ME-EM

MECHANICAL ENGINEERING — ENGINEERING MECHANICS

2014-15 ANNUAL REPORT

Human-Centered ENGINEERING

Michigan Tech

Human-Centered **ENGINEERING**

Mechanical engineers create products and processes that help humankind. Our strong desire to help people brings us together and fuels our motivation to solve the world's most challenging problems in meaningful ways.

At Michigan Tech, our relationship with the automotive industry is long-standing (over 100 years), positive, and strong. In this Annual Report, we present this productive, multifaceted relationship through three lenses. First, we explore vehicle electrification and our collective influence on drivers, infrastructure planning, and the environment. Next, we share the various ways our curriculum and alumni inform our programs, and how they impact future automotive engineers. Finally, we profile researchers and graduates who are connected to the racing industry. The engineering achievements in racing generate rapid innovations that cascade into consumer products.

The advanced aerodynamics, materials, and safety features developed in racing have a direct influence on the cars we drive every day, bringing human-centered engineering in the automotive industry full circle. While the focus here is on the automotive industry, it is important to note that we have graduates working in every field. The courses and research opportunities we provide to students—from simulation to controls—prepare them to hit the ground running in any industry.

In this report I am equally proud to feature the awards and nominations received by our ME-EM faculty and staff, and we welcomed several new members to our human-centered endeavors. Our aspirations require widespread support. We directly experience the impact of the individuals and industries with whom we engage, including multidisciplinary researchers, alumni, and donors. To these many partners, I would like to express the gratitude shared by our students, faculty, and staff. I look forward to reporting on the many future innovations that are just ideas in the minds of our present and future engineers.

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

ON THE COVER

Reagan May, a senior studying mechanical engineering, drives the Coleman Racing Products #33 car following her dreams to become a NASCAR driver or work as an engineer with a top-tier team.

Cover photo: © Vincent Alonzo Photography

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ME-EM **RESEARCH**

Research in the ME-EM Department continues to develop favorably as our faculty members secure innovative research opportunities and draw in qualified graduate students, producing leaders in the field. Our expenditures have remained stable, allowing us to consolidate recent gains and lay plans for future expansion.

A growth area for this year, in both small and large applications, is managing energy usage with microgrids. Through the Center for Agile and Interconnected Microgrids (AIM), Dr. Nina Mahmoudian has expanded opportunities in underwater microgrids, integrating collective controls when operating multiple agents simultaneously. By using nonlinear control and stochastic analysis, her team has achieved energy-efficient motion control strategies in uncertain underwater environments.

Underwater microgrids are being leveraged on the energy production side to improve wave energy generation. Led by Dr. Ossama Abdelkhalik, optimization support through dynamic programming is being provided to assist design and analysis for real-time implementation.

Another new area of research in optimization is HVAC building controls for energy efficiency. Dr. Mahdi Shahbakhti's research in energy system management utilizes advanced control techniques applied to thermodynamic systems, with the goal of optimizing the overall exergy. Some building designs are targeted to result in a net positive energy balance—producing more power than consumed.

The expansion of our research in two established centers, AIM and the Advanced Power Systems Laboratory (APS LABS), continues to increase engagement with national laboratories and other partners. As a result, we have expanded our graduate program, involving our PhD and Master's degree-seeking students in the research effort.

RANKINGS

American Society for Engineering Education

- 23rd in BSME degrees awarded, 8th in BSME enrollment
- 8th in MSME degrees awarded, 11th in MSME enrollment
- 30th in PhD degrees awarded, 26th in PhD enrollment

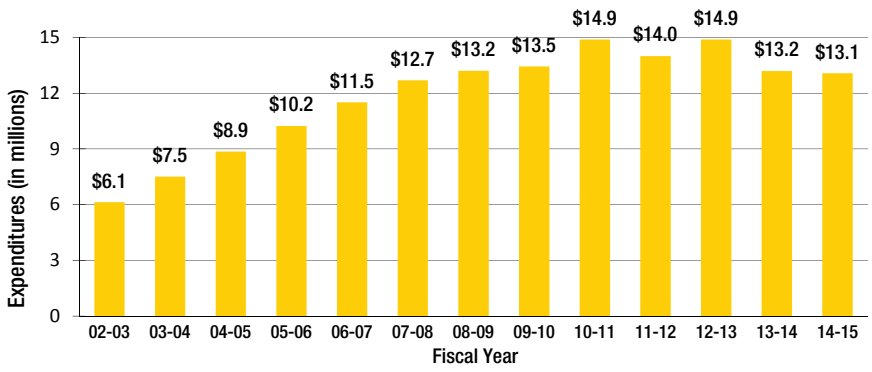
National Science Foundation

20th in research expenditures ($14.79 million) among all mechanical research in the US.

US News & World Report America's Best Graduate Schools

53rd among the top 177 (top 30%) doctoral-granting ME departments.

ME-EM RESEARCH EXPENDITURES: 2002-2015



Note: The research expenditures are sometimes an estimate at the time of publication and, if needed, are corrected in the following year's annual report.

CONTENTS

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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Dr. Gregory M. Odegard
Associate Chair & Director of Undergraduate Studies

Paula F. Zenner, MS
Director of Operations & Finance

Dr. Rush D. Robinett
Research Director

Dr. William W. Predebon
The J.S. Endowed Department Chair & Professor

Human-Centered ENGINEERING

ELECTRIFICATION

THE TRANSPORTATION INDUSTRY FACES INCREASING CHALLENGES

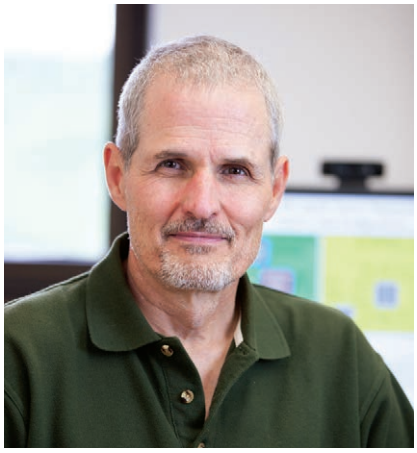
as government agencies push for reduced emissions and the utilization of renewable resources. The development of hybrid electric technology and vehicle-to-grid integration is central to the emerging low-carbon economy and among the many ways our faculty and alumni impact the world through human-centered engineering.

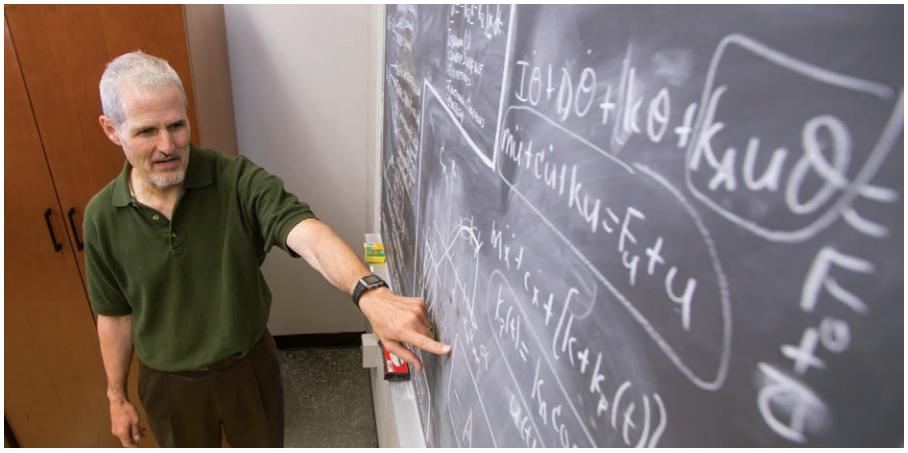
FEATURED ALUMNI

- Doug Parks '84
- Martha Sullivan '85

ELECTRIFICATION

THE SEMI-REVERSIBLE PROCESS CREATED THROUGH ELECTRIFICATION IS A PORTABLE AND VERSATILE OPTION FOR VEHICLES ON THE ROAD TODAY.





"Because of the microgrid research being conducted at Michigan Tech and Sandia National Laboratories, the director of the Navy's all-electric ship program came to our teams saying, 'You need a first adopter for your technology,' and 'You are solving a problem we need solved.' Although we're a new participant in a program that's been running for 25 years, we are a trusted partner."

—DR. RUSH ROBINETT

ME-EM: BY THE NUMBERS

8th

IN BSME ENROLLMENT
according to the American Society for Engineering Education.

Electrification Optimization & Controls

The agent-based control models developed through the intercollege research team AIM (Agile and Interconnected Microgrids) have been applied to military HEVs to securely manage energy flow. Now these agent-based control optimization schemes are being extended beyond terrestrial transportation to seagoing and air-going microgrids, including those used by the US Navy.

The electrification of naval vessels requires a fully-integrated system to store and distribute energy across the ship, from the propulsion system to the weaponry. Control schemes and security protocols are being developed by researchers like Dr. Rush Robinett for the Navy's all-electric ship program. These novel technologies are critical to future defense by providing an alternative to rocket-fueled missiles, canons, and machine guns. Electric weapons, such as lasers, high energy radar, and rail guns generate high-level fire power at a fraction of the traditional cost, leaving gun powder and missiles behind. Furthermore, electric actuators and electromagnetic drives are replacing traditional hydraulic systems and even aircraft launch catapults.

Optimization is a critical feature to manage these highly transient power demands and to maximize performance while minimizing the overall space and weight of the energy storage systems. Optimal usage by each system ensures the requirements of the ship are met through load balancing. The control schemes developed by Robinett and other Michigan Tech researchers incorporate agent-based systems to govern the demand-response behavior, relative to the people on the ship, ensuring the system communicates effectively. The top-of-the-line technology used on the naval vessel to provide power to components across the ship is revolutionizing the US defense systems.

"Developing mitigation strategies for cyberattacks on vehicle-to-vehicle networks alongside Dr. Steven Goldsmith and Robert Jane has been a challenge, but is something that will benefit the industry greatly."

—DR. GORDON PARKER

Secure Power Management

The intelligent communication between devices,homes, and electric cars opens a new front in the battle for cybersecurity. When a vehicle is connected to the grid, energy is passed from the grid to the vehicle, along with user information and demand-response system data.

Agile and Interconnected Microgrid (AIM) researchers at Michigan Tech, including Dr. Gordon Parker, are developing secure, intelligent management protocols that will be implemented during power shortages, allowing appliances and vehicles on the grid to communicate with each other and the main power grid. This can be visualized as a group of networked laptops sharing their battery power as well as their data. Such advanced communication will optimize power to prioritized resources, while monitoring grid communication practices for emerging interoperability standards for cybersecurity.

The agent-oriented controls being developed will help the grid system harmonize its power sharing through negotiations between devices in a secure manner. With the increasing popularity of microgrid-based systems, a safe and secure form of communication needs to be established to promote business confidentiality, privacy, and civil liberties.

Education in Power Systems

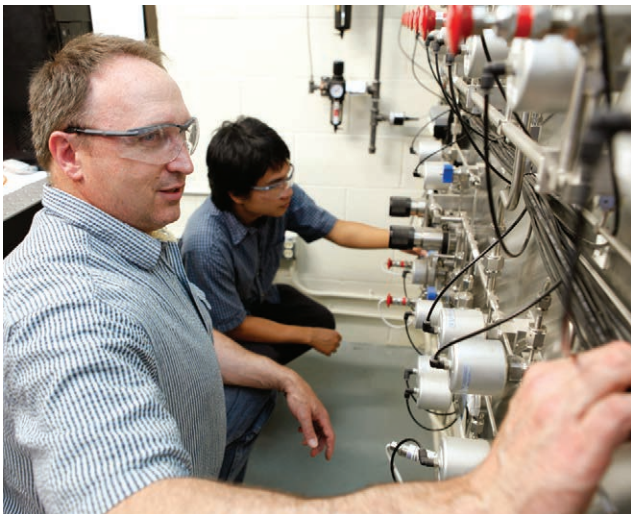
Finding a pathway to reduce the heavy dependence on fossil fuels through alternative fuel options can widen opportunities in automotive and heavy-duty vehicle industries.

For example, not all countries have equal access to the same grades of gasoline or diesel, yet the widening of transportation into developing countries demands new technology to maintain performance.

The Advanced Power Systems Labs (APS LABS) at Michigan Tech, under the direction of Dr. Jeff Naber, partners with industry and federal agencies focused on improving utilization and/or replacing fossil fuels for both electric power generation and transportation. Naber's work with industry on the development of new fuel systems for natural gas applications and advanced combustion and control systems directly impacts the industry.

His research at APS LABS is inherently dual-focused, educating engineers in the field through hands-on short courses, training future engineers in the classroom at Michigan Tech, and impacting young minds through K-12 outreach programs with the Michigan Tech Mobile Lab.

Read more at
apslabs.me.mtu.edu



"Within the APS LABS team we continue to co-develop technologies including novel injectors and closed loop combustion control with our industrial partners. Our goal is to improve engine efficiency and lower emissions with respect to varying fuel properties and alternative fuels, so that future engines will continuously adapt."

—DR. JEFF NABER

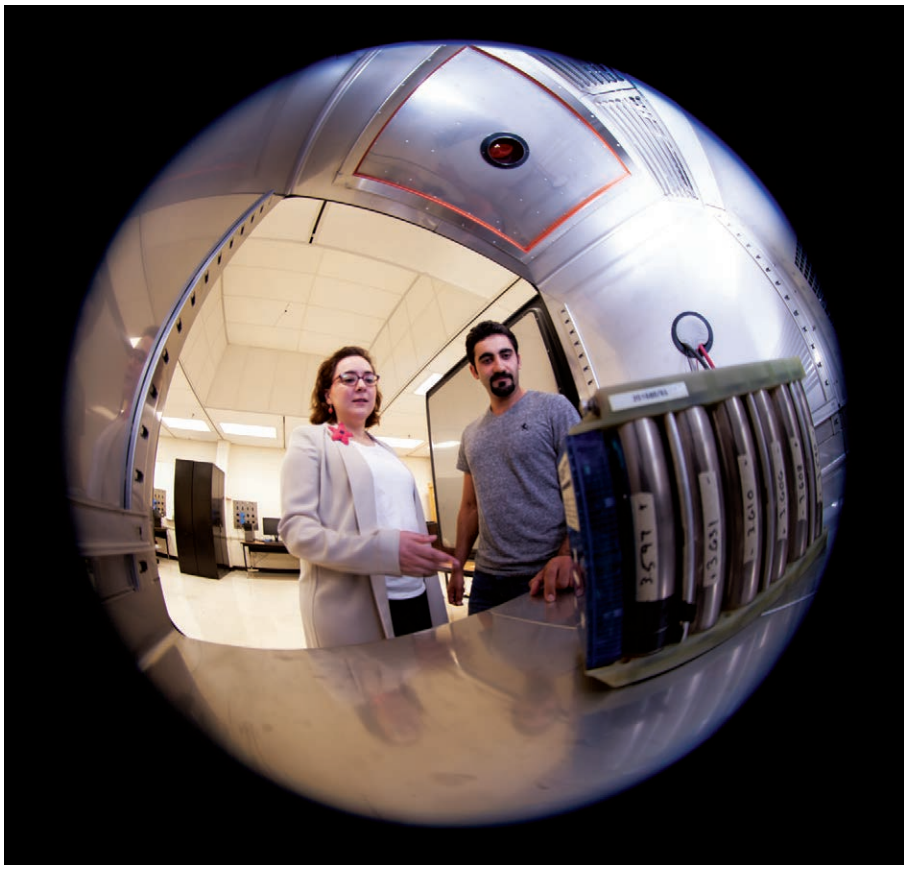
ELECTRIFICATION

"We have just completed the analysis of large-data, real-world driving cycles in collaboration with Dr. Kuilin Zhang (Civil and Environmental Engineering) and with the support of the REF Seed Fund. We have obtained interesting results about the effect of traffic flow and driver behavior on battery aging for electric vehicles."

—DR. LUCIA GAUCHIA

ME-EM: BY THE NUMBERS

2 **ONLINE LEARNING OPTIONS** for masters and PhD degrees.



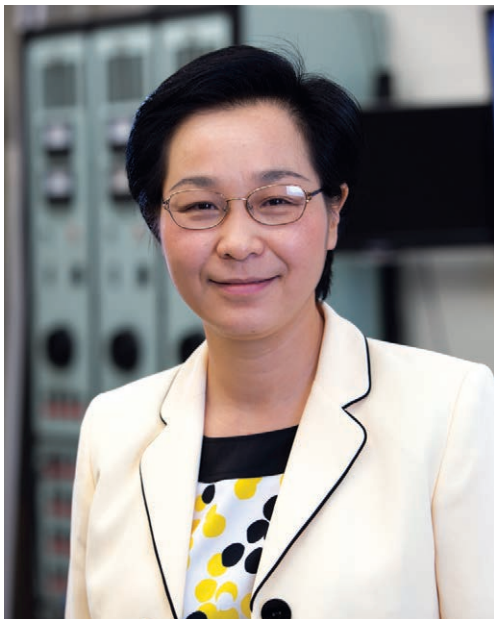
Cost-Effective Power Source

Consumers across the country are turning to electric and hybrid electric vehicles. Research in this area conducted at Michigan Tech is impacting technological enhancements across the automotive industry.

While electric vehicles are already on the market today, much of the technology is still emerging. Extensive research is being conducted by Dr. Lucia Gauchia to mature the technology through analysis of a battery's life, operation, power, and density, while ensuring it remains cost effective.

As consumers turn to hybrids for lower greenhouse gas emissions, higher efficiency, and reduced dependency on petroleum, optimized energy storage will make hybrids attractive to a growing segment of the market.

Gauchia also analyzes the systems for safety, environmental issues, and cost—all of which impact the growth of vehicle electrification across the country.



"It has been exciting to explore the impact of vehicle integration with the grid—taking power from the grid, and providing power back to it."

—DR. BO CHEN

Vehicle Power-Up

Beyond hybrid electric vehicles, consumers are also utilizing plug-in electric vehicles (PEVs) as an alternative to reduce their carbon footprint. To help ensure consumers turn to these environmentally-friendly options, Dr. Bo Chen is exploring ways to extend the battery life for PEVs, to increase their range and economic appeal to consumers.

In addition to PEV research, her team has been developing a physics-based Li-ion battery model for integration into a hybrid electric vehicle simulation system. This system allows Chen and her team to analyze HEV systems through hardware-in-the-loop simulation to create health conscious battery control algorithms and measure real vehicle battery charge and discharge profiles under a range of temperature conditions.

While reducing the automotive industry's dependence on fossil fuels, Chen and other researchers at Michigan Tech are optimizing performance and improving battery life to make HEVs and PEVs a driving force in the low-carbon economy.

ME-EM: BY THE NUMBERS

35+ **INDUSTRY-SPONSORED SENIOR DESIGN PROJECTS** active and new each year.

ELECTRIFICATION

"Inventing a new category of transportation, Extended Range Electric Vehicles, with some of the most satisfied owners in the industry makes me proud. I'm excited for customers to experience the all-new, second-generation Volt!"

—DOUG PARKS

BY THE NUMBERS

93 mpg

ESTIMATED FUEL ECONOMY
of the all-electric Chevy Volt.

Leading Automotive Electrification

DOUG PARKS '84, GENERAL MOTORS

There is a transformation taking place in the automotive industry, as consumers look for vehicles with a positive impact on the environment and a reduction of fuel cost over long commutes. Doug Parks ('84) is at the forefront of those changes at General Motors, where he played a lead role in the development of the Chevrolet Volt.

As the Global Vehicle Line Executive and Chief Engineer for Global Electric Vehicles during the development of the Volt, Parks used his experience on vehicle lines including the Cruze and Solstice to improve ride and handling, while reducing noise, vibration, and fuel consumption. During the Volt's development, he led his team through engineering and manufacturing challenges to develop the Voltec propulsion system—the first of its kind in the industry.

Today, Parks continues to make a difference in the electrification of vehicles in the automotive industry by overseeing a team of thirteen executive chief engineers, each operating their own product program, where he serves as Vice President of Global Product Programs.

Sensing an Impact

MARTHA SULLIVAN '85, SENSATA

Sensors play a significant role in the world around us, improving personal safety and providing input for controlling our environment. Automotive sensors, like those developed by Sensata, where Martha Sullivan ('85) serves as CEO, are evolving rapidly as the market moves toward electric and self-driving vehicles.

From micro-hybrid to plug-in electric vehicles, sensors from Sensata are employed for regenerative braking, expansion of load management, battery life management, and vehicle temperature and pressure sensing. Sensata is also credited with developing a robust sensor using brake-by-wire technology to supplement service brakes or to serve as a stand-alone braking system.

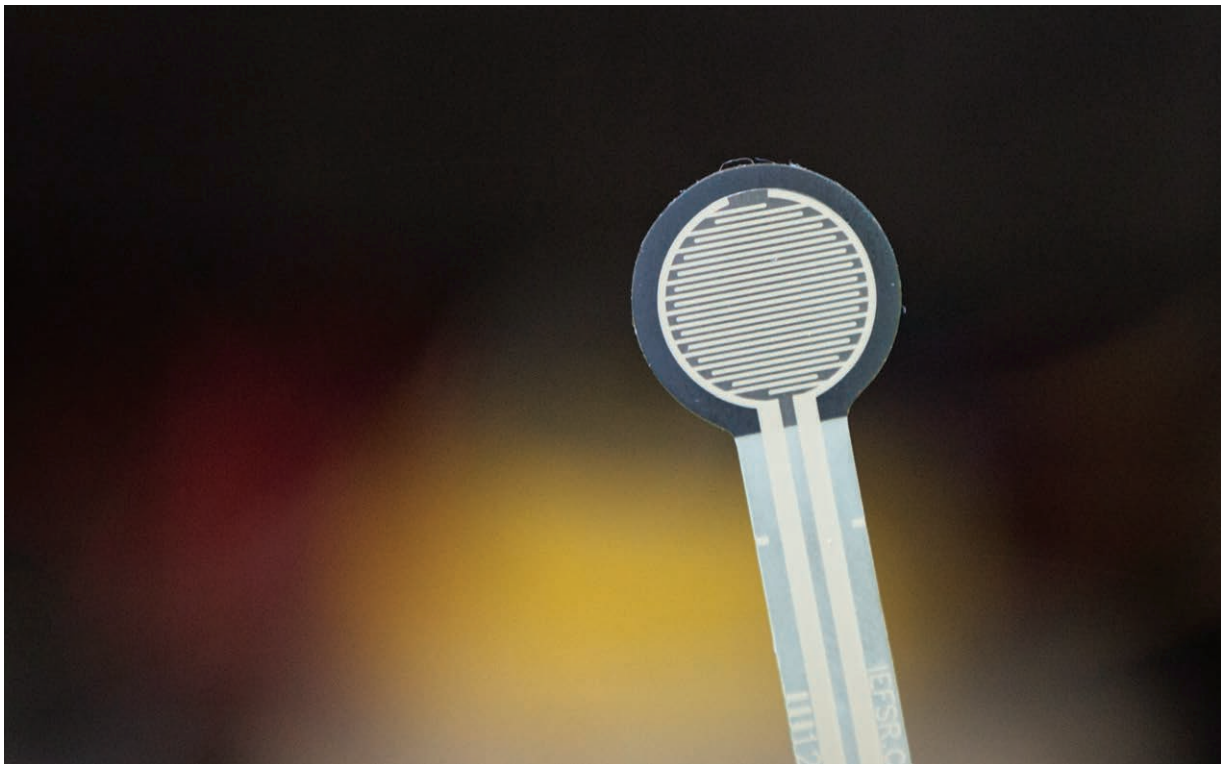
Beyond automotive sensors, Sensata impacts industry by producing devices used in appliances, aircraft, industrial, military, heavy vehicle, heating, air conditioning, data, telecommunications, recreational vehicle, and marine applications.

"At Sensata, we provide sensors that make the world cleaner and more energy efficient. We proudly enable start/stop systems, regenerative braking, and many sub-systems found on hybrid vehicles."

—MARTHA SULLIVAN

BY THE NUMBERS

30 **SENSORS, SWITCHES, AND SAFETY DEVICES** present in a typical home.



Human-Centered ENGINEERING

EDUCATION

HUMAN-CENTERED ENGINEERING begins with the education of future engineers. From developing outreach programs that spur K-12 students to discover a passion for STEM, to our research-based education of undergraduate and graduate students, our faculty members engage the automotive industry and other industries to meet real-life challenges.

FEATURED ALUMNI

- Terry Woychowski '78
- Dave Hill '65
- Cynthia Hodges '87, '89
- Jennifer Shute '96

EDUCATION

THE ME–EM EDUCATIONAL PROGRAMS ARE CONTINUALLY REVISED TO PROVIDE FUTURE ENGINEERS WITH THE RESOURCES TO SUCCEED.

"I am very proud of our successful development and implementation of the courses 'Mechanical Engineering Practice 1' and 'Mechanical Engineering Practice 2' in the 2014-2015 academic year. I look forward to the successful implementation of the remaining new curriculum courses over the next two years."

—DR. GREGORY ODEGARD

ME-EM: BY THE NUMBERS

50,000+

SQUARE FEET of labs and computer centers available to students.

Adaptable Curriculum

To maintain its position as eighth in enrollment nationwide by the American Society for Engineering Education (ASEE), the undergraduate program in mechanical engineering provides adaptability in the curriculum to ensure students are prepared for the challenges they will face during internships, co-ops, and their careers.

The heart of the undergraduate program lies with the four "Mechanical Engineering Practice" courses offered second and third year. Developed to emphasize hands-on learning, students experience a variety of engineering challenges not covered in traditional lecture courses. These practice courses focus on reverse engineering, communication, testing, team building, and data acquisition and encourage peer-based learning with guidance from faculty and professional staff. Simulation activities have been added to all core courses, so that the principles covered are reinforced by use of industry-standard digital tools.

While similar courses are taught at other universities across the country, the ME-EM Department at Michigan Tech is the only department applying this hands-on approach on a large scale. "Our graduates are ready to 'hit the ground running' immediately after graduation, a hallmark trait that brings employers back to our campus year after year," notes Dr. Gregory Odegard.

As part of the curriculum revision, and as a way to strengthen the undergraduate education program, the required credits for engineering core courses have been reduced in favor of technical elective classes. By offering new technical electives, undergraduates have the opportunity to enroll in courses targeted to their field of interest.

Rigorous Research

The adaptability present in the undergraduate curriculum carries over into the graduate curriculum, allowing students flexibility in selecting courses to meet their needs in the ME-EM Department, other engineering departments, and other academic units on campus, including business and economics. This versatility is encouraged by industry partners and co-op supervisors as a way to provide students with a broader base of experience.

Graduate students explore a range of applications across the field of mechanical engineering with the semester-long Graduate Seminar, which brings in nationally and internationally recognized speakers from a variety of research areas. These speakers help demonstrate that the fundamentals of the degree can be applied to nearly any industry, laboratory, or enterprise. Students have the option of taking communication courses focused either on research-oriented projects (such as grant proposals, journal papers, and conference presentations) or business-oriented communication tasks (beginning Fall 2016). Each course integrates lessons in ethics and engineering communication standards.

The APS LABS offers graduate students an opportunity to extensively apply their technical knowledge through laboratory experiences on industry-based projects, including the configuration of hybrid electric vehicles and the use of a high pressure and temperature combustion vessel. Students can learn about full vehicle integration through courses in fundamental thermodynamics and combustion, chassis dynamics in vehicle handling, engine calibration and the impact on fuel economy and power, and the human factors of interacting with a vehicle system. This ensures students are fully prepared for challenges faced by engineers working in the automotive industry.

With continually advancing technology and the support of industry partners, Michigan Tech also remains one of the few institutions in the US with an online PhD program serving industry and federal laboratory employees. With research benefitting their employers, their engagement with sponsors and advisors is similar to that of on-campus students. Rigorous standards of research maintained throughout ensure continued integrity of the masters and PhD degrees.

"Our faculty and staff embraced our strategic graduate growth plan, and took on the extra burden to help make that growth nationally recognized. Their efforts positively impact our campus and our students."

—DR. CRAIG FRIEDRICH

EDUCATION

ME-EM: BY THE NUMBERS

24+ **COURSES TAUGHT ACROSS THE US** in the Michigan Tech Mobile Lab.

Mobile Education

The Michigan Tech Mobile Lab is the cornerstone for industry short course training and K-12 outreach delivered across the US. The Mobile Lab got its start through a 2009 grant from the US Department of Energy, with assistance from industry partners, to bring hybrid electric vehicle engineering education to displaced automotive engineers in Detroit. Since that time, options for hands-on professional development training has grown to over two-dozen course titles in areas including internal combustion (IC) engines, vehicle dynamics, controls, energy storage, data acquisition, and many others.

Set up on-site at a company's location, the expandable semi-trailer has a climate-controlled classroom with configurable workspaces to meet any training need. Additionally, the on-the-go training facility features two powertrain test cells with combustion and emissions analysis equipment, and automated testing and controls with rapid prototyping capability. Outside the semi-trailer is a fleet of nearly twenty instrumented test vehicles and a portable chassis dynamometer.

With the remote presence of the Mobile Lab, Michigan Tech has emerged as a leader in professional development training, as the only known provider with fully integrated, hands-on activities delivered on-site at the organization's location.

"Starting with its inaugural event on the lawn of Capitol Hill in Washington DC, to the short courses delivered this summer, it's been tremendously rewarding seeing this one-of-a-kind facility support so many different events from STEM outreach, to product and technology demonstrations, to professional development training."

—JEREMY WORM

Hands-On HEV Education

In keeping up-to-date with the latest technology and trends in the automotive industry, Michigan Tech has created new undergraduate- and graduate-level hybrid electric vehicle certificates. The certification is available to any engineering degree-seeking student as a way to provide them with the experience and expertise needed to analyze and develop electric drives in the light vehicle industry.

Through hands-on laboratories and interactive lectures, initiated by Dr. Carl Anderson, Dr. Wayne Weaver, Dr. Jeff Naber, and Jeremy Worm, students learn about the design, analysis, control, calibration, and operating characteristics of HEVs. Classes are offered on campus, online, and through the Mobile Lab, as a way for students to have direct access to Michigan Tech's fleet of hybrid electric vehicles and the configurable hybrid electric vehicle.

With more than thirty course offerings, engineers with mechanical, electrical, materials, and chemical backgrounds can choose the optimal HEV course for their industry application. Michigan Academy of Green Mobility for training automotive engineers selected Michigan Tech's HEV certification for training automotive engineers, incorporating flexible options for full-time students and professionals seeking continuing education.

"Creating the HEV curriculum was a large task. Our faculty and staff worked together, under the leadership of Wayne Weaver, Jeff Naber, and Jeremy Worm, to create a fantastic set of courses that serves both our on-campus and distance learning students."

—DR. CARL ANDERSON

ME-EM: BY THE NUMBERS

30+

NUMBER OF COURSES
offered as part of the HEV Certificate.

EDUCATION

IN JANUARY 2015,
Terry Woychowski was inducted into the College of Fellows at The Engineering Society of Detroit. He's pictured with ten college interns from American Axle & Manufacturing.

"I look at the formation of the trilateral partnership between MTU, ESD, and GM to retrain hundreds of displaced automotive engineers in the area of advanced propulsion as one of my fondest experiences in advancing STEM education and in aiding fellow engineers during a very difficult time in our industry."

—TERRY WOYCHOWSKI

Commitment to Future Engineers

TERRY WOYCHOWSKI '78, AMERICAN AXLE & MANUFACTURING

In order to address the economic crisis that hit the automotive industry in 2008, Terry Woychowski ('78), approached Dr. William Predebon, Chair of the ME-EM Department, about joining forces with General Motors and the Engineering Society of Detroit to provide free retraining in green technology for displaced automotive engineers.

Although the industry was going through an economic downturn, Woychowski, who was serving as Vice President of Global Vehicle Program Management at General Motors at the time, saw an opportunity for training in the creation and calibration of advanced propulsion systems. Over the course of the program, Michigan Tech and engineers like Woychowski came together to train over 100 automotive engineers on important practices in hybrid electric vehicles.

Now serving as Senior Vice President of Engineering and Quality at American Axle & Manufacturing, Woychowski believes in the importance of engineering as a force for good in society, displayed through his sponsorship of several Michigan Tech Senior Design teams to build a human-powered hammer mill to help villages in developing countries process their own grain. Woychowski stipulated that the mill had to be low tech: simple, cheap, and made with materials available locally. That meant no motors. To ensure the project's success, he put the resources of his family foundation behind it.

"Over the years, through the seminars and trainings I've helped provide, I've continued to see the productivity of Michigan Tech students rise. They're no strangers to hard work and that continues to advance Michigan Tech's program as a whole. It's been an honor to be a part of that."

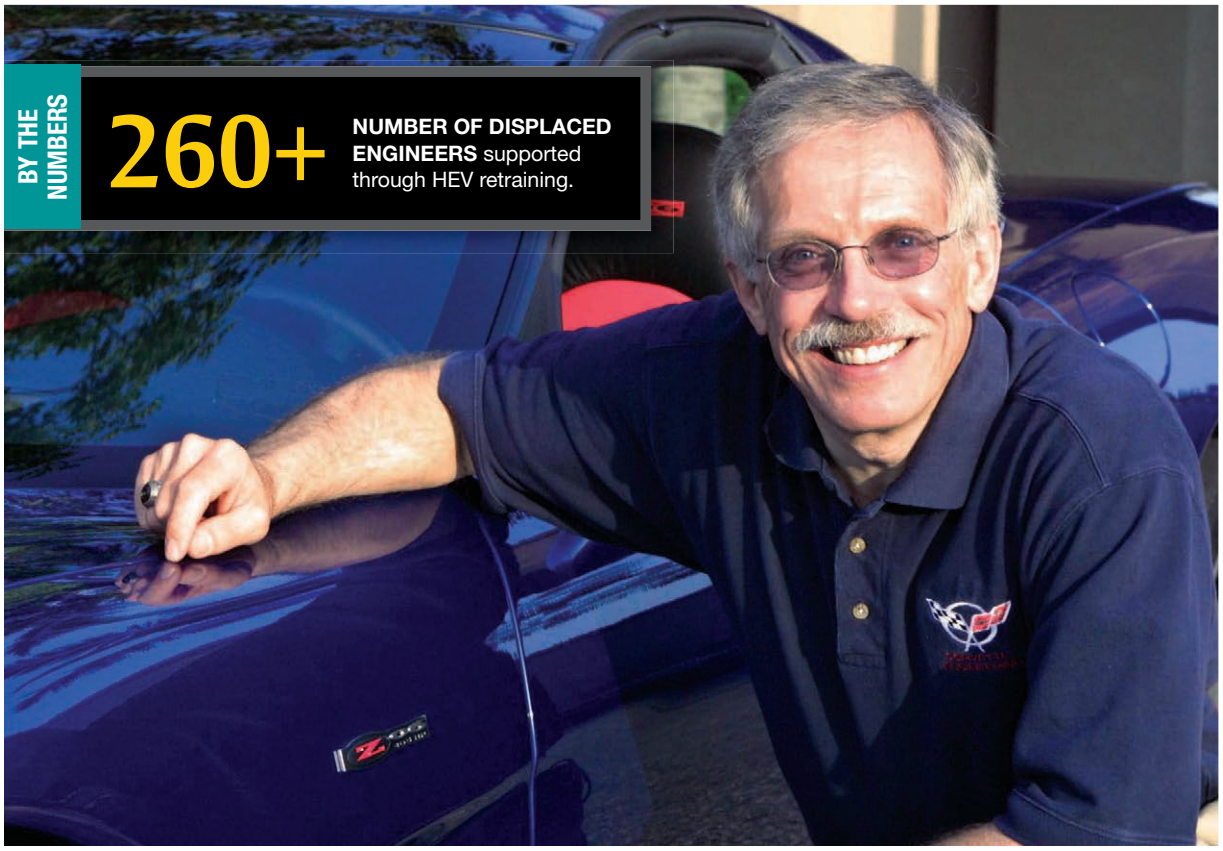
—DAVE HILL

Classic Cars & Collaboration

DAVE HILL '65, GENERAL MOTORS

Engineers from Michigan Tech make an impact around the globe, but few have had a chance to work with legendary brands like Cadillac and Chevrolet. Dave Hill ('65) is one of the engineers who developed the pollution control devices we now take for granted. In his position as vehicle chief engineer, he was responsible for Cadillac vehicles introduced from 1987 through 1994. He became the third-ever chief engineer for the Chevy Corvette, and was responsible for the fifth and sixth generation of America's performance icon.

During his time at General Motors, Hill returned to his alma mater numerous times to share his expertise through seminars and workshops within the department. After retiring from his position as chief engineer for the Corvette in 2006, he furthered this relationship by teaching a course for Michigan Tech as part of GM's free training for automotive engineers displaced by the layoffs of 2008. Hill believes in the value of engineering and manufacturing, and continually supports the education of future engineers.



EDUCATION

"Even though the ME-EM Department is a big department, I always felt that my professors knew me and cared about who I was as a person and helped me along through my studies."

—CYNTHIA HODGES

ME-EM: BY THE NUMBERS

$10,000

DONATED BY FORD MOTOR COMPANY
for young women attending Women in Engineering through Summer Youth Programs.

STEMming from Education

CYNTHIA HODGES '87 BSME, '89 MSME, FORD

As a first year student in Mechanical Engineering, Cynthia Hodges ('87,'89) was certain of one thing: she would not be part of the automotive industry – having viewed it stereotypically as all engines, gears, and grease. But on a whim during her final semester, she had an impromptu interview for a position with Ford, and realized she could have a career working on something that people are truly passionate about – their cars. From that moment on, her career developed around the human-centered engineering approach that she fostered among new recruits over the past twenty-five years.

Through participation in the Women in Engineering Summer Youth Program (WIE SYP), Hodges developed a penchant for experiential learning. To build on that first taste of engineering, Hodges came to Michigan Tech, gaining strong practical knowledge and developing the body of experiences that are a central tenet of the ME curriculum. After rising through the corporate ranks at Ford, Hodges took the opportunity last fall to give back to the program that guided her toward a career in engineering by sponsoring tuition through Ford for ten high school women to attend WIE SYP.

Vehicles often become a part of an individual's identity, and commuters typically spend a substantial amount of time in the driver's seat. The emotional energy that people invest in their cars is a strong motivator for Hodges. Likewise, the automotive industry offers tangible benefits for its engineers, who influence society through the machines they develop; seeing the vehicle they helped to create drive by is a deeply satisfying experience. Hodges makes sure other young people see their potential to impact the world by supporting education in the STEM fields. Her SYP and college experiences also inspired her toward a lifelong goal – to return to the Houghton area after retirement, summoned by the region's rugged beauty and proximity to Lake Superior.

Opportunities Beyond Engines

JENNIFER SHUTE '96, FCA US LLC

Because the auto industry competes heavily on style, vehicles are rapidly developed with each new model year. This continuous flow of challenges means that engineering performance and vehicle comfort is crucial, and the OEMs continuously seek confident engineers with strong practical experience, who appreciate the myriad aspects of vehicle development and manufacturing.

When looking for a career path to follow after graduation, Jennifer Shute ('96) learned about a critical aspect of human-centered vehicle development: ergonomics. The company representatives who first shared those ergonomic principles renewed her latent interest in biomechanics, and Shute was excited to secure a position developing human interfaces for vehicles.

Shute has focused broadly on vehicle ergonomics, developing all manner of solutions from how a person physically fits into a vehicle to what controls need priority access. As she moved up in her career, she became involved in the hiring process, and she often turns to Michigan Tech for recruiting because of the attitudinal and technical character that it fosters: a hands-on approach, collaborative experience, and leadership to deliver a complete solution.

To educate students about the opportunities a degree in engineering can provide, FCA US supports outreach to middle school students, fostering the growth of candidates for engineering-focused universities, like Michigan Tech.

Shute takes an active role in the promotion of programs like the YES! Expo (Youth, Engineering, and Science) to give students in Detroit a day of hands-on experience centered on engineering. To further encourage the presence of women in the automotive industry, FCA will begin sponsoring a session of the Summer Youth Programs called "Women in Automotive Engineering," to convey to high school females the wide range of backgrounds needed to develop a vehicle and bring it to market. By supporting this type of outreach and demonstrating human-centered engineering in action, Shute is drawing minorities to STEM fields and creating the sense of possibility.

"J.D. Power recently released awards for their Initial Quality Study and Automotive Performance, Execution, and Layout (APEAL), which examines what drivers like about their vehicles ninety days after purchase based on overall design, ride, handling, and comfort. The 2015 Dodge Challenger earned both of these awards, so working on that program was a huge honor."

—JENNIFER SHUTE


MOTOROLA
IMSA

Human-Centered ENGINEERING

RACING

SAFETY HAS BEEN BROUGHT TO THE FOREFRONT OF AUTOMOTIVE RACING

in recent years following various high-profile accidents, and while there is no way to eliminate risk, the safety of drivers and spectators has emerged as a central factor in vehicle design. The idea of human-centered engineering in the racing industry has led to technology exchange between the consumer automotive and racing research industries.

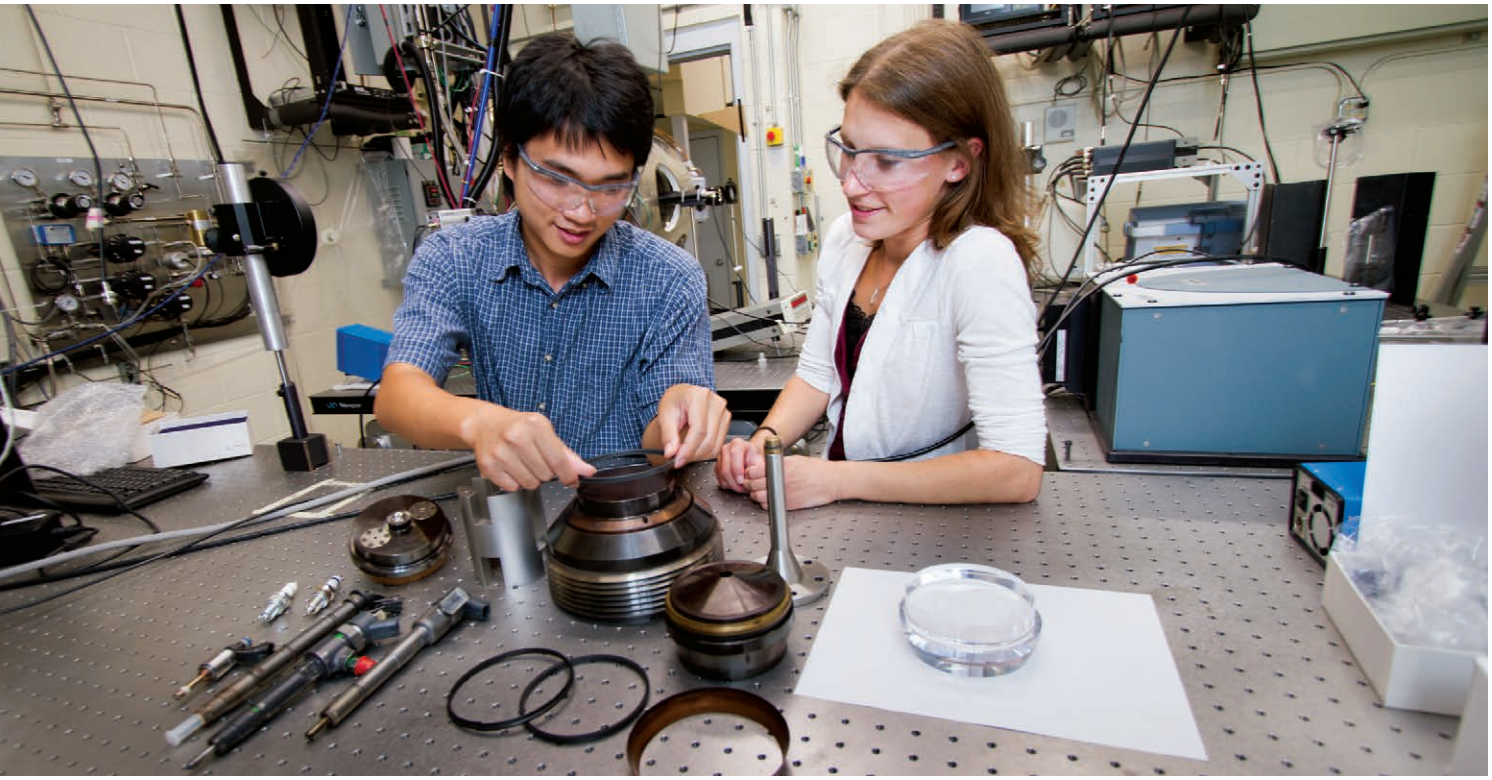
The result: professional race cars are now equipped with higher engine efficiency, intuitive driver controls, and fire suppression systems. Training is also provided to assist professional drivers with vehicle control in both standard vehicles and more recently, electric race vehicles.

FEATURED ALUMNI

- Shannon Knight '99
- Greg Ives '03
- Reagan May '16
- Chris Coxon '96
- Robert Waara '09
- Steve Bethel '85
- Chais Eliason '14
- Matthew Beckman '94
- Doug Wojcik '15
- Seth Kooiker '09
- David House '65
- Dan Rivard '59

RACING

THE RACING AND AUTOMOTIVE INDUSTRY
FORM A SYMBIOTIC RELATIONSHIP WITH DEVELOPMENTS IN ONE LEADING TO CHANGES IN THE OTHER.



"As a master's student, I had the opportunity to integrate and instrument the lab for the combustion vessel. When I saw the spray and combustion process occur —that was a highlight for me, and now I get to share that excitement with future engineers in the IC engines and thermodynamics courses."

—DR. JACLYN JOHNSON

Future of Fuel Injection

Race tracks around the world are home to engines of all types, from petrol to hybrid, and even diesel engines are now included in the mix. This is all as part of the industry's goals to cut costs and emissions, encouraging teams to build engines with improvements in efficiency, lightweight designs, and enhanced fuel injection technology.

On the basis of fundamental research, such as the diesel spray combustion characterization research being conducted by Dr. Jaclyn Johnson, high performance race diesels will see emissions reductions through industry and research contributions. Because diesel combustion and emissions are highly sensitive to the fuel spray characteristics, it is critical to understand the vaporization of the fuel in developing an ideal injector nozzle.

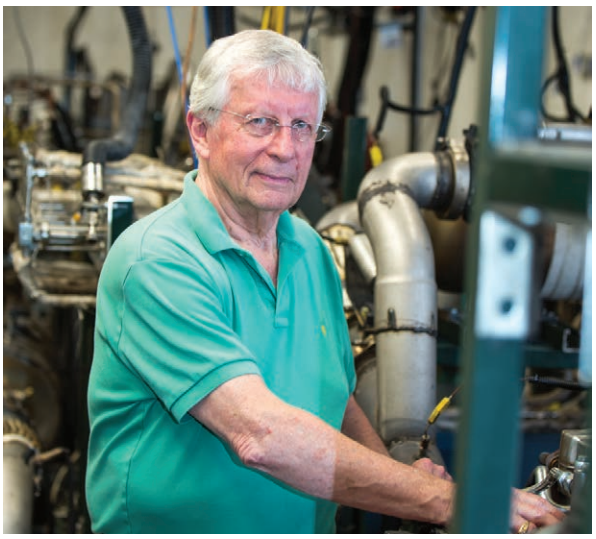
Michigan Tech's state-of-the-art research laboratories, equipped with an optically accessible constant volume combustion vessel, provide researchers with the tools needed to test spray behavior theories and influence both the future of racing diesels and standard highway engines.

Impacting Fuel Consumption & Emissions

Automotive racing, from Formula 1 to NASCAR and IndyCars, has taken a turn toward reducing overall fuel consumption through new injection systems and alternative fuels. To reduce fuel consumption and emissions, engineers throughout the automotive world are turning to Dr. John Johnson's research and modeling for insight on diesel engines and emission controls.

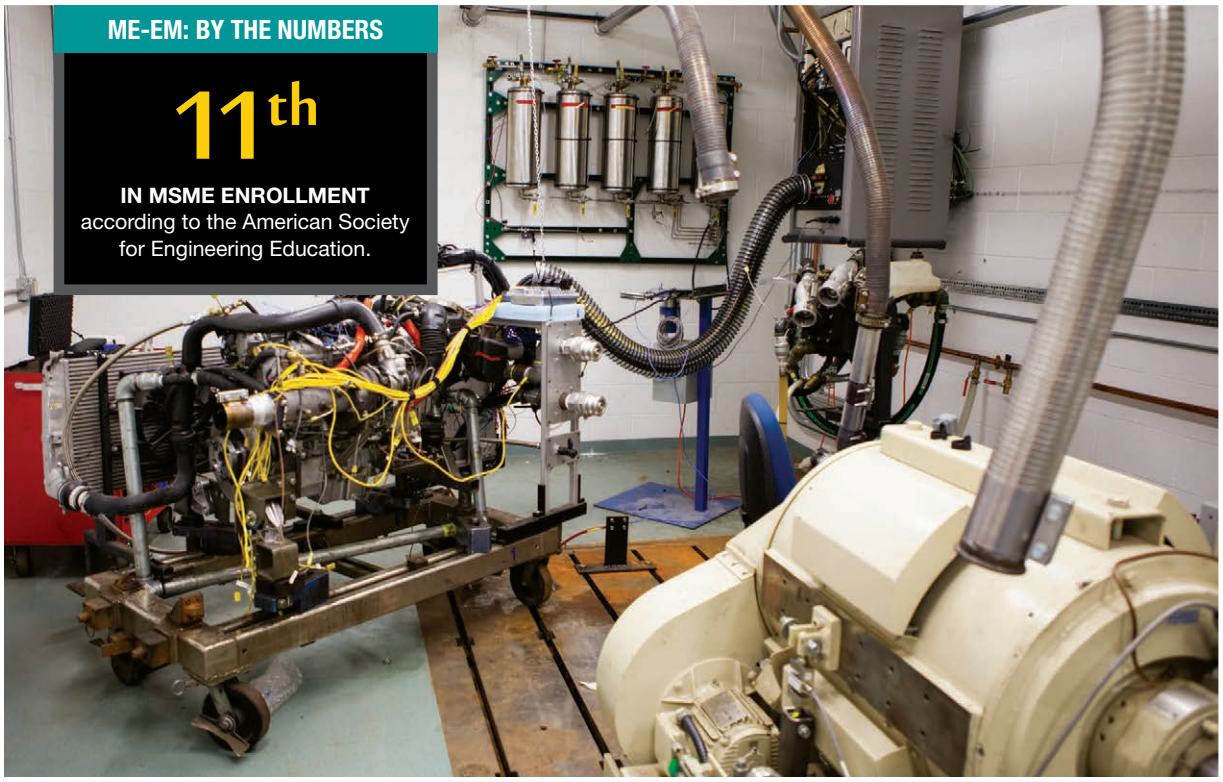
Johnson's work in the diesel and heavy-duty truck industries has directly impacted improvements in fuel consumption and emissions for vehicles coming off assembly lines worldwide. As part of his role as chair of the National Academies Committee, he and the committee members have been exploring engine systems, hybrid propulsion systems, vehicle power demands, idle reduction, vehicle safety, the SuperTruck, and efficient operations. The ultimate goal is to develop technological improvements in commercial and military trucks and buses. The report from this Committee was made available to the public in September 2015.

The outcome of this effort will inform and influence how manufacturers guide future engine development and vehicle fuel consumption, which affects drivers on race tracks and roadways worldwide.

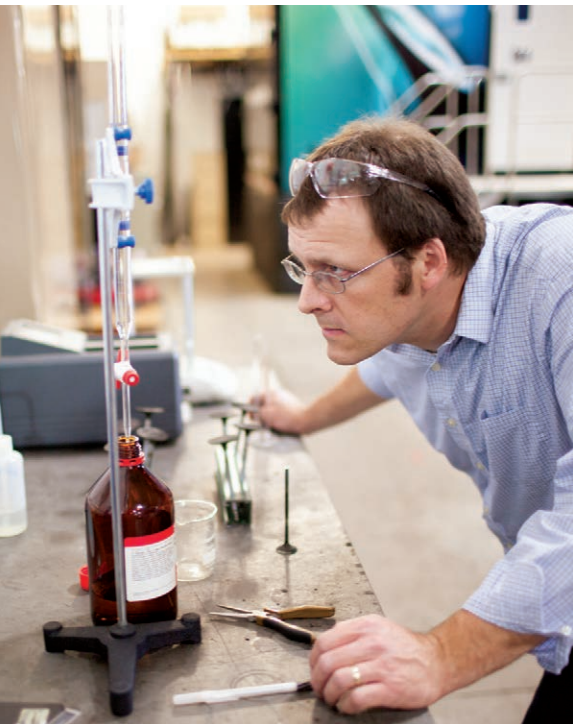


"Our research team has been able to simulate, with a multi-zone model calibrated to experimental data, a diesel particulate filter (in production since 2007 in heavy-duty vehicles), with the output being the transient temperature and the particulate matter distribution in the filter."

—DR. JOHN JOHNSON



RACING



"As a researcher focusing on internal combustion engines, you want to improve engine efficiency, reduce emissions, and incorporate alternative fuels, but you don't expect you're going to be doing that while your heart is just about jumping out of your chest with anxiety and excitement as you test a fire-breathing V8 at 550 hp and 7,000 RPMs. The green racing project has been a huge success, and shows that there is a place for university research in the world of high-performance engines."

—JEREMY WORM

Racing to Green Technology

While racing has not always been thought of as an environmentally-conscious sport, the Green Racing Initiative hopes to change that connotation through the installation of green technologies in vehicles speeding around the track. Representatives from the initiative, organized by Circle Track Magazine, Argonne National Laboratory, General Motors, and McFarland Consulting, came to Michigan Tech to get answers about engine operation and effectiveness while using alternative fuel sources.

Researchers at Michigan Tech, like Jeremy Worm, partnered with the initiative to study how green technologies and alternative fuels impact the performance in racing engines, specifically benchmarking a Chevrolet Camaro. Although many in the racing industry feared alternative fuels like E85 with eighty-five percent ethanol would de-power the vehicle, the opposite was found to be true, producing more power with a lower fuel cost on the same engine.

Researchers also evaluated engines with electronic controls to improve mileage and reduce emissions, demonstrating that, compared to traditional carburetors which burn with an inconsistent pattern, with fuel injection, all eight cylinders powered consistently. The results of these experiments have been shared with racing teams across the country to bring a powerful, new vision of green racing effectiveness to engineers and sponsors.

Connecting at the Racetrack

SHANNON KNIGHT '99, FCA US LLC

Not only does racing lead to safety innovations in the automotive industry, it is intensely social and can be a doorway to networking opportunities. After working at Tier 1 automotive suppliers, Shannon Knight ('99) was eager to tackle OEM-level challenges. She began track racing her PT Cruiser and then her Nissan 350Z. Coaches taught her to improve her speed and handling, and at the track she crossed paths with fellow Michigan Tech alumna Jennifer Shute, who shared an interview opportunity at Chrysler with her.

The vehicle development role at Chrysler (now FCA US) aligned well with Knight's broad, practical background: she loved cars, earned a solid education from Michigan Tech, and knew the industry from working with suppliers. As a Jeep owner, she was delighted to have the 2007 Wrangler for her first project, finding ways to improve the vehicle without losing the essential characteristics loved by Jeep owners worldwide.

Since completing the Wrangler effort, Knight has been fortunate to adapt the Fiat 500 to the North American customer and make adjustments to the Jeep Cherokee for the markets outside of the US. She is now working on the next generation of large cars, including the Grand Cherokee, 300, Charger, and the Challenger programs. Much like in the racing industry, her focus has been on weight reduction and fuel economy.

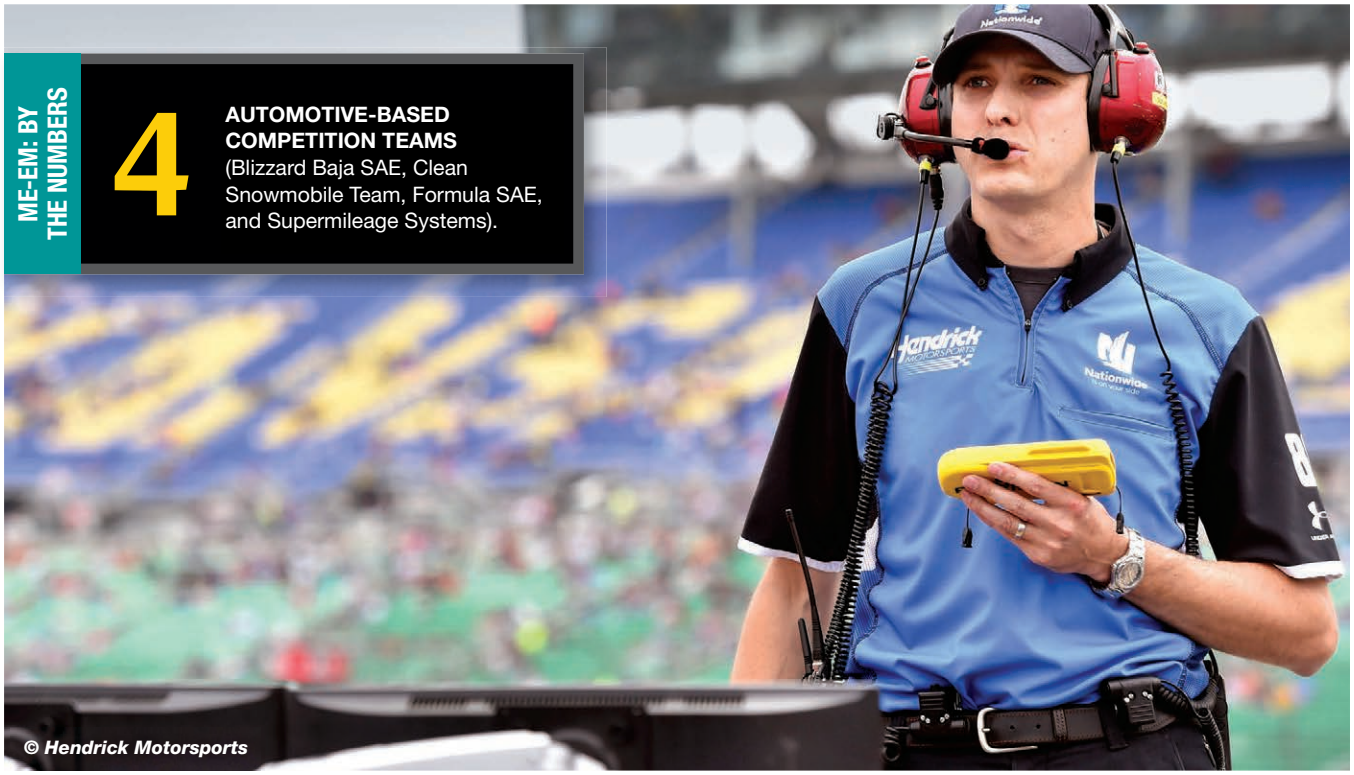
"When you work on a car for an extended period of time and gain expertise in it, you grow attached and want everyone to drive it. The Jeep Wrangler has changed since we launched the program in 2007, but every time I drive one, I'm reminded of the experience and the pride. Everyone should get to feel that way."

—SHANNON KNIGHT

RACING

ME-EM: BY THE NUMBERS

4 **AUTOMOTIVE-BASED COMPETITION TEAMS** (Blizzard Baja SAE, Clean Snowmobile Team, Formula SAE, and Supermileage Systems).



© Hendrick Motorsports

"The ultimate goal for any team is the championship, and being able to achieve that in 2014 with Chase Elliott and the NAPA team was a huge milestone. Currently, the 88 team and I are in the NASCAR Chase, working toward another championship."

—GREG IVES

Seated Safely

GREG IVES '03, HENDRICK MOTORSPORTS

The world of NASCAR racing has taken a closer look at safety in the past decade, installing new barriers at race tracks, mandating the use of head and neck restraints for all drivers, and creating new rules for seats and seat belts with a roof-hatch escape system—all designed to keep the driver safe.

As crew chief for NASCAR driver Dale Earnhardt, Jr., within the Hendrick Motorsports 88 team, Greg Ives ('03) stays up-to-date on these safety standards with his pit crew, from body builds to car set-ups and testing through simulation. This idea of testing and simulation was something that was emphasized during his education at Michigan Tech. One safety feature, the carbon-fiber seat, used by a majority of today's NASCAR drivers, was designed, built, and tested at Hendrick Motorsports. Ives and his crew thoroughly test any changes and determine their impact on the driver to avoid issues come race day.

The Hendrick Motorsports racing team and the track managers do everything in their power to make the sport safe for all involved. Through his education and his position as crew chief, Ives continually provides a safe environment for the driver, crew, and race spectators.


© Lavender Photography

"My engineering experience at Michigan Tech, combined with my success on the track, provided me with the opportunity to be selected as one of seven drivers nationally for the Kulwicki Driver Development Program, established to develop 'grassroots' racers and keep Alan Kulwicki's memory alive."

—REAGAN MAY

Adjustments for the Future

REAGAN MAY '16, REAGAN MAY RACING

In the world of racing, the car, driver, and pit crew must operate in synchronized motion for success. Racing her Super Late Model in seventeen races so far in 2015, Reagan May, a senior studying Mechanical Engineering at Michigan Tech, has logged six feature wins, fourteen top five finishes, and seventeen top ten finishes.

Earlier this year, she won the Super Late Model Track Championship at Golden Sands Speedway. She was also named Rookie of the Year last year after winning the TUNDRA Super late Model Series at LaCrosse Speedway.

When May isn't on the track, she spends time in the pits, learning about the fine adjustments other drivers make to improve her own car and automotive knowledge base. This year, she was honored as one of seven participants in the Kulwicki Driver Development Program, established in memory of Alan Kulwicki, a NASCAR driver in the early 1990s, to assist grassroots racers working toward a degree in engineering.

Crediting her success to the knowledge she's gained in the classroom, combined with her family support in the pits and off the track, May has dreams to one day become involved with NASCAR. With her demonstrated success in racing, that dream might not be too far into the future.

ME-EM: BY THE NUMBERS

31 **STUDENTS PER CLASS; all taught by faculty.**

© Tom Loos Photography

RACING

© Dan Boyd


© Dan Boyd

"I was very fortunate in my racing career to work with strong teams. In 1999, I was ten years younger than any other race engineer on the circuit and those experiences taught me about safety and vehicle weight distribution, which are applied to my job on a daily basis."

—CHRIS COXON

ME-EM: BY THE NUMBERS

$63,291

AVERAGE STARTING SALARY
for ME-EM undergraduates.

Threading the Liquid Needle

CHRIS COXON '96, GS ENGINEERING

At every race track, safety is a concern because there is a human controlling the vehicle at speeds we associate with aircraft. In IndyCar racing, the driver is essentially the pilot of an aircraft with upside-down wings, creating tremendous down force. For the driver, it is critical that the team understands the mechanics of vehicle dynamics, as well as fluid dynamics, in order to manage the aerodynamic effects and maintain stability. Failure is not an option as it can cause loss of life.

From a young age, Chris Coxon ('96) was traveling to races with his dad, who was in charge of all pace cars for the IndyCar series for PPG Industries. At age thirteen, he was encouraged by IndyCar driver, Pancho Carter, to pursue a formal education, and gain a stronger career path into racing. His passion for racing grew to the obsessive levels required to travel with the Roush team across the country while completing his degree in Mechanical Engineering at Michigan Tech, even without the accommodations allotted to students involved in other sports.

Throughout his career in IndyCar and NASCAR, Coxon has seen first-hand the impacts of racing innovations on the sedans of today, from the shift toward increased simulation at OEMs to rearview mirror placement, rollover protection, anti-lock brake systems, and newer technology like blind-spot detection. Bringing his experience in motor racing to his position at GS Engineering, he now oversees the application of a range of technologies to achieve vehicle performance outcomes, from early structural analysis to field testing of prototypes. His success in racing enabled him to succeed with GS Engineering, arriving with an understanding of marketing, knowledge of management, and the drive to take on tough challenges.

Controlling the Track

ROBERT WAARA '09, ROUSH, DODGE VIPER RACE TEAM

Just as racing influences the design of standard vehicles, the opposite is also true. Fundamental research on combustion characteristics is applied to the engines used in automotive racing by the teams' chief engineers, impacting the professional drivers and the racing audience.

Application of this research requires accurate measurement of many engine parameters before implementing any changes, so their effects can be quantified. Engine calibration, durability testing, and engine simulations on dynamometers are just a few of the critical tests run by lead engine engineer Robert Waara ('09) prior to races with the Dodge Viper Race Team. Since graduating, Waara has traveled to Le Mans with the team for race preparations, which includes configuring traction control and constant monitoring from thirty sensors that wirelessly stream engine performance data.

While on the race track, he continues to leverage his experience in controls from Michigan Tech, to optimize the transmission and assist with on-the-fly engine calibration. While he doesn't drive race cars, it was his co-op experience at Roush and his work ethic that secured the job with the Dodge Viper Race Team at Roush.

"It's been an honor to be part of the DVRT that won the 2014 IMSA GTLM Drivers and Team Championship. I'm looking forward to working with new teams and bringing them more podium finishes."

—ROBERT WAARA

ME-EM: BY THE NUMBERS

13 **YEARS HOSTING** the SAE Clean Snowmobile Challenge.

RACING

"Growing up, I discovered there is a passionate relationship between humans and the engine, with the engine responding to the human input and that's something that has always fascinated me and encouraged me to learn more."

—STEVE BETHEL

The Heart of the Engine

STEVE BETHEL '85, LEADFOOT ENGINEERING

The heart of the IC engine is the piston, and yet its nuanced behavior inside a racing engine remains mysterious to many engineers and crew members of race teams. But the many secrets of the piston were something Steve Bethel ('85) had started to collect during his youth while working on dirt bikes, dune buggies, and cars. After completing his ME degree, he joined Mercury Marine with a ten-year plan to get back to the Houghton area. Powerboat racing was central to the culture at Mercury Marine, where Bethel worked with a team to improve and develop new products, finding the minute differences that improve the engine's performance and durability. He was tasked with redesigning the two-stroke engines around improved piston designs, which led to a long period of market dominance by Mercury.

Through the corporate racing culture, he made connections in the automotive racing industry, where his expertise in pistons and engine design were deeply valued. Among the auto racers, Bethel discovered there was a knowledge gap between the pistons used by most teams, and the technology available. Seeking to return to the Keweenaw region, he joined a Michigan Tech spinoff, IR Telemetrics, before founding his own firm, Leadfoot Engineering.

To date, Bethel has collaborated with teams in NASCAR, drag racing, NHRA Pro Stock, and NHRA Superstock Hemi Shootouts, expanding his capabilities from consulting to piston manufacturing with full finite element analysis, and start-to-finish design. The Pro Stock team, with driver Jeg Coughlin, brought Bethel his first big win with pistons he had designed and machined for them. The NASCAR team supported by Bethel and Leadfoot Engineering has also experienced success, winning numerous championships. His experience as the "heart surgeon of the engine," both in theory and application, has substantially contributed to the success of many racing teams.

Engineering Passion

CHAIS ELIASON '14, HENDRICK MOTORSPORTS

Every car on the road has hundreds of engineers behind it, looking out for the safety and well-being of its passengers. Likewise, behind each race car driver is a team of highly qualified engineers, from pit crew to over-the-wall crew to road crews: each driver has countless people they must trust. Jimmie Johnson, NASCAR driver for Hendrick Motorsports, has a Michigan Tech mechanical engineer to turn to in the pits.

Pursuing his racing passion through high school and into college, Chais Eliason ('14) landed a fifteen-month internship with Hendrick Motorsports and, following graduation, became the third engineer on Johnson's team, working under crew chief Chad Knaus. Eliason is responsible for tracking the racing database and recording any adjustments made by Knaus, Johnson, and the rest of the pit crew.

Although decisions are made mere seconds before Johnson arrives in the pits, Eliason enjoys the adrenaline rush of the races and his role in monitoring the changes made at each stop. Accuracy is critical because his record keeping is a resource for the team to use on future design decisions.

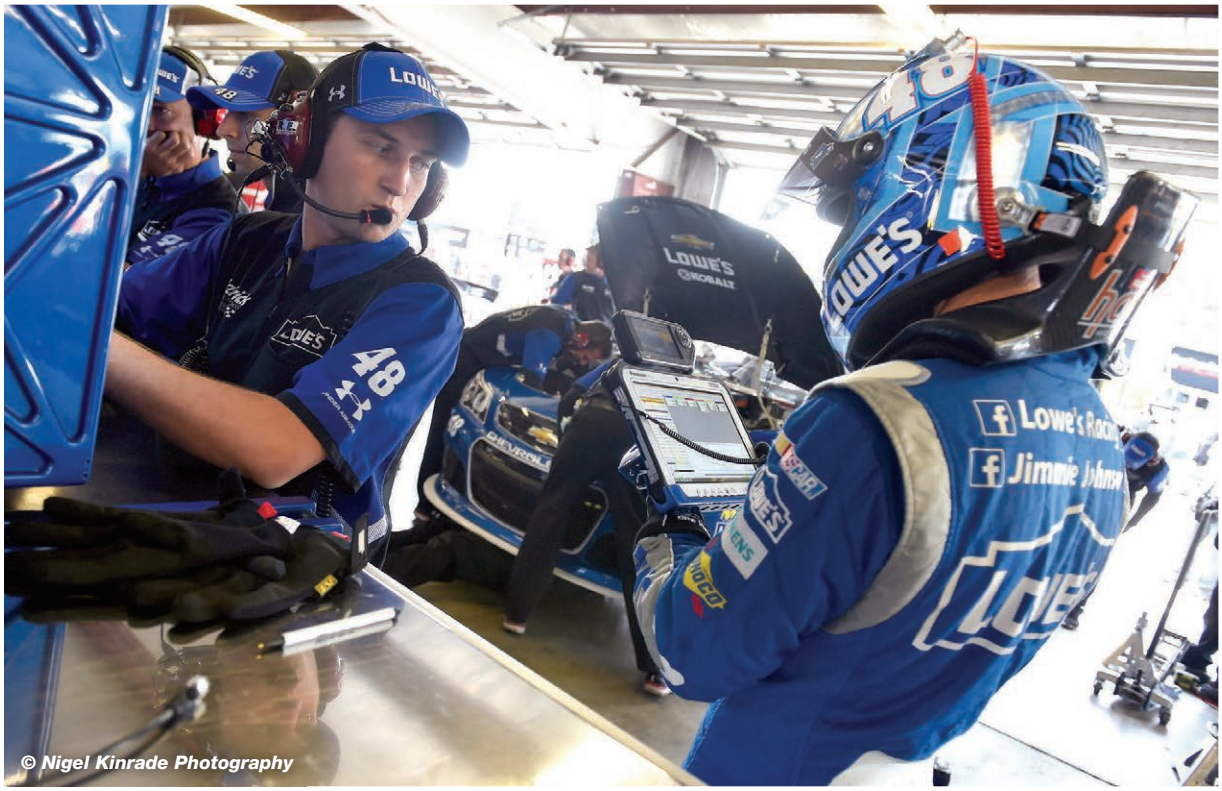
© Nigel Kinrade Photography

"Becoming a race engineer for a top NASCAR team is my dream come true, and even though the work and hours are demanding and require a lot of sacrifice, the champagne shower in victory lane makes every second worth it."

—CHAIS ELIASON

ME-EM: BY THE NUMBERS

95% JOB PLACEMENT RATE.



© Nigel Kinrade Photography

RACING

"I really enjoy the testing side of my job, trying to figure out how to make it easier for the driver to get more out of the car. There is no right way—you need to analyze the situation in front of you to try and be better and faster than everyone else at the track. You don't get that competition in the office. On race day, the results are right there for everyone to see."

—MATTHEW BECKMAN

Structurally Sound Education

MATTHEW BECKMAN '94, JOE GIBBS RACING

In the field of engineering, the impact of a structural or design change frequently takes months or even years to be realized by consumers, however, at the race track, changes made to the suspension and overall vehicle dynamics are noticed immediately by the driver and crew team. The crowd takes notice when the sum total of changes makes or breaks a race.

The sense of urgency and thrill of competition are what pulled Matthew Beckman (CE '94) from his role in structural engineering to the fast-paced world of racing, where he serves as race engineer for Joe Gibbs Racing No. 19 driver, Carl Edwards. In this position, Beckman develops the setup of the car to best optimize the trade-off between mechanical grip and aerodynamics, shaving valuable seconds from the track time. Without a set recipe for success, a position in racing requires constant adaptation to match vehicle handling to the driver's racing style.

To supplement his education in engineering, Beckman took courses in vehicle dynamics and data acquisition before accepting his first position in racing in 2000. Through his education at Michigan Tech, he gained analytical skills and the tools to efficiently find solutions rooted in engineering principles.

Although he now lives in the NASCAR world, Beckman got his start with the Newman Haas Racing team competing in the CART World Series. One of the defining moments in his career in racing was winning the 2002 American CART Championship with driver Cristiano da Matta. While CART helped him get started in the industry, he enjoys the vast landscape of racing technologies, in both physical testing and the simulation capabilities that are employed by NASCAR teams. The racing industry is ripe with opportunities for engineers looking for the extreme challenge of producing better results in each successive race.

ME-EM: BY THE NUMBERS

1st

MECHANICAL ENGINEERING PROGRAM in the Peace Corps Masters International Program.

"My Mechanical Engineering degree prepared me for the field where things happen quickly. The results we get from testing are implemented on the cars right away."

—DOUG WOJCIK

Racing to the Finish

DOUG WOJCIK '15, HENDRICK MOTORSPORTS

Working full-time in Charlotte, North Carolina while completing a degree in Mechanical Engineering from Michigan Tech is not something most recent graduates can say, but was reality for Doug Wojcik ('15). After completing an internship with JR Motorsports in 2014 under Greg Ives, Wojcik was sought for a position on the Hendrick Motorsports team in December, before returning to Houghton for his final semester.

Working closely with his advisor, Wojcik was able to complete his degree and graduate in May, after beginning his career as a set-up engineer, working to adjust suspension geometry and vehicle set-up.

For Wojcik, working in racing is a dream that began at the dirt track, racing stock cars with his family. It continued through his involvement in the Formula SAE enterprise at Michigan Tech, where he interfaced with a range of personalities and sought out each teammate's strengths: a key step on the path toward working with his dream team.

Engineered to Race

SETH KOOIKER '09, JR MOTORSPORTS

A passion for racing can be ignited at a young age, and the spark may come from any of the motorsports. Growing up racing karts in western Michigan and later racing throughout the Midwest and eastern US, Seth Kooiker ('09) always knew he wanted to enter professional racing. To prepare himself to be among the best, he chose to study Mechanical Engineering at Michigan Tech.

The hands-on education, industry-oriented programs, and the quality faculty layered theory onto Kooiker's impressive racing background. To further round-out his resume, he applied his full range of experiences to the Formula SAE enterprise project.

As a race engineer for JR Motorsports No. 9 team, Chase Elliott, Kooiker continues to rely on his education to improve vehicle performance and dynamics, and assist with car set-up to keep the driver, crew, and fans safe during NASCAR XFINITY Series races.

"Being able to apply the degree and what I learned in class to the Formula SAE car and see the real-world application was invaluable for me. When you put the degree and the application of the knowledge together, you become a well-rounded engineer; ready to hit the workplace."

—SETH KOOIKER

RACING

"Racing, like in business, is focused on the space where people and technology interact."

—DAVID HOUSE

ME-EM: BY THE NUMBERS

53rd

AMONG THE TOP 177 (TOP 30%) DOCTORAL-GRANTING ME DEPARTMENTS.

(US News & World Report America's Best Graduate Schools)

Support Beyond Victory Lane

DAVID HOUSE '65, ONE MOTORSPORTS

Fierce competition and the thrill of risk are driving forces behind every race car team member, from the driver to the mechanics and engineers. A deep understanding of engineering principles and human interaction are required to succeed in the racing industry. This managed risk and eye for detail is something David House (EE '65) developed during his time at Michigan Tech.

His passion for precision in competition was honed by his time in industry, serving as General Manager of Intel's microcomputer division for thirteen years, then as Intel's Chief Marketing Officer during the creation of the Intel Inside® program. He managed corporate strategy development and launched Intel's entry into the server market where the company now dominates. In 1996, House began his new role as CEO and Chairman at Bay Networks, which he later merged with Nortel, where he became President. Prior to retirement, he served as CEO and Chairman of Allegro Networks from 2001 to 2003. Throughout that period, House continued to challenge himself with fast moving sports—heli-skiing, heli-snowboarding, and driving Formula and prototype cars around the race track.

On the race track, House and his team video and date log every track session to later graph and analyze the minute details, ensuring they achieve maximum vehicle performance during braking, cornering, and acceleration. He recognizes that every millisecond counts—from the practice run to the qualifiers and the final race laps. His impact is felt beyond the race track by the ME-EM Department and across the Michigan Tech campus through several endowed faculty positions. Unlike grant-based research funding, which often favors incremental, "safe" research, House's endowments enable researchers to pursue higher-risk topics that can lead to paradigm-shifting breakthroughs.

Roadway Process Improvement

DAN RIVARD '59, FORD

Improvements in vehicle safety and overall vehicle build efficiency have a high impact not only on the race drivers and their teams, but also on the consumer auto industry as a whole.

Ford Motor Company drew Dan Rivard ('59) out of retirement so the former Executive Director for Product and Process Quality Improvement could lead Ford's racing effort.

The industry has long viewed racing as a means to innovate and test new technologies, but Rivard made it his mission to build better production vehicles, with faster development time of reliable parts with greater accuracy in warranties, through the rigorous tests that races provide. Racing also provides testing engineers with significantly more data than is collected in a traditional production environment in the form of simulation, modeling, and actual on-road testing.

Rivard's role in process improvement on the racetrack was focused on adaptability. He constantly looked for ways to analyze the driver, track, team, and vehicle to ensure all the elements were aligned. Rivard's legacy has now grown beyond the auto industry, influencing future engineers through his gift of the Dan and Carol Rivard Product Realization Center, which allows Michigan Tech students to utilize state-of-the-art machining, fabricating, and wood prototyping equipment to bring their designs to field-testable reality.

"I concentrated on the saying 'one team, one plan, one goal' to help ensure everyone was focused on the same desired outcome and bringing their piece of the puzzle to the party; always making progress together as a team. This applies both to my work on the race track, in the office, and while serving on the Michigan Tech Board of Trustees."

—DAN RIVARD

ME-EM: BY THE NUMBERS

3,200

ESTIMATED NUMBER OF ME STUDENTS who have utilized the Rivard Product Realization Center.

$3 MILLION GIFT FUNDS **ME-EM ENDOWED DEPARTMENT CHAIR**

"This is a very important recognition for the ME-EM Department."

—WILLIAM W. PREDEBON
The J. S. Endowed Department Chair in Mechanical Engineering–Engineering Mechanics

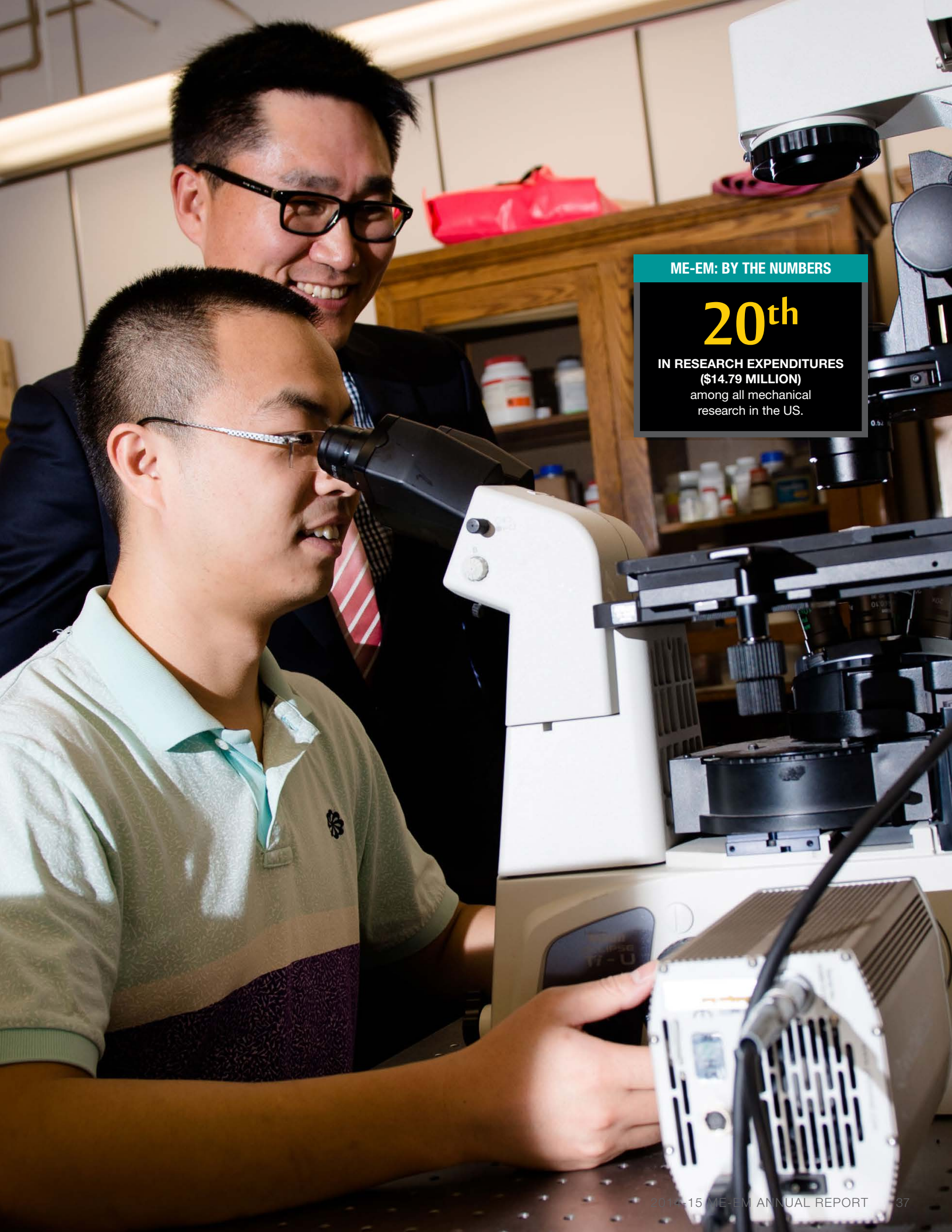
An anonymous gift from an alumnus to Michigan Tech will provide an endowed department chair for the ME-EM Department, Michigan Tech's largest academic department. The $3 million estate gift from the donor, whom the University refers to as "Jack," will fund the Endowed Department Chair in Mechanical Engineering-Engineering Mechanics (ME-EM).

The position, currently held by William W. Predebon, will be realized and fully recognized by naming the position through Jack's estate. Until the gift is realized, the position will be known as the "J.S. Endowed Department Chair in Mechanical Engineering-Engineering Mechanics."

Dale Kero, senior major gift officer for ME-EM, says this is not the first example of Jack's philanthropy to his alma mater. "Jack has already established an endowed scholarship in the amount of $250,000 for graduating students at his local high school who major in mechanical engineering-engineering mechanics at Michigan Tech," Kero says.

According to Kero, "Jack really appreciated the 'hands-on' education he received from Michigan Tech that he continues to use in his career." Kero says Jack believed in "life-long learning" and hopes these gifts to Michigan Tech will provide that same opportunity for future generations. "This is a very important recognition for the ME-EM Department," says Predebon.

As the department's current chair, Predebon says he is humbled and honored to receive this named position. "I am very grateful to Jack for his trust and support of the ME-EM Department."



ME-EM: BY THE NUMBERS

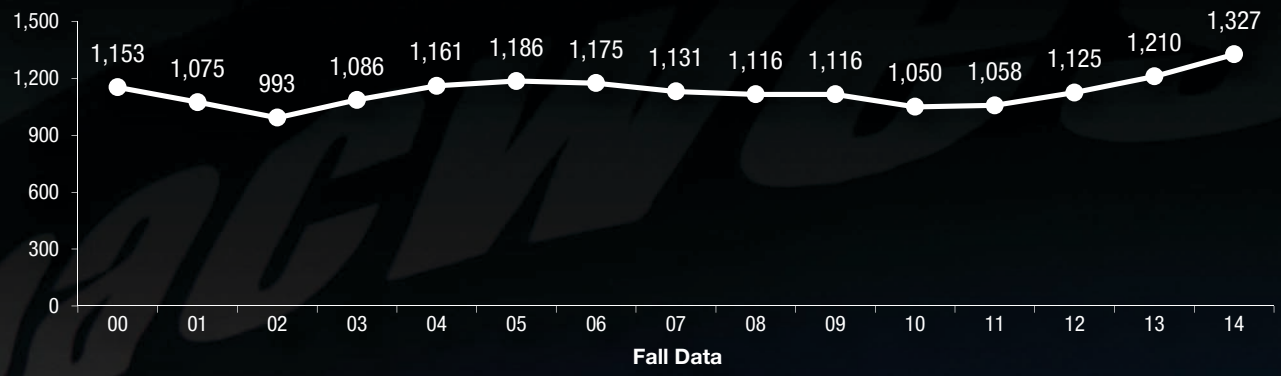
20th

IN RESEARCH EXPENDITURES ($14.79 MILLION)
among all mechanical research in the US.

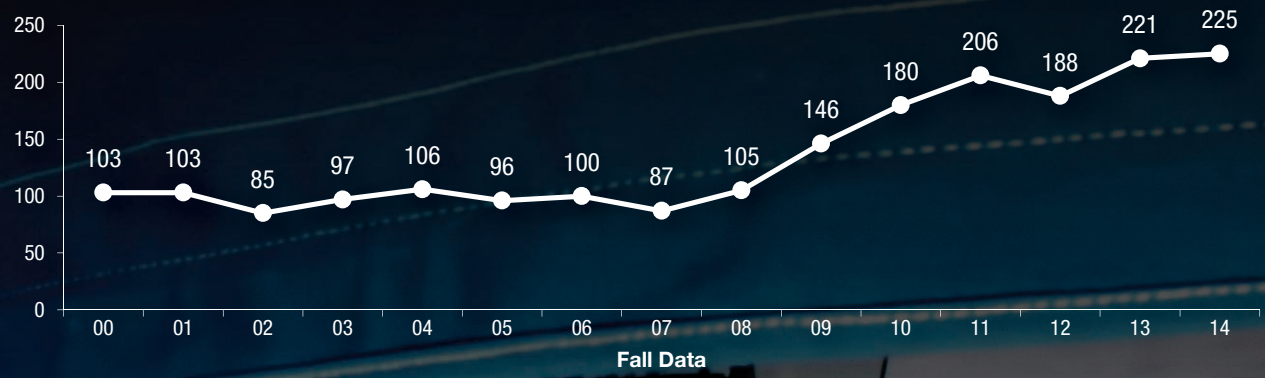
ME-EM **ENROLLMENT**

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



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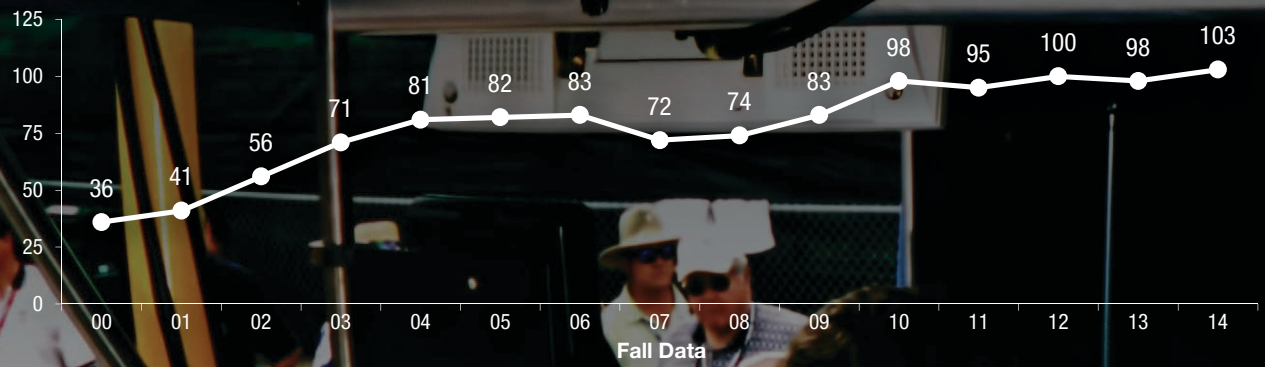
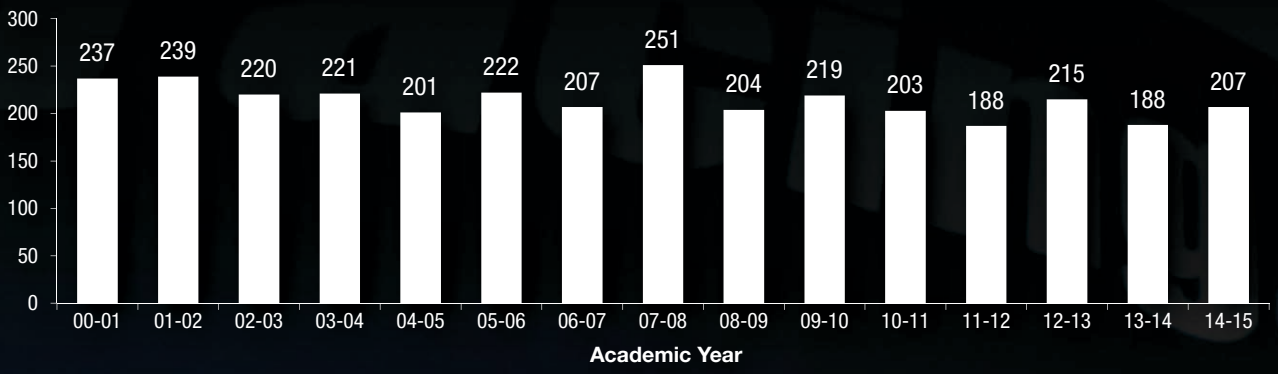
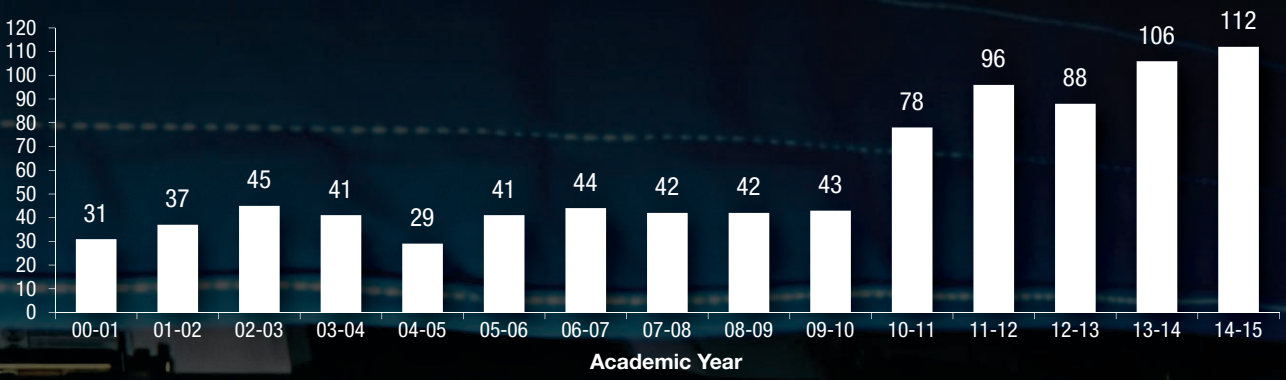


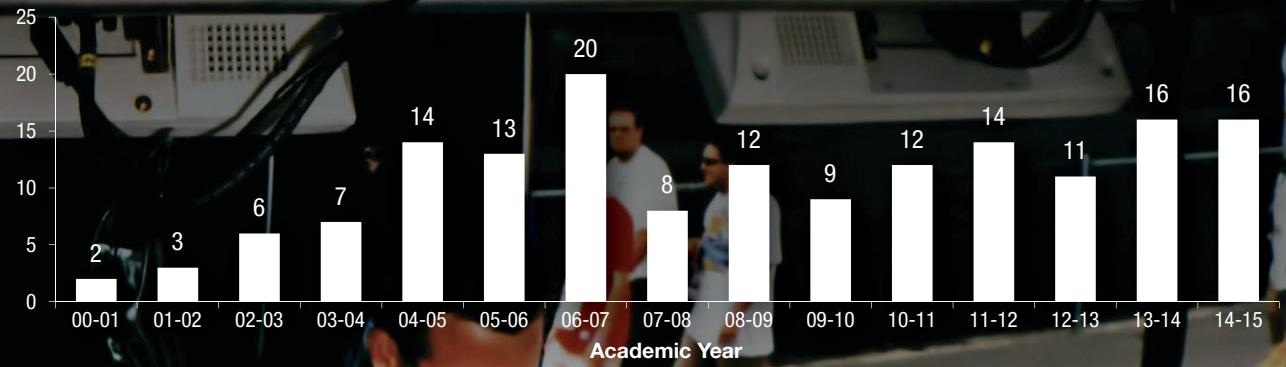
BS DEGREES



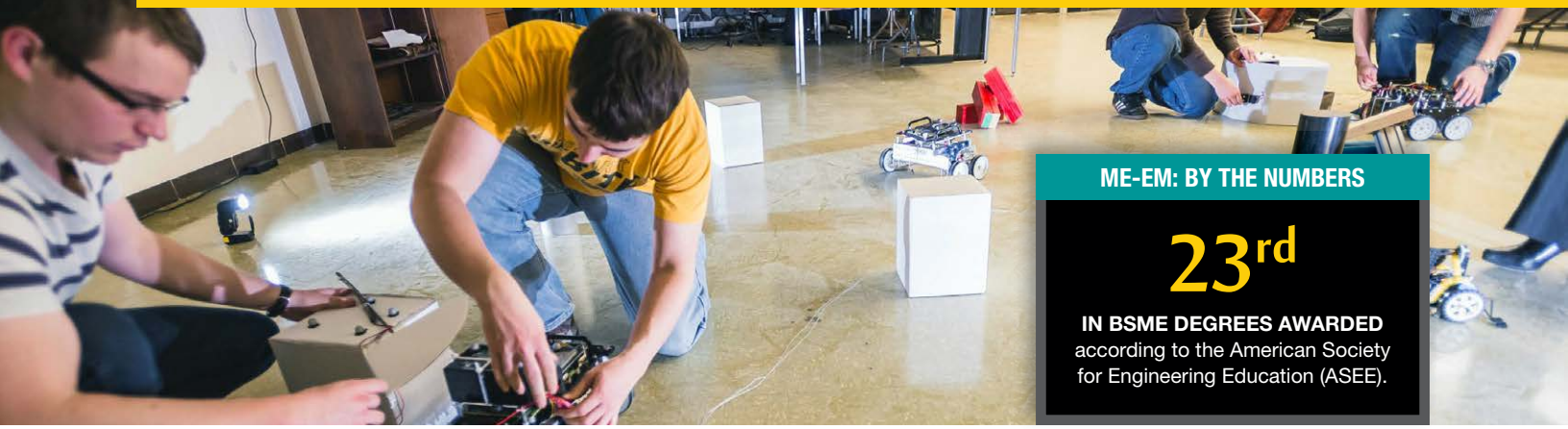
MS DEGREES



PHD DEGREES



ME-EM **GRADUATE SEMINAR SERIES**



ME-EM: BY THE NUMBERS

23rd

IN BSME DEGREES AWARDED
according to the American Society for Engineering Education (ASEE).

EXTERNAL SPEAKERS

Dr. Chen-Fang Chang, GM Global Research & Development, *Automotive Powertrain Control: Opportunities and Challenges*

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

Dr. Jeffrey Doering, Ford Motor Company, *Driveline Input Shaping via Clutch Torque to Mitigate Shuffle After Lash Crossing*

Dr. Emmanuel Gdoutos, University of Thrace, Greece, *Multiscale Mechanical And Fracture Characterization Of Cementitious Nanocomposites*

Dr. Kahlid Hattar, Sandia National Laboratory, *In situ Nanoscale Testing to Validate and Elucidate Mechanism for Predictive Modelling*

Dr. Margot Hutchins, Sandia National Laboratory, *Building the Basis for Cybersecurity and Cyber Resilience in Critical Infrastructure*

Dr. Masahiro Kawaji, City College of New York, *Characterization of Gas-Liquid Two-Phase Flows in Micro to Nuclear Reactors*

Dr. Robert Keynton, University of Louisville, *Micro/Nanotechnologies for Field Deployable Environmental Sensing & Biomedical Applications*

Dr. Karen Krueger, Department of Orthopaedics, University of Iowa, *Computational and Experimental Biomechanics of Total Hip Wear Increase Due to Femoral Head Damage*

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

Dr. Dean Miller, Argonne National Laboratory, *Applications of Electron Microscopy to Materials for Energy*

Dr. J. G. Pharoah, Fuel Cell Research Centre, Royal Military College of Canada, Queen's University, *Multi-Scale Modelling Tools for Fuel Cell Development*

Dr. Fabio Semperlotti, University of Notre Dame, *Structural Dynamics Tailoring for Health Monitoring and Acoustic Metamaterials Applications*

Dr. Renu Sharma, National Institute of Standards and Technology, Center for Nanoscale Science and Technology, *Correlative Microscopy for in Situ Characterization of Catalyst Nanoparticles*

Dr. Ghatu Subhash, University of Florida, Gainesville, *Cavitation-Induced Damage in Brain Tissue and Surrogates: Relevance to TBI*

Dr. Nestor Voronka, Principal, M42 Technologies, *Space Tethers, Small Satellites, and System Engineering*

Dr. Karl Walczak, Lawrence Berkeley National Laboratory, *Artificial Photosynthesis Prototypes*

Dr. Chester Wilson, Louisiana Tech University, *Micro- and Nanotechnologies for Americas Strategic Challenges*

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

MICHIGAN TECH SPEAKERS

Andrew Barnard, ME-EM Assistant Professor, *From Carbon Nanotubes to Crowd Noise: An Overview of Interesting Topics in Acoustics*

Nancy Barr, ME-EM Communications and Senior Design Program Advisor, *Strong Communication Skills are Critical for Success*

Dr. Steven Elmer, Kinesiology and Integrative Physiology, *Positive Aspects of Negative Work*

Jaclyn Johnson, ME-EM Lecturer, *Vaporizing Diesel Spray Characteristics Studied in an Optically Accessible Constant Volume Combustion Vessel*

Daniel Kawano, Rose-Hulman Institute of Technology, *Advances in Decoupling*

Dr. Dong Hwan Shin, ME-EM post-doctoral fellow, *Local Aggregation Characteristics and Visualization of Intermediate Layers during Evaporation of Nanofluid Droplets*

Ye (Sarah) Sun, ME-EM Assistant Professor, *Human-Centered Monitoring: From Enabling Technology, Human Factor to Computational Diagnosis*

Dr. Amer Tahat, Computational Sciences and Engineering, *Prototype Verification System PVS: Cutting Edges Human-Machine Interactive Verification, Modelling and Analysis Software*

Jeremy Worm, ME-EM Research Engineer and Instructor, *Hands-On Education with the Michigan Tech Mobile Lab*

ORDER OF THE ENGINEER

FALL 2014

Gerald E. McGlynn III '84
Intellectual Property Attorney
Howard and Howard

SPRING 2015

Jeff Zawisza '85
Fellow
The Dow Chemical Company

GRADUATE STUDENT FELLOWSHIPS

SUMMER 2014–SPRING 2014

Finishing Fellowships
Ryan Lemmens
Seyedmehdi Morazavi Zanjani
Ranjeeth Naik
Anqi Zhang
Mehran Bidarvatan

Dean's Award for Outstanding Scholarship
Ranjeeth Naik
Gaurav Pandit
Anqi Zhang
Mehran Bidarvatan
Jordan Klinger
Udit Shrivastava

King-Chávez-Parks Future Faculty Fellowship
Alexander Miranda
Sterling Prince

ME-EM: BY THE NUMBERS

6

MECHANICAL ENGINEERING-FOCUSED STUDENT ORGANIZATIONS.

(American Society of Mechanical Engineers, Pi Tau Sigma, Michigan Tech Society of Women Engineers, Society of Automotive Engineers, Engineers Without Borders, and Women's Committee of American Society of Mechanical Engineers)

ME-EM **BS GRADUATES**

SUMMER 2014 (13)

Groen, John
Janczy, Andrew
Lay, Colin
McElreath, Timothy
McKenzie, Corey
Melcher, William
Meng, Fanxing - Cum Laude
Meske, Jordan
Ren, Zhehao
Sandvik, Sondre Kareliussen
Truong, Nghia
Wagner, Cylee
Yu, Te

FALL 2014 (58)

Abraham, Benjamin
Anderson, Patrick
Balbierz, Steven
Beyers, Nathan - Summa Cum Laude
Bruening, Rigel
Burns, William
Christensen, Zachary
Clement, Daniel
Croft, Dillon
Dalrymple-Kelly, Justin
Diao, Xin
DuMez, Tyler
Dvorak, Zachary
Dziuda, Brandon
Ekstrum, Kyle - Magna Cum Laude
Eliason, Chais
Erva, Taylor
Frey, Kathryn
Genord, Samuel - Cum Laude
Hages, Joshua
Hanson, Seth
Haugen, Kyle
Heenan, Ryan - Cum Laude
Hill, Shawn - Summa Cum Laude
Hillaker, John
Jarvey, Anne
Jaskolski, Jesse - Magna Cum Laude
Kangas, Ben - Cum Laude
Keech, Amanda - Magna Cum Laude
Lewis, Andrew - Cum Laude
Martinez, Gabriel
McAuliffe, Andrew
McGee, Alan
Michels, Samuel - Magna Cum Laude
Minteer, Martin
Niemi, Mark
Oberholtzer, Gary
Olsen, Tyler
Pennala, Bradley
Perigo, Ross - Cum Laude
Peterson, Riley - Magna Cum Laude
Pierce, Philip
Pietila, Eric - Cum Laude
Porter, Matthew - Magna Cum Laude
Roberts, Greg
Roberts, Wade
Sexton, Tyler
Shepherd, Douglas
Splittstoesser, Thomas
Tateosian, Alexandra - Magna Cum Laude
Tauchen, Benjamin - Magna Cum Laude
Thiel, Corey
Torres, Mark
VanDommelen, Derek
Vue, Long
Waggener, Jordan
Wang, Zhen - Cum Laude
Wenzel, Steven
Zheng, Da

SPRING 2015 (134)

Abate, Corey
Andor, Molli - Cum Laude
Antinossi, Marc
Baker, Jeffrey
Bancroft, Alexander - Cum Laude
Barber, Beau - Magna Cum Laude
Barber, Braden
Benaglio, Kristopher - Cum Laude
Berestetsky, Galina
Birr, Trevor
Blanchet, Christopher - Magna Cum Laude
Booth, Charles - Magna Cum Laude
Brechting, Anna - Cum Laude
Brock, Aaron
Buck, Jessica - Cum Laude
Buhr, Michael - Magna Cum Laude
Burg, Daniel
Cochrane, Dustin
Crepeau, Andrew
Daavettila, David
DeGroot, Christopher - Summa Cum Laude
Deibler, Adam
Demarais, Jacob
Dubie, Garrett
Dubiel, Zachary
Dupre, Aaron - Cum Laude
Dzwigalski, Michael - Magna Cum Laude
Evenson, Karl

ME-EM **BS GRADUATES**

ME-EM: BY THE NUMBERS

8th

IN MSME DEGREES AWARDED
according to the American Society for Engineering Education.

Farrell, Maxwell - Magna Cum Laude
Farrish, Megan
Ford, Nathaniel
Ford, Benjamin
Garrod, Andrew
George, Clayton
Giddens, Jonathan
Gielda, William
Giles, Autumn
Grady, Ryan
Greutman, Stephen
Harmon, Andrew
Harris, Bret
Haselhuhn, Stephanie - Cum Laude
Haupt, Brian - Magna Cum Laude
Herzog, Benjamin - Magna Cum Laude
Hill, Spencer - Cum Laude
Hoffmann, Jeremy
Holmes, Samuel - Magna Cum Laude
Holtz, Benjamin
Holzer, Patrick
Hurd, Sean
Jendrusina, Joseph
Jensen, Benjamin - Magna Cum Laude
Joffre, Dagny - Summa Cum Laude
Kallman, Samantha
Keithly, Dean - Magna Cum Laude
Kita, Michael - Cum Laude
Kizer, Joshua
Klotz, Maverick
Kolb, Benjamin - Magna Cum Laude
Koning, Rebekah
Krudy, Daniel
Kubista, Jordan Kuchta, Sean
Kuyper, Tyler
Lagowski, Arick - Cum Laude
Lane, Jani - Summa Cum Laude
Larson, James - Magna Cum Laude
Li, Dian
Li, Xiaohe
Locher, Jordan
Loew, Pattrick
Lord, Nicholas
Loubser, Chris - Summa Cum Laude
Ma, Teng
Mackey, Sean
Maley, Jonathon - Cum Laude
Mashak, John - Cum Laude
Matiash, Joshua - Cum Laude
Merzlyakov, Andrey
Miltenberger, Alexander
Mims, Jeremy
Morgan, Cameron
Morgan, Zachary - Summa Cum Laude
Niemi, Ivan
O'Brien, Kelsey - Summa Cum Laude
Olson, Stephen - Cum Laude
Page, Brian - Cum Laude
Pristov, Michael
Radtke, Jacob
Ragland, Parry
Raspel, Megan - Cum Laude
Rau, Noah
Rautio, Ethan
Regentik, Otto
Rizzo, Sophia
Roehm, Paul - Summa Cum Laude
Schaub, Martin - Magna Cum Laude
Scheetz, Nathaniel
Schlicker, Karl - Magna Cum Laude
Schlueter, Matthew - Summa Cum Laude
Schober, Kyle - Cum Laude
Schuman, John
Sekely, Clay
Shanahan, Kelly
Sieberg, Alex - Cum Laude
Sill, Nicholas
Sokol, Benjamin - Summa Cum Laude
Southerton, Lee
Steinbrueck, Alexander
Steinmetz, Timothy - Summa Cum Laude
Stevens, Richard - Magna Cum Laude
Stuhldreher, Spencer
Teall, Travis
Tissue, Tyler
Tromp, Nathan
Trupp, Daniel
Turner, Benjamin
Vermeer, Levi
Vincent, Tyler - Cum Laude
Vuorenmaa, Trevor
Wachlin, Erik
Wang, Yakun
Wang, Kaiquan
Waters, David - Summa Cum Laude
Wesoloski, Colton - Magna Cum Laude
Westcott, Zachary - Cum Laude
Whalen, Stephen
Wilhelm, Michael - Magna Cum Laude
Wilkening, Eric
Wojcik, Douglas - Magna Cum Laude
Xie, Jiyuan
Yagley, Joshua
Zhang, Jianfeng
Zheng, Qichen - Cum Laude
Zochowski, Nicholas - Cum Laude

SUMMER 2014 (15)

Agashe, Pushkar
Advisor: Bo Chen
Model-Based Design and Hardware-in-the-Loop Simulation of Internal Combustion Engine Control Systems

Ahmed, Fouad
Advisor: Craig Friedrich
Course work only

Ahmed Abdul Moiz, FNU
Advisor: Seong-Young Lee
Course work only

Badgujar, Pankaj
Advisor: Bo Chen
Integration of GT-POWER Model with dSPACE Vehicle Model for Co-Simulation and Validation

Bhute, Rohit
Advisor: Gregory Odegard
Course work only

Chinkanjanarot, Sorayot
Advisor: Gregory Odegard
Density of Amorphous Carbon by Using Density Functional Theory

Jain, Yash
Advisor: Craig Friedrich
Course work only

Kadam, Pratik
Advisor: Craig Friedrich
Course work only

Ketkale, Anupkumar
Advisor: Craig Friedrich
Course work only

Kolte, Akshay
Advisor: Craig Friedrich
Course work only

Munshi, Riten
Advisor: Craig Friedrich
Course work only

Nandrajog, Puneet
Advisor: Craig Friedrich
Course work only

Schmidt, Henry
Advisor: Jeffrey Naber
The Effect of Solid Deposit Formations on SI PFI Engine Performance and Control

Vasiliauskas, Andrew
Advisor: Craig Friedrich
Course work only

Wu, Shiran
Advisor: Craig Friedrich
Course work only

FALL 2015 (40)

Abhang, Chandrika
Advisor: Gopal Jayaraman
Measuring Head Impact Contact Pressure in Collegiate Football Games to Correlate Head Kinematics to Brain Kinetics Elucidating Brain Injury Dynamics

Adimulam, Sai Saagar
Advisor: Craig Friedrich
Course work only

Aluri, Aditya
Advisor: Craig Friedrich
Course work only

Bhavalkar, Abhishek
Advisor: Gopal Jayaraman
Course work only

Bista, Anuj
Advisor: Craig Friedrich
Course work only

Carter, Steven
Advisor: Charles Van Karsen
Test-Analysis Model Correlation and Calibration of a Multi-Component Plastic Part

Chadha, Anshaj
Advisor: Scott Miers
Effect of Fuel Spray Impingement on Engine Performance in a Gasoline TurboCharged Direct Injection (GTDI) Engine

Chalke, Jayant
Advisor: Craig Friedrich
Course work only

Chavan, Sagar
Advisor: Craig Friedrich
Course work only

Cheng, Han
Advisor: Kazuya Tajiri
Reproducing an Experiment to Measure the Saturation Curve for Porous Media Used for Electrochemical Applications

Cui, Xuebo
Advisor: Reza Shahbazian-Yassar
In-Situ TEM Plasma Chip Nanofabrication and Characterization

Garg, Akash
Advisor: Craig Friedrich
Course work only

Ghanegaonkar, Tanay
Advisor: Craig Friedrich
Course work only

Jackson, Brandon
Advisor: Lyon (Brad) King
Course work only

Kamble, Suyash
Advisor: Craig Friedrich
Course work only

Karmaker, Ratool
Advisor: Craig Friedrich
Course work only

Kleinendorst, Jamie
Advisor: Charles Van Karsen
Understanding Chassis Inputs from the Rear Suspension of a Snowmobile

Kothari, Deepak
Advisor: Mahdi Shahbakhti
Experimental Setup and Controller Design for an HCCI Engine

Mitchell, Anza
Advisor: Michele Miller
Course work only

Moridian, Barzin
Advisor: Nina Mahmoudian
Autonomous Power Distribution Systems

Narang, Dheeraj Kumar
Advisor: Craig Friedrich
Course work only

Nikhil Shankar, FNU
Advisor: Amitabh Narain
An Assessment of Flow Regime Maps and a Numerical Heat Transfer Correlation for the Stratified/Annular Regime of Shear-Driven Internal Condensing Flows

Norris, Donald
Advisor: Michele Miller
Water Access and Maintenance in Karonga, Malawi

Pandit, Gaurav
Advisor: Craig Friedrich
Course work only

Paranjape, Madhura Nandan
Advisor: Mahdi Shahbakhti
Optimal Control of Building Energy with Smart-Grid Interaction

Pasupathy, Jayadev
Advisor: Mahdi Shahbakhti
Course work only

Pathak, Mayuresh
Advisor: Charles Van Karsen
A Study of Acoustic Cavity Boom Generation Due to Vibro-Acoustic Coupling in Passenger Cars

Quan, Wei
Advisor: Craig Friedrich
Course work only

Ramya Chandrasekaran, FNU
Advisor: Craig Friedrich
Course work only

Ranadive, Tejas
Advisor: Craig Friedrich
Course work only

Saigaonkar, Hrishikesh
Advisor: Mahdi Shahbakhti
An Investigation of Variable Valve Timing Effects on HCCI Engine Performance

Sawant, Nikhil
Advisor: Craig Friedrich
Course work only

Sharma, Rahul
Advisor: Craig Friedrich
Course work only

Shinde, Sachin Pandurang
Advisor: Gregory Odegard
Development of Conformable CNG Tank for Automotive Application

Singireddy, Anusha Reddy
Advisor: Craig Friedrich
Course work only

Thakkar, Vishal
Advisor: Mahdi Shahbakhti
Modeling and Experimental Setup of an HCCI Engine

Wadhwa, Nikhil
Advisor: Craig Friedrich
Course work only

Yang, Zhuyong
Advisor: Jeffrey Naber
Impact of Cam Splay Angle in a Spark Ignited Engine with Variable Valve Timing

Yuan, Kunwen
Advisor: Craig Friedrich
Course work only

Zakkam, Raviteja Reddy
Advisor: Craig Friedrich
Course work only

SPRING 2015 (58)

Aitken-Palmer, Wade
Advisor: Michele Miller
A Market-Based Approach to 3D Printing for Economic Development in Ghana

Bachu, Pruthvi Ravi Raj
Advisor: Craig Friedrich
Course work only

Bhide, Aniruddha
Advisor: Craig Friedrich
Course work only

Bhogle, Sanket
Advisor: Fernando Ponta
Advanced Computational Modeling of the Internal Structure of Smart Wind-Turbine Blades

Cao, Yue
Advisor: Craig Friedrich
Course work only

Chendvankar, Prathamesh
Advisor: Jeffrey Naber
1D Simulation of Direct Water Injection in a Spark Ignited Engine

Desai, Swapnil
Advisor: Gordon Parker
Course work only

Deshpande, Nimish
Advisor: Fernando Ponta
Computational Analysis of the Aeroelastic Dynamics of a Wind Turbine Blade with Variable-Speed Stall

Fatate, Tanmayee
Advisor: Craig Friedrich
Course work only

Gohad, Koustubh
Advisor: Craig Friedrich
Course work only

Haldar, Souman
Advisor: Jeremy Worm
Development and Validation of a Radtherm Model to Predict Exhaust System Behavior for a Hybrid XM1124 HMMWV

Hale, Kevin
Advisor: Michele Miller
A Field Investigation of Composite Mud Brick Compressive Strength

Hao, Sinan
Advisor: Craig Friedrich
Course work only

Heuvers, Joseph
Advisor: Craig Friedrich
Course work only

Hong, Yuanzhou
Advisor: Craig Friedrich
Course work only

Jadhav, Pranav Babasaheb
Advisor: Craig Friedrich
Course work only

Jadhay, Prathamesh Balasaheb
Advisor: Craig Friedrich
Course work only

SPRING 2015 (cont.)

Jagtap, Saili Dilip
Advisor: Gopal Jayaraman
Course work only

Jaju, Narayan
Advisor: Craig Friedrich
Course work only

Jaya Prakash, Deepika
Advisor: Craig Friedrich
Course work only

Jiang, Lingyu
Advisor: Craig Friedrich
Course work only

Joshi, Jeetendra
Advisor: Craig Friedrich
Course work only

Kang, Ruiyu
Advisor: Mohammad Rastgaar Aagaah
Course work only

Khodadadi Sadabadi, Kaveh
Advisor: Mahdi Shahbakhti
Modelling and Control of Combustion Phasing of an RCCI Engine

Kurian, George
Advisor: Craig Friedrich
Course work only

Mahajan, Kishor
Advisor: Craig Friedrich
Course work only

Meruva, Prathik
Advisor: Craig Friedrich
Course work only

Mysore Srinivasa, Karthik
Advisor: Ossama Abdelkhalik
Spacecraft Attitude Control Using Magnetic Actuators

Ni, Huajun
Advisor: Craig Friedrich
Course work only

Nutulapati, Harshith
Advisor: Craig Friedrich
Course work only

O'Toole, Amanda
Advisor: Lyon (Brad) King
Course work only

Pandey, Amit
Advisor: Craig Friedrich
Course work only

Pandita, Ashish
Advisor: Craig Friedrich
Course work only

Panickar, Ronak
Advisor: Craig Friedrich
Course work only

Pargaonkar, Isha Nitin
Advisor: Craig Friedrich
Course work only

Parmar, Janak
Advisor: Jeffrey Naber
Single Cylinder Engine Studies with Nostrum Impinging Fuel Injector with Variable Start of Injection and Determination of Fuel Vaporization with Skip Injection

Patel, Tejas Dasharathbhai
Advisor: Craig Friedrich
Course work only

Patil, Rohan
Advisor: Craig Friedrich
Course work only

Pawade, Vaishnavi
Advisor: Craig Friedrich
Course work only

Petluru, Sai Srinivas Chakravarthy
Advisor: Craig Friedrich
Course work only

Razmara, Meysam
Advisor: Mahdi Shahbakhti
Model Predictive Control of Building HVAC Systems

Saparia, Parimal
Advisor: Craig Friedrich
Course work only

Shelar, Amol
Advisor: Craig Friedrich
Course work only

Shen, Pengyun
Advisor: Craig Friedrich
Course work only

Sheth, Nirag
Advisor: Ossama Abdelkhalik
Course work only

Shinde, Devendra
Advisor: Craig Friedrich
Course work only

Song, Jiajun
Advisor: Craig Friedrich
Course work only

Song, Xiaoyu
Advisor: Michele Miller
Improved Sensitivity of Resonant Mass Sensor Based on Micro Tilting Plate and Micro Cantilever

Sridhar, Vinaya
Advisor: Craig Friedrich
Course work only

Sumannth Nagendran, FNU
Advisor: Craig Friedrich
Course work only

Sun, Shishan
Advisor: Craig Friedrich
Course work only

Therakathu, Alex
Advisor: Craig Friedrich
Course work only

Umarani, Bageshree
Advisor: Craig Friedrich
Course work only

Upreti, Aadarsh
Advisor: Craig Friedrich
Course work only

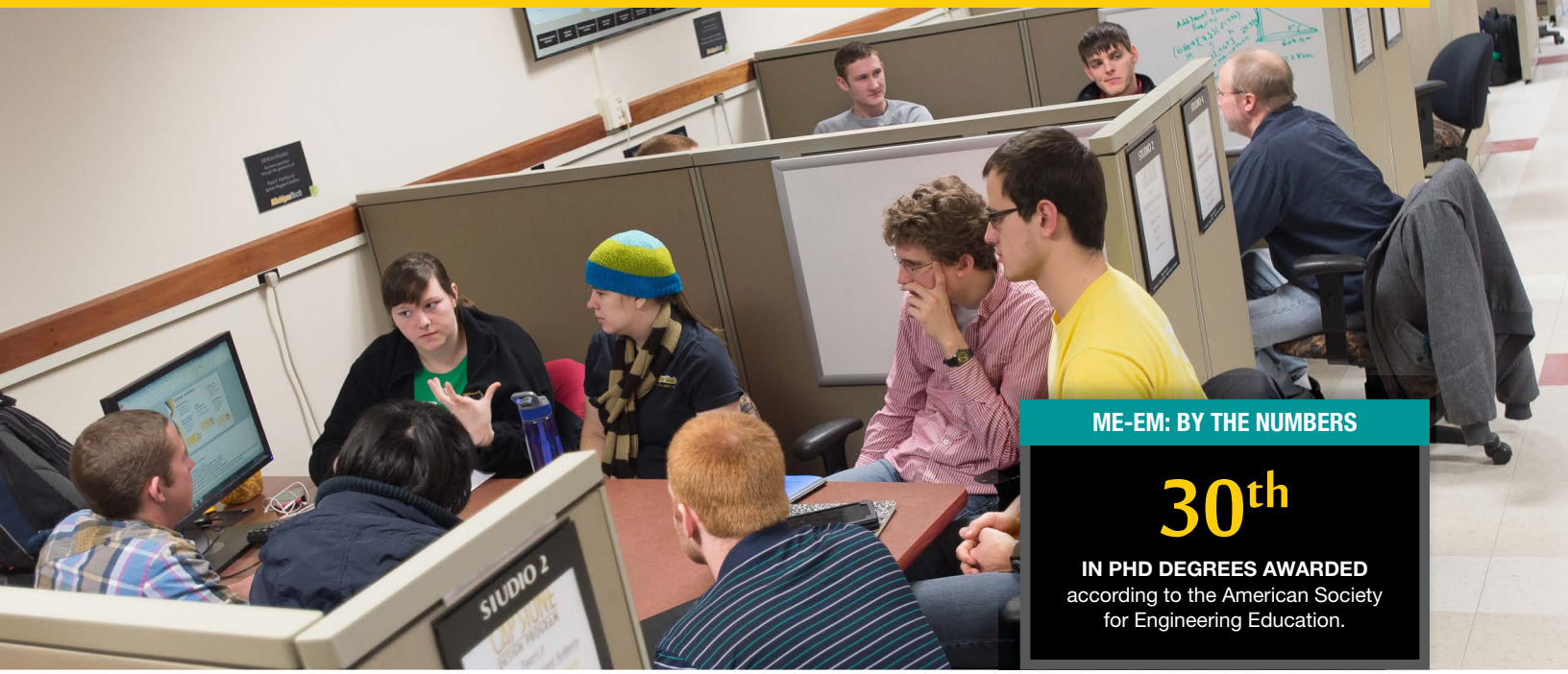
Wang, Luting
Advisor: Bo Chen
Course work only

Ye, Xiaofan
Advisor: Craig Friedrich
Course work only

Zhang, Jiongxun
Advisor: Jeffrey Naber
Optical Access Engine Setup and Validation

Zhao, Yu
Advisor: Scott Miers
Effect of Intake Expansion Chamber Volume on Engine Performance Parameters

ME-EM **PHD GRADUATES**



ME-EM: BY THE NUMBERS

30th

IN PHD DEGREES AWARDED
according to the American Society for Engineering Education.

SUMMER 2014 (2)

Hamlekhan, Azhang
Advisor: Tolou Shokuhfar
Co-advisor: Cortino Sukotjo
Fabrication of Drug Eluting Ti Implants for Dental/Orthopedic Applications

Lemmens, Ryan
Advisor: Desheng Meng
Co-advisor: Qingli Dai
Microfluidic Encapsulation for Self-Healing Material and Investigation of its Impacts on Composite Performance

FALL 2014 (9)

Jenkins, Timothy
Advisor: John Sutherland
Size Optimization of a Biomass to Liquid Fuel Conversion Facility within a Biomass Supply Chain

Kale, Vaibhav
Advisor: Jeffrey Naber
Improving Startability and Reducing Emissions in Flexfuel Spark Ignition Direct Injection Variable CAM Timing Engine

Luo, Wei
Advisor: Bo Chen
Study of Real-Time Stochastic Knock Detection and Control for Spark-Ignition Engines

Meyer, Edmond
Advisor: Lyon (Brad) King
Development of an Ionic Liquid Ferrofluid Electrospray Source and Mode Shape Studies of a Ferrofluid in a Non-Uniform Magnetic Field

Mortazavi Zanjani, Seyedmehdi
Advisor: Kazuya Tajiri
Water Transport Through Porous Media and in Flow Channels of Proton Exchange Membrane Fuel Cell

Rizzo, Denise
Advisor: Gordon Parker
Military Vehicle Optimization and Control

Taheri, Ehsan
Advisor: Ossama Abdelkhalik
Rapid Space Trajectory Generation Using a Fourier Series Shape-Based Approach

Tewari, Radheshyam
Advisor: Craig Friedrich
A Backing Device Based on an Embedded Stiffener and Retractable Insertion Tool for Thin-Film Cochlear

Zhang, Anqi
Advisor: Seong-Young Lee
Combustion Initiation by Electrical-Discharge-Induced Plasma in Lean and Dilute Methane-Air Mixture: Experimental and Modeling Investigation

SPRING 2015 (5)

Chang, Jen-Yung
Advisor: Chang Kyoung Choi
Microfluidic Diode Pumping (Part I) and Rapid Detection of Stem Cell Differentiation using Indium Tin Oxide Opto-Electric Sensing (Part II)

Geng, Xiaobao
Advisor: Desheng Meng
Self-Adaptive Thermal Management - The Fundamentals and Applications in Li-Polymer Batteries

Hadden, Cameron
Advisor: Gregory Odegard
Molecular Modeling of Epon 862-DETDA/Carbon Composites

Hopkins, Mark
Advisor: Lyon (Brad) King
Evaluation of Magnesium as a Hall Thruster Propellant

Kivisalu, Michael
Advisor: Amitabh Narain
Experimental Investigation of Certain Internal Condensing and Boiling Flows: Their Sensitivity to Pressure Fluctuations and Heat Transfer Enhancements

YOUNG INVESTIGATOR **PROGRAM AWARD**

NINA MAHMOUDIAN'S RESEARCH focuses on how to keep underwater robots under water longer and with better performance.

"Improving AUVs will help a variety of missions in the Navy, and my work can make long-term observation in hard-to-reach places possible."

—NINA MAHMOUDIAN

Only 36 faculty across the US were invited to join the Young Investigator Program (YIP) from the Office of Naval Research this year; additionally, only a small percent of faculty receive the CAREER Award from the National Science Foundation (NSF). Nina Mahmoudian, an assistant professor of mechanical engineering-engineering mechanics at Michigan Technological University, is one of a select few to receive both in the same year.

"To be selected for the prestigious NSF CAREER award is a major accomplishment in itself," says Bill Predebon, the chair of the Department of Mechanical Engineering-Engineering Mechanics at Michigan Tech. "Being selected for the Young Investigator Program in the same year puts her in a small group of very talented faculty in the US."

Mahmoudian's work in underwater robotics earned her the awards, both of which are granted to early career researchers. Specifically, Mahmoudian's research focuses on the continuous operation of autonomous vehicles—in other words, how to keep underwater robots under water for longer and with better performance. The NSF CAREER Award funding, a total of $681,124, allows Mahmoudian to dive deeper into the mechanical challenges of long-term coordination of a fleet of Autonomous Underwater Vehicles (AUVs).

"Improving AUVs will help a variety of missions in the Navy, and my work can make long-term observation in hard-to-reach places possible," Mahmoudian says. AUVs can be used not only for underwater environmental monitoring, but they also can scope out unsafe waters, monitor war zones, disarm bombs and move supplies.

The vehicles Mahmoudian and her team work with at her Nonlinear and Autonomous Systems Laboratory (NAS Lab) are often deployed in fleets, which she compares to a school of fish. And like a school of fish—moving in coordinated masses with dexterity—Mahmoudian says she wants her machines to be efficient. To do so requires overcoming a number of hardware and software challenges; the biggest limitation right now is energy efficiency.

Even high-end AUVs can only manage a matter of hours underwater currently. They need to refuel or charge batteries, and the time it takes—along with the human intervention—costs a pretty penny. Improving AUV undersea persistence, how long the machines can stay underwater, is a key part of Mahmoudian's research. She says that persistence hinges on the ability to recharge. Establishing stable recharging cycles has to meet specific technical challenges and has to contend with physical and environmental constraints.

The goal is to create an architecture that integrates three elements: energy, communication and docking, to guarantee undersea persistence where limited power resources are available. Having multiple static charging stations underwater in the area of operation is an approach that Mahmoudian plans to assess along with developing mobile charging systems for underwater.

To make this happen, Mahmoudian will work with researchers at the Great Lakes Research Center and the Center for Agile Interconnected Microgrids, both at Michigan Tech.

WINNING SENIOR DESIGN TEAM, L-R: Jessica Buck, Sean Mackey, Sophia Rizzo, Nicholas Sill (in the back), John Schuman, Joshua Kizer (wearing the suit), Jaclyn Johnson, Mikhail Alexander, Kevin Johnson, and Bill Endres, Director of Senior Design Capstone Program.

ME-EM UNDERGRADUATES WIN AFRL UNIVERSITY DESIGN CHALLENGE

It's hot in the desert, where many American military men and women serve. By designing a cooling apparatus to wear in such climates, one of Michigan Technological University's Mechanical Engineering Senior Design teams may help countless suffering soldiers.

Their design won first place in the Air Force Research Lab University Design Challenge.

The Michigan Tech team competed with 15 other universities and three military service academies. As the top-ranked team, they brought home a traveling trophy—theirs to keep until next year's competition—and the satisfaction of knowing that their work may someday help soldiers serving in difficult circumstances overseas.

Student team members include Mikhail Alexander, Jessica Buck, Joshua Kizer, Sean Mackey, Sophia Rizzo, John Schuman and Nicholas Sill. Faculty advisors to the team are Jaclyn Johnson, a lecturer in ME-EM and Kevin Johnson, a ME-EM research engineer and scientist.

The heat stress prevention kit they developed includes a small fan that blows air through a soldier's gear, using separation pads under their armor to help the air circulate and force evaporation to cool them more efficiently.

Team member John Schuman has an insider's appreciation for the project. He served for four years as an infantryman in the US Marine Corps, including a deployment to Iraq. "I had experienced combat situations in extremely hot conditions," Schuman says. "The challenge was how to make a device that could actually keep someone cool in one of the hottest regions of the world, but be small and light enough that it could easily integrated into the operator's current combat equipment. These troops are already carrying 90-130 lbs of equipment, so it was crucial to keep the size and weight down."

The device the team came up with uses current battle gear and the body's natural cooling mechanism, enhancing each to help cool the person. "It's something I wish I'd had while I was overseas," says Schuman. "It is one less thing a soldier, sailor, airman or Marine has to worry about while on a combat patrol."

CHRISTOPHER DUKE (fourth from the left) and the RAM Tailgate Structure & Accessory senior design team, L-R: Christian Vreeland, Thomas Gruber, Evan Rosemore, Taylor Erva, Kraig Kadletz, Andrew Pospychala, Chad Dickenscheid, and Greg Reed.

CHRISTOPHER DUKE: NINETEEN SENIOR DESIGN PROJECTS AND COUNTING

Christopher Duke '95 is Design Responsible Manager, Rear Closures at Fiat Chrysler Automobiles (FCA), where he brings the vision of lightweight closures architecture into reality. Duke is FCA's representative on the ME-EM department external advisory board, and the FCA lead for senior design projects. Thanks to Duke, FCA has sponsored no less than 19 senior design projects over the last five years at Michigan Tech.

Duke explains; "Michigan Tech has a world class senior design program that blends theory with practice which sets it apart from other universities. The experience is extremely valuable to both the students and the company. We use the program as an incubator for developing new out-of-the-box ideas which the Michigan Tech students excel at due to their technical proficiency and creativity. It also creates recruiting opportunities for FCA while bolstering our image on campus as an employer of choice."

Projects in the ME–EM Department in recent years: Ram Tailgate Structure & Accessory, Lightweight POP Rivet Gun, Roadside Repair Module, Pickup Truck Bed Side-Access Design, B-Pillar Revision Project, Chrysler 300 Split Tailgate, and Automatic Loading and Unloading Gravity Flow Rack System.

NEW **FACULTY**

ANDREW BARNARD, PHD

Dr. Barnard joins the ME-EM Department as an assistant professor. He comes to Michigan Tech from Penn State University where he was a research associate in the Applied Research Laboratory. Barnard earned a master's in mechanical engineering at Michigan Tech and a PhD in Acoustics from Penn State. He is a member of the Acoustical Society of America and a board-certified member of the Institute for Noise Control Engineering.

ANTONIO GAUCHIA, PHD

Dr. Gauchia joins the ME-EM Department as a senior lecturer. He comes to Michigan Tech from University Carlos III of Madrid (Spain), where he taught and developed mechanical engineering courses with a special emphasis in vehicle dynamics. His teaching and research interests are focused on the automotive and material handling fields, in particular the experimental testing and modeling of vehicles, vehicle safety (rollover threshold prediction), and hybrid electric vehicle power train.

JACLYN JOHNSON, PHD

Dr. Johnson joins the ME-EM Department as a lecturer. Previously, she was an instructor and research staff member at Michigan Tech. Johnson earned a PhD in Mechanical Engineering–Engineering Mechanics and a Master's in Mechanical Engineering at Michigan Tech. Her teaching interests are energy thermofluids and solid mechanics. Her research interests are in combustion, diesel spray characteristics and structure, and fundamental spark ignition studies of gaseous fuels.

NEW **FACULTY**

ANEET NARENDRANATH, PHD

Dr. Narendranath joins the ME-EM Department as a lecturer. He was a visiting assistant professor. Narendranath has a PhD in Mechanical Engineering–Engineering Mechanics from Michigan Tech. He held numerous leadership roles at Michigan Tech while a graduate student, including secretary of the Daniell Heights Apartment Council and president of the Indian Students Association. He belongs to the American Society of Mechanical Engineers and the American Physical Society.

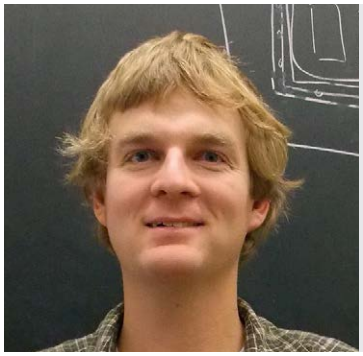
YE (SARAH) SUN, PHD

Dr. Sun joins the ME-EM as an assistant professor. Sun comes to Michigan Tech from Case Western Reserve University. She received a PhD in Electrical Engineering from Case Western Reserve University and a bachelor's in precise instrumentation of measurement and control from Tianjin University. Sarah has worked on two National Science Foundation projects. She is a member of the IEEE, the American Society of Mechanical Engineers and the International Society of Optical Engineering.

RADHESHYAM TEWARI, PHD

Dr. Tewari joins the ME-EM Department as a lecturer and graduate seminar series coordinator. Previously he was an instructor at Michigan Tech. Tewari received two degrees from Michigan Tech, an MS and a PhD in Mechanical Engineering, and holds a bachelor's in mechanical engineering from Maulana Azad National Institute of Technology in India. He has three years of industry experience in machining processes, production planning, quality engineering and total productive maintenance. Tewari also has research experience using semiconductor fabrication and metrology tools for micro/nano-manufacturing.

NEW **STAFF**



PAUL DICE

Paul Dice joined the ME-EM Department as a Mechanical Engineering Researcher and Manager of the Advanced Power Systems Research Center (APSRC).

MICHAEL GOLDSWORTHY

Michael Goldsworthy joined the ME-EM Department as a Senior Capstone Design Training Specialist.

JONATHAN LUND

Jonathan Lund joined the ME-EM Department as a Machine Shop Attendant.

EZEQUIEL MEDICI

Ezequiel Medici joined the ME-EM Department as a Research Engineer.

CHRIS PINNOW

Chris Pinnow joined the ME-EM Department as an Electronics/ Computer Technician.

HENRY SCHMIDT

Henry Schmidt joined the ME-EM Department as a Mechanical Engineering Researcher and Manager of the Advanced Energy Research Building (AERB).

CHERYL SIMPKINS

Cheryl Simpkins joined the ME-EM Department as an Office Assistant.

FACULTY & STAFF **AWARDS**

FRIEDRICH NAMED ASME FELLOW

Professor Craig Friedrich has been elected a Fellow of the American Society of Mechanical Engineers. William Predebon, chair of Michigan Tech's Department of Mechanical Engineering-Engineering Mechanics, said Friedrich was recognized for his "outstanding contributions in mechanical micromilling for micro-device packaging, micro heat exchangers and fluidic interconnects, deep x-ray lithography masks and biomedical implants."

Predebon, who nominated Friedrich, said "Dr. Friedrich is not only an outstanding researcher and engineer, he is also a leader in his profession and in the ME-EM department as the associate chair and director of graduate studies."

Friedrich said it is gratifying to have been formally recognized by such an esteemed professional society and by the support of peers and colleagues over nearly three decades. "To be honored in such a way shows that it isn't a single day that defines success but rather the years of hard work that precedes it."

DR. OSSAMA ABDELKHALIK promoted to associate professor with tenure.

DR. JEFFREY ALLEN promoted to professor with tenure.

DR. ANDREW BARNARD named to the board of directors for the Institute for Noise Control Engineering (INCE-USA).

NANCY BARR appointed to a national advisory board to develop a digital learning platform called Core Grammar for Engineers run by Carnegie Mellon, Stanford, and UNC-Chapel Hill, and based off the Core Grammar for Lawyers program.

Dr. CHANG KYOUNG CHOI promoted to associate professor with tenure.

DR. JAMES DECLERCK selected as a 2014 SAE Outstanding Faculty Advisor for his work with the Michigan Tech SAE Formula Car Enterprise team.

DANISE JARVEY nominated for the Michigan Tech Staff Council Making a Difference/Serving Others Award.

DR. JOHN JOHNSON selected by the National Research Council (under the National Academies) to chair the Committee on the Review of the 21st Century Truck Partnership, Phase 3.

STEVEN LEHMANN nominated for the Michigan Tech Staff Council Making a Difference/Rookie Award.

DR. SCOTT MIERS promoted to associate professor with tenure. Received the Michigan Tech 2014 Distinguished Teaching Award in the assistant professor/lecturer category. Received the ME-EM Department Teacher of the Year Award, chosen by a vote of students. This is the second time he has received the award.

DR. MICHELE MILLER promoted to professor with tenure.

DR. GREGORY ODEGARD promoted to professor with tenure. Named ME-EM Associate Chair and Director of Undergraduate Studies. Received the ME-EM Department Exceptional Graduate Student Mentor Award.

DR. GORDON G. PARKER selected as a 2014 Fellow of Society of Automotive Engineers International.

DR. WILLIAM W. PREDEBON awarded the Dedicated Service Award by the American Society of Mechanical Engineers. Received the 2015 Michigan Tech Diversity Award.

DR. MOHAMMAD RASTGAAR promoted to associate professor with tenure.

DR. RUSH D. ROBINETT III received the Outstanding Aerospace Engineer Award by the Department of Aerospace Engineering at Texas A&M University Aerospace Alumni Academy.

DR. REZA SHAHBAZIAN-YASSAR headed a team of researchers successful in securing the funding to purchase a $1.7M, state-of-the-science transmission electron microscope (TEM).

DR. TOLOU SHOKUHFAR recipient of Insight Into Diversity magazine's 100 Inspiring Women in STEM Award.

DR. PAUL VAN SUSANTE promoted to senior lecturer.

DR. CARL VILMANN recognized by Michigan Tech for 35 years of service.

RYAN TOWLES nominated for the Michigan Tech Staff Council Making a Difference/Serving Others Award.

ME-EM **ACADEMY***

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
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 ME-EM 1981
Jack Real, BSME 1939
James Reum, BSME 1953
Dan Rivard, BSME 1959
Richard Robbins, BSME 1956
Dale Roberto, BSME 1969
Vijay Sazawal, PHD 1975
Harold Schock, BSME 1974, PhD EM 1979
Fred Sherriff, BSME 1963
James Sorenson, BSME 1960, MSEM 1961
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
Dr. Terry Woychowski, BSME 1978
Hussein Zbib, BSME 1981, MSME 1983, PhD ME-EM 1987

* Only Michigan Tech degrees listed

ME-EM **PCA MEMBERS**

REBECCA UFKES AND MELISSA MARSZALEK are the most recent ME-EM alumnae to be inducted into the President Council of Alumnae at Michigan Tech (PCA).

REBECCA UFKES

Rebecca Ufkes graduated from Michigan Tech in 1987 with a BS degree in mechanical engineering. She joined Kaman Aerospace in Broomfield, Connecticut, and then took a position with Sikorsky Aircraft. She remained with Sikorsky as a consultant while starting Ufkes Engineering after a move to South Carolina in 1990.

In 1994 Rebecca earned an MBA from The Citadel and in 1995 partnered with her husband, Phillip Ufkes, BSEE '86 (also a Michigan Tech grad) to expand Ufkes Engineering into UEC Electronics, where Rebecca now serves as President and Philip is Vice President of Technology and Chief Technology Officer. UEC provides product development, prototyping, and comprehensive manufacturing services to aerospace, defense, medical, and industrial markets. UEC's OEM product line includes renewable/hybrid energy and power distribution management systems.

Rebecca also serves on the Board of Directors of the Charleston Metro Chamber of Commerce, and on the Advisory Board for The Citadel's School of Engineering and SunTrust Bank. She is actively involved in the Charleston Defense Contractors Association and STEM initiatives within the local academic community. She has been recognized over the years for numerous achievements including the White House "Champion of Change" Award for Innovation & Manufacturing (2012), the South Carolina Small Business Person of the Year (2010), and the US Small Business Award for Excellence.

Rebecca and her husband, Philip, have two children, Nicole and Jacob. They reside in Sullivan's Island, South Carolina.

ME-EM **PCA MEMBERS**

MELISSA MARSZALEK

Along with the Certificate in International Business she received in 2000, Melissa Marszalek earned two Bachelor of Science degrees, Mechanical Engineering and Business Administration, in 2001. In addition to her Michigan Tech education, she attended the Engineering College of Copenhagen in 2001 for her Mechanical Engineering senior design project and graduated from the International Business Linkage Program at Helsinki University of Technology in 1999.

After graduation Melissa accepted a position with Caterpillar Inc. in Mossville, Illinois as a Commercial Engines Service Representative. After spending a year and a half at Caterpillar Inc. she returned to Michigan Tech to pursue a Master of Science degree in Mechanical Engineering, which she received in 2006. She was hired by The Boeing Company to work in various areas supporting Structures, Interiors and Propulsion commodities of commercial airplane programs. Throughout her years with Boeing Melissa has been invited to participate in several career advancement and leadership opportunities including the Engineering Leadership Program.

Since 2011, Marszalek has been in management, most recently within the Manufacturing Technology Integration and Program Support organization for the Boeing Research and Technology division.

As a student at Michigan Tech she received the Woman of Promise award in 2005. She was also very active in outdoor life, serving as the Assistant Director of the annual Keweenaw Chain Drive Festival and as a SHINE Program Leader promoting youth mountain biking activities in the local Houghton community. Melissa serves on the ME-EM Department's External Advisory Board.

Within her community, Melissa is involved with the American Cancer Society's Seattle Hope Gala, Aviation Day sponsored by the Boy Scouts of America/Alaska Airlines, and the "Making Engineering Cool Again" (MECA) program in the Puget Sound area. She resides in Seattle, Washington.

ME-EM **PCA MEMBERS** (as of Fall 2015)

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 L. 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
RePaula Zenner

ME-EM: BY THE NUMBERS

30

THE NUMBER OF PRESIDENTIAL COUNCIL OF ALUMNAE members who are graduates of the ME-EM department.

2015 **OUTSTANDING YOUNG ALUMNA**

BRITTA JOST was also named the Distinguished New Engineer by the Society of Women Engineers in 2014.

BRITTA A. JOST, CATERPILLAR

Britta Jost earned a BS in Mathematics in 2002 and MS in Mechanical Engineering in 2004. She joined Caterpillar Inc. in 2005 and is currently a senior engineer in large structures design engineering. She is Caterpillar's lead engineering recruiter at Tech and as such, her duties include selecting, training and organizing teams of interviewers and hosts and managing the relationship between Caterpillar Inc. and Michigan Tech.

In her current role at Caterpillar Inc., Jost has design control responsibility for D6 track-type tractor chassis components worldwide. Her goals are to provide new, quality designs; to work with the product support and manufacturing areas to provide timely resolutions to field and production problems; and to pursue cost reduction initiatives.

In her first few years at Caterpillar Inc.Jost worked in the dynamic simulation area, where she built on her academic study of dynamic systems modeling by using internally-developed simulation software to build and run computer models of track-type tractors. Her simulations were used to evaluate operator comfort, performance and tractor durability.

In 2008 she accepted a developmental assignment as a test engineer at Caterpillar's Proving Ground. She designed tests and collected data that validated the computer models she once built. In 2010 Jost coordinated and implemented all D7E track-type tractor product improvements on D7E field machines for the waste industry, working with customers to develop solutions to improve the tractor's performance in trash. She was named co-inventor on three patents, two which were granted and one that is pending approval.

In addition to her technical experience, Jost has been a dedicated, active member of the Society of Women Engineers (SWE). In 2014 she was named SWE Distinguished New Engineer, and award that recognizes a SWE member with less than ten years of experience for her SWE leadership, work accomplishments, and community service. She has served the Central Illinois section as President-Elect, President and Section Representative, and received her section's Distinguished Member award in 2012. She is currently the society's Membership committee chair and is Counselor for the Michigan Tech SWE section.

Her community service commitment is strong, as demonstrated by her work as a Court Appointed Special Advocate (CASA) for children. As a CASA, she is specially trained and appointed by the judge to advocate for abused and neglected children. Over the past six years, she has advocated for two sets of siblings, logging over 600 hours of volunteer work on her cases. She was named one of Peoria's 40 Leaders Under Forty in 2013.

She is married to fellow engineer Jeff Jost and they have a daughter, Liesl, who is 4 years old, and an infant son, Warner.

ME-EM **EXTERNAL ADVISORY BOARD**

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 CHAUDINARD
Altair Engineering

BRIAN DEMOS
American Axle & Mfg.

CHRISTOPHER DUKE
Chrysler

ALEXA ELLSWOOD
General Motors

ALAN FRANK
Whirlpool Corporation

JAMES HELDT
Mercury Marine

MICHAEL HOFMAN
Roush Industries

COLLEEN L. JONES-CERVANTES
Chevron Corp

DR. SHASHI KARNA
US Army Research Laboratory

DR. FRANK LEBAN
Naval Surface Warfare Center

JOHN LEINONEN
Exponent

KEVIN MANOR
Toyota Motor Sales

MELISSA MARSZALEK
Boeing

MARK MASCO
Bayer MaterialScience

BRENDA MOYER
Dana Corporation

SETH NEWLIN
Oshkosh Corporation

CHRISTOPHER OBERSKI
Ford Motor Co.

CHRISTINE ROBERTS
Motorola

DR. PAUL ROGERS
US Army

PETER SANDRETTO
Chrysler

JENNIFER TRICE
3M Corporation

JASON VERBOOMEN
Kimberly-Clark

BRIAN WELLER
Caterpillar Inc.

PAUL D. WICZYNSKI
Cummins Inc.

JEFF ZAWISZA
Dow Chemical Co., Co-Chair

DR. HUSSEIN M. ZBIB
Washington State University

2014 - 2015 **ME-EM DONORS**

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 2014 to April 2015** are listed below. This year the company matching gifts are included with the individual gift.

$100,000–$2,500,000

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John '64 & Cathi Drake
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Patricia Smith

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Susan Spruit
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Michael '07 & Mary Brunet
Herman '55 & Ruth Brunke
J. Dale '06 & Juliann Bulinski
Daniel '82 & Connie Burke
John '66 & Gai Burnett
William '08 & Katherine Burr
Michael '96 & Illeana Byers
Thomas '59 & Barbara Carlson
James '89 & Jean Carow
David & Amy Chard
Rodney '74 & Teresa Chervus
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Philip '81 & Anna Jerzyk
Roger '09 & Jennifer Johnson
William Jones '65
Nicholas '95 & Kelly Jordache
Jeffrey Katalenich '09
Mark '89 & Claire Kearby
Robert '58 & Shigeko Keefer
David Kemmer '07
Timothy '91 & Laura Kilbride
William '59 & Patricia Kincaide
John '05 & Joyce Kline
Nathan Koetsier '13
Stephen '63 & Audrey Kohel
Stephen '83 & Kris Kolpacke
Steven '84 & Mary Ann Kuehl
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ADVANCED POWER SYSTEMS $5,460,925

TITLE	NAME	SPONSOR	AWARD
NSF/DOE Partnership on Advanced Combustion Engines: Ignition and Combustion Characteristics of Transportation Fuels under Lean-Burn Conditions for Advanced Engine Concepts	PI: Seong-Young Lee Co-PI: Jaclyn Johnson	National Science Foundation	$712,274
Torrefied Wood Biofuel	PI: William Predebon	Michigan State University	$2,435
Chrysler Spray Test	PI: Jeffrey Naber Co-PIs: Seong-Young Lee; Jaclyn Johnson	Chrysler Group, LLC	$176,046
Cummins Vehicle Test Apparatus	PI: Jeffrey Naber Co-PI: Kazuya Tajiri	Cummins, Inc	$12,500
Closed Loop Combustion Control (CLCC) for SI Engines	PI: Jeffrey Naber Co-PI: Bo Chen	Ford Motor Company	$86,861
Nostrum Injector Evaluation and Validation on a Single Cylinder DI SI Engine with Exhaust	PI: Jeffrey Naber Co-PI: Paul Dice	Nostrum Energy, LLC	$59,089
Nostrum Engine Dynamometer Studies and Analysis of Nostrum Cycle and Injectors on Cummins 6.7L ISB Diesel Engine	PI: Jeffrey Naber Co-PI: Paul Dice	Nostrum Energy, LLC	$128,090
Hitachi NG Gasoline Engine Studies	PI: Jeffrey Naber Co-PIs: Jeremy Worm; Paul Dice	Hitachi America, LTD	$109,825
Demonstration of Densification of Biocoal Prepared from Low Lignin Woods	PI: Ezra Bar-Ziv	U.S. Endowment for Forestry and Communities	$285,613
Rapid Screening with Paddle Fast Pyrolysis Systems	PI: Ezra Bar-Ziv	Battelle Energy Alliance, LLC	$80,000
Experimental Investigation for Characterization of a High Pressure 4-Hole Impinging Jet Injector under Diesel Engine Conditions	PI: Seong-Young Lee Co-PI: Jeffrey Naber	Nostrum Energy, LLC	$51,000
Travel to Attend the 3rd Laser Ignition Conference at Argonne National Laboratory	PI: Seong-Young Lee	National Science Foundation	$5,000
Evaluation of an Advances Ignitor for Spark Ignition Engines	PI: Jeremy Worm Co-PI: Jeffrey Naber	FlashNition, Inc	$12,353
Numerical Simulation Study of Post Collision Angles for Multiple Impinging Jet Injectors	PI: Seong-Young Lee Co-PI: Jeffrey Naber	Nostrum Energy, LLC	$38,000
Nostrum Injector Evaluation and Validation on a single Cylinder DI SI Engine with Exhaust Gaseous and PN Emissions	PI: Jeffrey Naber Co-PI: Paul Dice	Nostrum Motors, LLC	$124,107

ADVANCED POWER SYSTEMS (cont.) $5,460,925

TITLE	NAME	SPONSOR	AWARD
Michigan Tech Consortium in Diesel Engine Aftertreatment Research	PI: John Johnson Co-PIs: Jeffrey Naber; Gordon Parker	Cummins Inc., John Deere Co., Diamler Trucks, Tenneco Inc., Johnson Matthey, Corning Inc.	$885,366
GOALI: Collaborative Research: Easily Verifiable Controller Design	PI: Mahdi Shahbakhti	National Science Foundation	$198,390
HEV and EV Hands-On Education for the 2014 Calendar Year	PI: Jeremy Worm	Ford Motor Company	$34,791
Development of a Robust Igniter for Methane Fueled SI Engines	PI: Jeremy Worm	E3 Spark Plugs	$28,929
Global Conversations in Sustainable Transportation	PI: Jeremy Worm	Wayne County Community College District	$6,000
Hands-On Education in Sustainable Transportation	PI: Jeremy Worm	University of Michigan	$4,000
Off-Highway Tire Drop Testing for Titan Tire	PI: Paul Dice Co-PI: Jeffrey Naber	Titan Tire Corporation	$19,379
Raising Awareness to the Need for Growth in Engineering Talent in Michigan and the Training Assets Available at the 2014 CAR Conference	PI: Jeremy Worm	Michigan Economic Development Corporation	$12,810
Emissions Evaluation of a Yamaha Viper with a MPI Turbocharger	PI: Scott Miers	Mountain Performance, Inc	$9,576
Development of Conformable CNG Tanks for Automotive Development	PI: Greg Odegard Co-PIs: Jeremy Worm; Jeffrey Naber; Paul Sanders (Materials Science & Engineering)	Southwestern Energy	$2,178,704
Providing Hands-On STEM Education at the 2014 Heroes Alliance Young Urban Intellectual Summit	PI: Jeremy Worm Co-PIs: Jeremy Worm; Paul Sanders (Material Science & Engineering); Jeff Naber	National Center for the Advancement of STEM Education (nCASE)	$8,279
Testing and Analysis on a Single Cylinder DI SI Engine for Injector Evaluation and Validation with Exhaust Gas Analysis	PI: Jeffrey Naber	Nostrum Motors, LLC	$71,390
Thermal Modeling of a Prototype Hybrid Electric Military HMMWV	PI: Jeremy Worm	ThermoAnalytics, Inc	$5,118
Continuation of Ignition Studies	PI: Jeffrey Naber	Ford Motor Company	$115,000

AGILE INTERCONNECTED MICROGRIDS $802,354

TITLE	NAME	SPONSOR	AWARD
Control System Design for Cargo Transfer from Offshore Supply Vessels to Large Deck Vessels	PI: Gordon Parker	Craft Engineering Associates	$268,953
Advanced Control and Energy Storage Architectures for Microgrids	PI: Wayne Weaver (Electrical and Computer Engineering) Co-PI: Ossama Abdelkhalik	Sandia National Laboratory	$88,645
Understanding the Cavity Mode of Tires	PI: Jason Blough	Ford Motor Company	$64,000
Micro CSPs Contribution on the Management of an Electrical Grid Including Renewable Energy Sources	PI: Rush Robinett III	Mohammadia School of Enginnering, Rabat, Murocco	$17,616
CPS: Breakthrough: Toward Revolutionary Algorithms for Cyber-Physical Systems Architecture Optimization	PI: Ossama Abdelkhalik	National Science Foundation	$269,735
Advanced Control of Wave Energy Converters	PI: Ossama Abdelkhalik	Sandia National Laboratory	$50,000
Dual Cutting Head Measurements and Dynamic Modeling	PI: John Beard Co-PI: Ed Trinklein	EMT International, Inc.	$34,580
JHSV Crane Requirements Review	PI: Gordon Parker	Craft Engineering Associates	$8,825

ENGINEERING EDUCATION INNOVATION $1,136,659

TITLE	NAME	SPONSOR	AWARD
Senior Design: AFRL Design Challenge Project Sequence	PI: William Endres	Technology Service Corporation	$29,739
Fuze Testing Capability Development	PI: William Endres	Air Force Research Lab	$332,172
Senior Design: Bearing Adjuster Lock Ring Test Rig	PI: William Endres	American Axle & Manufacturing	$25,650
Senior Design: Pickup Truck Bed Side Access Design	PI: William Endres Co-PI: Charles Van Karsen	Chrysler, LLC	$26,765
Senior Design: 4 Passenger Vehicle B-Pillar Design	PI: William Endres Co-PI: Paul van Susante	Chrysler, LLC	$26,765
Senior Design: Surgical Power Tool Irrigation Pump Controller	PI: William Endres	Stryker Instruments	$24,535
Senior Design: Automatic Loading and Unloading Gravity Flow Rack System	PI: William Endres Co-PI: Paul van Susante	Chrylser, LLC	$26,765

ENGINEERING EDUCATION INNOVATION (cont.) $1,136,659

TITLE	NAME	SPONSOR	AWARD
Senior Design: Chrysler 300 Split Tailgate	PI: William Endres Co-PI: Kevin Johnson	Chysler, LLC	$26,765
Senior Design: Intake Manifold Design	PI: William Endres	John Deere Co.	$26,021
Senior Design: Low Voltage Piezoelectric Bone Sculptor	PI: William Endres	Stryker Instruments	$24,535
Enterprise: Pump in a Hub 2	PI: Paul van Susante Co-PI: Steven Lehmann	Specialized Bicycle Components	$14,870
Senior Design: Drive Motor in Dowel Agitation	PI: William Endres	Bissell Homecare Inc.	$26,765
Senior Design: Multiple Filter Changer Apparatus Design	PI: William Endres	Cummins, Inc	$25,650
Senior Design: Bearing Adjuster Sleeve Lock Design	PI: William Endres	American Axle & Manufacturing	$20,520
Senior Design: Vacuum Noise Reduction	PI: William Endres	Bissell Homecare, Inc	$26,765
Senior Design: Solving Cold Temperature Diesel Fuel Filter Plugging Issues	PI: William Endres	Donaldson Company, Inc	$26,765
Senior Design: Tool-less Lawn Mower Blade Attachment	PI: William Endres	Ariens Company	$22,304
Senior Design: Snowblower Quick-adjustable Skid Shoes	PI: William Endres	Ariens Company	$22,304
NRI: Co-Robots to Engage Next Generation of Students in STEM Learning	PI: Nina Mahmoudian Co-PIs: Michele Miller; Mohammad Rastgaar in conjunction with Michigan Tech Great Lakes Research Center (GRLC)	National Science Foundation	$403,308

MULTISCALE TECHNOLOGIES INSTITUTE $5,351,303

TITLE	NAME	SPONSOR	AWARD
Microsensor for Intramuscular Pressure Measurement	PI: Greg Odegard	Mayo Clinic	$49,013
Multiscale Modeling of Graphite/CNT/Epoxy Hybrid Composites	PI: Greg Odegard	U.S. Department of Defense, Air Force Office of Scientific Research	$252,555

MULTISCALE TECHNOLOGIES INSTITUTE (cont.) $5,351,303

TITLE	NAME	SPONSOR	AWARD
A New Experiment for Determining Evaporation and Condensation Coefficients of Cryogenic Propellants and Development of an Efficient Computational Model of Cryogenic Film Stability in Microgravity	PI: Jeffrey Allen Co-PI: Chang-Kyoung Choi	National Aeronautics and Space Administration	$526,784
Mass Measurements of an Electrospray Beam from a Single Emittor Ionic Liquid Ferrofluid Electrospray Source	PI: Lyon (Brad) King Co-PI: Kurt Turhune	National Aeronautics and Space Administration	$210,000
CAREER: A New Perspective on Biomineralization in Healthy and Dysfunctional Ferritins	PI: Tolou Shokuhfar	National Science Foundation	$554,593
I/UCRC: Novel High Voltage/Temperature Materials and Structures	PI: Greg Odegard	National Science Foundation	$637,495
Fundamental Investigations for Very High Heat-Flux Innovative Operations of Milli-Meter Scale Flow Boilers	PI: Amitabh Narain	National Science Foundation	$305,781
Fundamental Understanding on the Role of Structural Defects on Lithiation of Nanoscale Transition Metal Oxides	PI: Reza Shahbazian Yassar	National Science Foundation	$445,658
MRI: Acquisition of a High Resolution Transmission Electron Microscope for In Situ Microscopy Research and Education	PI: Reza Shahbazian Yassar (PI) Co-PIs: Yoke Kin Yap, (Physics); Stephen Hackney, (Materials Science & Engineering); Tolou Shokuhfar; Claudio Mazzoleni, (Physics)	National Science Foundation	$1,736,592
Analysis of Mobile Haulage Equipment Operating Dynamics	PI: Nina Mahmoudian	National Institute for Occupational Safety & Health Office of Mine Safety and Health	$24,000
New Sulfur-Carbon Material with Improved Electrochemical Performance	PI: Reza Shahbazian Yassar	UChicago Argonne, LLC	$42,367
In-Situ Liquid Microscopy of Biological Materials	PI: Tolou Shokuhfar	Pacific Northwest National Laboratory	$44,378
Proton Exchange Membrane Characterization at Subzero Temperature	PI: Kazuya Tajiri	Toyota Motor Coporation	$40,000
Study of Two-Phase Flow Behavior in PEM Fuel Cell Flow Channels	PI: Kazuya Tajiri	Toyota Motor Corporation	$26,000

MULTISCALE TECHNOLOGIES INSTITUTE (cont.) $5,351,303

TITLE	NAME	SPONSOR	AWARD
Center for Novel High Voltage/Temperature Materials and Structures	PI: Greg Odegard Co-PI: Julia King (Chemical Engineering)	Colorado Seminary (University of Denver)	$101,143
In-Situ Liquid Microscopy of Fiber-Fluid Interactions	PI: Tolou Shokuhfar	University of Illinois-Chicago	$54,129
Technical Survey on High Efficient Intensive Cooling Control Technology	PI: Chang Kyoung Choi Co-PI: Jeffrey Allen	Chung-Ang University	$176,724
Center for Novel High Voltage/Temperature Materials and Structures	PI: Greg Odegard	University of Illinois at Urbana-Champaign	$14,091
In-Situ Transient Analysis of Two-Phase Flow Pressure Drop in PEMEC Flow Channels	PI: Kazuya Tajiri	Toyota Motor Corporation	$110,000

SPACE SYSTEMS $1,369,373

TITLE	NAME	SPONSOR	AWARD
Deposition Rate of Propellant Backflow from a Magnesium Hall-Effect Thruster - Graduate Research Fellowship	PI: Mark Hopkins Co-PI: Lyon (Brad) King	National Science Foundation	$132,000
Characterization Test-Bed for Nanostructured Propellants	PI: Lyon (Brad) King	U.S. Department of Defense, Air Force Office of Scientific Research	$456,539
Electrospray from Magneto-Electrostatic Instabilities	PI: Lyon (Brad) King	U.S. Department of Defense, Air Force Office of Scientific Research	$770,578
Trajectory Analysis for NASA Asteroid Redirect Mission	PI: Ossama Abdelkhalik	Exo Terra Resources, LLC	$10,256

ADDITIONAL RESEARCH TOPICS $1,153,124

TITLE	NAME	SPONSOR	AWARD
CAREER: Autonomous Underwater Power Distribution System for Continous Operation	PI: Nina Mahmoudian in conjunction with Michigan Tech Great Lakes Research Center (GRLC)	National Science Foundation	$681,124
Melt-5a—Developing and Deploying Thin Wall Ductile Iron Casting for High Volume Production	PI: Paul Sanders (Materials Science & Engineering) Co-PIs: Greg Odegard; Stephen Kampe (Materials Science & Engineering) in conjunction with the Michigan Tech Institute of Materials Processing (IMP)	American Lightweight Materials Manufacturing Innovation Institute (ALMMII)	$472,000

ME-EM **PATENTS & PUBLICATIONS**

This includes books and journal articles published from **May 1, 2014 to April 30, 2015.**

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

BOOKS, CHAPTER IN

Malysz, Pawel, **Gauchia Babe, Lucia,** Yang, Hong "Fundamentals of Electric Energy Storage Systems," Advanced Electric Drive Vehicles, Ed. A. Emadi, Taylor & Francis Group, October 2014, pp. 237-282, ISBN 9781466597693

Ficanha, Evandro, **Rastgaar Aagaah, Mohammad,** Kaufman, Kenton R., "Multi-axis Capability for Powered Ankle-foot Prostheses," Neuro-Robotics: From Brain Machine Interfaces to Rehabilitation Robotics, Ed. Artemiadis, Springer, July 2014, pp. 85-103, ISBN-13: 978-9401789318

Rastgaar Aagaah, Mohammad, Lee, Hyunglae, *Ficanha, Evandro*, Ho, Patrick, Krebs, Hermano Igo, Hogan, Neville, "Multi-Directional Dynamic Mechanical Impedance of the Human Ankle; a Key to Anthropomorphism in Lower Extremity Assistive Robots," Neuro-Robotics: From Brain Machine Interfaces to Rehabilitation Robotics, Ed. Artemiadis, Springer, July 2014, pp. 157-178, ISBN-13: 978-9401789318

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Fultz, Derek W., **Allen, Jeffrey S.**, "Nonintrusive Pressure Measurement in Microfluidic Systems via Backscattering Interferometry," *Experiments in Fluids,* Jun 2014, Vol. 55, No. 6, Article No. 1754, pp. 1-12, DOI: 10.1007/s00348-014-1754-0

Chang, Jen-Yung, Wang, Shuo, **Allen, Jeffrey S.**, Lee, Seong Hyuk, Chang, Suk Tai, Choi, Young-Ki, **Friedrich, Craig R., Choi, Chang Kyoung**, "A Novel Miniature Dynamic Cell Culture Platform using Electro-Osmosis Diode Pumping", *Biomicrofluidics*, Aug 2014, Vol. 8, No. 4, pp. 0444116, DOI:10.1063/1.4892894

Shin, Dong Hwan, **Allen, Jeffrey S., Choi, Chang Kyoung**, Lee, Seong Hyuk, "Visualization in the Contact Line Region of an Evaporating Nanofluid Drop," *Journal of Heat Transfer*, Aug 2014, Vol. 136, No. 8, Paper No. HT-14-1211, pp. 080913, DOI: 10.1115/1.4027531

Shin, Dong Hwan, **Allen, Jeffrey S., Choi, Chang Kyoung**, Lee, Seong Hyuk, Visualization of an Evaporating Thin Layer during the Evaporation of a Nanofluid Droplet," *Langmuir*, Jan 2015, Vol. 31, No. 4, pp. 1237-1241, DOI: 10.1021/la504133h

Barnard, Andrew R., "Quantifying Acoustic Sources through Sound Power Measurements," *Sound and Vibration, Materials Reference Issue*, Jul 2014, Vol. 48, No. 7, pp. 8 – 11

Barnard, Andrew R., Brungart, Timothy A., McDevitt, Timothy E., Aliev, Ali E., Jenkins, David M., Kline, Brian L., Baughman, Ray H., "Advancements Toward a High-power, Carbon Nanotube, Thin-film Loudspeaker," *Noise Control Engineering Journal,* Sep 2014, Vol. 62, No. 5, 2014, pp.360 – 367, DOI: 10.3397/1/376235

Bar Ziv, Ezra, Saveliev, Roman, Korytnyi, Efim, Perelman, Miron, Chudnovsky, Boris, Talanker, Alexander, "Evaluation of Performance of Anglo-Mafube Bituminous South African Coal in 550 MW Opposite-Wall and 575 MW Tangential-Fired Utility Boilers," *Fuel Processing Technology,* Jul 2014, Vol. 123, pp. 92-106, DOI: 10.1016/j.fuproc.2014.01.026

Bar Ziv, Ezra, Mody, Jaisen, Saveliev, Roman, Perelman, Miron, "Firing Tests of Biocoal," *ASME Power*, Jul, 2014, Vol. 1, Paper No. POWER2014-32037, pp. V001T01A004, 9 pages, DOI: 10.1115/POWER2014-32037

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Shin, Dong Hwan, **Choi, Chang Kyoung**, Lee, Seong Hyuk, Kang, Yong Tae, "Local Aggregation Characteristics of Nanofluid Droplet During Evaporation," *International Journal of Heat and Mass Transfer*, May 2014, Vol. 72, pp.336-344, DOI: 10.1016/j.ijheatmasstransfer.2014.01.023

Ha, Moonsik, Lee, Jung Hee, **Choi, Chang Kyoung**, Kim, Jae Hyung, Choi, Young Ki, "Understanding the Structure of Table-Type Dolmens Using Numerical Analysis," *Journal of Mechanical Science and Technology*, May 2014, Vol. 28, No. 5, pp. 1789-1795, DOI: 10.1007/s12206-014-0325-x

Gwon, Hyuk Rok, Chang, Suk Tai., **Choi, Chang Kyoung**, Jung, Jung-Yeul, Kim, Jong-Min, Lee, Seong Hyuk, "Development of a New Contactless Dielectrophoresis System for Active Particle Manipulation using Movable Liquid Electrode," *Electrophoresis*, Jul 2014, Vol 35, No. 14, pp. 2014-2021, DOI: 10.1002/elps.201300566

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Castano, Sandra, **Gauchia Babe, Lucia**, Voncila, Elena, Sanz, Javier Fdez, "Dynamical Modeling Procedure of a Li-ion Battery Pack Suitable for Real-time Applications," *Energy Conversion and*

Management, Mar 2015, Vol. 92, No. 1, pp. 396-405, DOI: 10.1016/j.enconman.2014.12.076.

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King, Lyon B., *Hopkins, Mark A.*, "Magnesium Hall Thruster with Active Thermal Mass Flow Control," *Journal of Propulsion and Power,* May 2014, Vol. 30, No. 3, pp.637-644, DOI: 10.2514/1.B34888

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ME-EM: BY THE NUMBERS

5 **NUMBER OF ENTERPRISES**
with ties to the automotive and racing industries (HEV, Supermileage, Baja, Clean Snowmobile, Formula SAE).

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

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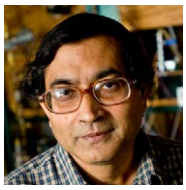

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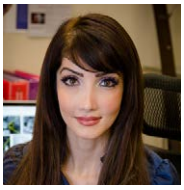

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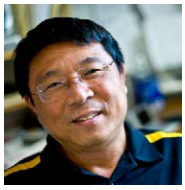

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