power draw and enabling mobile devices to last longer.

At ANSYS, Yap and his colleagues are working to bring simulation beyond product development into the manufacturing process. While many companies utilize computer aided design (CAD) to document their geometry and as a blueprint for the manufacturing process, the paradigm has shifted to encourage companies to forgo "subtractive" CAD methods, in favor of parametric topology optimization. This freeform approach is gaining favor, especially when paired with an additive manufacturing process. With additive manufacturing, simulation tools can be utilized to design parts that meet the product requirements and produce complex parts easily using 3D printing technologies.

Yap has a tremendously broad view of this digital frontier: he began practicing simulation as a student, has taught simulation as a professor, and used it as an engineer. He has also kept the user at the center of his concerns, becoming an energetic evangelist for simulation and setting a goal no less ambitious than a Mars landing: to put these tools into the hands of every engineer, starting with their education and ramping upward through their career. It's an endeavor that would appear too daunting to be realistic. That is, until you meet Dr. Yap.

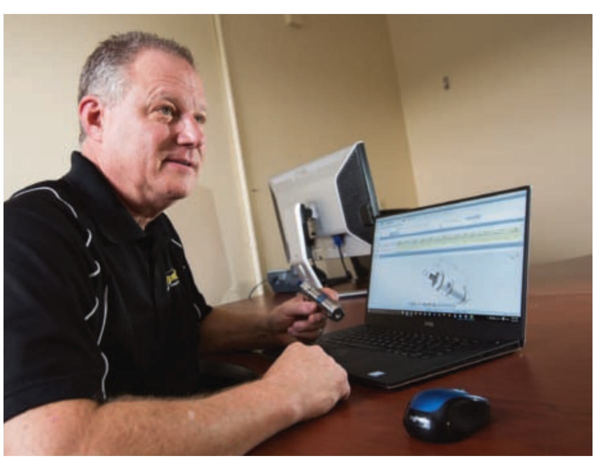
Master Model Solutions

TIM THOMAS '81, CADENAS PARTSOLUTIONS

Rapid development is critical in the field of engineering, and with assemblies consisting of small, standard, but complex parts, engineers of the past frequently were building and rebuilding models of these components to ensure accuracy in their models. For example, bearings and fasteners must be part of structural models, but creating them can sap crucial time from a project. A recent study by the Aberdeen Group found that 30 to 40 percent of an engineer's time is spent looking for or re-creating a part that already exists.

While serving as the director of CAD development at the Structural Dynamics Research Corporation (now Siemens PLM), Tim Thomas ('81) worked in the CAD environment where the CAE models were de-featured for the simulation process. Working on models from multiple platforms, he found there was a disjoint where CAD feeds the model. He wanted to find a way to tie the CAE, CAM, and CAD models into one homogenous solution for standard components.

Utilizing systems like CADENAS PARTsolutions, engineers are able to find a library of supplier parts from manufacturers worldwide to meet the requirements of form-fit-function models (lightweight, yet with fidelity). This process to reduce the effort of designing components, eliminates the need for pre- and post-processing of the geometry. As CEO of CADENAS PARTsolutions, Thomas works with parts suppliers and standards bodies like American Society of Mechanical Engineers (ASME), Society of Automotive Engineers (SAE), and American Institute of Aeronautics and Astronautics (AIAA) to ensure that engineers have the essential pieces to insert their models in a format NATIVE to their CAD system that can also be inserted in a MULTI-CAD domain.



"We are looking at the design problem differently than most and making the technology fit around the human to ensure that the elements of the model meet the design criteria."

—TIM THOMAS

"Our goal is to bring visibility to the desktop of engineers by re-examining their workflows and making it more efficient," says Thomas. "We practice 'Purchineering,' where engineering can't source a part that purchasing doesn't have visibility to."

This software helps engineers reduce a product's time-to-market by easily accessing standard and supplier parts to develop an understanding of their limitations and whether a new part needs to be designed. Completely integrated with the suppliers, engineers are also notified once a part is no longer available, eliminating what was once a manual process.

Not only is CADENAS PARTsolutions transforming the workflow of engineers in the workforce, it is also transforming the design process for engineers on the Michigan Tech campus. Thomas has donated the software to the University as a way to educate students on the system and provide them with the necessary pieces to develop an accurate model in their coursework. This approach is also embraced by the millennial-generation students and graduates who are accustomed to working with libraries of data, readily embracing Thomas' solution.

ALUMNI

Journey from Road to Lab to Math

TERRY WOYCHOWSKI '78, LINK ENGINEERING

The development and continual enhancement of simulation has had a transformative impact on the automotive industry. Manufacturers like General Motors were forced to maintain facilities and develop prototype vehicles to test using shakers and driving prototype vehicles on test tracks to gather data from hundreds of sensors. These tests, while considered accurate at the time, were prone to difficulties and errors, and were also expensive and time consuming to conduct.

As market forces favored shorter design cycles, allowing for styling to be more dynamic, full road tests began to give way as manufacturers discovered they could bring some of the traditional tests into the lab environment where there was greater control—resulting in reliable and repeatable results. With the advent of simulation, engineers are able to model these systems mathematically at a faster pace and with a lower cost than laboratory tests could offer.

While serving as chief engineer at GM over full size trucks, Terry Woychowski ('78) worked with a team to redesign a truck frame completely in simulation space due to changes in the law requiring trucks to comply with laws written for cars. In the redesign phase, Woychowski's team ran 147 simulation cycles before they found a balance between how the frame should behave in a crash and how it should vibrate over normal operation.

"You couldn't build that many prototypes, so we completed it in a much more refined and faster process, critical to achieve our time-to-market deadline," says Woychowski. "With simulation you have the ability to prototype from math; designing a vehicle so you have the confidence to pass each requirement rather than the physical prototype development of the past, where you build the model to crash into a wall and hope you were right, or it becomes scrap metal."

"We were able to do everything with that vehicle in math and never build a prototype, but it was a vehicle similar to other models that were already in production, so we had a base to work from. It was a managed risk because we had tested the models that surrounded it," says Woychowski.

"After graduation you are just beginning your journey of lifelong learning. As engineers, we are paid to get smarter every day and continue to look for ways to make tools more effective and faster."

—TERRY WOYCHOWSKI

The math behind simulation allows automotive engineers to skip over the hundreds of prototype models; however, Woychowski wanted his team to also remember that models are not always reliable. "I used to remind my team that all models are wrong, and some are useful. If they are useful, use them. Some are only indicative, so you need to back it up with physical testing to prove validity," says Woychowski. "As engineers, it is our job to always be working with the models to make them more useful."

The automotive industry continues to create a pathway from road testing to lab testing to math-based representations. Woychowski sees the future of simulation in developing processes for engineers to virtually test human factors for in-vehicle displays and seating, providing a space where the math and prototypes converge.

Speaking the Language

MELISSA MARSZALEK '01, BOEING

Throughout her career at Boeing, Melissa Marszalek ('01) has witnessed firsthand that when people speak the language of engineering, the concepts are the same; nuances of native language matter less than having a common view of the data and results.

"Humans are the focus of our engineering goals. We build products that connect people to each other—bringing them to travel destinations and families. Our number one job is to keep them safe," says Marszalek. "And that's the great thing about simulation; it helps you choose the best possible options."

Simulation is a tool used by engineers around the world to represent and test systems with the goal of building a safe product for consumers. Models resulting from simulation can create common ground between people from different cultures and language barriers. Through simulation, engineers in China can look at the same model as engineers in the United States and review all of the options tested to ensure the product is being manufactured in an efficient and optimal manner.

"Simulation helps Boeing efficiently evaluate investments that could bring value to the company, from both market and IP value perspectives," says Marszalek. With simulation and modeling, engineers can understand the impact of new material options, such as compatibility problems, weight reduction improvements, and possible cost reduction. Engineers can examine the entire product lifecycle and solve problems without simply shifting the burden of problems up the road for other engineers, understanding not only what they are doing themselves, but how that impacts the engineers around them.

The concepts of modeling and simulation, which are so often visual in the world of engineering, extend to other fields as well. Theories and relationships permeate all fields of study, but people aren't always cognizant of how simulation can be applied.

Marszalek is presently working with a team of mathematicians at Boeing to run financial models to support strategic decisions on engineering concepts or management processes. As she has risen into management and now leads over 80 people, Marszalek uses models and simulation to facilitate effective collaboration. As she puts it, "Simulations give us pictures and illustrate relationships. By starting there, my entire team can reshape our plans quickly and effectively."

"Modeling isn't difficult if you break it down into chunks. What are my inputs, what is my optimization factor, and what am I solving for. People ask questions like that on a daily basis, but not always in the field of engineering."

—MELISSA MARSZALEK

ALUMNI

"Customers want pep in their engines with great performance, so we need to be smarter about how we design the components, while meeting the requirements for quality in a manner that is cost effective and accurate."

—DR. ROBIN CASH

Condensation Method Cascading Industries

ROBIN CASH '15, FORD MOTOR COMPANY

Corporate Average Fuel Economy standards continue to drive the auto industry toward lighter-weight, fuel-efficient vehicle design. One weight reduction method is to use mechanical aspiration of smaller engines, forcing more air and fuel through a physically smaller engine. The compressed air from a turbo charger is hot, and intercoolers are used to cool the air prior to the intake, reducing risk of auto-ignition. However, under certain conditions, intercoolers can form condensation inside them, leading to downstream problems. Simulation was the cornerstone of Robin Johnson-Cash's research as she investigated the factors leading to this type of condensation. Recognized as the first African American to earn a PhD from the Mechanical Engineering – Engineering Mechanics Department in December 2015, Cash was part of the growing number of the Department's distance learning doctoral students.

Cash's research focused on predicting when the onset of condensation occurs, leading to a collection of water in the tubes. When the throttle opens quickly, the condensation is pushed into the intake manifold, potentially causing hydrolock.

"My research was around creating a CFD model that predicted the creation of condensation and the flow pattern of that condensation," says Cash. "I modeled from a singular tube around a singular model, setting up boundary conditions for the 3D flow regime, so at different intake temperatures and velocities I knew what the velocity profile looked like and how the condensation was forming and moving through the tube and what could leak out."

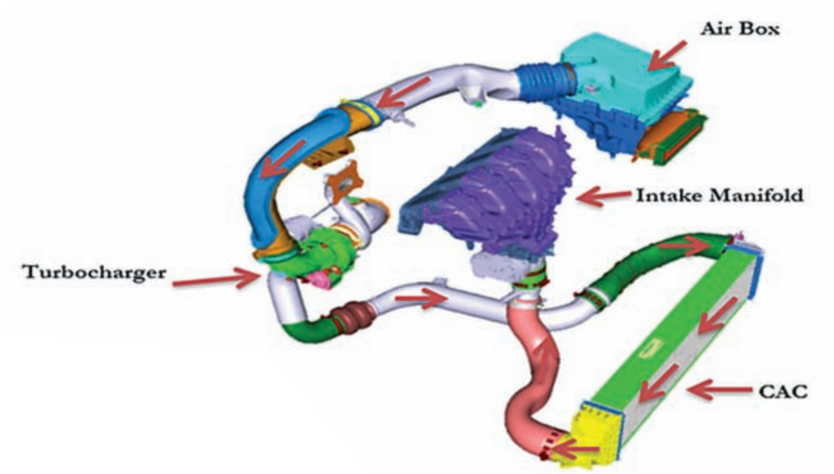
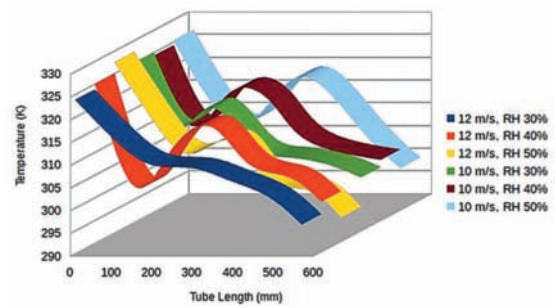


FIGURE 1
Airflow direction from air induction to engine intake.

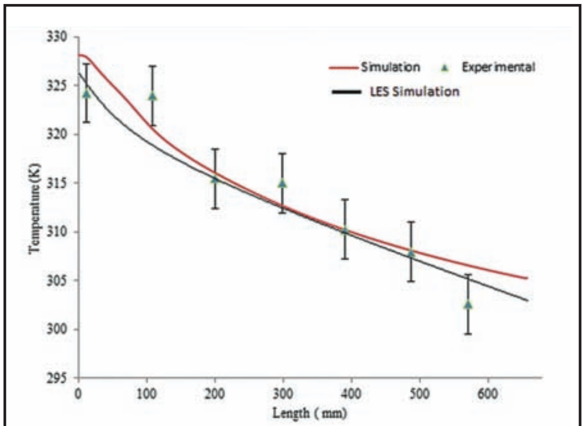
Temperature vs. Length
of the CAC Tube for All Experimental Cases



Understanding the complexities in this controlled experiment, Cash was able to correlate her results with experiments with a 95 percent confidence interval. "Using this solution to design our cooling methodologies, we can keep out of the dew point range long enough to avoid condensation… that leads to contamination of the intake… that introduces the failures," says Cash. "Most industries need to understand how to predict this, to design outside of the condensation range, and using simulation avoids many problems."

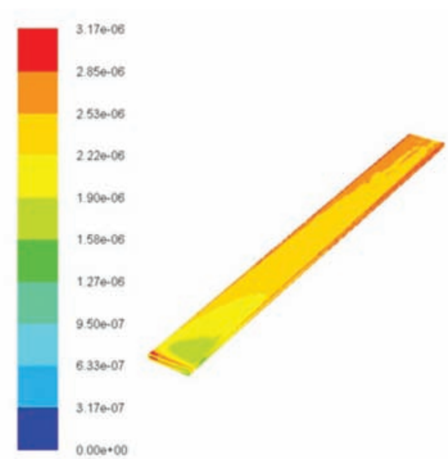
The methodologies published in her research have a unique user-defined function that allows multi-physics models to speak to each other in a way that is different from commercial codes. Boundary conditions can be adjusted to be applicable for the specific industry of study.

Completing her studies through the distance learning option, she was able to utilize the state-of-the-art equipment at Ford Motor Company to conduct her research, while leveraging the expertise of Michigan Tech faculty, Drs. Jason Yang, Jeff Allen, and Edward Lumsdaine.



Temperature Profile Comparison for Simulation and Experimental Data 10 m/s and 30% RH

"The benefit to being at Ford for my research was the use of the phenomenal lab with no constraints. Using the high computing performance grid at Ford, I was able to produce CFD models in 1/16 or 1/32 of the time it would take on other grids," says Cash. "On my committee, my advisor (Dr. Lumsdaine) went over and above, traveling repeatedly to Ford to work with me in the lab. I also had weekly meetings with Dr. Jeff Allen, who has vast experience in two-phase flow and capillaries through his work in the aerospace industry and helped me apply that to the error states of our coolers. The sheer commitment from the faculty and my committee at Michigan Tech was my biggest asset."



Film Thickness (m) for 10 m/s and 40% RH Using LES

While Cash credits the advancement of CFD technology for the completion of her research, noting that technology and the tools of the industry will continue to advance; students need to know how to utilize them for success in their careers.

"The transition from road to lab to CFD and CAE has led to the development of key life-test simulation of real-world applications to drive costs down and keep the automotive industry efficient in their product delivery," says Cash. "Customers want pep in their engines with great performance, so we need to be smarter about how we design the components, while meeting the requirements for quality in a manner that is cost effective and accurate."

ALUMNI

Engineered for Hockey

JOHN SCOTT '10

In Canada, hockey isn't just a sport; it's a lifestyle, and alumnus John Scott has lived it to the fullest. From the moment he was recruited by Michigan Tech and visited the campus, he—like so many others—fell in love with the place and its legacy of great hockey. But great loves require great effort, and Scott would prove himself equal to the balancing act that athletes face: a rigorous practice schedule on top of a full course load.

"I always enjoyed numbers, but I wasn't a business guy," says Scott. "Mechanical engineering appealed to me, but was also extremely challenging."

The WCHA conference meant that Scott would travel eight to 10 hours to play against opponents in Minnesota and lower Michigan. For games in Colorado and Alaska, it often meant flying out Wednesday or Thursday.

"Balancing school with hockey was difficult. We left during the middle of the week, so I often had to take quizzes and tests ahead of time, sacrificing precious study time. I worked on homework every spare minute—on the bus, before and after practice, between games," says Scott. "We had practice every day at 3 p.m. and then Friday and Saturday were often spent preparing for and playing our games."

Scott recalls his biggest academic struggle was walking into Calculus One. "I am glad I stuck with the coursework in Calculus One and Chemistry. I found that once I moved into the meat of the program with thermodynamics and physics, it was really enjoyable," says Scott. "I liked working on problems and being able to apply what I learned in my first two years of study."

Over time Scott has discovered that engineering would spill over into his hockey career.

"I was always good at figuring out the angles I needed to throw a pass off on the boards, and after a few courses in thermodynamics I also learned to tell how hard the ice is and I would adjust the sharpness of my skates to compensate," says Scott. "Most guys sharpen their skates to one-half of an inch, but I know how to increase or decrease my bore. Sometimes you don't even realize how ingrained the math and sciences are in your thinking until you step back."

Beyond his role as a defenseman on the Michigan Tech hockey team, he also participated in the Clean Snowmobile Enterprise.

"I worked with Chris Connor (a hockey teammate) to lighten the snowmobile as much as we could, while maintaining the strength and stiffness of the body," says Scott. "We used simulation to test our designs for the thermal and structural performance, with the exhaust line being a concern. It was a great experience."

After wrapping up his scholarship at Michigan Tech in 2006, Scott left to pursue a career in the National Hockey League (NHL), playing for the Arizona Coyotes and receiving MVP honors in 2016. But he kept his degree alive by participating in summer courses at Michigan Tech.

He was one course shy of graduating while training with the Minnesota Wild and wanted to maintain his existing schedule. He spoke with Dr. Predebon regarding the controls lab he needed to take, and Professor Gordon Parker found a suitable replacement lab at the University of Minnesota that would transfer credit to Michigan Tech.

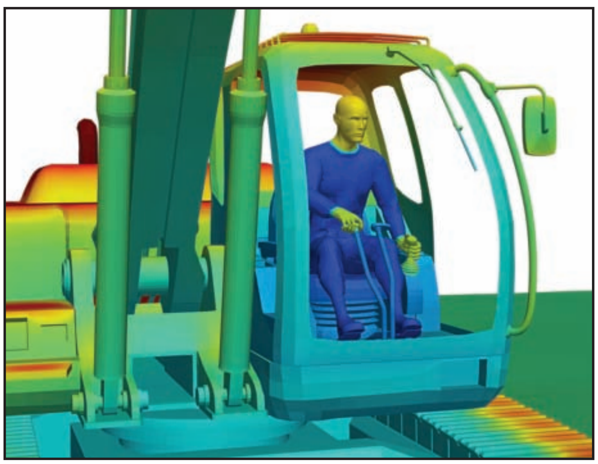
"It would have really hurt my hockey career if I would have been forced to take the course at Michigan Tech and give up training with the Minnesota Wild, so I am grateful for the efforts of the Department to work out a solution," says Scott. "I knew it was important to finish my degree and I am proud of the accomplishment. I still see engineering in my long term future plans."

Michigan Tech Spinoff

THERMOANALYTICS, INC.

ME graduates led by a former ME-EM faculty member are shaping thermal simulation in the automotive and aerospace industries. ThermoAnalytics, Inc., located in Calumet, Michigan, launched as a defense focused company with an infrared signature code, but quickly transitioned into the automotive industry with the capability of analyzing thermal radiation.

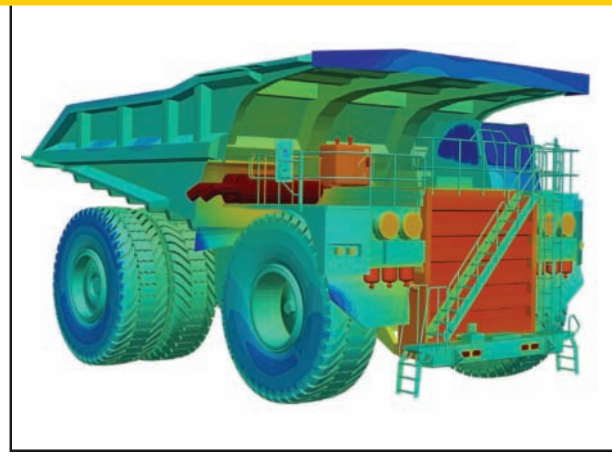
Founded in 1996, ThermoAnalytics has grown from an eight-person team (five of whom were Michigan Tech ME graduates) to over 60 employees with offices in the United States and Europe. Currently, 24 alumni support the software development and engineering teams.



The original software product has been developed continuously and can now solve full multimode heat transfer problems. The software has also expanded to encompass transient human thermal and battery thermal simulations in the aerospace and automotive industries. The software helps engineers create thermal solutions from take-off to braking duty cycles, ventilated seats to heated steering wheels.

"In the automotive industry, you would be hard pressed to find a vehicle where the thermal management aspect isn't designed using ThermoAnalytics software," says Al Curran, co-founder and former ME-EM professor. TAITherm software addresses complex heat transfer questions under dynamic real-world scenarios to shorten production cycles and save on labor, testing, and material costs.

"The software uses a multi-physics approach to solve thermal conduction, radiation, and convection under both steady-state and transient conditions. Transient is one of the differentiators between our software and traditional

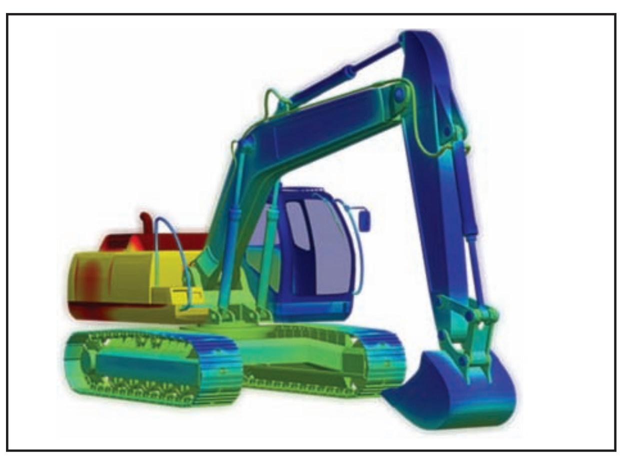


CFD codes," says Curran. "With the Human Thermal Model, automotive OEMs can get an accurate prediction of cabin comfort and use simulation to optimize the HVAC system and then use sensor readings to verify the simulation accuracy and system performance."

In an industry focused on the J.D. Power ratings, the race is on for automotive OEMs to build systems that have HVAC, seats, and steering wheels with integrated thermal controls—maximizing comfort and minimizing energy consumption.

Beyond their influence on the automotive and aerospace industries, ThermoAnalytics also has an impact on the ME-EM Department. Their TAITherm software is licensed to Michigan Tech to help students evaluate the thermal performance of their designs in both Enterprise and Senior Capstone Design. Further impact is felt by the PhD and master's degree students they fund through tuition benefits.

"Not only are we hiring graduates, but we are also sending our employees back to graduate school and getting solid research through that collaboration with the ME-EM Department," says Curran. "We are mutually benefitting from our proximity to Michigan Tech and the ME-EM Department, where collaboration with companies like us supports the ongoing investment in our technology and leads to the development of a tool that will grow through the coming decades."



SIMULATION

Education

SIMULATING THE FUTURE

ME-EM faculty members are preparing engineers of the future.

Our recent undergraduate curriculum revision brings simulation front and center through all four years of study. Students learn to operate an array of software simulation tools, used in a variety of industries, through project-based experiences.

Our goal: to prepare our graduates to use simulation in industry from day one, so they can effectively use these tools to meet the stringent design requirements that keep consumers safe.

SOFTWARE PROGRAMS TAUGHT:

- Altair
- ANSYS
- MATLAB
- LS-DYNA

EDUCATION

SIMULATION COMES FULL CIRCLE

AS OUR STUDENTS USE THE SIMULATION SOFTWARE OUR ALUMNI SHAPED AND OUR FACULTY ENHANCED.

Simulation Leads Design

Faculty in the ME-EM Department continuously monitor industry for shifts in the engineering process to assure their graduates are equipped with the necessary tools and background to be productive on day one. When faculty members started noticing a transition from design, build, and test to a new process with simulation at the forefront, they decided it was time for a change.

“We saw that the whole engineering design cycle had changed to one of model-based systems engineering,” says Professor Chuck Van Karsen. “We found industry was building system models with all of the pieces, including motors, heat exchanges, and controls, as a first step to answer questions about feasibility and determining uncertainties. This process gives you a much better, more efficient idea of what you need to do.”

While prototypes used to drive engineering processes, the process was becoming more expensive; thus, industry had to make a change to become more efficient, leading to simulation leading design.

“In the old curriculum, students were making design decisions based on their opinions and modest engineering experience, rather than actual facts,” says Dr. James DeClerck. “When it came to the new curriculum, we wanted to change the process so students had the data to make decisions by running simulations, looking at the results, and comparing the results to the requirements. We wanted them to provide reasons for any design decisions they made.”

While considering the decision to bring simulation in as an integral element of the curriculum, changes also needed to be made in the way the simulation software tools were introduced.

“We saw in the Senior Capstone Design projects that our students were asked to run finite element models; however, we had not provided them with classroom experience or training in the utilization of those tools, so I was training them on the fly,” says Dr. Greg Odegard. “In the new curriculum, one of the many things we wanted was for all the students to be exposed to modeling and keep them using it as a tool throughout their courses, while teaching them the theory behind the tools in class.”

Mechanical Engineering Practice Courses

From their first semester in their second year in Mechanical Engineering Practice (MEP) I, students are introduced to FEA modeling in various dimensions and continue to expand on that knowledge through MEP II, MEP III, and MEP IV before transitioning into their Senior Capstone Design projects.

"As part of the new curriculum, we don't just use the software, we teach students to interpret the results and tell us how it impacts their design and what they can learn from the results," says Dr. Paul van Susante. "Simulation is more than just learning which buttons to click; it's the proper application of the tool."

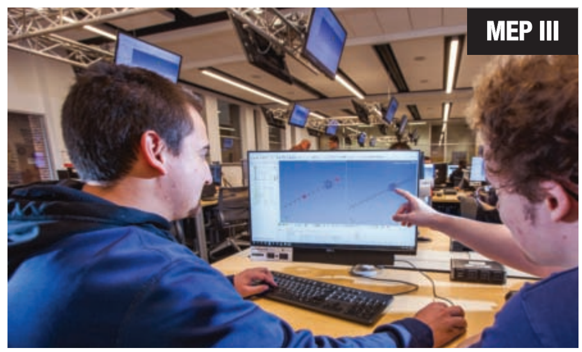
In MEP I (taught by van Susante), the students use the same models to learn how to measure deflection of a bridge structure, while also comparing software results between different code bases to help determine the most effective tool and the limitations of each. In addition to stress testing of structures, students also conduct an elevator experiment, where they begin by creating a simple model, validating the model by displacing the mass and watching the response, and comparing to the model. In this course, focus is put on two-dimensional finite element modeling and one-dimensional simulation.

Dr. Jeff Allen leads MEP II, where students build on MEP I theories and skills by modeling and validating dynamic mechanical and thermal systems and two-dimensional simulations. In MEP III, Professors Van Karsen and DeClerck use model-based design principles to help students make design decisions in the three-dimensional space and select their own system parameters and components to meet design requirements.


MEP II

"We give students a problem with a box that needs to move on a horizontal and linear path, but the students come up with their own specific application and drive the requirements," says DeClerck. "Every team does something different. Some make trains, some delivery systems within a factory, others boats between islands, but all of them have to move people or goods along the way."

The students are able to be more creative when they are given the fundamental problem with the opportunity to contextualize it, often putting in additional effort with intricate details and complexities.


MEP III

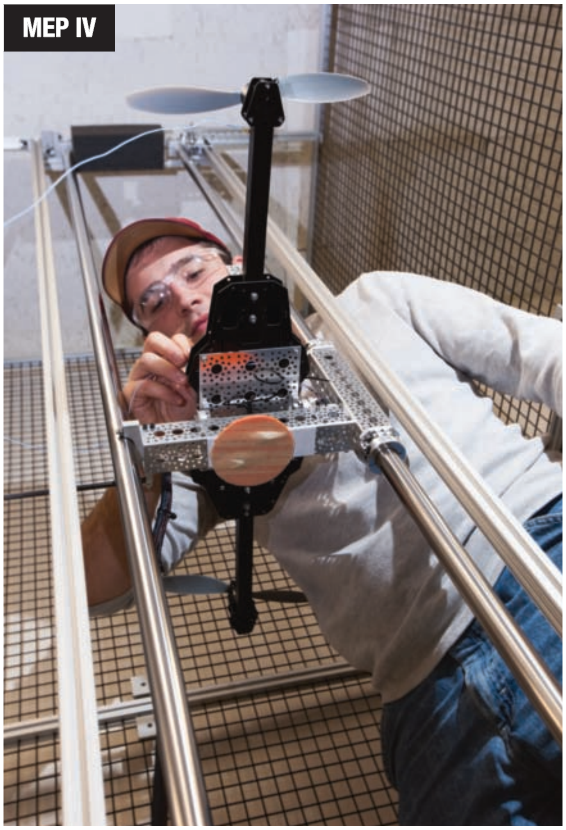
By MEP IV (taught by Dr. Brad King), students tackle complex systems by gathering evidence, designing an actual experiment, setting up an appropriate simulation, and iterating to find the optimal solution.

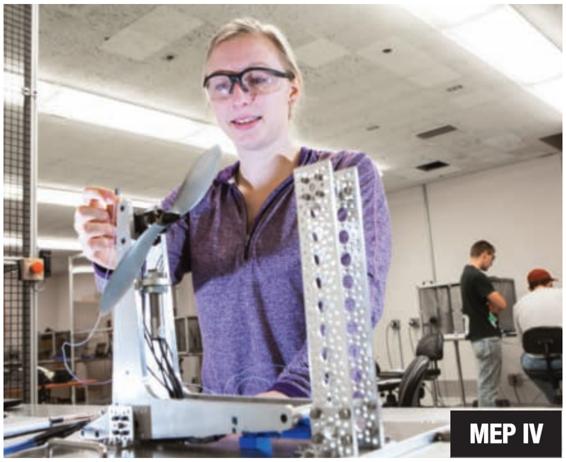
"We teach students how to make predictions using a series of experiments. We ask them, 'How do we answer this question?' with physical testing and computational calculator approaches," says Dr. Michele Miller, who initially spearheaded the curriculum revision.

Throughout the MEP courses, students utilize MATLAB and tools from Altair with access to ANSYS and LS-DYNA in their senior year. While simulation tools are heavily integrated in the MEP courses, students are expected to watch tutorials on the various software programs on their own and utilize classroom time to ask questions.

"We want our students to self-learn the software. We are there with them while they run tutorials in class, and when they get stuck in the application, we come in to help," says DeClerck. "It is a unique approach to teaching software. We teach them about where the software is most applicable and provide them tutorials on those and then hope to inspire their curiosity."

EDUCATION





Mechanical Engineering Practice Courses (cont'd)

The MEP courses not only teach students how to be independent learners, but they also provide them with the resources and background necessary to tackle Senior Capstone Design courses.

"The MEP courses are an integration of threads from applying engineering science to prototype development to communication and simulation while using software tools, data acquisition, and sensors," says Miller. "The four courses go together and serve as the thread from sophomore through senior year. These courses teach independent learning, utilizing project-based learning in a professional practice environment.

To accompany the professional practice environment, communication modules are embedded into the courses. The modules in the course follow industry best practices to teach students writing basics on how to structure documents and create effective graphics, along with presentation skills and how to tailor the message to their audience.

"There are a series of 16 modules across the four MEP courses that use one textbook, with assignments linked between chapters of the textbook and what is happening in the classroom," says Dr. Nancy Barr. "Students learn from the communication modules by reading the chapters and completing assignments and watching videos that I have created or that are on YouTube and relevant to the topic."

The MEP communication modules provide faculty members with the tools to teach effective communication, while also incorporating in their own experience from industry. Like every paper or presentation, the communication modules and the MEP courses are being adapted based on student feedback each semester and observations made while coaching students through project-based learning.

"The most rapid feedback loop is the instructors and course coordinators who have made changes each time the courses are taught—not that the syllabus has changed, but that the documentation that accompanies the lectures and lab sessions have been adjusted to better fit the student's needs," says Miller.

The impact of the curriculum revision and the transition to simulation-driven, project-based learning will be realized in fall 2016, as students participating in the first MEP courses begin Senior Capstone Design.

Keeping PACE

As part of the simulation process, it is also crucial for students to have an understanding of product lifecycle management (PLM) from design through manufacturing, marketing, distribution, maintenance, and recycle or disposal of the product.

To help ensure future engineers and designers are equipped with the tools necessary to work on a PLM team, General Motors Corporation selects institutions worldwide to participate in the Partners for the Advancement of Collaborative Engineering Education (PACE) program. Additional PACE partners include Autodesk, HP, Oracle, and Siemens.

Since 2003, students in the Department model, assemble, and draft a real world product developed by their team. The group is judged on form, fit, function, presentation, and teamwork by industry representatives and faculty members.

Students can gain further experience through global forum participation with combined teams from other participating institutions around the world. This year, the Department formed a team including students from three other institutions, and sent four undergraduate ME students to the competition in Cincinnati, Ohio, to present their design of a four-wheel reconfigurable shared-use mobility system. The team conducted finite element analysis and computed the static and dynamic load conditions of the chassis.

Both the institution level and global competition were established to provide students with the opportunity to complete a project using industry-standard software simulation tools, while closely collaborating with student peers through the product lifecycle analysis.

Project-Based Learning Leading Diversity

Michigan Tech was selected as one of five schools in the United States to participate in Transforming Engineering Culture to Advance Inclusion and Diversity (TECAID) program through the National Science Foundation, ASME, Women in Engineering ProActive Network (WEPAN), and Purdue University. TECAID is set-up as a diversity training program for inclusivity of women and under-represented minorities.

Michigan Tech and other participating universities, including Purdue, Oregon State, Texas Tech, and the University of Oklahoma, trained with TECAID experts on ways to encourage inclusiveness among diverse students in the classroom.

“We want students to see that mechanical engineering is about more than cars; to have an inclusive and open mind about the team tasks at hand that can be translated to their careers,” says Dr. Greg Odegard.

The TECAID program pairs well with the project-based learning environment that was introduced in the MEP courses through the curriculum revision. As part of the environment fostered through the new curriculum, students are separated into teams and participate in training to work respectfully in groups.

“We have learned that conflict within a team is not necessarily a bad thing,” says Odegard. “We are helping the students set up a team agreement to define priorities and conflict resolution plans, preparing them for these situations as their group continues.”

While the TECAID program has concluded, Odegard and the committee, including Dr. William Predebon, Dr. Michele Miller, Dr. CK Choi, and Dr. Nancy Barr, are implementing changes and adding a permanent committee to encourage an inclusive environment for all faculty, staff, and students.

The ME-EM Department recently won the WEPAN President’s Award for TECAID. See page 46.


SAMSUNG

SIMULATION

FACULTY

ADVANCING SIMULATION

Commercial simulation software limits user modification to user functions or limited API functionality; the user cannot make changes to the code base. But to make advancements in the core technology for various environments and high model resolution, code base-level adjustments are required.

Faculty members in the ME-EM Department are developing their own software to improve the physics, dynamics, and models of complex chemical reactions, and providing new simulation methods for complex phenomena. Applications also include preventing blackouts during extreme weather conditions and developing lightweight materials for aircraft. These advances aid industry in the development of reliable products to keep the lights on, engines running efficiently, and planes flying safely.

FEATURED FACULTY

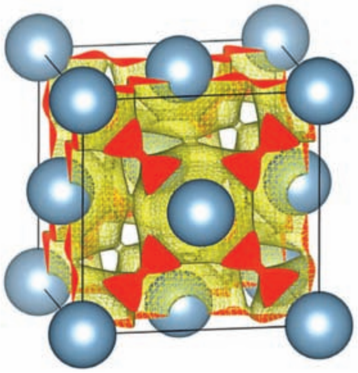
- Dr. Greg Odegard
- Dr. Chunpei Cai
- Dr. Song-Lin (Jason) Yang
- Dr. Youngchul Ra

FACULTY

BY ADVANCING SIMULATION MODELS AND METHODS, ME-EM FACULTY SERVE AS A GUIDING FORCE BEHIND SOFTWARE CODE BASE UPDATES TO IMPROVE ACCURACY AND ENVIRONMENTS IN MODELS.

"There are so many opportunities for the simulation of materials and we are only scratching the surface for polymer nanocomposites. With molecular dynamics, we are expanding the range of opportunities for new material development."

—DR. GREG ODEGARD



Structured Simulation

DR. GREG ODEGARD

While experiments traditionally occur in a laboratory environment with expensive equipment, simulation provides opportunities to run experiments computationally in a virtual space. Simulation eliminates the need for costly and difficult experiments and provides researchers with physical insight into structural behavior. An example of this is finite element analysis.

After graduating with a master's and PhD with a focus on finite element simulation, Dr. Greg Odegard took a postdoc position with NASA Langley Research Center, where he began to develop his area of expertise: molecular dynamic simulation. He began developing simulations of atoms and molecules and their interaction with one another under specific time frames, temperatures, and pressures.

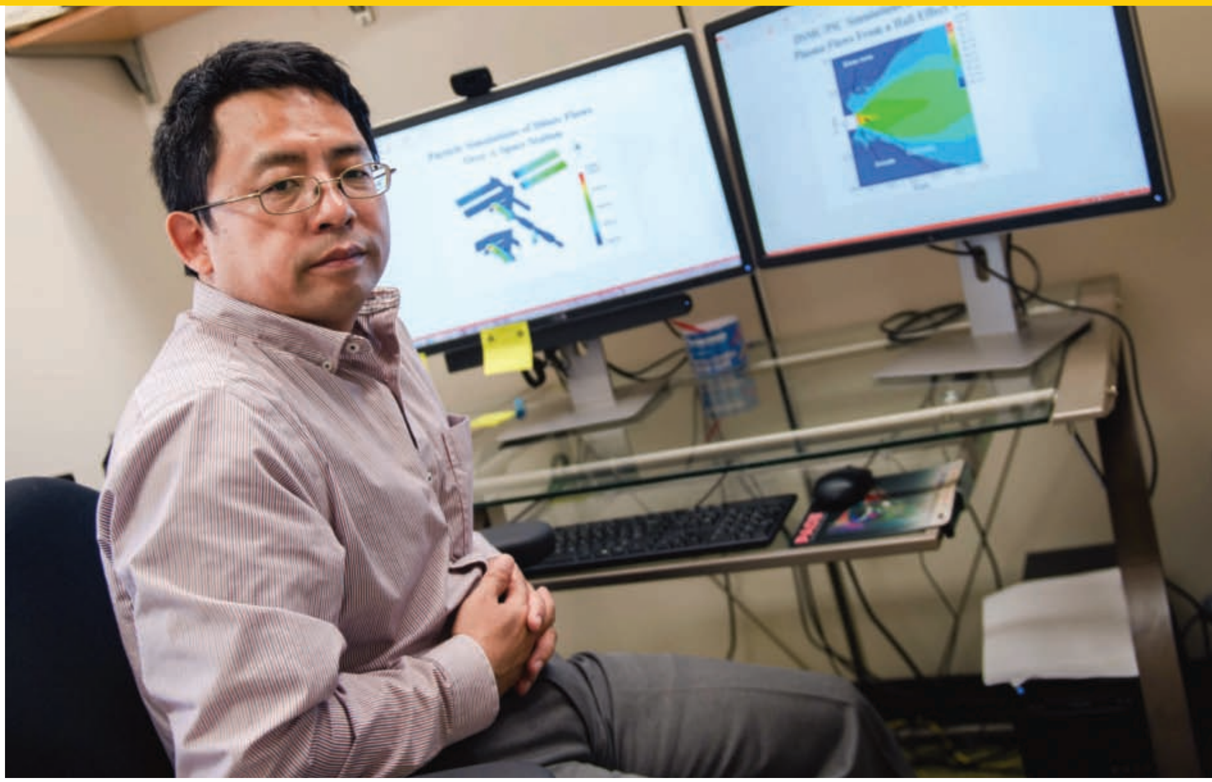
Analyzing the molecular structure of non-crystalline materials, such as polymers, lead Odegard to his research focus at Michigan Tech in the development of structural property relationships for polymer nanocomposites.

"My focus became: for a given material microstructure, can we predict its macroscopic behavior using only simulation," says Odegard. "The materials we have had the most success with are epoxy composites reinforced with nanoparticles."

Odegard helps his PhD students simulate their individual nanocomposite material systems, each featuring different fillers and epoxy types. The simulation of the materials at the atomic level is completed using the LAMMPS molecular dynamics software package, a code developed and maintained by Sandia National Labs and updated through research conducted at educational institutions, including Michigan Tech.

Through these computational simulation efforts, Odegard and his team are reducing the cost of traditional trial-and-error laboratory-based development of polymer nanocomposites.

"There are two routes for the materials we work on. The first is the aerospace route, where we work with the aerospace industry to create lightweight, strong, and stiff materials for aircraft," says Odegard. "The second is for the development of power transmission lines using composites in the core for structural benefits. Traditional steel cable power lines expand under high-temperature conditions, such as hot summer days, resulting in sagging and potential electrical shorting with vegetation and structures. These new composites in the lines do not expand when they get hot, thus preventing blackouts."



Space Simulation Exploration

DR. CHUNPEI CAI

Simulation methodologies are often utilized as a cost-saving practice for the automotive industry, but in the aerospace industry, they are required to evaluate algorithms and theories not easily tested in Earth's atmosphere. Aircraft and spacecraft operating near space are equally difficult to test, and Dr. Chunpei Cai has developed his own CFD codes to help predict the chemical reactions and heat transfer in the boundary layer; and simulate plasma flows related to electric propulsion devices.

Cai's work in simulations began as a PhD student at the University of Michigan, where he developed 3D models of plasma flow from a cluster of four Hall-effect thrusters, with complex physics governing ion and electron flows.

"I developed a specific package for many factors, including multi-physics, multi-dimension, and multi-scale simulations, with accurate results when compared to the experimental data. This work was completed in 2005 and people continue to use this model and try to improve it," says Cai.

His research today continues investigating hypersonic and plasma flows, dealing with complex chemical reactions for 10 to 20 species and in low pressure applications, improving the dynamics and creating models that are physically accurate. Because traditional software packages are frequently one or two generations behind academic research, Cai uses his own CFD models to analyze gas kinetics, relating statistical methods with energy and velocity distributions.

"The goal is for the research to be integrated into commercial CFD codes in the future. It can be applied to any industry, but is more accurate for hypersonic, micro- and plasma flows..."

—DR. CHUNPEI CAI

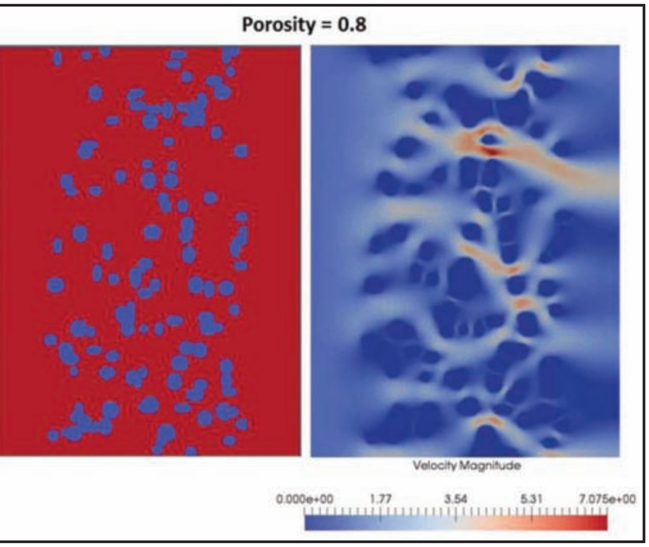
Using plasma dynamics equations, his research focuses on the flow of plasma through rarefied gas with complex physics, such as ionizations. The simulations are bottom-up, starting at the molecular level, including electrons and ions. As particles collide, if there is a force between them, his research works to simulate the particle motions and extrapolate upward. This is utilized to develop new technologies for space engineering and particle flows.

"The goal is for the research to be integrated into commercial CFD codes in the future. It can be applied to any industry, but is more accurate for hypersonic, micro-, and plasma flows where there are relevant effects on several levels, including simulations at different levels, i.e., the microscopic (particles), mesoscopic (velocity distributions), and macroscopic (non-conventional CFD)," says Cai.

FACULTY

"We are working on the proof of concept technology and then beginning our research in analyzing and developing a solution for fluid flow and heat transfer problems."

—DR. SONG-LIN (JASON) YANG



Fluid Flow Simulation Techniques

DR. SONG-LIN (JASON) YANG

New simulation algorithms are continually being developed to improve on traditional engineering workflows. Traditional computational fluid dynamic techniques employ a top-down approach where the fluid must be a continuum medium, meaning the function itself is continuous and the field is variable.

Dr. Song-Lin (Jason) Yang is a numerical methods expert working on a bottom-up approach to CFD techniques that does not require a continuum medium assumption, for example in microchannel flow through the use of the lattice Boltzmann method. Yang also solves the lattice Boltzmann equation with direct numerical simulation for turbulent and transitional flow.

"This CFD technique can be used for many applications, including single-phase single-component flow, multiphase single-component flow, and multiphase multi-components flow," says Yang.

This new simulation with the lattice Boltzmann method is particularly useful in simulation of disordered media, such as the porous wall of diesel particulate filter. "This is because of the simplicity of the bounce-back boundary condition for such a complicated geometry," says Yang. "We are working on the proof of concept technology and then beginning our research in analyzing and developing a solution for fluid flow and heat transfer problems."

Beyond the new algorithm based on the lattice Boltzmann method for engineering applications, Yang has also been involved in the development of an in-house CFD code for the simulation of the flow field around turbine blades, along with simulation for jet engine combustion. Working within the KIVA code base from Los Alamos National Laboratory, Yang has developed ways to simulate complex flow and combustion processes by setting up complex combustor mesh, defining the governing equations, and analyzing the data using the reduced chemical reaction mechanisms.

His research has also covered conjugate heat transfer for IC engines, also using the KIVA code. The purpose is to predict the "hot spot" temperature of the cylinder, piston, or cylinder head for cooling schemes to prevent knock. Always innovating, Yang has been able to capture the process using unstructured mesh, simulating cylinder pressure and temperature, along with the reduced combustion reaction mechanisms.

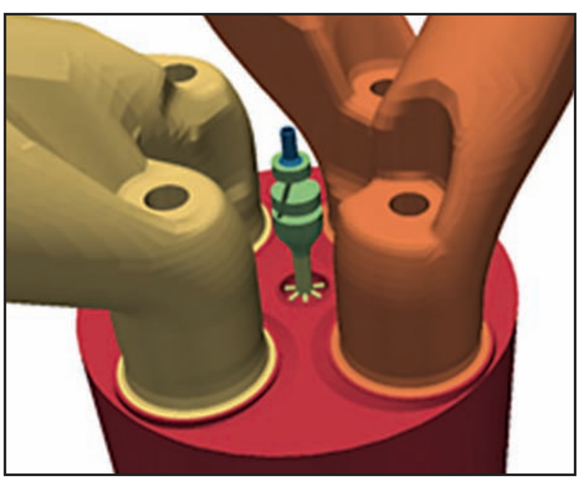
Coding for Engine Efficiencies

DR. YOUNGCHUL RA

While commercial computational codes help engineers to perform accurate simulations, the code base is proprietary and does not provide the freedom of modification required to devise new methodologies. In academia, researchers develop their own codes to run parametric variations and maintain the source code to continually change, improve, and modify it for more accurate models. Commercial codes are still used as a baseline comparison tool to ensure the in-house codes deliver correct benchmark results.

When Dr. Youngchul Ra joined the faculty in the ME-EM Department at Michigan Tech, he brought with him the code base he developed during his tenure at the University of Wisconsin. His code is utilized in realistic fuel research to describe the physical and chemical properties and how this impacts engine performance, because traditional CFD codes are not yet providing reliable models. While the model can't include every type of compound for an absolutely realistic fuel, the appropriate number of compounds for the model to simulate is visible. The in-house code provides researchers with the opportunity to enhance the fidelity of the models. These models are used to simulate combustion in engines with a goal of improving overall engine efficiency.

"We have developed the code and tested it and now commercial codes are utilizing those features," says Ra. "We lead and develop a good physical and numerical model and the performance is then adapted by commercial codes, helping them handle the fuels in a more realistic manner, which results in a more efficient engine and cleaner burning fuels for today's consumers."



"What took a week, we can now use more computers with faster speeds to get the same results in a day. The overall money total and accumulated time may not have changed, but the time to results and the quality have advanced."

—DR. YOUNGCHUL RA

Simulation code and model development research has been able to move forward not only through utilization of research from academia, but also through the advancement of computational power. The capabilities in computational power have allowed for larger capacity computer clusters to shorten simulation turnaround time.

"What took a week, we can now use more computers with faster speeds to get the same results in a day. The overall money total and accumulated time may not have changed, but the time to results and the quality have advanced," says Ra. "The complexity of the problems that we can handle has also increased because of the higher fidelity models."

Simulation tools provide engineers with the ability to use fine, high-resolution grids to describe very small, detailed parts. Engineers are able to produce models with reasonable and reliable data with higher complexities in the models. Ceaselessly revising the state-of-the-art, Ra and his graduate students will continue to push the boundaries of what is possible in combustion simulation.

GRADUATE SEMINAR SERIES

EXTERNAL SPEAKERS

Dr. Giorgio Bacelli, Sandia National Laboratory, *Converting Energy from Ocean Waves: Fundamentals in Modeling and Control System Design*

Dr. Robin Cash, Lecturer, Eastern Michigan University and Technical Training Manager, Ford Motor Company, *The Discipline of Experimentation*

Dr. Brandon Dilworth, MIT Lincoln Laboratory, *LLCD Experimental Line-of-Sight Jitter Testing*

Dr. Julie Ford, New Mexico Tech, *The Road to Clear and Engaging Engineering Presentations*

Harvey Gershman, Gershman, Brickner & Bratton, Inc., *Status of Solid Waste Management in the US with Focus on the Technologies*

Dr. Elisabeth Graffy, Arizona State University, Professor of Practice; Co-Director, Energy Policy, Law and Governance, *Death Spirals and Energy Independence: The Volatility of Contemporary Energy Policy*

Dr. Gustavo Gutierrez, University of Puerto Rico - Mayaguez, *Mathematical Mode of a Reluctance Accelerator (Coilgun)*

Dr. George A. Hazelrigg, Deputy Division Director of Civil, Mechanical and Manufacturing Innovation (CMMI) at the National Science Foundation, *The Engineer as a Decision Maker*

Dr. Amanda Hanford, Pennsylvania State University, *Fluid and Structure Interaction Research at the Applied Research Laboratory at Penn State*

Dr. Mark Hepokoski, ThermoAnalytics, *Human Physiological Modeling Techniques for Predicting Thermal Comfort*

Dr. Kunal Karan, University of Calgary, *The complexity of microstructure and transport phenomena in polymer electrolyte fuel cells (PEFCs) catalyst layer: the role of chameleonic ionomer*

Dr. Mary Kasarda, Virginia Tech, *The Virginia Tech Smart Infrastructure Laboratory: A High Performance Smart Research Building on the VT Campus*

Dr. Umesh Korde, South Dakota School of Mines and Technology, *Hydrodynamic Design of Wave Energy Converters*

Dr. Mehdi Maasoumy, PhD Candidate, University of California, Berkeley, *A Contract-Based Framework for Integrated Demand Response Management in Smart Grids*

Dr. Moshe Matalon, University of Illinois at Urbana-Champaign, *The "Turbulent Flame Speed" – Recent Developments*

Dr. Reginald Mitchell, Stanford University, *The Impact of Co-firing Coal and Biomass on Mixed Char Reactivity under Gasification Conditions*

Dr. Marie Paretti, Virginia Tech, *What Do Faculty Teach and What Do Students Learn: Studies of Teamwork in Engineering*

Scott Parrish, General Motors, *Complexities of Fuel Sprays at Engine-Like Condition*

Dr. Ugur Pasaogullari, University of Connecticut, *Wettability in Electrochemical Systems*

Dr. Weisong Shi, Wayne State University, *Wireless Health: Opportunities, Challenges and Beyond*

Dr. Michael Stanisic, Purdue University, *The Singular Planes of Industrial Manipulators and a Solution to the Problem*

Dr. Pablo Tarazaga, Virginia Tech, *A Unique and Multidisciplinary Building Instrumentation Project with Non-conventional Applications*

Dr. Karl Walczak, Lawrence Berkeley National Laboratory, *Development of Durable High Efficiency Artificial Photosynthesis Prototypes*

Dr. Wangda Zuo, University of Miami, *Equation-Based Modeling and Simulations for Sustainable Buildings*

MICHIGAN TECH SPEAKERS

Dr. Ezequiel Medici, Michigan Technological University, *Acoustic Emissions of Explosive Volcanic Eruptions*

Dr. Amitabh Narain, Michigan Technological University, *High Heat-Flux Millimeter Scale Flow-Boilers and Flow Condensers – Experimental and Modeling Results*

ORDER OF THE ENGINEER

FALL 2015

Christopher Duke '95
Design Responsible
Manager—Closures
Fiat Chrysler Automobiles

SPRING 2016

Seth Newlin '94
Chief Engineer,
Oshkosh Airport Products
Oshkosh Corporation

GRADUATE STUDENT FELLOWSHIPS

FALL 2015-SPRING 2016

DEAN'S AWARD FOR OUTSTANDING SCHOLARSHIP

Hasti Asayesh Ardakani
Raghavendra Krishna Tej Bhamidipati
Evandro M Ficanha
Melissa A Mack
Sweetu Patel
Pratir Rajesh Punjani
Meysam Razmara
Kurt Terhune

GRADUATE STUDENT SERVICE AWARD

Muraleekrishnan Menon Menon Muraleedharan Nair

OUTSTANDING GRADUATE STUDENT TEACHING AWARD

Behdad Afkham
Shahab Bayani Ahangar
Prathamesh Deshpande
Behrouz Khoshbakht Irdmousa
Rachael N. McFarland
Brian Page
Meysam Razmara
Paul Roehm
Udit N. Shrivastava

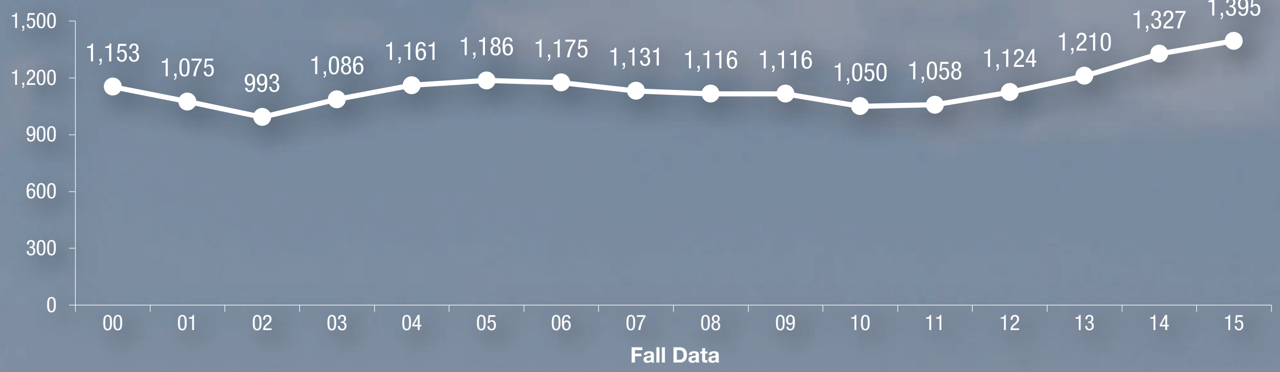
DOCTORAL FINISHING FELLOWSHIPS

Mehran Bidarvatan
Khanh Cung

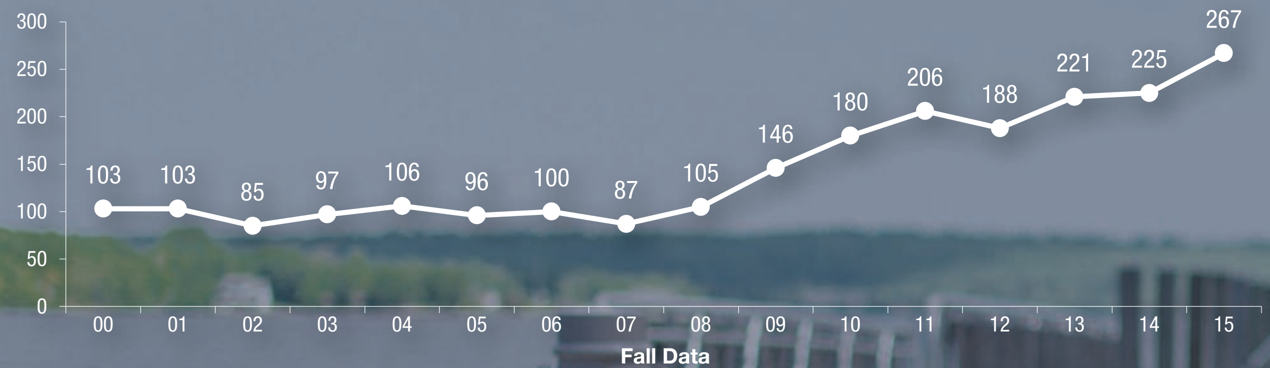
ME-EM **ENROLLMENT**

NOTE: *In a few cases, the BS enrollment data shown below differs from past publications because the official, final enrollment data is only available after this publication goes to press.*

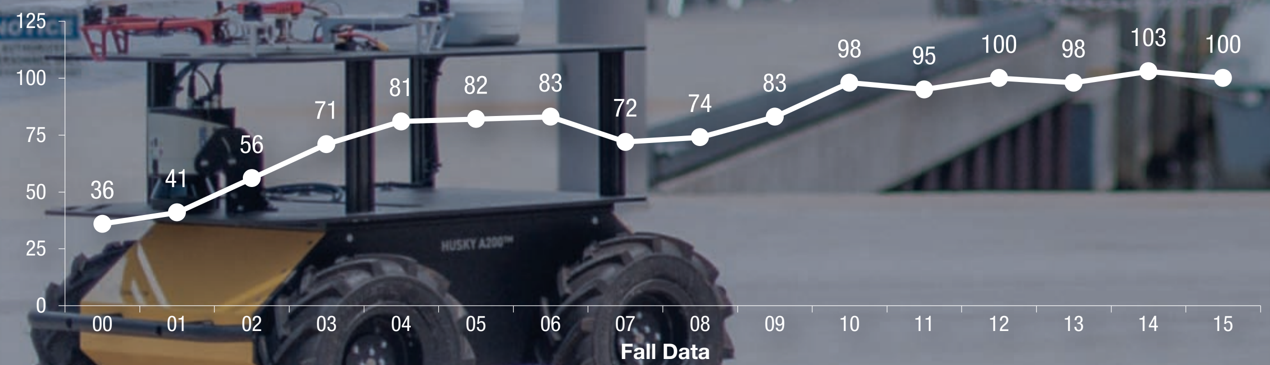
BS ENROLLMENT



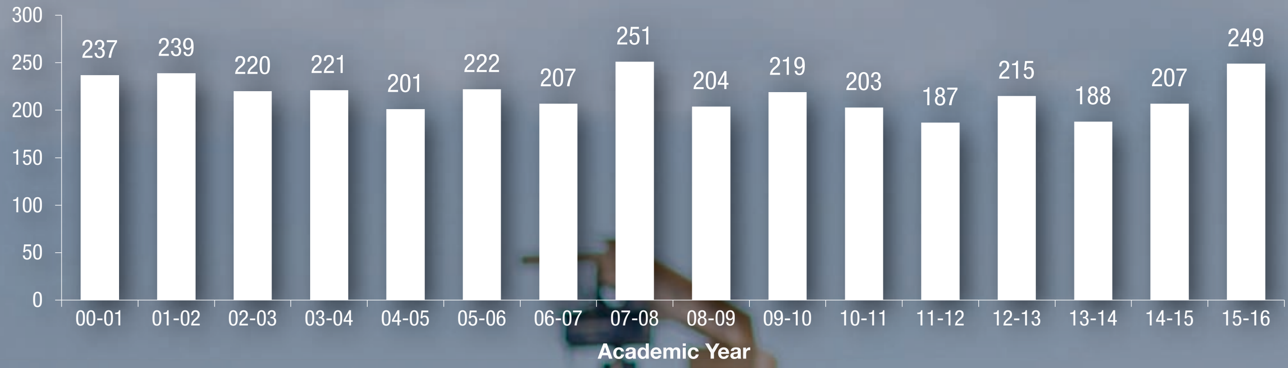
MS ENROLLMENT



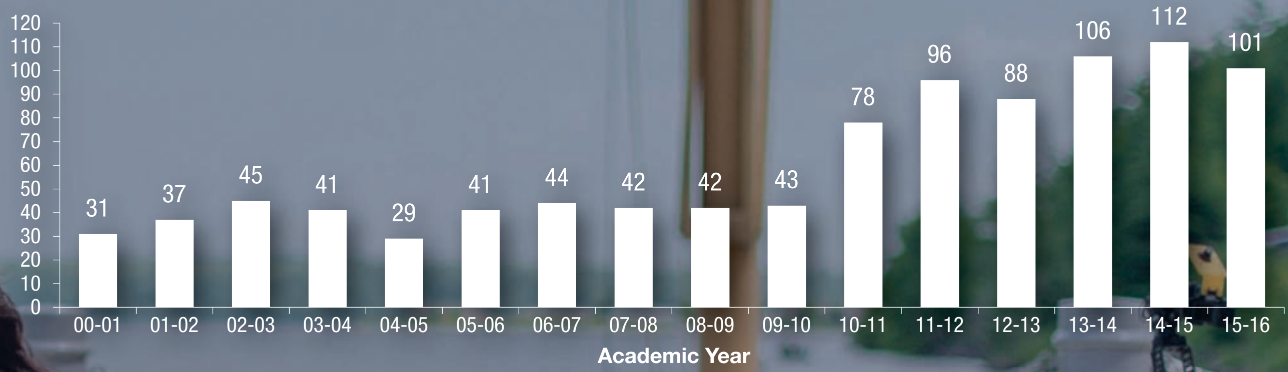
PHD ENROLLMENT



BS DEGREES



MS DEGREES



PHD DEGREES

BS GRADUATES (249)

SUMMER 2015 (15)

Cory Dean Calkins
Troy James Foster
Jordan Thor Jackola
Nicholas Michael Latuszek
Izaak Geoffrey Lauer
Jason Allen Lynch - Cum Laude
Joel R Mancewicz
Mareah Ann Meulemans
Stuart Daniel Montgomery
Gaosihao Qiu
Halley Eryn Shawbitz
Kenneth Richard Smith
Travis William Smith
Robert F Stark
Jun Zou

FALL 2015 (75)

Nasser Thuwaini T AlShammari - Cum Laude
Patricia Jean Andersen - Magna Cum Laude
Robert G Arden
Jack Andrew Babcock
Neil Adam Bergsma
Christian Shane Bersano
Rahul Bose
Benjamin Thomas Bromann - Cum Laude
Dmitri John Carder
Connor James Chrisman
Tiffany Noel Claflin
Christopher T Combs
Cody John Curtin
Nicholas Ryan Dal Pra
Melissa Sue Dapra
Tyler David Ernest
Zachary Christopher Fata - Cum Laude
Garrett Michael Fisk
Jon Einar Furlich - Magna Cum Laude
Michelle Ann Gaedke - Cum Laude
Molly Johanna Gerarden - Cum Laude
Luke Alan Grossmann - Magna Cum Laude
Kevin W Halagan
Kyle Douglas Hanson - Summa Cum Laude
Michael Gene Hartl
Eric Josef Hecker
Justin B Henker
Taylor Walcott Hoensheid - Cum Laude
Austin A Howland
Nicholas L Jensen
Brandon Steven Johnson
Zebadiah Curtis Johnston
Cory R Jokela
Zachary Thomas Karsten
Kyle Theodore Kearly - Cum Laude
Phillip Andrew Keavey
Austin Tyler Ketterhagen - Cum Laude
Jonah Matthew Kimmes - Cum Laude
Ethan Allen Klaski
William S Larsen
Michael Henry Larson
Joshua Charles Lawson
SunHo Lee
Joshua Robert Leskinen
Catrina Elise Lesko
Alex Micheal Liermann
Christopher James Maki
Daniel Henry Mazurek
Kyle Rupert Michaelson
Eric Richard Mordorski
Tyler John Nault
Miles Benjamin Penhale - Cum Laude
Benjamin M Pietila
Scott Leonard Potrykus - Cum Laude
Hannah Danielle Powers - Cum Laude
Haley Ann Raatz
Allison Rose Range - Summa Cum Laude
Luke Michael Roberts
Bernard John Schmitt - Cum Laude
Rui Shan
Haley Alexandra Swanson - Magna Cum Laude
David P Tefft
Cody Dean Therrian
Micaela Madigan Thiery - Summa Cum Laude
Jacob Charles Thill
Joseph Russell Thomas - Magna Cum Laude
Jared Martin Timmer
David Theodore Valo - Magna Cum Laude
David Lee Walter - Magna Cum Laude
John William Ware
Alex Anthony Wells
Garret Thomas Wescott
Clifford Thomas Young
Mu Yuan
Mengqiao Zhang - Magna Cum Laude

SPRING 2016 (159)

Jacob Hutton Ahlborn
Mikhail Grant Alexander
Zachary David Andres - Magna Cum Laude
Kyle James Badour
Jacob Anthony Bailey - Magna Cum Laude
Corey R Bakker
Nick Barber - Magna Cum Laude
Kyle Lewis Barie
David H Bayer
Kevin Albert Belvitch
Joseph Ryan Billman - Cum Laude
Michael Thomas Black
Shane S Blystone
Alexandria Elizabeth Bonner
Kayla Danielle Branton
Joseph A Brubaker
Daniel Steven Bruck
Trevor Edward Buswell
Nathan B Campbell - Magna Cum Laude
Zachary Michael Chenier
Tyler Jacob Childress
Michael Paul Ciupke
Paul Ronald Classen
Travis Edward Claus
Dylan James Cleereman
Mark Andrew Coldren - Magna Cum Laude
Andrew T Conley - Summa Cum Laude
Ryan Patrick Connor
Chet Robert Daavettila - Magna Cum Laude
Daniel Benjamin Davis
Charles Edward Davis
James Lucien Diem

Christopher Scott Doig - Summa Cum Laude

Jonathan David Drake - Magna Cum Laude

Jonathan Earl Eddy

Korey M Erickson - Magna Cum Laude

Joshua James Esch

Nathaniel Adam Evenhouse

Neil Allen Feliksa - Magna Cum Laude

Kristen Marie Florence

Melissa Rose Galant - Magna Cum Laude

Matthew Marten Garn

Jacob Edward Gefroh

Ryan Keith Robert Gentner - Magna Cum Laude

Earl Alexander Getchel - Magna Cum Laude

Marissa Vincene Graziano

Joshua James Greib - Cum Laude

Allena Bernice Greiner

Jacob Connell Grobbel

Derek Richard Grogg - Cum Laude

Evan Allan Halloran

Dean Raymond Halonen

Jeffrey Raymond Halonen

Hunter Alan Hamlin

David Matthew Hancock - Cum Laude

Nathaniel Alan Hartness

Ian Andrew Hatzilias

Eric J Hecht

Christopher James Helmer

Steven James Helminen - Cum Laude

Jennifer Ann Holthouse - Cum Laude

Rachel Ann Hook

Lee Foster Hovey

Ian T Hufford

Wil Tanner Jakeway

Jonathan Michael Jerred

Gunnar R Johnson

Kevin Alan Kahl

Calvin Lee Kahl

Bradon Reed Kampstra

Arthur Paul Kangas

Nathaniel Michael Karlsrud

Korey Harvey Keipe

Donald Patrick Keller

Scott J Klein

Connor Joseph Kmiec

Michael Anthony Kostick - Summa Cum Laude

Jordan Thomas LaCombe - Cum Laude

Grant Christian Larson

Joel Brian Larson - Magna Cum Laude

Evan A Leaf - Cum Laude

Zachary L Lemke

Keith W Lewis

Justin Drew Lichtenwald

Benjamin Jerome Limberg - Cum Laude

Alexander Marcus Lurie - Cum Laude

Jingyun Ma - Cum Laude

Neal Michael Magnuson - Cum Laude

Caroline Alexandra Major - Cum Laude

Ethan J Marshall

Zachary James Mauerman

Steven Thomas Maurer

Nathan Alexander Mazurowski

Jordan Leonard McInnis

Tyler John Menucci

Stefano James Michaud

Kevin R Miller - Cum Laude

Chad M Moore - Magna Cum Laude

Justin Dakota Mueller - Magna Cum Laude

Brent Andrew Myers - Cum Laude

Matthew C Neutkens

Samuel Mahlon Nichols

Alexander John Niemi

Ian Paul Ollis

Joshua Michael Olsen - Magna Cum Laude

Casey Michael Olson

Dakota J Oparka - Cum Laude

Matthew Zobitz Palo - Magna Cum Laude

Ashley S Pedrotte - Magna Cum Laude

Matthew Raymond Peltier

Samuel Daven Perram

Lance Peter Pietila

Mikhail Andreevich Putintsev

Donald Stanley Rogers

Sylvia Grace Rokosh

Christian James Romans

Phillip Craig Romback

Tyler Steven Root

Austin John Ross

Andrew L Ross

Joseph Lee Saumier

Nicholas E Saur

Andrew Benjamin Schaub

Cole Michael Schiefelbein

Aaron Thomas Schneider

Christopher Dale Schnettler

Jacob Andrew Schoff

Jenna Ann Seaser - Magna Cum Laude

Ryan W Seitter

Abbey Jillian Senczyszyn - Cum Laude

Steven Anthony Senczyszyn

Andrey A Sergeyev - Cum Laude

Shang Shi - Cum Laude

Kurt Alan Siebenaller

Ann Marie Silski

Anna Evelyn Sinclair

Abigail Kathleen Skibowski

Chad Ryan Smith

Paul R St Louis

Derek James Saiji Stone

Garrison David Strand - Summa Cum Laude

Tyler Michael Sykes - Cum Laude

Nalani Akemi Taniguchi

Jerry Lee Tozer

Lauren M Tromp - Magna Cum Laude

Kent Michael VanSickle

William C Venis

Brad Robert Vinckier - Magna Cum Laude

Vincent R Virga

Zhi Wang

Jarad M Weeks

Ryan K Werner

Levi E Whipple

Kyle Conrad Williams

Elizabeth Grace Wohlford - Cum Laude

Brent Nathan Womble

Cheng Yang

Patrick C Ylitalo - Cum Laude

Wenbin Zhang

MS GRADUATES (101)

SUMMER 2015 (20)

Borkar, Sai Neelraj
Advisor: Gopal Jayaraman
Course work only

Curtis, Jonathan
Advisor: Craig Friedrich
Course work only

DeJong, Gregory
Advisor: Craig Friedrich
Course work only

Deshpande, Prathamesh
Advisor: Mahdi Shahbakhti
Modeling and Analysis of Reactivity Controlled Compression Ignition (RCCI) Combustion

Deshpande, Rajat
Advisor: Craig Friedrich
Course work only

Feng, Lei
Advisor: Craig Friedrich
Course work only

Gujjal, Shrikanth
Advisor: Craig Friedrich
Course work only

Jia, Chen
Advisor: Ossama Abdelkhalik
Course work only

Khaire, Manjusha
Advisor: Craig Friedrich
Course work only

Kirolkar, Sandesh
Advisor: Craig Friedrich
Course work only

Kumbhar, Girish Pandurang
Advisor: Gregory Odegard
Structural Analysis of Integration of a Non-Cylindrical CNG Fuel Tank

Liu, Chuanliangzi
Advisor: Craig Friedrich
Course work only

Marthi Somashankar, Abhilash
Advisor: Bo Chen
Course work only

Mohanty, Rakesh
Advisor: Jeffrey Naber
Design and Implementation of a Mobile Test Cell

Nazemi, Mohammadreza
Advisor: Craig Friedrich
Course work only

Okkema, Timothy
Advisor: Jeffrey Naber
An Experimental Investigation into the Effect of NO2 and Temperature on the Passive Oxidation and Active Regeneration of Particulate Matter in a Diesel Particulate Filter

Raghavan, Krishnan
Advisor: Bo Chen
Development of Hardware-in-the-Loop Simulation System for Electric Power Steering Controller Testing

Shah, Nirav
Advisor: Craig Friedrich
Course work only

Tipre, Chinmay
Advisor: Mohammad Rastgaar Aagaah
Mechanical Impedance of Ankle as a Function of Electromyography Signals of Lower Leg Muscles Using Artificial Neural Network

Uppalapati, Lakshimidhar Reddy
Advisor: Mahesh Gupta
Combined Flow and Structural Analysis of Plastic Extrusion Die

FALL 2016 (31)

Ansari, Ehsan
Advisor: Jeffrey Naber
Course work only

Aravinda, Sandesh
Advisor: Craig Friedrich
Course work only

Barkur Lakshmikanth, Shashank
Advisor: Aleksandr Vladimirovich Sergeyev
Design and Development of an Automated Robotic Stacker

Bhinderwala, Husein
Advisor: Craig Friedrich
Course work only

Cheruvathur, Merwyn Raphel
Advisor: Craig Friedrich
Course work only

Dangwal, Vijay
Advisor: Craig Friedrich
Course work only

Davis, Christopher
Advisor: Jeffrey Naber
Development and Operation of a Mobile Test Facility for Education

Deole, Prasad
Advisor: Craig Friedrich
Course work only

Dobbs, Jeremy
Advisor: Mahdi Shahbakhti
Model Predictive Control of Building Energy Management Systems in a Smart Grid Environment

Gadiraju, Praveen
Advisor: Craig Friedrich
Course work only

Guo, Chunqiu
Advisor: Craig Friedrich
Course work only

Huang, Jiayin
Advisor: Ye Sun
Course work only

Jane, Robert
Advisor: Gordon Parker
Course work only

Kale, Kaustubh
Advisor: Craig Friedrich
Course work only

Karra, Anudeep Reddy
Advisor: Craig Friedrich
Course work only

Kulkarni, Pavan
Advisor: Craig Friedrich
Course work only

Kulshreshtha, Manan
Advisor: Craig Friedrich
Course work only

Limbu, Sanjeet
Advisor: Seong-Young Lee
Multi-Hole Impinging Jet Spray Analysis in Engine-Like Conditions

Mack, Melissa
Advisor: Craig Friedrich
Course work only

McFarland, Rachael
Advisor: Craig Friedrich
Course work only

Nukavarapu, Sai Siva Kumar
Advisor: Craig Friedrich
Course work only

Padira, Venkatesh
Advisor: Craig Friedrich
Course work only

Phadnis, Mrunmayee
Advisor: Craig Friedrich
Course work only

Piggott, Alfred
Advisor: Jeffrey Allen
Transient Thermoelectric Supercooling: Isosceles Current Pulses from a Response Surface Perspective and the Performance Effects of Pulse Cooling a Heat Generating Mass

Pinjari, Nawaz Shareef
Advisor: Craig Friedrich
Course work only

Punjani, Pratir Rajesh
Advisor: Craig Friedrich
Course work only

Ravikumar, Siddharth
Advisor: Amitabh Narain
Elementary Assessments and Simulations-Based Proposals for New Heat Transfer Correlations and Flow Regime Maps for Annular/Stratified Regime of Shear Driven Internal Condensing Flows

Shah, Nikhil Sukumar
Advisor: Craig Friedrich
Course work only

Sohani, Kshitij
Advisor: Craig Friedrich
Course work only

Tankala, Chetan
Advisor: Craig Friedrich
Course work only

Wei, Chenglong
Advisor: Craig Friedrich
Course work only

SPRING 2016 (50)

Achara, Utkarsh Jagdish
Advisor: Craig Friedrich
Course work only

Bankar, Shrikant
Advisor: Craig Friedrich
Course work only

Bellur, Kishan
Advisor: Jeffrey Allen
An Assessment of the Validity of the Kinetic Model for Liquid-Vapor Phase Change by Examining Cryogenic Propellants

Berkey, Richard
Advisor: Craig Friedrich
Course work only

Beyers, Nathan
Advisor: Nina Mahmoudian
Simulation of Scalability for Autonomous Mobile Microgrids

Bhamidipati, Raghavendra Krishna Tej
Advisor: Gopal Jayaraman
A NOCSAE Drop Test/3D-FEM Study on the Relationship Between Kinematic Response of the Head, Head Impact Contact Pressure (HICP) and Kinetic Response of the Brain to Delineate the Risk of Traumatic Brain Injuries (TBI)

Bhat, Ajit Badanidiyoor
Advisor: Craig Friedrich
Course work only

Bouman, Troy
Advisor: Andrew Barnard
Drive Signal Development for the Thermoacoustic Loudspeaker

Daud, Omkar Fakira
Advisor: Ibrahim Miskioglu
Creep and Wear Properties of Ultrafine Grained Zn-3%CU-9%AL Alloy Obtained by Equal Channel Angular Extrusion

Deshkar, Nishad
Advisor: Craig Friedrich
Course work only

Deshpande, Parag
Advisor: Gregory Odegard
Design Optimization Process of Differential Case

Dighe, Pratik Maruti
Advisor: Craig Friedrich
Course work only

Ehite, Ekramul Haque
Advisor: Kazuya Tajiri
Study of Two-Phase Flow Pressure Drop Characteristics in Proton Exchange Membrane (PEM) Fuel Cell Flow Channels of Different Geometries

Ghosh, Saurav
Advisor: Craig Friedrich
Course work only

Gokhale, Rutika Kaustubh
Advisor: Craig Friedrich
Course work only

Gujarathi, Karan
Advisor: John Gershenson
Course work only

Gurram, Bhargav Ram
Advisor: Craig Friedrich
Course work only

Hande, Akanksha Laxman
Advisor: Craig Friedrich
Course work only

Hirzel, Alexander
Advisor: Craig Friedrich
Course work only

Holmes, Samuel
Advisor: Craig Friedrich
Course work only

Ippili, Srinivasa Rao
Advisor: Craig Friedrich
Course work only

Joda, David
Advisor: Gregory Odegard
Finite Element Modeling of Active and Passive Behavior of the Human Tibialis Anterior: A Preliminary Approach

Kapadane, Aniket
Advisor: Craig Friedrich
Course work only

Kasture, Pranit Vijay
Advisor: Craig Friedrich
Course work only

MS GRADUATES
SPRING 2016 (cont'd)

Larson, Cody
Advisor: Craig Friedrich
Course work only

Lolap, Anand Mahendra
Advisor: Craig Friedrich
Course work only

Mahajan, Gaurav
Advisor: Craig Friedrich
Course work only

Mahajan, Bhalchandra
Advisor: Gregory Odegard
Hertzian Contact Analysis of Tapered Roller Bearing

Malik, Anil Kumar
Advisor: Craig Friedrich
Course work only

Mandali, Satya Naren Karthik
Advisor: Craig Friedrich
Course work only

Menon Muraleedharan Nair, Muraleekrishnan Menon
Advisor: Fernando Luis Ponta
On the Aerodynamic Properties of Slotted-Flap Flow-Control Devices for Wind Turbine Application

Mohale, Ninad
Advisor: Craig Friedrich
Course work only

Nipunage, Sanket
Advisor: Craig Friedrich
Course work only

Pandhare, Rohit Sunil
Advisor: Craig Friedrich
Course work only

Panghat, Karthik
Advisor: Craig Friedrich
Course work only

Paranjape, Pranav
Advisor: Craig Friedrich
Course work only

Pathak, Abhishek
Advisor: V.C. Komaravolu
Course work only

Patil, Soham
Advisor: Craig Friedrich
Course work only

Ramesh, Ekanth
Advisor: Craig Friedrich
Course work only

Ravella, Siva Bhargav
Advisor: Craig Friedrich
Course work only

Ravi, Aravind
Advisor: Craig Friedrich
Course work only

Reddy, Danapana Vishal
Advisor: Craig Friedrich
Course work only

Sarode, Mahesh
Advisor: Craig Friedrich
Course work only

Schober, Kyle
Advisor: Craig Friedrich
Course work only

Sepahyar, Soroush
Advisor: Craig Friedrich
Course work only

Shanmugam Pillai Gnanasekar, Mugesh
Advisor: Craig Friedrich
Course work only

Sohoni, Pallav
Advisor: Craig Friedrich
Course work only

Subba Rao, Nithin
Advisor: Craig Friedrich
Course work only

Syed, Jawad Haider
Advisor: Craig Friedrich
Course work only

Yeakle, Kyle
Advisor: Jeffrey Naber
Comparison of Ignition Delays and Liquid Penetrations of JP-8, Synthetic JP-8, and a JP-8 Surrogate Under Diesel Engine Conditions

PHD GRADUATES (11)

SUMMER 2015 (4)

Cung, Khanh
Advisor: Seong-Young Lee
Spray and Combustion Characteristics of Dimethyl Ether Under Various Ambient Conditions: An Experimental and Modeling Study

Klinger, Jordan
Advisor: David Shonnard
Co-Advisor: Ezra Bar-Ziv
Modeling of Biomass Torrefaction and Pyrolysis and Its Applications

Naik, Ranjeeth
Advisor: Amitabh Narain
Development of Unsteady Two-Dimensional Computational Simulation Tools for Annular Internal Condensing Flows—and Their Use for Results on Heat-Transfer Rates, Flow Physics, Flow Stability, and Flow Sensitivity

Shrivastava, Udit
Advisor: Kazuya Tajiri
Segmentation of Proton Exchange Membrane Fuel Cell in the Land-Channel Direction

FALL 2015 (4)

Bidvartan, Mehran
Advisor: Mahdi Shahbakhti
Physics-Based Modeling and Control of Powertrain Systems Integrated with Low Temperature Combustion Engines

Johnson-Cash, Robin
Advisor: Edward Lumsdaine
A Quantitative Investigation of the Water Condensation Inside Tubes of Compact Charge Air Cooler

Chen, Wei
Advisor: Jeffrey Naber
Co-Advisor: Bo Chen
Impact of Spark Ignition Duration, Energy and Phasing on Combustion and Performance in a Gasoline Turbocharged Direct Injection Engine Near the Dilute Limit

Ficanha, Evandro
Advisor: Mohammad Rastgaar Aagaah
Anthropomorphic Robotic Ankle-Foot Prosthesis with Active Dorsiflexion-Plantarflexion and Inversion-Eversion

SPRING 2016 (3)

Feng, Lei
Advisor: Bo Chen
Incorporating Driver's Behavior Into Predictive Powertrain Energy Management for a Power-Split Hybrid Electric Vehicle

Karwaczynski, Sebastian
Advisor: Gregory Odegard
Restraint System Design and Evaluation for Military Specific Applications

Zouhri, Khalid
Advisor: Seong-Young Lee
Performance Analysis on Hybrid Dye Sensitized Solar Cell and Solid Oxide Fuel Cell Using Water Electrolysis: Theoretical and Analytical Study

THE NEXT FRONTIER

With the upcoming launch of a space imaging satellite and the kickoff of two new satellite missions, the Aerospace Enterprise program, led by Dr. Brad King, is making an impact both on campus and in the aerospace industry.

Under development by students for several years, the Oculus-ASR Nanosatellite is scheduled to launch in spring 2017 from Cape Canaveral. The satellite was designed and built by students to help the US Air Force exercise their ability to inspect spacecraft from the ground using telescopes. The Enterprise is impacting recruiting, with students applying to Michigan Tech specifically to participate in the program.

The Enterprise team will undergo an extensive two-day design review this fall with representatives from the Air Force Research Lab on campus—the same review that industry giants like Boeing must pass prior to launch approval.

The next mission for Enterprise students is the development of Auris, a listening satellite that uses radio frequency in high orbit to pinpoint the location of other satellites using multilateration, or time difference of arrival. GPS uses a similar process to pinpoint terrestrial objects.

"Space is so congested and competitive, with so many vehicles transmitting, that there is a need for an orbital system to attribute transmissions to each specific satellite," says King. "Auris will be used to point out the exact position of satellites that are broadcasting high-power communications signals to help ensure compliance with the 'real estate' of space communications."

LEARN MORE: mtu.edu/aerospace

A third satellite project is in the works through NASA funding to image clouds using asynchronous stereo imaging from a satellite the size of a shoebox. The satellite, dubbed Stratus, will collect 3D images of cloud structures to determine the cloud fraction covering the earth at specific locations and the cloud-top wind vectors to provide "hyperlocal" weather.

"This technology is ideal for the financial energy markets," says King. "With thousands of these in the atmosphere, you could predict solar conditions over the next hour in the area as small as a city block, to guide trading decisions for energy credits. It will also determine when a solar farm can expect to have peaks and valleys for trading surplus power on the market."

Both NASA and the Air Force have continued to select the Aerospace Enterprise for missions based on their robust project management, creative approaches, and focus on data-relevant missions.

"We are building on our successes with winning programs under our belt," says King. "We have also created partnerships across various departments, including Dr. Michael Roggemann for his expertise in image and RF signal analysis and Dr. Ossama Abdelkhalik for his background in orbital mechanics."

The team's workflow is becoming the benchmark for satellite design projects: the Air Force now often requires other universities to follow Michigan Tech-developed procedures for status, requirement checking, and design verification. With graduates working at SpaceX and many other space startups, the impact of the Aerospace Enterprise will play out over decades, as these graduates move into leadership positions across the nation.

MAHDI SHAHBAKHTI WINS SAE RALPH TEETOR AWARD

Assistant Professor Mahdi Shahbakhti was named winner of the Society of Automotive Engineers (SAE) 2016 Ralph R. Teetor Educational Award.

The national award recognizes top engineering educators. “Your outstanding contributions have distinguished you as one of the top engineering educators,” the SAE said in its announcement.

Established in 1965, the award honors the late Ralph R. Teetor, 1936 SAE International president, who believed that engineering educators are the most effective link between engineering students and their future careers.

The award recognizes outstanding engineering educators and enables them to meet and exchange views with practicing engineers in their fields.

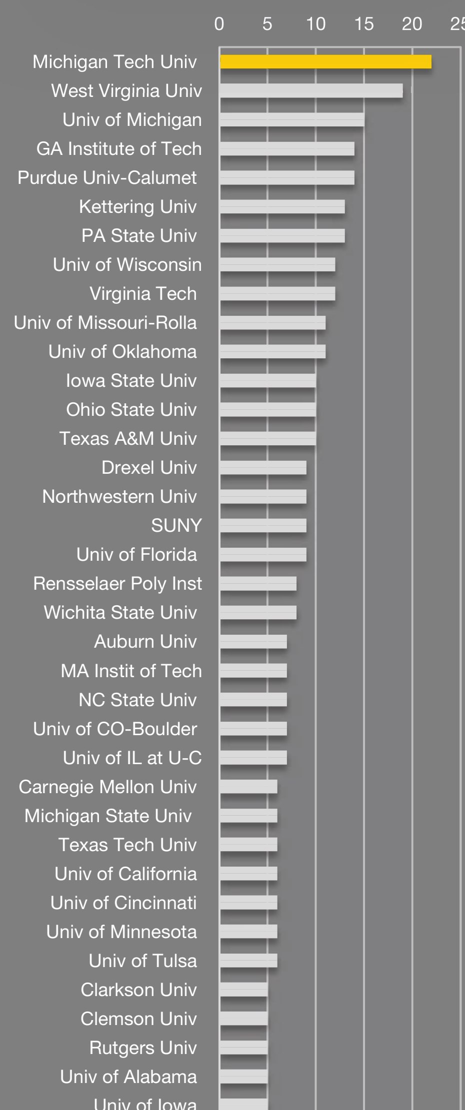
Shahbakhti accepted the award at the 2016 SAE World Congress, April 11-14. His research uses advanced control techniques to increase the efficiency of energy systems.

MICHIGAN TECH: WHERE TO GO TO GET A TOP AEROSPACE & AUTOMOTIVE ENGINEERING EDUCATION

SAE has honored 22 Michigan Tech faculty members with the Ralph R. Teetor Award since its inception: 19 from the ME-EM Department and one each from the Department of Electrical and Computer Engineering, the Department of Materials Science and Engineering, and the School of Technology—more than any other university in the US.

RALPH R. TEETOR AWARDS

Number by University: 1965 - 2016



NEW **FACULTY**

YOUNGCHUL RA, PHD

Dr. Ra joined the ME-EM Department as an associate professor in fall 2015. He comes to Michigan Tech from the Engine Research Center at the University of Wisconsin, where he was a senior scientist. Ra received a PhD in mechanical engineering from the Massachusetts Institute of Technology and a master's in mechanical engineering from Seoul National University. He has been published in *FUEL* and the *Journal of Engineering for Gas Turbines and Power*. He has also received grants from Mitsubishi Heavy Industries and Hyundai Motor Company.

CHUNPEI CAI, PHD

Dr. Cai joined the ME-EM Department as an associate professor in fall 2016. Prior to coming to Michigan Tech, he was an associate professor of mechanical and aerospace engineering at New Mexico State University. He earned a PhD in aerospace engineering from the University of Michigan. His research focuses on plasma flows in propulsion devices. Dr. Cai has received funding from the National Science Foundation and ZONA Technology. His research has been published in the *Journal of Spacecraft and Rockets* and the *AIAA Journal*.

STAFF SPOTLIGHT: **EDDY TRINKLEIN, RESEARCH ENGINEER**

"When I first started five years ago, my job was an extension of my master's research at Michigan Tech. I focused on cargo handling and offloading, testing crane systems by developing and implementing control strategies through simulation and small-scale testing. Once vetted, our industry partners implemented the control strategies at full scale. I spent considerable time studying and testing various sensor systems, including 3D vision, inertial IMU, GPS position, and angular measurement.

"Right now I am working on microgrids—small electrical grids that have their own generation loads, and can operate connected or disconnected from the macrogrid. While this may sound vastly different from my previous work, it has some similarity since the modeling and control techniques are somewhat common between electromechanical systems and the electrical systems used to model microgrids."

"I also teach two controls courses and advise Senior Capstone Design teams. I especially enjoy helping students work through problems in real-time. My best advice: 'Don't be afraid to try something. You likely won't find a solution without starting somewhere.'"

NEW **STAFF**

PETER CHOSA

Peter Chosa, academic advisor, comes to the ME-EM Department from InDyne Inc., where he worked as the director of sustaining engineering. He holds a BS in civil engineering from Michigan Tech and an MS in engineering management from the Air Force Institute of Technology.

JULIE FOSTER

Julie Foster joins the ME-EM Department as graduate program assistant and office assistant. She has worked at Michigan Tech for 20 years in the athletics and human resources departments.

CHRIS MORGAN

Christopher Morgan, operations manager for the Michigan Tech Mobile Lab, and advanced powertrain systems instructor, comes to the ME-EM Department from General Motors, where he worked as a diagnostic strategist.

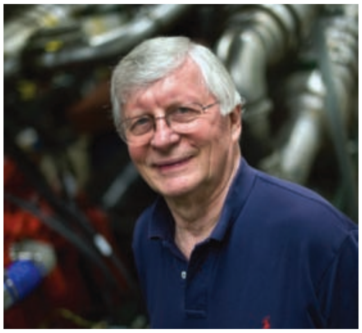
BARZIN MORIDIAN

Barzin Moridian, research engineer in the Nonlinear and Autonomous Systems Lab, earned his MS in mechanical engineering at Michigan Tech in 2014.

ALEX NORMAND

Alex Normand, staff assistant, earned a BA in history from Michigan Tech last year, and divides his time between the ME-EM Department and the Department of Civil and Environmental Engineering.

FACULTY & STAFF **AWARDS**



SAE PRESENTS AWARD NAMED FOR PROFESSOR JOHN JOHNSON

At the SAE 2016 World Congress in Detroit, SAE International presented the John Johnson Award for Outstanding Research in Diesel Engines to Rolf D. Reitz, a professor in the Engine Research Center at the University of Wisconsin–Madison.

The award is named for Michigan Tech Presidential Professor John Johnson (ME-EM), whose expertise in the field of diesel engines spans a wide range of analysis and experimental work related to advanced engine concepts, emissions studies, fuel systems, and engine simulation. Johnson is a fellow of SAE International and the American Society of Mechanical Engineers.

Established in 2008, the award recognizes authors of an SAE International outstanding technical paper that addresses research advancements in diesel engines and individuals who have demonstrated outstanding leadership in research and development in the field of diesel engines through a singular accomplishment or lifetime achievement.

MAHMOUDIAN SELECTED FOR NAE FRONTIERS OF ENGINEERING

Nina Mahmoudian was one of 83 of the nation's brightest young engineers that were selected to take part in the National Academy of Engineering's (NAE) 22nd annual US Frontiers of Engineering (USFOE) symposium.

She joins other engineers ages 30 to 45 who are performing exceptional engineering research and technical work in a variety of disciplines. Mahmoudian focuses on robotics with a specialty in marine robotics. The participants, from industry, academia, and government, were nominated by fellow engineers or organizations.

The symposium covers cutting-edge developments in four areas: technologies for understanding and treating cancer, pixels at scale, water desalination and purification, and extreme engineering.

"The USFOE symposium gives our nation's brightest, youngest engineers the opportunity to engage, collaborate, and develop long-term relationships that are critical to advancing our nation's future," said NAE President C. D. Mote, Jr.

WEPAN AWARD FOR DIVERSITY EFFORTS IN ENGINEERING EDUCATION

Michigan Tech's efforts to increase the numbers and diversity of women in engineering have been recognized by Women in Engineering ProActive Network (WEPAN), a national network of women engineers, engineering educators, universities, corporations, and non-profits who are working together to develop a diverse and innovative engineering workforce.

Michigan Tech's Department of Mechanical Engineering-Engineering Mechanics received the WEPAN President's Award for what the organization described as "outstanding accomplishments" in the National Science Foundation-funded engineering diversity initiative, TECAID (Transforming Engineering Culture to Advance Inclusion and Diversity), led by Dr. Greg Odegard.

FACULTY & STAFF **AWARDS**

CHOI WINS MICHIGAN TECH DISTINGUISHED TEACHING AWARD

Chang Kyong Choi encourages his students to visit him in his office as much as they want. In doing so, he creates a personalized learning connection and what he calls an "inclusive classroom environment." Choi's efforts have earned him Michigan Tech's 2016 Distinguished Teaching Award.

Choi, ME-EM associate professor, has been at Michigan Tech for less than a decade, but despite that relatively brief period of time, his personalized, engaging teaching style has brought him the University's highest teaching honor.

Affectionately known as "CK," Choi received his bachelor's and master's degrees in mechanical engineering from Chung-Ang University in Seoul, Korea, and earned a PhD from the University of Tennessee, Knoxville. He expanded his research in biomedical engineering and biology before coming to Michigan Tech in 2009. Choi emphasizes a personalized learning connection with each of his students, achieved through active individual meetings while valuing what he calls the "unique ideas, experiences, strengths, and attitudes" each student brings to the classroom.

His students seem to agree. As one student puts it, "I've never had an instructor ask their students to come to office hours so much. He makes time for you if you can't make it during a specific time, and every time I've met with him, I took something valuable away from it."

Choi works to create what he calls an "inclusive classroom environment" and tries to be conscious of and available to students struggling with classroom materials. Another focal point in Choi's teaching is to encourage class participation and mutual communication. "He has the perfect level of seriousness with a humorous side to him, which is underrated in the teaching world," says a student.

ME-EM Department Chair William Predebon calls Choi "a very talented and dedicated teacher." Predebon emphasizes Choi's personal connection with students, calling him "one of those rare people who is humble and unselfish with a passion to help his students succeed no matter what it takes. He cares about them as individuals and tries to connect with them at every level."

Choi says he is honored and humbled by the award, calling it "the most valuable achievement I have ever made."

"My heartfelt thanks to God and to my family, particularly my wife, Bina Kim, for helping me achieve this honor," says Choi.

DR. JASON BLOUGH received a 2015 SAE Outstanding Faculty Advisor Award, in the category Student Branch and Collegiate Design Series Team Advisors.

DR. CHANG KYOUNG CHOI received the Michigan Tech 2016 Distinguished Teaching Award.

KATHY GOULETTE received the Michigan Tech Staff Council Making a Difference Award in the category, "Serving Others."

DR. JOHN JOHNSON presented an award named after him by the 2016 SAE World Congress. The first John Johnson Award for Outstanding Research in Diesel Engines was awarded to Rolf D. Reitz, a professor in the Engine Research Center at the University of Wisconsin–Madison.

DR. NINA MAHMOUDIAN was selected as a 2016 Emerging Scholar by *Diverse: Issues in Higher Education* magazine. Invited to the 2016 NAE Frontiers of Engineering Symposium.

JAY MELDRUM has been named Michigan Tech Executive Director of Sustainability.

DR. SCOTT MIERS received the 2016 ME-EM Department Teacher of the Year award, presented by the ME Student Advisory Committee.

DR. GORDON PARKER was selected as a finalist for the Michigan Tech 2016 Distinguished Teaching Award.

DR. FERNANDO PONTA was promoted from associate professor with tenure to professor with tenure.

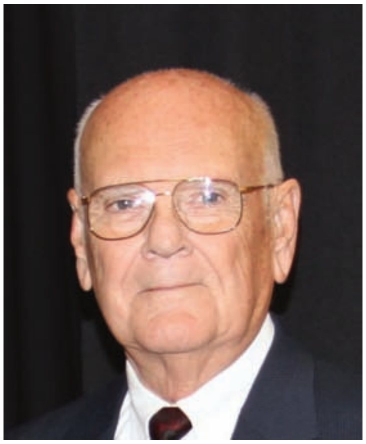
DR. MAHDI SHAHBAKHTI received the 2016 SAE Ralph R. Teetor Educational Award.

DR. PAUL VAN SUSANTE was nominated for the 2016 ME-EM Department Teacher of the Year award, presented by the ME Student Advisory Committee.

DR. CARL VILMANN was nominated for the 2016 ME-EM Department Teacher of the Year award, presented by the ME Student Advisory Committee.

ME-EM 2015 **ACADEMY INDUCTEES**

The purpose of the Academy is to honor outstanding graduates of the ME-EM Department. Selection into the Academy recognizes excellence and leadership in engineering and civic affairs. Portraits and a brief biography of Academy members are prominently displayed in the R.L. Smith building to serve as inspirational role models for our students.



JOHN T. EASTMAN, SR.

BSME '58

Right after graduation from Michigan Tech, John Eastman went to work for General Motors Corporation in the Buick Automobile Engineering Section assigned to the Experimental Noise and Vibration Engineering Section. There he introduced dynamic rubber testing machine and procedures. Involvement in that project led to handling all test car rubber parts, and he helped introduce and implement a new automobile tire test machine known as the "Loaded Radial Runout Machine," that was used to develop the new belted tires that were replacing bias angle tires.

In 1968, Eastman joined Monarch Rubber Co. as a senior development engineer. It was bought out by Teledyne, Inc. and became the Teledyne Monarch Rubber Division. He became manufacturing manager and then vice president of manufacturing. While there he created an industrial engineering department, helped plan four major plant expansions, increased the manufacturing capacity from $27 million to $120 million in sales per year, introduced the Desma rotary station rubber injection machine and process, and tripled the production volume of motor mounts and suspension bushings.

While at Michigan Tech, Eastman married Barbara Bader, a registered nurse. All five of their children—John Jr., Jeffrey, Jayme, Jean, and Janet—are college graduates.

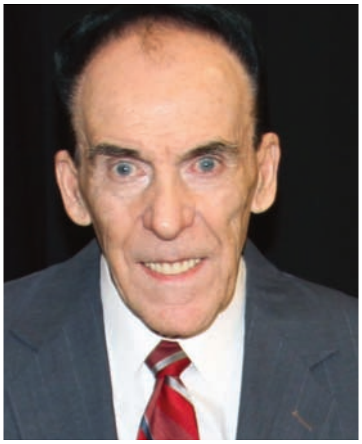
PAUL D. ROGERS

BSME '88, PHD '04

Serving as the director of the US Army Tank-Automotive Research, Development and Engineering Center (TARDEC), Paul D. Rogers provides executive management to deliver advanced technology solutions for all Department of Defense ground systems and combat support equipment. He manages a workforce of more than 1,700 engineers, scientists, researchers, and support staff and sets strategic direction for a full range of investments that affect more than 270 Army systems.

Rogers received his Army commission through Michigan Tech's Army ROTC program and has served in varying capacities for the past 28 years. He was recently promoted to brigadier general and is deputy commanding general, 46th Military Police Command in the Michigan Army National Guard. Rogers served in Iraq as the battalion commander for the 507th Engineer Battalion. He has a Bronze Star, Army Meritorious Service Medal, Army Achievement Medal, Iraqi Campaign Medal, Airborne Badge, and the Bronze Order of the de Fleury Medal.

Rogers is a member of the ME-EM Advisory Board at Michigan Tech and at the University of Michigan. He and his wife Sally (MS Statistics '91) have raised three children together, Timothy, Katherine, and Nicholas. They reside in Farmington Hills, Michigan.



FRED L. SPAGNOLETTI

BSME '65

Rocketdyne offered Fred Spagnoletti a position right before graduation. His first assignment was at their test site in the Santa Susana Mountains in California, where he worked on the turbo pump for the F-1 rocket engine. It was the engine on the Apollo program Saturn V main booster rocket used on all manned missions to the moon. In 1972 he became a manager of engineering in the Turbine Support Division at Chromalloy American Corp, which worked with all the major airlines in the world. In 1979 Spagnoletti became president of the Turbine Support Division. He earned an MBA from The Ohio State University in 1980.

By 1993 his division had grown to five plants and 1,500 employees. He was general manager of Aero Component Technologies, president of the Chromalloy Compressor Technologies Group, which he also founded, and executive vice president of its parent company, Chromalloy Gas Turbine Corp.

After a 30-year career in aerospace, Spagnoletti began a second career, conducting health insurance research and studying human mind and memory processes, and authored a series of books on the subject. While working for Rocketdyne, Spagnoletti met his first wife, Fran, mother of his two daughters Patsy and Jane. He and his wife Gaye now reside in Dallas.

STEPHEN L. WILLIAMS

BSME '86

Stephen Williams started out at Cadillac Rubber & Plastics as a project engineer, and then moved to TRW Vehicle Safety Systems as a project engineer working on the first production airbag systems in many of Ford Motor Company's vehicles.

Williams is head of vehicle validation in Vehicle Sciences, Restraint Engineering and Virtual Analysis at Fiat Chrysler Automobiles (FCA). He joined Chrysler in 1990 as a project engineer in Vehicle Impact and Analysis, and two years later became a design engineer responsible for all Jeep and Truck driver airbag systems, including the first production driver airbag system in a sport utility vehicle. In late 2009 he was appointed vice president of innovation and pre-program concepts. As part of this role, he re-engineered Chrysler's advanced research funding and innovation processes. In 2010 Williams' role was expanded to include responsibility for engineering planning, regulatory affairs, and vehicle architecture.

A leader and mentor, he has sponsored 15+ Chrysler Institute of Engineering students and is now in charge of the program. Williams earned an MBA in finance and marketing in 1992 and a MS degree in mechanical engineering in 1996, both from Wayne State University. He resides in West Bloomfield Township, Michigan, with wife Lisa (BSME '88) and twin daughters, Libby and Becca.

ME-EM **ACADEMY MEMBERS**

* Only Michigan Tech degrees listed

FRANK AGOSTI
BSME 1958

CARL AVERS
BSME 1962

RICHARD BAYER
BSME 1944

JOHN M. BEATTIE
BSME 1963

WILFRED BOBIER
BSME 1943

JOHN CALDER
BSME 1967, MBA 1976

TIMOTHY COFFIELD
BSME 1984

JOHN COOK
BSME 1942

CHARLES CRETORS
BSME 1963

CHARLES CRONENWORTH
BSME 1944

ROBERT D'AMOUR
BSME 1948

DEAN DIVER
BSME 1965

JOHN DRAKE
BMSE 1964, MSBA 1969

JOHN T. EASTMAN SR.
BSME 1958

THEODORE EDWARDS
BSME 1950

PAUL FERNSTRUM
BSME 1965

EDWARD GAFFNEY
BSME 1951

JOSEPH GEMIGNANI
BSME 1953

DR. JAMES GERDEEN
BSME 1959

JOHN HALLQUIST
MSEM 1972,
PhD ME-EM 1974

DOUGLAS HAMAR
BSME 1984

WILLIAM HARTWICK
BSME 1948

GERALD HAYCOCK
BSME 1968

RALPH HAYDEN
BSME 1933

RAY HERNER
BSME 1954

COLLEEN JONES-CERVANTES
BSME 1983

DANIEL KAPP
BSME 1976

RAYMOND KAUPPILA
MSME 1960

PETE KNUDSON
BSME 1964

MARTIN LAGINA
BSME 1977

CHARLES LAMOREAUX
BSME 1956

CHARLES LAURILA
BSME 1959

GARY LAWREY
BSME 1979

CRAIG LAZZARI
BSME 1942

ALBERT MAKI
BSME 1948

PAUL MASINI
BSME/BBA 1969

TOM MCKIE
BSME 1947

FRED MITCHELL
BSME 1961

BOB MONICA
BSME 1950

TOM MOORE
BSME 1966

LAWRENCE MULHOLLAND
BSME 1955

ERIC NIELSEN
BSME 1980

MERLE POTTER
BSME 1958, MSEM 1961

NORMAN PRATT
BSME 1942

ANTHONY RAIMONDO
BSME 1962

KAMLAKAR RAJURKAR
MSME 1978, PhD 1981

JACK REAL
BSME 1939

JAMES REUM
BSME 1953

DAN RIVARD
BSME 1959

RICHARD ROBBINS
BSME 1956

DALE ROBERTO
BSME 1969

PAUL D. ROGERS
BSME 1988, PhD 2004

VIJAY SAZAWAL
PhD 1975

HAROLD SCHOCK
BSME 1974, PhD EM 1979

FRED SHERRIFF
BSME 1963

JAMES SORENSON
BSME 1960, MSEM 1961

FRED SPAGNOLETTI
BSME 1965

JAMES STONE
BSME 1940

MARTHA SULLIVAN
BSME 1980

PAUL SWIFT
BSME 1933

MAURICE TAYLOR
BSME 1968

CAMIEL THORREZ
BSME 1970

ROBERT THRESHER
BSME 1962, MSME 1967

RAYMOND TREWHELLA
BSME 1956

WILLIAM TURUNEN
BSME 1939

JAMES VORHES
BSME 1947

THOMAS WALKER
BSME 1968

DONALD WHEATLEY
BSME 1962, MSME 1963

HAROLD WIENS
BSME 1968

STEPHEN WILLIAMS
BSME 1986

DR. TERRY WOYCHOWSKI
BSME 1978

HUSSEIN ZBIB
BSME 1981, MSME 1983,
PhD 1987

ME-EM **PCA MEMBERS**

ME-EM **PCA MEMBERS** (as of fall 2016)

The Presidential Council of Alumnae (PCA) at Michigan Tech recognizes successful Michigan Tech women graduates for their educational excellence, past student service, professional accomplishments, and community contributions.

Mary Barker
Elzbieta Berak
Diana Brehob
Margaret Cobb
Nancy Cragel
Laura Farrelly
Mary Fisher
Kathy Grisdela
Cynthia Hodges
Sabina Houle
Susan Jesse
Colleen Jones-Cervantes
Tanya Klain (deceased)
Pamela Klyn
Rose Koronkiewicz
Wendy Kram
Merrily Madero
Melissa Marszalek
Christine Roberts
Jillian Rothe
Lee Ann Rouse
Sylvia Salahutdin
Sandra Skinner
Sheryl Sorby
Martha Sullivan
Judy Swann
Susan Trahan
Kimberly Turner
Rebecca Ufkes
Paula Zenner

ME-EM **EAB**

The External Advisory Board (EAB) is a select group of corporate, university, and government leaders, many of whom are alumni. EAB members share their expertise and provide assistance with curriculum direction, research, topics, resource development, and education-industry partnership. They offer professional insight and provide valuable input, shaping the state-of-the art engineering education that takes place in the ME-EM Department. Members can serve a maximum of two four-year terms.

JOHN ADAMS
Calpine Corporation

DR. KIRBY BAUMGARD
John Deere

BRETT CHOUINARD
Altair Engineering

MICHAEL DAVENPORT
US Steel

BRIAN DEMOS
American Axle & Mfg.

CHRISTOPHER DUKE
Fiat Chrysler Automobiles

ALEXA ELLSWOOD
General Motors

ALAN FRANK
Ford Motor Company

JAMES HELDT
Mercury Marine

COLLEEN JONES-CERVANTES
Chevron Corp

DR. SHASHI KARNA
US Army Research Laboratory

DR. FRANK LEBAN
Naval Surface Warfare Center

JOHN LEINONEN
Exponent

LEAH LEMANSKI
Nexteer Automotive Corporation

JASON MAES
Stryker Corporation

JASON MAKELA
Aerojet Rocketdyne

KEVIN MANOR
Toyota Motor Sales

MELISSA MARSZALEK
Boeing

MARK MATSCO
Covestro

BRENDA MOYER
Dana Corporation

SETH NEWLIN
Oshkosh Corporation

CHRISTOPHER OBERSKI
Ford Motor Co.

CHRISTINE ROBERTS
Motorola

DR. PAUL ROGERS
US Army

PETER SANDRETTO
Fiat Chrysler Automobiles

JENNIFER TRICE
3M Corporation

JASON VERBOOMEN
Kimberly-Clark

WILLIAM SCHELL
Caterpillar Inc.

PAUL WICZYNSKI
Cummins Inc.

BRIAN WITT
Ariens Company

JEFF ZAWISZA
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Donors are critical to the success of the Department of Mechanical Engineering-Engineering Mechanics. Please consider directing your donation to the ME-EM Department Building for the Future, Phase II, Endowing Excellence Fund using the enclosed self-addressed envelope. Every gift counts and will be used to make a difference in the education of our students.

The following list encompasses the many people who have generously shared their treasure to create an outstanding ME-EM Department. We are extremely grateful for their ongoing support. Those contributing from May 1, 2015 to July 31, 2016 are listed below. This year, the company-matching gifts are included with the individual gift.

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"Since Michigan Tech played such a big role in our success, it is a no-brainer to help the new generation."

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Greater Houston Community Foundation
High Sierra Snow Removal
Honeywell International Charity Matching
KAM Plastics Corporation
Magline
Marathon Petroleum Company LP
Morley Foundation
Mosaic Global Sales LLC

$500–$999
FCA US LLC
Milwaukee Electric Tool Corporation
Vanguard Charitable End Program

$100–$499
Beach & Associates LLC
Benevity Community Impact Fund
DJ Strauss Enterprises
J & R Tool
Quality Lubrication & Oil Change Centers

HENES DONATES $2 MILLION TO MECHANICAL ENGINEERING

"Liz and I decided to invest our resources in what will help the world, and Michigan Tech was our choice."

—ELIZABETH AND RICHARD HENES ME '48
Founder of Henes Manufacturing Company and Henes Products Company

Richard Henes, a 1948 ME graduate of Michigan Tech, donated $2 million to the Department of Mechanical Engineering-Engineering Mechanics (ME-EM). Henes' gift, made in August 2015, will be used to fund an endowed faculty position, and for faculty/department development and student development.

Calling Henes and his late wife Elizabeth "the most generous donors and long time supporters," ME-EM Department Chair William Predebon said this latest gift continues Henes' history of philanthropy to ME-EM.

"After Liz died a few years ago, Dick continued his support," Predebon said. "He keeps up to date on the latest technological developments and wants to make a difference in the world. He believes that ME-EM and Michigan Tech can be a part of those advances and wants to help through his support."

Predebon said Henes has supported several endowed faculty chairs and professorships in ME-EM and understands the importance of attracting and retaining quality faculty, which endowed positions make possible.

"He also funded scholarships and wants to help students who lack the resources but are motivated and hardworking," Predebon said. Over the years, the Henes have established endowed scholarships for students in mechanical, computer, electrical, and chemical engineering.

In addition to his gift to the ME-EM Department, last September Henes donated $2 million to establish The Elizabeth and Richard Henes Center for Quantum Phenomena within the Department of Physics.

A native of Menominee, Richard Henes graduated from Michigan Tech in 1948 with a bachelor's degree in mechanical engineering and went on to earn a law degree from the University of Michigan. In the late 1950s, he moved to Arizona and established what was to become the Henes Manufacturing Company, Henes Products, and Henes Stamping. He also became a successful real estate investor in Phoenix.

Predebon said the Henes' generosity will long be remembered. "The faculty, students, and staff of the ME-EM Department will be forever grateful and humbled by the support of Dick and Liz Henes."

ADVANCED POWER SYSTEMS $5,506,048

TITLE	NAME	SPONSOR	AWARD
MTU Consortium in Diesel Engine Aftertreatment Research	PI: John Johnson Co-PI: Jeffrey Naber, Gordon Parker	John Deere, Cummins, Diamler Detroit Diesel, Johnson Matthey, Corning, Tenneco, Isuzu	$1,055,848
Characterization of Torque Converter Cavitation Level during Speed Ratio Operation—Year 3	PI: Jason Blough Co-PI: Carl Anderson, Mark Johnson (School of Technology)	General Motors Corporation	$93,837
Chrysler Spray Test	PI: Jeffrey Naber Co-PI: Seong-Young Lee, Jaclyn Johnson	Chrysler Group, LLC	$234,847
Mineral Removal from Biocoal Produced from Municipal Solid Waste (MSW)	PI: William Predebon Co-PI: John Diebel (Innovation and Industry Engagement)	Treamin Energy, Inc.	$67,500
Evaporation Sub-Model Development for Volume of Fluid (eVOF) Method Applicable to Spray-Wall Interaction Including Film Characteristics with Validation at High Pressure/Temperature Conditions	PI: Seong-Young Lee Co-PI: Jeffrey Naber	US Dept of Energy: Office of Energy Efficiency and Renewable Energy	$655,159
Rapid Screening with Paddle Fast Pyrolysis Systems	PI: Ezra Bar-Ziv	Battelle Energy Alliance, LLC	$99,995
The Impact of Valve Timing on Intake Manifold Charge Temperature	PI: Jeremy Worm Co-PI: Jeffrey Naber	Infrared Telemetrics	$12,563
High Brake Mean Effective Pressure (BMEP) and High Efficiency Micro-Pilot Ignition Natural Gas Engine	PI: Jeffrey Naber	Westport Power, Inc.	$137,905
Continued Development of a Robust Igniter for Methane Fueled SI Engines	PI: Jeremy Worm	E3 Spark Plugs	$60,000
Fixtures for Light Duty Injector and Integration, Drive Setup, and Validation	PI: Jeffrey Naber Co-PI: Henry Schmidt	Aramco Services Co.	$38,000
Interactive Demonstration of Automotive HVAC Manikin System Coupled with Radtherm	PI: Jeremy Worm Co-PI: Henry Schmidt	Thermetrics	$11,830
John Deere: Bosch G4 CR Injector Spray Characterization	PI: Jeffrey Naber Co-PI: Seong Young Lee, Henry Schmidt	John Deere	$86,343
Development of a High BMEP SI Engine and Determination of Combustion Knock Mitigation via Water Injection	PI: Jeremy Worm Co-PI: Jeffrey Naber	Nostrum Energy, LLC	$189,014
Injector Evaluation and Characterization on Mahle Optical Single Cylinder DI SI Engine	PI: Jeffrey Naber Co-PI: Mahdi Shahbakhti, Paul Dice	Nostrum Energy, LLC	$63,477
Support of NIDays Chicago 2015 with the Michigan Tech Mobile Lab	PI: Jeremy Worm	National Instruments	$7,022
Development of Dynamic Torsional Measurement Capability using Hybrid Electric Motor	PI: Jason Blough Co-PI: Wayne Weaver (Elec. & Computer Engineering)	General Motors Corporation	$94,845

ADVANCED POWER SYSTEMS (cont'd) $5,506,048

TITLE	NAME	SPONSOR	AWARD
Closed Loop Combustion Control (CLCC) for SI Engines	PI: Jeffrey Naber Co-PI: Bo Chen	Ford Motor Company	$89,317
Continuation of Engine Ignition Studies	PI: Jeffrey Naber Co-PI: Seong Young Lee, Mahdi Shahbakhti	Ford Motor Company	$115,000
Delivery of Hands-On Professional Development Courses in Diesel Engine Systems	PI: Jeremy Worm Co-PI: Jeffrey Naber, Chris Morgan	John Deere & Co.	$84,858
Investigations of Fuel Injection Systems - Fundamental Nozzle Cavitation Studies	PI: Jeffrey Naber Co-PI: Youngchul Ra, Henry Schmidt	Cummins, Inc.	$96,806
Injector Evaluation and Validation on a Single Cylinder DI SI Engine with Combustion Analysis, Exhaust Gaseous and PN Emissions	PI: Jeffrey Naber Co-PI: Paul Dice	Nostrum Energy, LLC	$187,711
Engine Dynamometer Studies and Analysis of Nostrum Cycle and Injectors on Cummins 6.7 ISB Diesel Engine with Facilities for Nostrum On-Site Engineering Team	PI: Jeffrey Naber Co-PI: Paul Dice	Nostrum Energy, LLC	$129,215
The Impact of Fuel Properties on Ignition Delay in a Compression Ignition Engine	PI: Jeremy Worm Co-PI: Jeffrey Naber	VP Racing Fuels	$10,604
High BMEP and High Efficiency Micro-Pilot Ignition Natural Gas Engine	PI: Jeffrey Naber	US Department of Energy: National Energy Technology Laboratory	$1,229,000
Tailorable Resonant Plate Testing	PI: Jason Blough Co-PI: Charles Van Karsen, James DeClerck	Honeywell Federal Manufacturing & Technologies, LLC	$65,000
Investigation of Ignition Performance of Hitachi Coils for PFI Natural Gas Fueled Engine on a Single Cylinder, Boosted, Spark-Ignition Engine	PI: Jeffrey Naber Co-PI: Mahdi Shahbakhti, Paul Dice	Hitachi America, LTD	$42,500
Ignition System Characterization for Chrysler	PI: Jeffrey Naber Co-PI: Seong Young Lee, Henry Schmidt, Jaclyn Johnson	Fiat Chrysler, FCA US LLC	$84,695
Development of Advanced Modeling Tools for Diesel Engines	PI: Youngchul Ra	Korea Institute of Machinery and Materials	$177,916
Delivery of Hands-On Professional Development Courses	PI: Jeremy Worm Co-PI: Christopher Morgan	BorgWarner Inc.	$37,000
Testing of a Natural Gas Combined Heat and Power (NG CHP) System for Leidos Engineering	PI: Jeffrey Naber Co-PI: Scott Miers, Paul Dice	Leidos Engineering, LLC	$107,380
Natural Gas Research with Argonne National Laboratory	PI: Scott Miers	Argonne National Laboratory	$108,932
Analysis, Implementation and Evaluation of Stochastic Knock	PI: Jeffrey Naber	Honda Performance Development Inc.	$31,929

AGILE INTERCONNECTED MICROGRIDS $4,398,725

TITLE	NAME	SPONSOR	AWARD
Distributed Agent-Based Management of Agile Microgrids	PI: Gordon Parker; Co-PI: Wayne Weaver (Electrical & Computer Engineering), Laura Brown (Computer Science), Steve Goldsmith	US Department of Defense, Army Research Laboratory	$1,907,135
Advanced Control and Energy Storage Architectures for Microgrids	PI: Wayne Weaver (Electrical & Computer Engineering) Co-PI: Ossama Abdelkhalik	Sandia National Laboratory	$120,503
Support of RMCP Phase II SBIR	PI: Jason Blough	Quantum Engineering	$72,500
JHSV Crane Requirements Review	PI: Gordon Parker	Craft Engineering Associates	$10,330
On Integrating New Capability into Coastal Energy Conversion Systems	PI: Ossama Abdelkhalik Co-PI: Rush Robinett	South Dakota School of Mines & Technology	$405,139
Collaborative Research: On Making Wave Energy an Economical and Reliable Power Source for Ocean Measurement Applications	PI: Ossama Abdelkhalik Co-PI: Rush Robinett	National Science Foundation	$132,541
Autonomous Microgrids: Theory, Control, Flexibility and Scalability	PI: Wayne Weaver (Electrical & Computer Engineering); Co-PI: Rush Robinett, Nina Mahmoudian	US Department of Defense, Office of Naval Research	$869,980
Collaborative Research: CRISP Type 2: Revolution through Evolution: A Controls Approach to Improve How Society Interacts with Electricity	PI: Laura Brown (Computer Science) Co-PI: Ten Chee-Wooi (Electrical & Computer Engineering), Wayne Weaver (Electrical & Computer Engineering)	National Science Foundation	$699,796
Unstable and Pulse Load Control Designs for Nabal Electrical Systems	PI: Wayne Weaver (Elec. & Computer Engineering)	Sandia National Laboratory	$110,801
Distributed and Decentralized Control of Aircraft Energy Systems	PI: Wayne Weaver (Electrical & Computer Engineering)	Infoscitex Corporation	$70,000

ENGINEERING EDUCATION INNOVATION $756,893

TITLE	NAME	SPONSOR	AWARD
Senior Design: AFRL Design Challenge Project Sequence	PI: William Endres	Technology Service Corporation	$59,478
Fuze Testing Capability Development	PI: William Endres	Air Force Research Lab	$332,172
Senior Design: Driveline NVH Improvement	PI: William Endres	Ford Motor Company	$25,650
Senior Design: Axial Worm Gear Damper Design	PI: William Endres	Nexteer Automotive	$26,765
Senior Design: Pallet Cleaning System	PI: William Endres	Fiat Chrysler, FCA US LLC	$26,765

ENGINEERING EDUCATION INNOVATION (cont'd) $756,893

TITLE	NAME	SPONSOR	AWARD
Senior Design: Jeep Wrangler Direct Air Exhauster	PI: William Endres	Fiat Chrysler, FCA US LLC	$26,765
Senior Design: Bolt Feeding System	PI: William Endres	Fiat Chrysler, FCA US LLC	$26,765
Senior Design: Agricultural Tractor Three-Point Hitch Load Measurement System	PI: William Endres	John Deere Product Engineering Center	$25,650
Senior Design: Titanium Tow Hook for an SUV	PI: William Endres	Fiat Chrysler, FCA US LLC	$26,765
Senior Design: Piezoelectric Bone Sculptor - Phase 2	PI: William Endres	Stryker Instruments NSE	$24,535
Senior Design: High Speed Drill-Cutting Accessory Collet Design	PI: William Endres	Stryker Instruments NSE	$24,535
Senior Design: Surgical Power Tool Hub Interface	PI: William Endres	Stryker Instruments	$24,535
Senior Design: Flywheel Balance Measurement System	PI: William Endres	Mercury Marine	$25,650
Senior Design: Automated Seat Test System	PI: William Endres	Magna Seating (Detroit)	$30,780
Senior Design: Tailorable Resonant Plate Testing	PI: William Endres Co-PI: James DeClerck	Honeywell Federal Manufacturing & Technologies, LLC	$24,433
Senior Design: Bobcat Track Installation and Removal Tool	PI: William Endres	Bobcat Co.	$25,650

MULTISCALE TECHNOLOGIES INSTITUTE $830,769

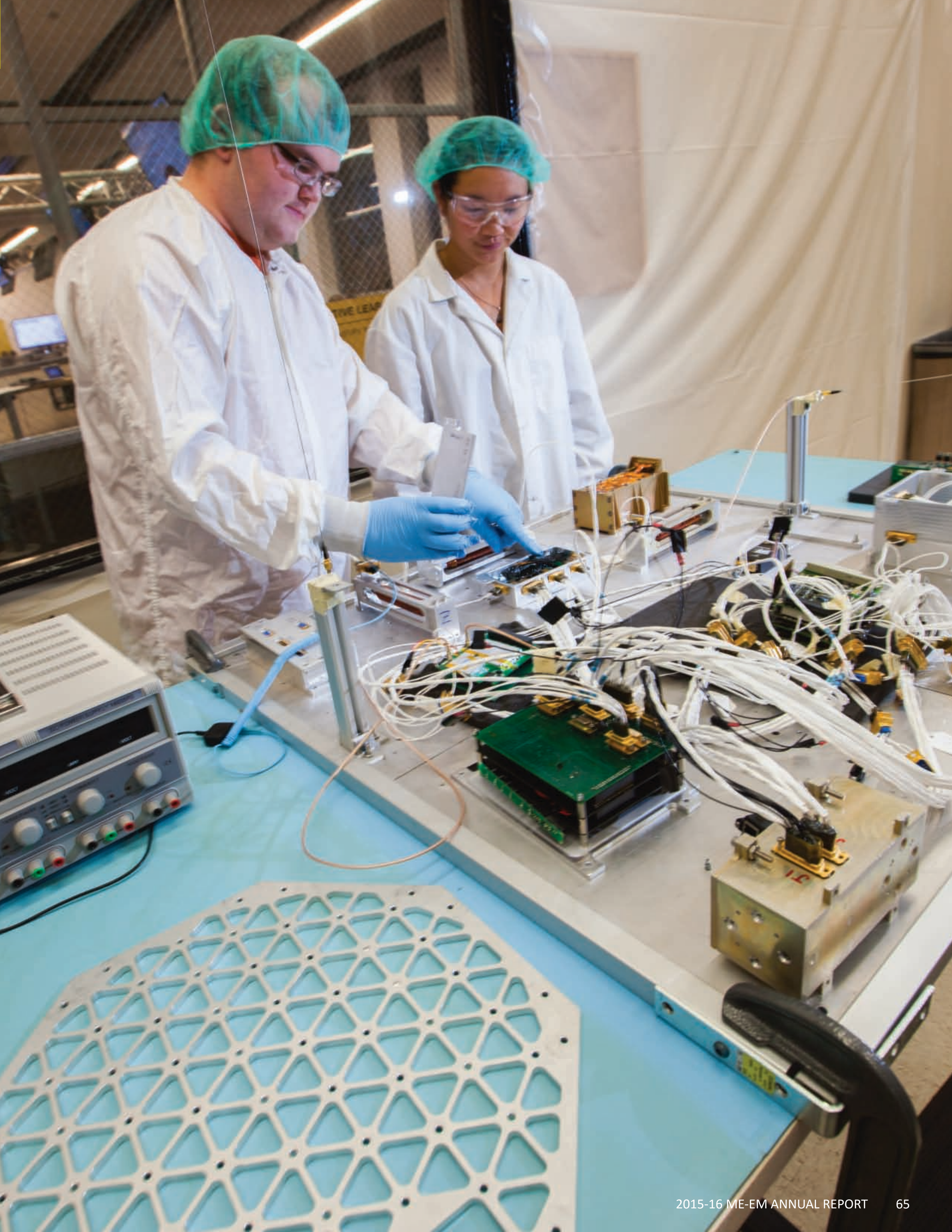
TITLE	NAME	SPONSOR	AWARD
I/UCRC: Novel High Voltage/Temperature Materials and Structures	PI: Gregory Odegard	National Science Foundation	$637,495
In Situ Liquid Microscopy of Biological Materials	PI: Craig Friedrich	Pacific Northwest National Laboratory	$91,586
I/UCRC: Novel High Voltage/Temperature Materials and Structures	PI: Gregory Odegard; Co-PI: Julia King (Chemical Engineering)	Boeing	$49,636
I/UCRC: Novel High Voltage/Temperature Materials and Structures	PI: Gregory Odegard Co-PI: Paul Sanders (Materials Science & Engineering)	General Cable	$52,052

SPACE SYSTEMS $1,137,447

TITLE	NAME	SPONSOR	AWARD
Electrospray from Magneto-Electrostatic Instabilities	PI: L. Brad King	US Department of Defense, Air Force Office of Scientific Research	$770,578
Stratus, a NASA CubeSat, and the Utilization of Effective Project Management to Enhance Student Learning	PI: L. Brad King Co-PI: Sam Baxendale	University of Michigan - Michigan Space Grant Consortium	$2,500
Stratus: A CubeSat to Measure Cloud Structure and Winds	PI: L. Brad King Co-PI: Ossama Abdelkhalik, Michael Roggeman (Electrical & Computer Engineering) in conjunction with the Center for Leadership and Innovation for Transformation (LIFT)	National Aeronautics and Space Administration	$232,692
Auris: A CubeSat to Characterize and Locate Geostationary Communication Emitters	PI: L. Brad King Co-PI: Ossama Abdelkhalik, Michael Roggeman (Electrical & Computer Engineering) in conjunction with the Center for Leadership and Innovation for Transformation (LIFT)	Utah State University Research Foundation, Space Dynamics Laboratory	$131,677

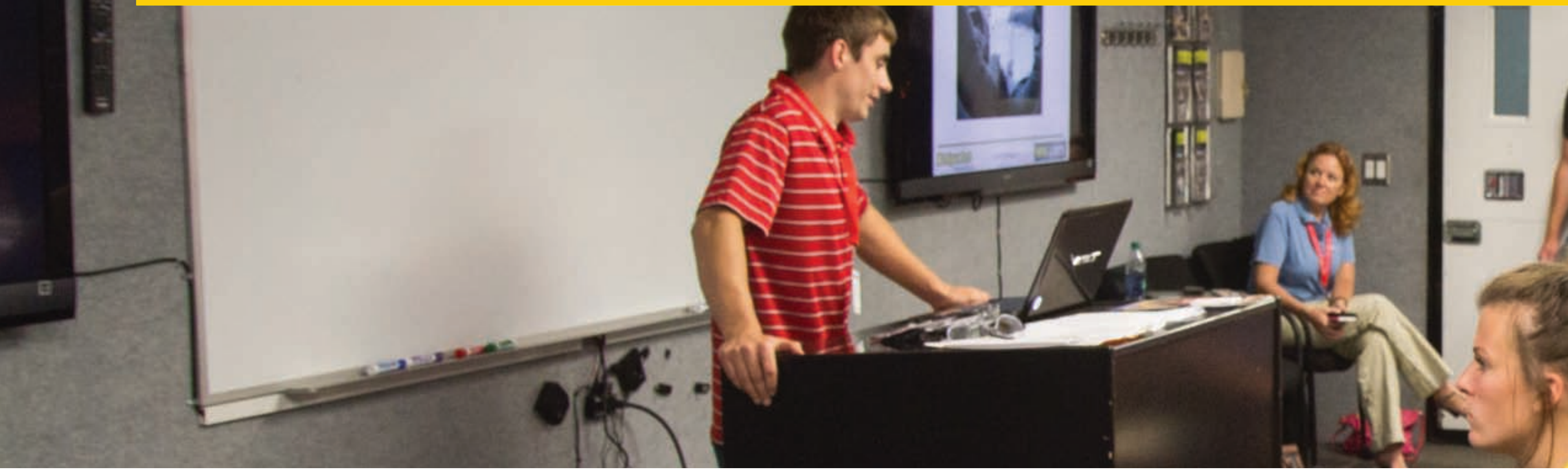
ADDITIONAL RESEARCH TOPICS $2,028,549

TITLE	NAME	SPONSOR	AWARD
CAREER: Autonomous Underwater Power Distribution System for Continuous Operation	PI: Nina Mahmoudian in conjunction with the Great Lakes Research Center (GLRC)	National Science Foundation	$681,124
Suspended Floor Material Testing	PI: Andrew Barnard	ACG Materials	$22,188
Sound Power Measurement System for Fire Protection Systems	PI: Andrew Barnard	Tyco Fire Protection Products	$28,352
Toward Undersea Persistence	PI: Nina Mahmoudian in conjunction with the Great Lakes Research Center (GLRC)	US Department of Defense: Office of Naval Research	$652,931
Developing a Talent Pipeline: Inspiring Future Naval Engineers and Scientists using Real-World Project Based Instruction	PI: Andrew Barnard Co-PI: Nina Mahmoudian, Guy Meadows in conjunction with the Great Lakes Research Center (GLRC)	US Department of Defense: Office of Naval Research	$643,954



ME-EM **PATENTS & PUBLICATIONS**

This includes books and journal articles published from **May 1, 2015 to April 30, 2016.**



NOTE: Bold text indicates ME-EM faculty members and *italicized text* indicates current and past ME-EM students.

PATENTS

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