IMAGINATION | COLLABORATION | INNOVATION | SOLUTIONS

20th ANNIVERSARY

design expo 2020

A Showcase of Enterprise & Senior Design Student Projects.

Michigan Technological University
1885

mtu.edu/expo

WELCOME TO MICHIGAN TECH'S DESIGN EXPO.

If this is your first visit, you'll be astounded at the creativity and sophistication of the demonstrations and displays. These Enterprise and Senior Design Student Projects reflect everything that goes into an engineer's education and preparation at MTU – a dedicated and involved faculty and staff, a laser-focused administration and tremendously supportive alumni, donors and corporate benefactors. It all adds up to an environment that produces top-tier engineers who are fully prepared to take on and master the most difficult real-world challenges.

– JON E. JIPPING, PE

Executive Vice President and Chief Operating Officer
ITC Holdings Corp.

MTU class of 1991 – MS, Electrical Engineering

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Scope

Design Expo highlights hands-on, discovery-based learning at Michigan Tech. More than a thousand students on Enterprise and Senior Design teams showcase their work and compete for awards. A panel of judges—made up of corporate representatives, invited guests, Michigan Tech staff, faculty members, and graduate students—critique student projects. Many team projects are sponsored by industry, which allows students to gain valuable experience through competition, as well as direct exposure to real industrial problems. Design Expo is hosted by the College of Engineering and Pavlis Honors College.

Design Expo Awards

Senior Design Awards
Based on video submissions

- First place—$400
- Second place—$250
- Third place—$150
- Honorable mention—$100 (four to be awarded)

Enterprise Awards
Based on video submissions

- First place—$500
- Second place—$300
- Third place—$200
- Honorable mention—$100 (one to be awarded)

Image Contest
Based on team photos submitted during Design Expo registration

- First place—$200
- Second place—$100
- Third place—$50

Design Expo Innovation Awards
Based on application

- First place—$250
- Second place—$150
- Third place—$100

Enterprise Awards
Based on nominations—$100 each

Student Awards

- Outstanding Leadership
- Rookie Award
- Innovative/Sponsor Relations
- Innovative Solutions

Faculty/Staff/Sponsor Awards

- Outstanding Enterprise Advisor
- Outstanding Sponsor
- Behind the Scenes
- Module Master

Husky Innovate

Pavlis Honors College

enterprise program

More Special Thanks

To the distinguished judges giving their time and talents to help make Design Expo a success, and to the faculty advisors generously and richly supporting Enterprise and Senior Design—thank you for your dedication to our students.

Tomorrow needs new solutions and agile thinkers. It needs champions of the unknown. Tomorrow needs technology—inventors, artists, engineers, innovators, and coders. Tomorrow needs integrators—visionaries who design for the human race, maximize the potential of both mind and machine, and optimize the value of the person in the process.

Design Expo brings student teams, industry partners, campus mentors, and the community together to explore a year's worth of developments—the products, processes, and breakthroughs that tomorrow needs.

mtu.edu/tomorrow-needs

1885
Michigan Technological University

Welcome, all, to our 20th annual—and first-ever virtual—Design Expo 2020!

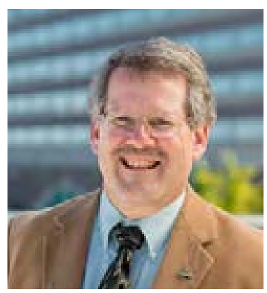
For these unprecedented times we offer this unprecedented event. This year marks an important milestone in celebrating hands-on, discovery-based learning at Michigan Technological University. For 20 years, Design Expo has focused the spotlight on thousands of Huskies as they work in teams, embrace design challenges, and push through adversity to develop solutions and communicate results. It should come as no surprise at all that when COVID-19 disrupted our well-established plans for a traditional ballroom event, we found inspiration in our students. As they say, with challenge comes opportunity—the opportunity to demonstrate agility and new thinking, to pull together as a community, and most importantly, to realize and maintain our focus on our students and the bright future they will help create.

This year's virtual showcase represents the work of more than a thousand students from our Senior Design and Enterprise programs. At Michigan Tech, Senior Design is a course where teams of highly dedicated, senior-level students address practical, open-ended design challenges—it's more like a first job than a last class. In Enterprise, interdisciplinary teams of first-year through graduate-level students from more than 30 majors work in a businesslike setting to invent products, provide services, and pioneer solutions. Regardless of the pathways our students chose to get here, this year's 20th anniversary event is sure to inspire hope and confidence in a better tomorrow.

Design Expo is generously supported by industry and University sponsorship. We are pleased to welcome ITC Holdings as Directing Partner for the ninth consecutive year. Supporting Partners include Kohler, Nexteer Automotive, and OHM Advisors. Collaborating Partners include Code Blue, FCA, Kimberly-Clark, Michigan Tech's Husky Innovate, Nucor, and Plexus. These ten partners, along with more than a hundred project and program supporters, have made a strategic investment in our educational mission. The benefits of industry, government, and academia working together as partners are clearly evident at Michigan Tech's Design Expo. Thank you.

Enjoy your virtual Design Expo experience, and Go Huskies!

Rick Berkey
Director
Enterprise Program



Leonard Bohmann
Associate Dean
College of Engineering

101
Blizzard Baja

Team Leaders
Olivia Vargo, Mechanical Engineering and Kurt Booms, Mechanical Engineering Technology

Advisor
Kevin Johnson, Mechanical Engineering Technology

Sponsors
General Motors, Aramco Americas, DENSO, SAE International, Magna, Fiat Chrysler Automobiles, Halla Mechatronics, Meritor, Oshkosh Corporation, Ford Motor Company, John Deere, Nexteer, IPETRONIK, FEV, Milwaukee Tool, Altair, Henkel, ArcelorMittal, Enterprise Manufacturing Initiative funded by General Motors, TeamTECH

Background
Michigan Tech's Blizzard Baja Enterprise builds a single-seat, off-road competition vehicle to compete in the SAE Collegiate Design Series-Baja SAE events held in various locations across the US. The team prepares and presents a written design report, cost analysis, and sales presentation for a panel of SAE judges. After passing a rigorous safety and technical inspection, we compete with other collegiate teams on acceleration, hill climb, maneuverability, suspension and endurance. The Blizzard Baja Enterprise also organizes and hosts the Winter Baja Invitational event, a long-standing university tradition dating back to 1981.

Overview
Our team custom fabricates an all-terrain single-seater vehicle that is intended to improve performance and driver experience in order to ultimately make an affordable alternative to the existing side-by-side industry. Blizzard Baja strives to do all that we can to make our vehicle faster, more responsive, and lighter each year. We directly work with our sponsors to gain helpful industry insights that help us to improve our design and product pitch. With the help of an engine dyno, wheel force transducer, and finite element analysis, we can acquire real-life loads and performance curves to tune and improve our current components. Through research, development, continuous testing and sponsor relations we have successfully cultivated a team who produces a vehicle that competes in wheel-to-wheel racing at the national level.

MTU Blizzard Baja Vehicle

102
Clean Snowmobile Challenge

MICHIGAN TECH.
CLEAN SNOWMOBILE

Advanced Motorsports

Team Leaders
Liam MacGillivray and Noah Squires, Mechanical Engineering

Advisor
Jason Blough, Mechanical Engineering-Engineering Mechanics

Sponsors
General Motors, Aramco Americas, DENSO, SAE International, Magna, Fiat Chrysler Automobiles, Halla Mechatronics, Meritor, Oshkosh Corporation, Ford Motor Company, John Deere, Nexteer, IPETRONIK, FEV, Milwaukee Tool, Altair, Henkel, Yamaha, Arctic Cat, Kohler, ArcelorMittal

Background
Michigan Tech's Clean Snowmobile Challenge Enterprise builds snowmobiles to compete in the SAE Collegiate Design Series Clean Snowmobile Challenge held at the Keweenaw Research Center in Houghton, Michigan. As part of the competition, the team submits an engineering design paper, determines a justified MSRP (Manufacturer's Suggested Retail Price), and presents an oral design presentation outlining its approach to the clean snowmobile conversion. Following a comprehensive technical inspection, the vehicles undergo dynamic testing including acceleration, handling, cold start, noise, and emissions. Michigan Tech's Clean Snowmobile Challenge Enterprise typically competes in both the Internal Combustion (IC) and Zero Emissions (ZE) classes.

Overview
The team's primary goal is to make cleaner burning, quieter snowmobiles that are still fun to ride. This year we are competing with a Yamaha Venture chassis as well as an Arctic Cat Bearcat chassis, powered by a diesel engine provided by Kohler Engines.

Clean Snowmobile team testing modifications made to the Venture chassis

FEV Halla KEYSIGHT TECHNOLOGIES IPETRONIK ARCTIC CAT MAGNA YAMAHA GENERAL MOTORS ArcelorMittal Henkel SAE INTERNATIONAL JOHN DEERE KOHLER Altair nexteer AUTOMOTIVE MERITOR Milwaukee FCA FIAT CHRYSLER AUTOMOBILES OSHKOSH aramco DENSO Crafting the Core Ford

103
Formula SAE

Team Leaders
Austin Arenz, Mechanical Engineering; Nathan Sodini, Engineering Management

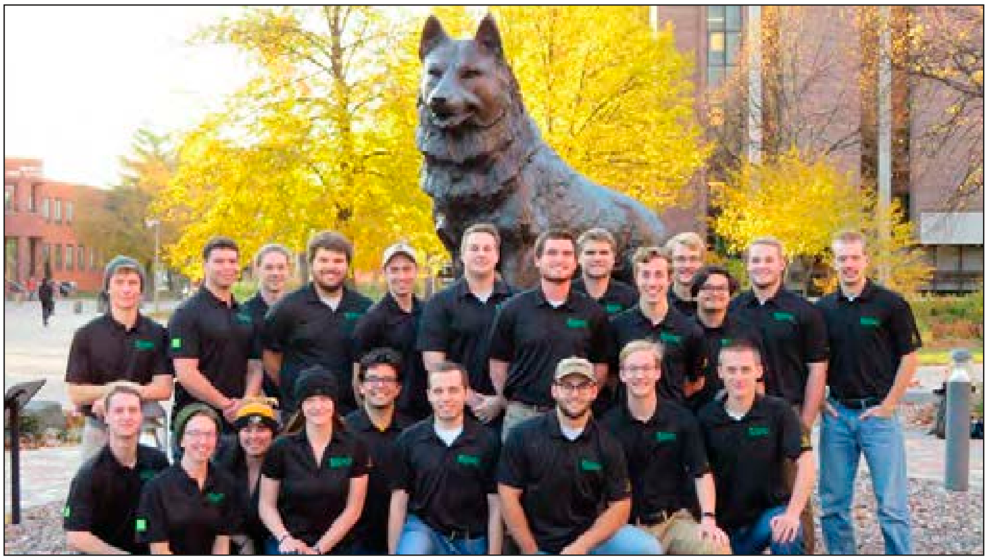
Advisor
James DeClerck, Mechanical Engineering-Engineering Mechanics

Sponsors
General Motors, Aramco Americas, DENSO, SAE International, Magna, Halla Mechatronics, Meritor, Oshkosh Corporation, Ford Motor Company, John Deere, Nexteer, IPETRONIK, FEV, Keysight Technologies, Milwaukee Tool, Altair, Henkel

Background
Michigan Tech's Formula SAE Enterprise builds a competition vehicle based on the concept of an affordable race car geared toward the weekend autocrosser. The team competes in SAE Collegiate Design Series Formula SAE events held in various locations across the country. For the competition, the team prepares a written design report, a cost analysis and a business case to present to a panel of judges. After passing a technical inspection, the vehicle competes in a series of dynamic events, including acceleration, skid pad, autocross, endurance, and efficiency. Michigan Tech Formula SAE has a long history of top-performing cars and has gained a reputation for developing cutting-edge designs that help shape the future of racing.

Overview
Michigan Tech Racing is proud to present the 2020 race car, the F-318! Our new platform design was evolved from the ground up, and incorporates many new features. Starting with goal setting, the team set performance and design requirements for all vehicle subsystems. An improved SLA independent suspension on all corners helps control the vehicle on all types of event courses. Driven by a turbocharged Yamaha Genesis 80 FI and coupled to a continuously variable transmission (CVT), power is delivered to the rear wheels through an electronic-limited slip differential (e-LSD). Our second-iteration aero package features improved front and rear wing elements with a new undertray and diffuser to increase downforce when driving. An active drag-reduction system (DRS) helps improve straight-line speed when downforce is not needed. Onboard sensors log dozens of data channels through the vehicle's CAN bus electrical architecture, which can be live-streamed to make informed tuning decisions. All vehicle improvements aim at helping the team achieve our performance goals, increasing reliability, and pushing our team's engineering limits.

2018-2019 F-276 Racecar



104
Supermileage Systems

Team Leaders
Connor Stark, Mechanical Engineering; Jacob Romang, Engineering Management

Advisor
Rick Berkey, Pavlis Honors College

Sponsors
General Motors, Aramco Americas, DENSO, SAE International, Magna, Fiat Chrysler Automobiles, Halla Mechatronics, Meritor, Oshkosh Corporation, Ford Motor Company, John Deere, Nexteer, IPETRONIK, FEV, Keysight Technologies, Milwaukee Tool, Altair, Henkel

Background
The Supermileage Systems Enterprise builds a single seat, high efficiency vehicle that competes in either the SAE Collegiate Design Series or the Shell Eco-marathon. The powertrain utilized by the vehicle is determined by the competition and is either a small displacement internal combustion engine or a battery electric design. Regardless of the event, the team must engineer a competitive vehicle and submit a written report detailing the vehicle design. The team must also deliver an oral presentation that demonstrates understanding of the engineering principles that support the design. Following a technical inspection, the vehicle must complete a dynamic performance event where miles per gallon (MPG) or miles per gallon equivalent (MPGe) is measured.

Overview
Supermileage Systems' overarching goals this year are to reduce vehicle mass, improve reliability, and increase fuel efficiency. This year, the team implemented an improved electronic fuel injection (EFI) system and developed a new engine calibration map through extensive dynamometer testing. The rear subframe has been redesigned to improve stiffness and chain tensioning, while maintaining or reducing weight. The carbon fiber body panels have been modified to improve fit and reduce drag. Finally, a new GPS-based vehicle tracking system will provide the driver feedback to operate the vehicle more efficiently during competition.

Supermileage Systems' Vehicle (Photo Credit: Rick Berkey)

105
Advanced Metalworks Enterprise (AME)

AME ADVANCED METALWORKS ENTERPRISE

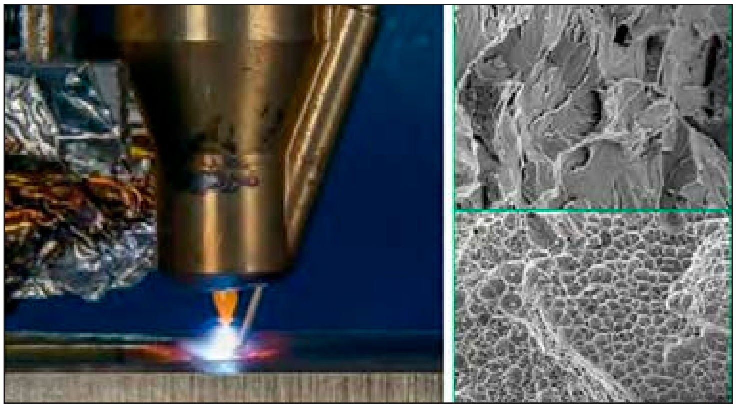
Team Leaders
Mike Groeneveld, Mechanical Engineering; Devin Deaton, Materials Science and Engineering

Advisor
Paul Sanders, Materials Science and Engineering

Sponsors
ArcelorMittal, Mercury Marine

Background
Advanced Metalworks Enterprise (AME) is composed of a diverse team of students who execute research and development projects for industrial sponsors. Interdisciplinary teams of four to five students model, fabricate, and characterize metallic systems such as aluminum, iron, zinc, titanium, and nickel-based alloys. AME helps industry sponsors increase productivity, identify causes of material failures, design near net castings, develop advanced material modeling techniques, and more.

Overview
Our current projects include metal 3D printing of quench and partition steels using wire arc additive manufacturing (WAAM) technology to create unique high strength and ductility steel components as well as the characterization of ductile and brittle fractures of new AHSS steels at different temperatures to make process recommendations.



AME undergraduate project photos

ArcelorMittal MERCURY

106
Aerospace Enterprise

Team Leader
Troy Maust, Computer Engineering; Matthew Sietsema, Electrical Engineering

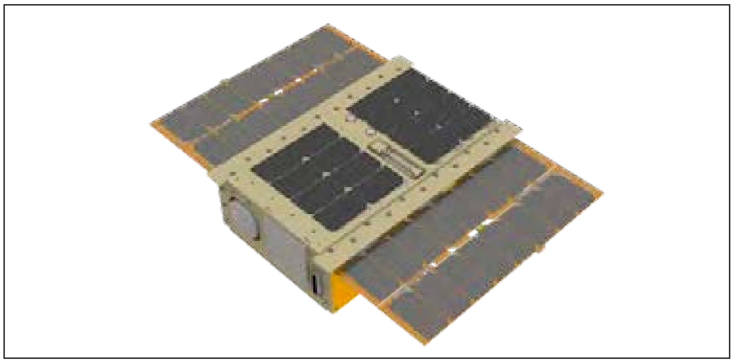
Advisor
L. Brad King, Mechanical Engineering-Engineering Mechanics

Sponsors
Auris: Air Force Research Laboratory
Stratus: NASA

Background
The Aerospace Enterprise was established to provide hands-on aerospace education and experience to Michigan Tech undergraduate students. The Enterprise works together on innovative and relevant aerospace related projects with all members contributing toward achieving specific project goals. The Aerospace Enterprise places an emphasis on space mission design and analysis, vehicle integration, systems engineering, and comprehensive ground-testing and qualification.

Overview
Auris: The Auris mission is a satellite project based on demonstrating the technical feasibility of a CubeSat's ability to provide situational data. In collaboration with the Air Force Research Laboratory (AFRL), the objectives of the Auris mission are to enhance Space Situational Awareness (SSA) by providing activity and location knowledge of space-based assets from on-orbit. This is achieved by measuring and characterizing RF emission patterns of a target satellite, as well as by providing an estimate for the location of that target. The Auris mission is intended to serve as a pathfinder toward increasingly complex space systems that leverage the low-cost and small form factor of CubeSats to achieve the performance of traditional, monolithic systems.
Stratus: The Stratus mission is a satellite project based upon demonstrating the collection of atmospheric and weather data from a CubeSat. In collaboration with NASA, the Stratus spacecraft utilizes a thermal imaging sensor to examine the activity of clouds in the upper atmosphere, for the purpose of better understanding weather over short timescales. Images generated by the mission will be analyzed on the ground to determine properties of the clouds, such as location and direction of travel. The Stratus mission is intended to serve as a pathfinder toward increasingly complex space systems that leverage the low-cost and small form factor of CubeSats to achieve the performance of traditional, monolithic systems.

Stratus: Detailed render of the Stratus spacecraft deployed on-orbit



Auris: Preliminary rendering of the Auris spacecraft in the deployed configuration

107
Alternative Energy Enterprise (AEE)

Team Leaders
Jacob Orlando, Chemical Engineering; Jordan Null, Mechanical Engineering

Advisor
Jay Meldrum, Keweenaw Research Center; David Shonnard, Chemical Engineering

Sponsors
Oshkosh Corporation, The Department of Natural Resources, Keweenaw Research Center, Keweenaw Brewing Company, Whirlpool, CURB Energy, John Soyring

Background
Alternative Energy Enterprise (AEE) provides opportunities for students in multiple academic disciplines to research and develop alternative energy sources. Projects, research, and development are done in conjunction with industry sponsors to produce viable solutions to real-world energy problems. Each team is interdisciplinary and receives a rewarding hands-on experience while working on challenging problems and seeking innovative solutions.

Overview
The Alternative Energy Enterprise concentrates on developing new technologies focusing on energy generation, distribution, and consumption for sustainable development throughout the University and Keweenaw communities. Our project teams include the Renewable Mission Module (REMM), Sustainable Demonstration House (SDH), Solar Analytics Team, Composting Team, CURB Team, Hydro Electric Team, Geothermal Heat Pump Team, and Biofuels. These teams help each student become an active part of changing the future of alternative energies.

OSHKOSH™

108
Blue Marble Security (BMS)

Team Leaders
Jackson Krsul and Ben Spiller, Mechanical Engineering

Advisor
Glen Archer, Electrical and Computer Engineering

Sponsors
Oshkosh Corporation, Deringer-Ney, General Motors, ArcelorMittal

Background
Blue Marble Security (BMS) Enterprise is a student-led Enterprise that focuses on securing the future through the thoughtful use of technology. The team specializes in engineering design and product development. Blue Marble has developed a culture that fosters high professional standards, creativity, and productivity. BMS defines the word “national security” through the provision of technological support to the defense, the corporate economy, and the personal well-being of the nation and all of its people.

Overview
BMS Enterprise continues to demonstrate its ability to tackle a diverse set of projects, with six projects spanning several industry sectors. The GM team is working to develop a commercial off-the-shelf (COTS) vision system for unexpected part detection in the manufacturing process. A project sponsored by ArcelorMittal is utilizing data mining and data analytics to predict line stoppages. Members of the Oshkosh team designed and tested a suspension system for the Oshkosh LCTV vehicle. The Deringer-Ney team developed a slip ring test bed. Our other project teams provide outreach to local schools and science fairs by hosting STEM activities as well as a team that built an autonomous vehicle to compete in the Intelligent Ground Vehicle Competition (IGVC).

Charlie, the autonomous robot built by our Autobot team

109
BoardSport Technologies (BST)

Team Leaders
MacKenzie Gibson, Electrical Engineering; Clayton Kowalewski, Mechanical Engineering Technology

Advisor
Ibrahim Miskioglu, Mechanical Engineering-Engineering Mechanics

Sponsors
Enterprise Manufacturing Initiative funded by General Motors, ArcelorMittal

Background
BoardSport Technologies (BST) focuses on the engineering, design, and manufacturing of skis, snowboards, skateboards, longboards, wakeboards, and other boardsport-related products. Through integration of composite materials and creative design approach, the team strives to refine existing boardsport technology and to produce new and innovative products.

Overview
BoardSport Technologies (BST) enables students to gain experience manufacturing their favorite boardsports. The Enterprise is currently concentrated in three different sports with two senior design teams. The Ski Team is creating a core press and drafting testing plans with an industrial partner K2. The Skate Team is updating the Enterprise skate press and designing a deck to endure more use than classic decks. The Wake Team is designing a removable hydrofoil. One senior design team is automating the Enterprise's snowboard press by adding heating blankets and a pneumatic pulley system. The second team is designing a snowboard teaching device that will alert new snowboard riders whether they have the right stance via a joystick they can hold while riding.

BST members prepping a snowboard

ArcelorMittal

GENERAL MOTORS

110
Built World Enterprise (BWE)

Team Leaders
Tristan Tarsa, Civil Engineering; Jared Parker, Environmental Engineering

Advisor
Audra Morse, Civil and Environmental Engineering

Sponsors
Airport Cooperative Research Program University Design Competition, General Motors, Michigan Technological University Pavlis Honors College's Enterprise Program

Background
The Built World Enterprise (BWE) addresses challenges typically solved by civil and environmental engineers, including designing infrastructure and solving waste management problems.

Overview
Built World Enterprise students are currently competing in the Airport Cooperative Research Program (ACRP) University Design Competition, contributing innovative ideas and solutions to issues facing airports and the National Airspace System. Currently, BWE has three student teams focusing in the areas of Runway Safety, Environmental Interactions, and Airport Management and Planning. The Runway Safety team is proposing a solution to mitigate runway incursions at airports through new pavement markings by increasing situational awareness. The Environmental Interactions team is proposing a solution addressing thawing permafrost at arctic airports through the use of thermal syphons to release heat in the ground, and using the heat to thaw frozen culverts underneath the runways. The Airport Management and Planning team is proposing a solution addressing landside congestion at major airports by moving curbsides offsite and providing alternative transit options. In addition to the ACRP University Design Competition, the Enterprise will also take on suitable sponsored projects from industry partners seeking to support project work.

111
Consumer Product Manufacturing (CPM)

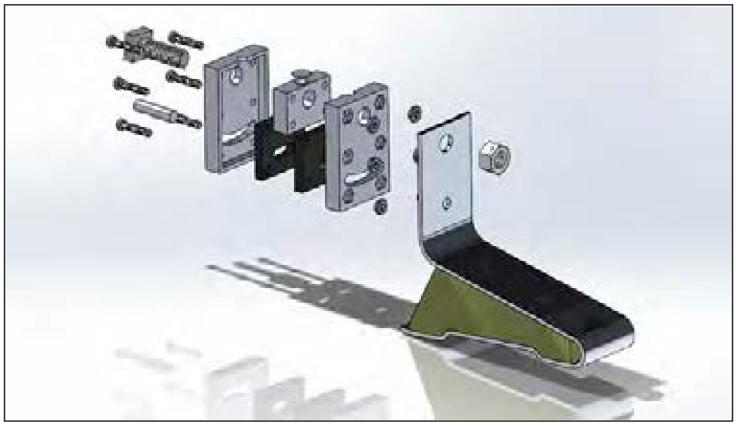
Team Leaders
Allysa Meinburg, Biological Sciences; Nick Vlahos, Chemical Engineering

Advisor
Tony Rogers, Chemical Engineering

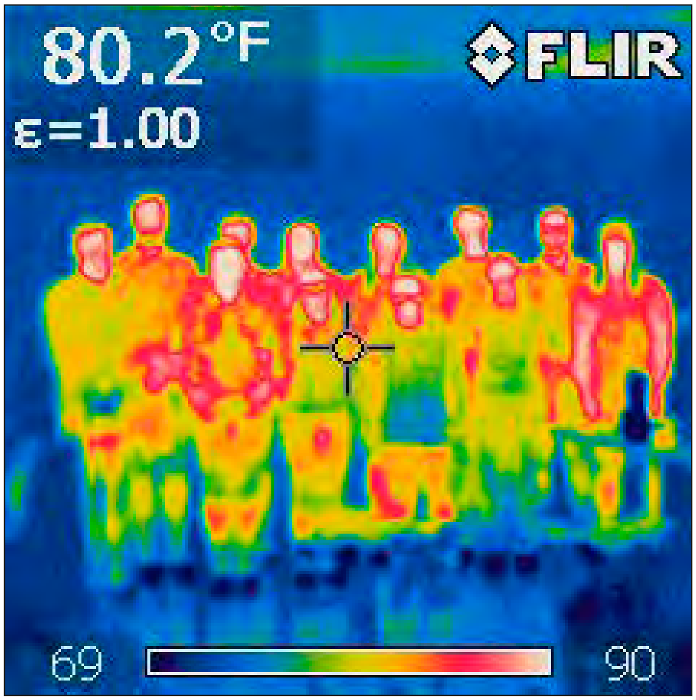
Sponsors
Sussex IM, Nalco (an Ecolab Company), Keweenaw Brewing Company, Libbey, Mel and Gloria Visser, Robert Carnahan, Michigan Technological University Dining Services

Background
Consumer Product Manufacturing (CPM) Enterprise aspires to empower students with the entrepreneurial, technical, and professional skills to conceive, develop, and market successful products in a company-like setting. Students on the team come from many disciplines and use hands-on experiences to identify and solve real-world engineering problems. CPM aims to exceed the expectations of company sponsors, improve the lives of consumers through innovation, and develop our team members into highly marketable professionals.

Overview
Being a member of the Consumer Product Manufacturing Enterprise means being part of one of our smaller sub-teams, each devoted to specific projects. These sub-teams include Commercial Keg Cleaner, Libbey Glassware Cleaner, Biogas, Mr. Lid, Nalco & Ecolab Water Treatment, AAA Prosthetics, and Height Right. Our hope is that all of the students who participate in CPM will leave empowered with the entrepreneurial, technical, and professional skills to conceive, develop, and market successful products in a company setting. We actively promote the expectation that some of our students will go on past graduation to start their own successful business ventures.



The AAA [Affordable, Accessible, Authentic] Prosthetics team's inversion/eversion passive ankle concept design



112
General and Expedition Adventure Research (GEAR)

Logo design by GEAR Enterprise, 2018

Team Leaders
Amanda Kautzer, Biomedical Engineering; Justin Mentink, Electrical Engineering

Advisor
Brett Hamlin, Engineering Fundamentals

Sponsors
Systems Engineering Research Center (SERC) Capstone Marketplace, Enterprise Manufacturing Initiative funded by General Motors, Milwaukee Tool

Background
The focus of the General and Expedition Adventure Research (GEAR) Enterprise is to design, model, test, prototype, and manufacture a wide variety of goods and equipment used in recreational outdoor and commercial expedition endeavors. Team members analyze and develop innovative solutions on both internal and industry-sponsored projects. GEAR has worked on soft and hard goods related to backpacking, camping, climbing, snowshoeing, kayaking, canoeing, mountaineering, and military applications.

Overview
GEAR Enterprise is currently working on three projects: an avalanche beacon training device, a cooling suit, and a redesigned sit ski. The avalanche beacon training device is a small antenna and circuit that will recreate the signal generated by the avalanche beacon when transmitting. The device will be able to help training courses better utilize the available beacons and create more courses for trainees to attempt. The sit ski is an update on the current sit ski design. The current sit ski is a rigid frame that is heavy and difficult to steer throughout the course. The new sit ski design is made for improved maneuverability and turning, while remaining as lightweight as possible. The Cooling Aid project will reduce the risk of heat stress for aircraft maintenance personnel wearing a Tyvek suit and gas mask. Non-breathable PPE traps heat by preventing sweat from evaporating, but the cooling aid passively removes moisture from the system. In an inexpensive, compact, and reusable belt pouch, the cooling aid will re-enable users to effectively cool down by sweating.

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Green Campus

green campus ENTERPRISE

Team Leaders
Seneca Stairs, Environmental Engineering; Ella Stone, Applied Ecology and Environmental Sciences

Advisor
Christopher Wojick, Civil and Environmental Engineering

Sponsors
Sussex IM, Michigan Tech Residence Education and Housing Services, Michigan Tech Facilities Management, Dave Bach Designs

Background
Green Campus Enterprise is an organization of students working to make Michigan Technological University's campus more sustainable through both low- and high-profile projects. Green Campus Enterprise annually measures the carbon footprint of Michigan Tech, and designs and implements projects to improve the sustainability of the Michigan Tech campus. Green Campus works closely with the Michigan Tech administration to effectively engage the University community in reducing its carbon footprint.

Overview
The Green Campus Enterprise is currently working on multiple projects. The Campus Culture team has partnered with Residence Education and Housing Services to increase sustainability on campus. We also have students who calculate the carbon footprint of the University every year. The GLRC Retrofit team is working on a new cooling system for the GLRC, and modeling the environmental effects of this new design. Students on the Single Use Process Water team are designing new processes that will re-cool water for heavy equipment in laboratories on campus. We also have students building a tiny house and designing a tiny house community. Lastly, the Mr. Lid team has partnered with CPM Enterprise to implement reusable containers into Dining Services.

Elsie Jorgenson of the GLRC team lowers a sensor into the Portage

SUSSEX

114
Humane Interface Design Enterprise (HIDE)

Team Leaders
Christopher Ward and Justin Martin, Computer Science

Advisor
Robert Pastel, Computer Science

Sponsor
CCDC Ground Vehicle Systems Center (US Army)

Background
The members of Humane Interface Design Enterprise (HIDE) come together to design, develop, and evaluate user interfaces. The goal is to make daily work more efficient and easier to manage. As a whole, the team works together to design and test different applications for industry sponsors that can be used on Android, iPhone, and other devices. HIDE accomplishes these projects by combining knowledge from multiple disciplines, such as computer science, psychology, and human factors. HIDE team members can get involved in various stages of the design process, from developing an app by programming, to evaluation by designing usability tests and analyzing data.

Overview
Tempi.st is a project from the Ground Vehicle Systems Center, a research center for the US Army located in Warren, Michigan. Tempi.st is a program designed to provide students with the opportunity to work on a real-world project, and is aimed to connect the students to an industry where they can actively participate in research in order to expand their knowledge base and deliver new ideas to the industry in return.

Our objective is to utilize Raspberry Pis to collect weather data in real time for its given location, and to send the collected data to a user through a device such as a phone, computer, or tablet in the form of an alert or by the user opening a web page.

How this will be implemented is purely up to our team. We will take these basic specifications and put our own twist to it. As long as the conditions are met, we can add as many of our own features to the project as we see fit.

An image of Tempi.st showing Raspberry Pi placement

115
Husky Game Development (HGD)

Team Leaders
Colin Arkens and Xixi Tian, Computer Science

Advisor
Scott Kuhl, Computer Science

Sponsors
Michigan Technological University Pavlis Honors College's Enterprise Program

Background
Husky Game Development (HGD) is a student-run Enterprise focused on developing video games. Each year, Husky Game Development breaks up into subteams of around six students who experience a full game development cycle, including ideation, design, and end product. HGD explores a wide variety of video game engines and platforms, including Windows, Android, Xbox, and an experimental Display Wall.

Overview
Do you know that old mansion down on the corner? Of course you do. Everyone does. No one who's entered it was ever seen again. Will you be? Lost in Mazie Mansion is a 2D mystery-puzzle game. To reform the mansion and escape, you'll need the help of Mazie, the only one to nearly solve the mystery. Play by the house's rules, dodge monsters patrolling the halls, solve puzzles, and find the keys to get Mazie's memory back.

Explore the mansion and solve puzzles to uncover the secrets within

Pavlis Honors College

116
Innovative Global Solutions (IGS)

INNOVATIVE. GLOBAL. SOLUTIONS.

Team Leaders
Nathan Tetzlaff, Mechanical Engineering; Marie Marche, Biomedical Engineering

Advisors
Radheshyam Tewari, Mechanical Engineering-Engineering Mechanics; Nathan Manser, Geological and Mining Engineering and Sciences

Sponsor
Enterprise Manufacturing Initiative funded by General Motors, Cummins, Milwaukee Tool

Background
Innovative Global Solutions (IGS) pursues solutions for the needs of developing countries, making contributions toward solving Grand Challenges. Team members improve technical skills and gain hands-on experience with an international engineering project. Typical project areas focus on energy, water, health, education, entrepreneurship, transportation, infrastructure, and more.

Overview
IGS is showcasing three projects for Design Expo 2020:

The goal of the Vaccine Transport Unit project is to design, manufacture and test an innovative vaccine container. This container will improve inefficiencies in viable vaccine accessibility experienced by developing countries due to transportation and cold chain challenges.

The Incubator Team is designing, manufacturing, and testing a low-cost, multifunctional infant incubator. This will help decrease infant mortality rates and help provide affordable and high-quality health care to those in developing areas.

The Integrated 3D Printer Team is developing an open-source-based 3D printer that can recycle plastic waste into usable products to meet basic community needs.

Vaccine cold transport container (Photo Credit: Nathan Tetzlaff)

GENERAL MOTORS

Milwaukee

Cummins

117
IT Oxygen

Team Leaders
Calvin Voss, Computer Science; Zack Metiva, Computer Network and System Administration

Advisors
Nagesh Hatti, Electrical and Computer Engineering; James Walker, Computer Science

Sponsors
DENSO, Ford Motor Company, Little Brothers Friends of the Elderly, Mel and Gloria Visser, Northern Specialty Health, Michigan Technological University Pavlis Honors College's Enterprise Program, Milan and Shailee Lathia

Background
IT Oxygen is a cross-disciplinary, student-run Enterprise that specializes in Information Technology (IT) for student organizations and businesses, with a focus on developing Information System and Information Technology solutions. Team members work on real-world projects that foster skill development and utilize business intelligence. Areas of interest include systems and information analysis, software development, database design, data sciences, cybersecurity, and web-based application development.

Overview
This year, the IT Oxygen Enterprise is working on projects sponsored by Ford, Little Brothers Friends of the Elderly, Northern Specialty Health, and DENSO. In the area of data analytics, IT Oxygen is building predictive models and applying statistical analyses to understand the relationship between technical obsolescence and purchasing strategy for automotive electronics—thanks to support from DENSO. For Ford, a team has been working with the Wireless Communication Enterprise (WCE) to provide data analysis and storage for a smart home energy management system. Finally, IT Oxygen is also collaborating with WCE on continued efforts to improve Little Brothers' holiday resource management and medical transportation scheduling systems.

Joe Kurtz and Zack Lewis presenting at the 2019 Michigan Tech D80 Conference

Pavlis Honors College

DENSO Crafting the Core

Ford

118

Mining INnovation Enterprise (MINE)

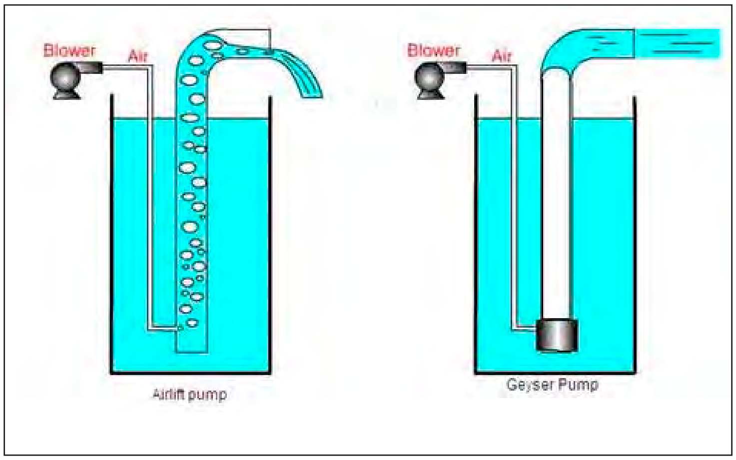
Team Leaders
George Johnson, Mechanical Engineering; Breeanne Heusdens, Geological Engineering

Advisor
Paulus Van Susante, Mechanical Engineering-Engineering Mechanics

Sponsor
Cignys, Cummins, General Motors, MEEM Advisory Board, Michigan Scientific Corporation, Michigan Space Grant Consortium, Milwaukee Tool, MISUMI, NASA, Raytheon, Team 6090: Wayland Wildcats

Background
The Mining INnovation Enterprise (MINE) seeks to design, test, and implement mining innovation technologies for industry partners. MINE works in interdisciplinary subteams to solve current and future challenges in the traditional mining industry as well as the emerging mining fields of deep sea and space mining. Opportunities include the improvement of safety and working conditions, increasing productivity and efficiency, and mine and equipment design and optimization.

Overview
The Mining INnovation Enterprise is a student-led, faculty-advised group at Michigan Technological University that focuses on innovation in the mining industry. The Enterprise focuses on aerospace and deep sea mining. Currently, with a grant from NASA, the Geological team is developing a gypsum process to mine water on Mars. Gypsum is 20 percent water by weight and is found abundantly on the surface of Mars. The Geological team is also focusing on performing research regarding deep sea mining. Additionally, our mechanical, electrical and control, and business teams are working on developing a robot for the NASA Lunabotics competition. This competition is held every year in Florida at the Kennedy Space Center with 50 teams from universities across the nation in attendance. This competition is used to simulate mining on the surface of the moon, via lunar stimulant, and the challenges it presents. This is our first year participating in the Lunabotics competition.



Deep sea mining process that is being looked into

NASA

Milwaukee

Cummins

GENERAL MOTORS

119
Open Source Hardware

open source hardware

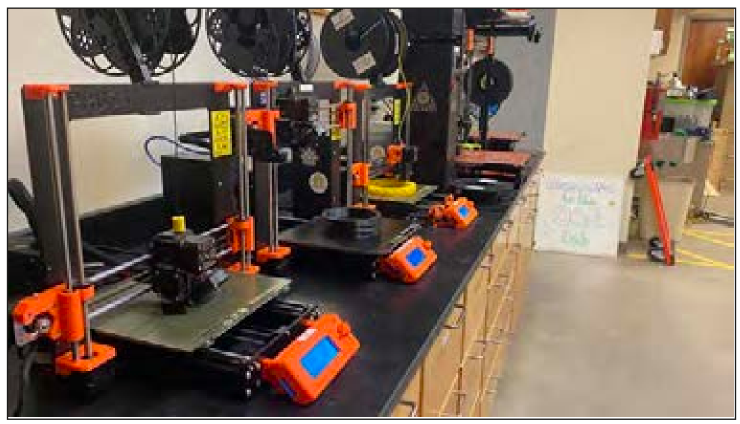
Team Leaders
Zach Arnold, Electrical Engineering; Lucas Beutler, Mechanical Engineering

Advisor
Joshua Pearce, Materials Science and Engineering

Sponsors
Enterprise Manufacturing Initiative funded by General Motors, ArcelorMittal, MOST Research Group, Michigan Technological University Pavlis Honors College's Enterprise Program, Milwaukee Tool

Background
Open Source Hardware (OSHE) specializes in building low-cost alternatives to expensive hardware/software, and then sharing the designs in the commons so that collaborative improvements can be rapidly made. Anyone who so desires can make changes or updates to the designs the Enterprise team creates, and through this process, designs are improved at a much higher rate than would be possible within the Enterprise alone. Open Source is all about collaboration.

Overview
OSHE has four projects this year: 3D Printer Automation, Growbot, Industrial Recyclebot, and Pellet Extruder for Desktop 3D Printer. The growbot is creating a robot to aid in the home farming process. The industrial recyclebot is a machine to manufacture 3D printer filament. The pellet extruder project is using a Lulzbot Taz to print with resin pellets. The 3D printer automation team is looking to develop a process to automate a Lulzbot Taz.



Our printer wall always has something printing

GENERAL MOTORS

ArcelorMittal

Pavlis Honors College

Milwaukee

120
Robotic Systems Enterprise (RSE)

Michigan Tech
Robotic Systems Enterprise

Team Leaders
Jonathon Beute and Kevin Coda, Electrical Engineering

Advisor
Jeremy Bos, Electrical and Computer Engineering

Sponsors
General Motors, SAE International, CCDC Ground Vehicle Systems Center (US Army), Continental, MathWorks

Background
The Robotic Systems Enterprise focuses on seamlessly integrating exceptional knowledge in electronics, robotics, and programming to solve real-world engineering problems. All majors are welcome—the team depends on more than just the skills and talents of engineering and science majors. The Robotic Systems Enterprise produces solutions that contribute to industry, recreation, and medical research.

Overview
The AutoDrive competition is a four-year-long project between eight different universities in the US and Canada. The goal of the competition is to create the best level four autonomous vehicle within the competition guidelines. The competition is currently in year three of the program. The team is also engaged in a Robot Leader/Follower project sponsored by the CDCC Ground Vehicle Systems Center (US Army) that will develop a method for autonomous vehicles to engage in sensing and action-based logic based on a set of guidelines.

Year one competition in Yuma, Arizona

GENERAL MOTORS

Continental

SAE INTERNATIONAL

SENSE is focused on Naval applications that begin in the Great Lakes Region (Photo Credit: Dayton Pax)

121
Strategic Education through Naval Systems Experiences (SENSE)

Team Leaders
Hannah Donajkowski and Andrea Udovich, Mechanical Engineering

Advisor
Andrew Barnard, Mechanical Engineering-Engineering Mechanics

Sponsors
Keweenaw Bay Indian Community (KBIC), Systems Engineering Research Center (SERC) Capstone Marketplace, NEEC, Milwaukee Tool, Cummins, ArcelorMittal

Background
The SENSE (Strategic Education through Naval Systems Experiences) Enterprise's mission is to enable the workforce of tomorrow to redefine the boundaries for air, land, sea, and cyber supremacy through experiential learning and discovery. Students will design, build, and test engineering systems with a focus on Navy applications in all domains: space, air, land, sea, and undersea. Get hands-on experiences with cutting-edge defense technologies that directly impact the safety and success of the armed forces. Prepare for civilian employment opportunities in Department of Defense research labs or with DoD contractors.

Overview
The Nautical Emergency Rescue Device (NERD) is our longest project and concludes this year. The team has designed an emergency rescue device that minimizes drowning.

Our Mass Rescue project, sponsored by the Systems Engineering Research Center (SERC), aims to create an efficient deployment mechanism for lightweight mass rescue device designs.

The Under Ice Acoustic project is sponsored by the Naval Engineering Education Consortium (NEEC). The goal is to test and further develop a machine learning algorithm that tracks noise sources through ice environments.

In support of our overall Enterprise goals, we are developing an environmentally safe marine material to use in future SENSE projects.

122
Velovations

Team Leaders
Luke Carstens and Jarod Russell, Mechanical Engineering

Advisor
Steve Lehmann, Mechanical Engineering-Engineering Mechanics

Sponsors
AK Tube LLC, Michigan Scientific, Milwaukee Tool

Background
Velovations is a bicycle design Enterprise dedicated to collaborating with the bicycle industry to develop new products and processes. The goal is to educate team members in the fundamentals of product development—from customer need through product and process design and testing, manufacturing, supply chain management, marketing, and distribution. Velovations leverages multiple majors, including mechanical, electrical, business, and technical communications to deliver product and process innovations to the bicycle industry.

Overview
This year, Velovations is working on three projects:

1. The Simple Dropper Post project is looking to fill a niche area between bikes that are reliable yet too expensive for most bikers, and bikes inexpensive enough to purchase but not robust enough to keep bikers on the trail. The Simple Dropper Team is bridging this gap between low cost and high reliability.

2. The Electric Shifter project is for the bicyclist who dreams of new, expensive, electronic shifting bikes, and is looking to upgrade their current bike. The system utilizes wireless communications for shifting for ease of installation and trouble-free operation on the road or trail.

3. The NEXBIKE subteam is working with AK Tube/AK Steel to develop a bicycle application for their Advanced High Strength Steel (AHSS). Aluminum and carbon fiber are typically the materials of choice these days, as steel has a history of being heavy. However, AHSS changes everything, and now a light steel frame is possible. High strength, low weight, reasonable cost, and that classic steel feel are the goals of this project.

Testing dropper posts in the snow (Photo Credit: Somer Schrock)

AK Tube LLC
A Subsidiary of AK Steel Corporation

Milwaukee

123
Wireless Communication Enterprise (WCE)

Team Leaders
Brett Annelin and Kenny Shivers, Computer Engineering

Advisor
Christopher Cischke, Electrical and Computer Engineering

Sponsors
Ford Motor Company, Whirlpool Corporation, ArcelorMittal, Little Brothers Friends of the Elderly, Mel and Gloria Visser

Background
The Wireless Communication Enterprise (WCE) focuses on wireless, optical, renewable energy, user interface, and biomedical technologies. WCE functions much like an engineering company with a variety of different project teams. These small project teams allow team members to be very involved in project work, and provide ample opportunity to gain technical skills, business presentation skills, and leadership experience.

Overview
The Wireless Communication Enterprise is providing hardware and software solutions to a variety of industry sponsors, spanning the breadth of our discipline. From renewable energy solutions and online volunteer scheduling to PCB design and RFID testing inside a washing machine, we're helping industry partners explore new frontiers in their sectors. Some internal projects reveal our entrepreneurial spirit as we apply those same skills to create office furniture that automatically customizes itself to your personal preferences, a micro-grid for providing power when you're camping or in emergency situations, and a Bluetooth speaker with LED visualizations. We're building prototypes of systems with 3D printing, PCB printers, and embedded microcontrollers to push the boundaries of what's possible.

124
High School Enterprise–Dollar Bay High School SOAR

Team Leaders
Molly Myllyoja and Maggie Gaunt

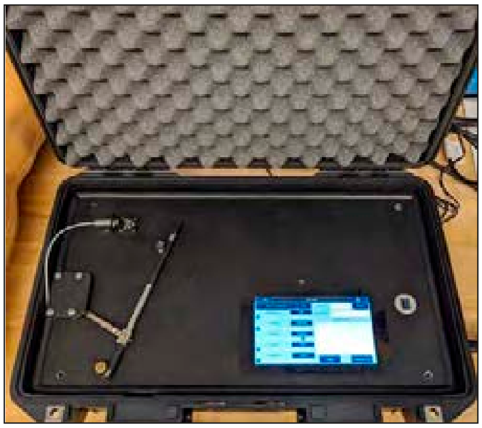
Advisor
Matt Zimmer, Dollar Bay High School

Sponsors
DBTC Area Schools, Lake Superior Stewardship Initiative

Overview
The SOAR Enterprise Team designs, builds, and deploys underwater remote operated vehicles (ROVs), provides technical solutions to water-related research challenges, and serves as a resource for additive manufacturing investigations for local businesses. As a place-based service learning Enterprise, SOAR partners with local community organizations to monitor, research, and improve the local watershed. They support local businesses with rapid prototype and small quantity part runs. Clients of SOAR present their needs and requirements to the Enterprise, and SOAR works to exceed expectations with the delivery of the product. Current clients include Isle Royale National Park, Delaware Mine, OcuGlass, and Michigan Tech's Great Lakes Research Center.

SOAR's SSROV Royale deployed in summers on Isle Royale National Park as part of the Enterprise partnership

201
Medical Device Ball Bearing Temperature Test Fixture



Fixture for the medical device ball bearing temperature test

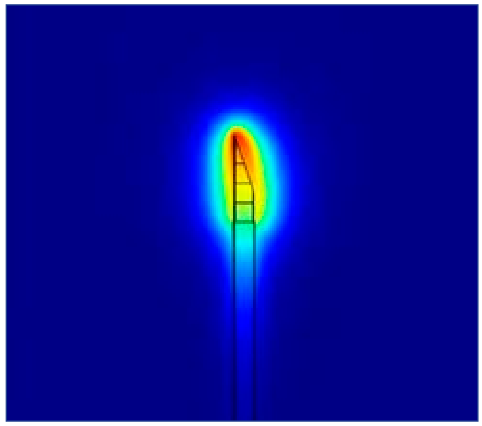
Team Members
Tyler Strauss and Alex Weber, Mechanical Engineering; Cece Attwell and Joe Stuck, Biomedical Engineering

Advisors
Bruce Lee and Jingfeng Jiang, Biomedical Engineering

Sponsor
Stryker

Project Overview
Our team is tasked with improving the repeatability and accuracy of the Medical Device Ball Bearing Temperature Test Fixture, provided to us by Stryker, confirmed through Gage R&R testing. The thermal performance results from the fixture are used to verify and choose the best ball bearing to use within various Stryker devices.

202
Radiofrequency Ablation Modeling and Validation of Cannula Designs



Thermal spread created by an RF ablation needle with insulation

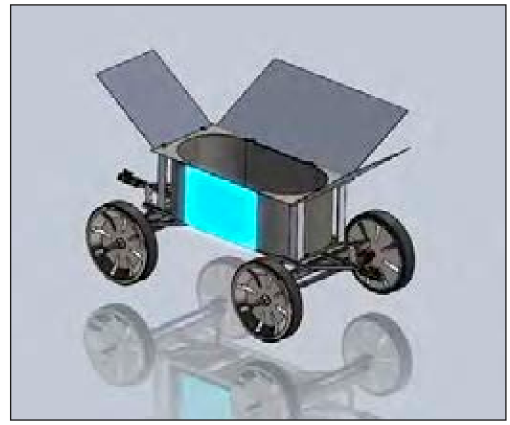
Team Members
Joe Caron, Electrical Engineering; Olivia Creamer, Becky Daniels, and North Leithauser, Biomedical Engineering

Advisors
Jeremy Goldman and Feng Zhao, Biomedical Engineering

Sponsor
Medtronic

Project Overview
Lesion formation caused by radiofrequency (RF) ablation must be placed in a precise location by medical professionals to be effective in killing nerve cells. Our goal is to increase the thermal profile around the needle to allow medical professionals to be less precise in their placement of the cannula. The heat spread of the cannula can be modified through alteration of the insulation properties and the overall design of the needle.

203
Airport Needs Design Challenge



Solidworks model of deicing fluid collection cart

Team Members
Derek Cingel, Jared Langdon, Bryce Leaf, Ruth Maki, and Douglas Pedersen, Mechanical Engineering

Advisor
Paul van Susante, Mechanical Engineering-Engineering Mechanics

Sponsor
Airport Cooperative Research Program

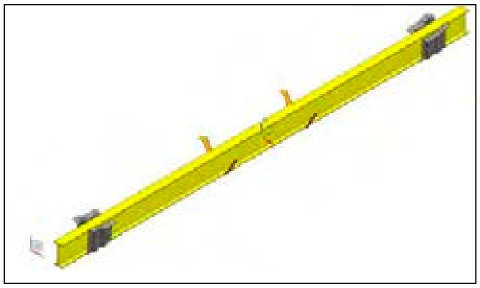
Project Overview
Our project goal is to reduce the contamination of deicing fluid in small airports. We developed a cart specially designed to capture deicing fluid. The fluid is primarily sprayed on the wings of the aircraft. This cart will help collect a significant amount of the fluid that comes from the wings. We will be creating a prototype, which is approximately a one-third model of the final design.

stryker

Medtronic

ACRP
AIRPORT COOPERATIVE RESEARCH PROGRAM

204
Vehicle Body Structure Component Design Using Pultrusion



Pultruded truck bed cross member with attachment brackets

Team Members
LeAnn Howe, Liam Munro, Kyle Sitkins, Noah Stark, and Joshua Walsh, Mechanical Engineering

Advisor
James DeClerck, Mechanical Engineering-Engineering Mechanics

Sponsor
Fiat Chrysler Automobiles

Project Overview
Our project involves researching current body structure components in present-day passenger vehicles and light-duty trucks, identifying potential applications and systems, then designing and prototyping a replacement part to demonstrate performance and functionality. We determined that truck bed cross members were the best application.

205
Digital Engineering Tool for Impact Assessment in Rack Based EPS Systems

Bringing physical realities into numerical simulation using Microsoft Excel software

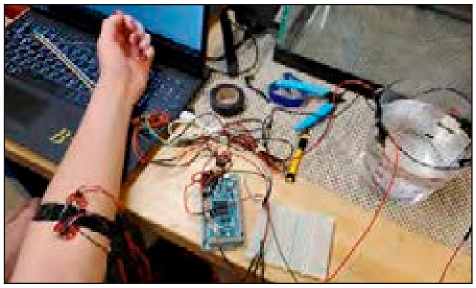
Team Members
Jacob Bart, Codi Anderson, Gita Deonarain, Heath Haverdink, and Sabrina Jensen, Mechanical Engineering

Advisor
Jeremy Worm, Mechanical Engineering-Engineering Mechanics

Sponsor
Nexteer Automotive Corp.

Project Overview
Our team was tasked to create a dynamic simulation of a rack based electric power steering system, from Nexteer Automotive, undergoing a standard in-house impact test. This simulation is required to take in available parameters of the rack geometry and test options and return position and force information of different sub-components. The goal is to be able to test component designs prior to prototyping and enable optimization of the steering rack performance.

206
Intraoperative EMG Waveform Identification



Experimental setup for electrode capture of muscular activation waveforms in a saline environment, filtered and recorded through an Arduino in the MATLAB environment

Team Members
Rachel Ping, Tony Ha, and James Roland, Biomedical Engineering; Joshua Ayres, Electrical Engineering

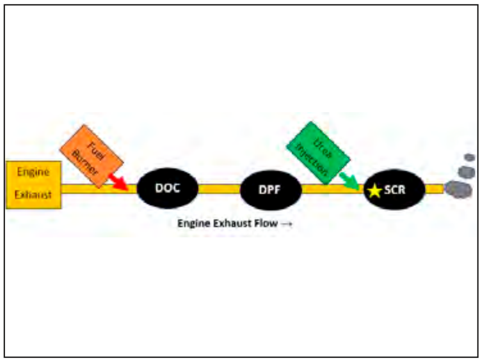
Advisors
Orhan Soykan and Rupak Rajachar, Biomedical Engineering

Sponsor
Stryker Instruments

Project Overview
Our proposed design accurately identifies true electromyography (EMG) responses and differentiates them from surrounding noise, limiting false responses. The feedback system will provide the surgeon with real-time evaluation of the procedure via a simple system of audio tones to direct immediate steps following application of the signal. Audio tones will signal compression and proximity to a nerve, notifying the surgeon without need for additional knowledge of EMG analysis. The proposed solution will be a mixture of hardware and software approaches to amplify positive EMG responses and apply filters to reduce noise, with a simple warning system to eliminate the need for a specialist to interpret the EMG signal response.

FIAT CHRYSLER AUTOMOBILES

207
Closed Loop Exhaust Aftertreatment Control System



Modern diesel exhaust aftertreatment setup

Team Members
Emma Kehus, William Hansley, Cole Butler, and Zach Rutherford, Mechanical Engineering

Advisor
Jeremy Worm, Mechanical Engineering-Engineering Mechanics

Sponsor
Tenneco

Project Overview
Design and prototype an improved exhaust aftertreatment control system.

208
PLC Hardware in the Loop Simulation

Hardware enclosure

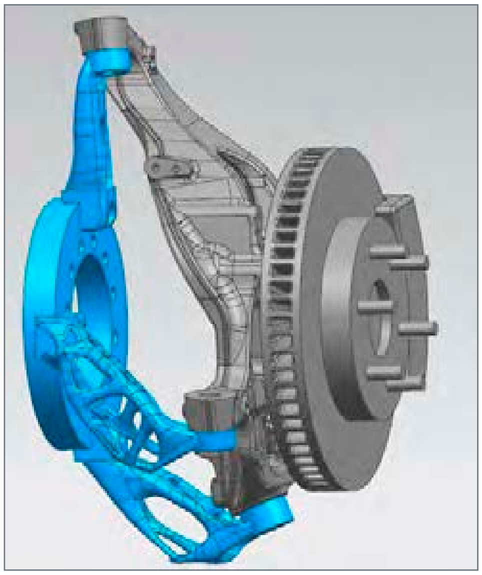
Team Members
Chris Vasser and Tim Leach, Computer Engineering; Jeremy Cragel, Alex Bathum, and Josh Overkamp, Electrical Engineering

Advisor
Trever Hassell, Electrical and Computer Engineering

Sponsor
Roberts Sinto

Project Overview
The purpose of this design project is to decouple system testing from the physical machine. Production scheduling currently prohibits the ability to perform system testing in the physical test loop. Development of a virtual machine would alleviate these scheduling conflicts and provide tools for better testing and debugging of the molding machine.

209
Rapid Brake System Test Filtering



Full fixture in modeling software with modified support arms

Team Members
Nathan Flancher, Hunter Hoerter, Ryan Montgomery, Ken Messina, Lars Daavettila, and Shane Arnold, Mechanical Engineering

Advisor
Robert Page, Mechanical Engineering-Engineering Mechanics

Sponsor
LINK Engineering

Project Overview
Design and implement a prototype fixture and its production process using an alternative means of design and manufacturing.

sinto

210
Michigan Tech Foundry Induction Furnace Ventilation Ring

Design Team with the 300-lb. furnace

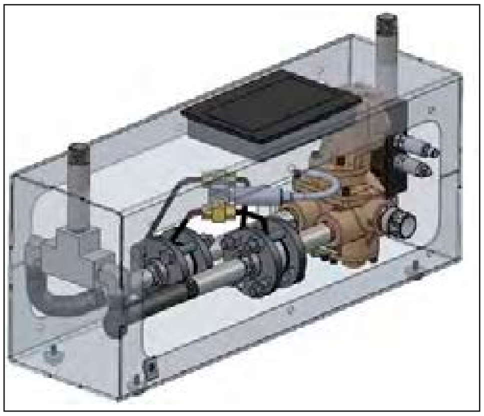
Team Members
Sam Dix, Hunter Karlen, and Rebecca Bergstrom, Mechanical Engineering Technology

Advisor
Scott Wagner, Mechanical Engineering Technology

Sponsor
ArcelorMittal, Department of Materials Science and Engineering

Project Overview
Design and install a fume ring on the 300-lb. Inductotherm furnace in the Michigan Tech Foundry and connect into the existing ventilation system.

211
Pneumatic Flow Totalizer



CAD assembly model

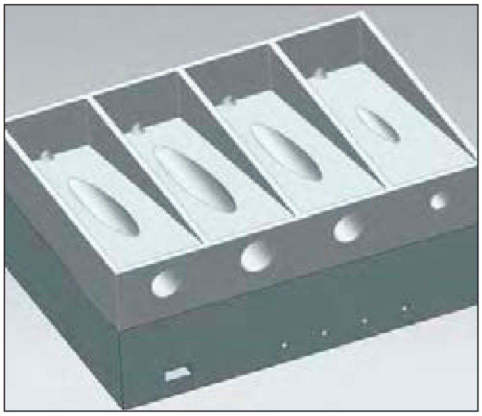
Team Members
Cole Schneider, Chris Peeters, Nathan Gradberg, Grant Johnson, and Lucas Frybarger, Mechanical Engineering

Advisor
Jaclyn Johnson, Mechanical Engineering-Engineering Mechanics

Sponsor
Donald Engineering, Inc.

Project Overview
Our team was tasked with designing a device that could totalize air flow to calculate cost of compressed air used by a machine. The device must measure 1-160 SCFM at 90 psi and be able to withstand pressures up to 125 psi. The team's design utilizes two separate flow paths, one for low flow leak detection (1-10 SCFM) and one for high flow measurement (10-160 SCFM). Each flow path consists of its own orifice plate that is connected to a differential pressure transducer. The reading from the pressure transducer is used to calculate flow in a program on the HMI screen.

212
Hospital Washer Auto Sampler Usage and Data Optimization



CAD model of hospital washer sampler

Team Members
Nick Golden and Jeremy Weaver, Biomedical Engineering; Jack Ivers, Mechanical Engineering

Advisors
Bruce Lee and Sangyoon Han, Biomedical Engineering

Sponsor
Stryker

Project Overview
Hospitals use wash systems to clean and sterilize instruments after use. Factors of the wash environments can harm surgical instruments. Our team designed a device that actively senses the conditions inside a hospital instrumentation washer. This device provides information for understanding the effects of the wash environment on medical instruments and will allow for wash cycle optimization.

ArcelorMittal

Michigan Technological University
Materials Science and Engineering

stryker

213
Penetration Testing Course

We developed course materials on ethical hacking for MTU GenCyber Camp.

Team Members
Chris Koch, Joe Bartkowiak, Kelson Rose, and Austin Clark, Computer Network and System Administration

Advisor
Yu Cai, College of Computing

Project Overview
To meet the need for new courses in the new Cybersecurity degree program, our team was tasked with developing a Penetration Testing course, which includes the business how-to as well as technical skills necessary to succeed in the field as a professional ethical hacker. We delivered a completed course, including a chosen course textbook, slides, an online lab set with accompanying lab manuals, and exams. GenCyber is a Michigan Tech summer program for local younger students. We provided instructional material, utilized Google Interland activities for younger students, and created the GenCyber camp curriculum to further develop and improve this course—another step toward the future of cybersecurity.

214
Automation of ISO 10555-1 Intravascular Catheter Corrosion Test

Custom Automated Catheter Test Instrument (CACTI).

Team Members
Olivia Demaree, Mariah Jackels, and Ian Mills, Biomedical Engineering

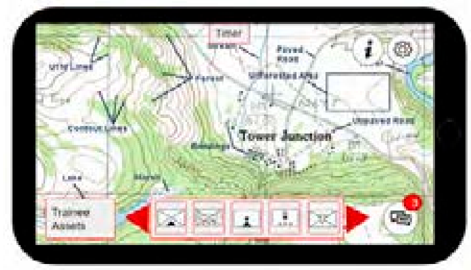
Advisor
Feng Zhao, Smitha Rao, Biomedical Engineering

Sponsor
Boston Scientific

Project Overview
The CONVEY Guiding Catheter is designed to provide a pathway through which therapeutic and diagnostic devices are introduced in the coronary or peripheral vascular system. The US Food and Drug Administration released a new standard outlining the intravascular catheter corrosion test method required to determine the corrosion resistance, stating that any metallic components intended for fluid path contact must show no signs of corrosion when tested. In current practice, Boston Scientific manually performs the required test process throughout a three-day period, as there is no commercial product available, limiting the company's productivity and flexibility. Our team was tasked with designing an objective, robust, and repeatable machine to perform the intravascular catheter corrosion test in an automated manner with continuous electronic measurements and data recording.

Boston Scientific

215
Ground Force Commander Simulation



Simulation concept design

Team Members
Collin DeNooyer, Malik Busch, Brandon Searle, Clarence Hardwick and Junyao Yang, Computer Engineering; Andrew Brown, Electrical Engineering

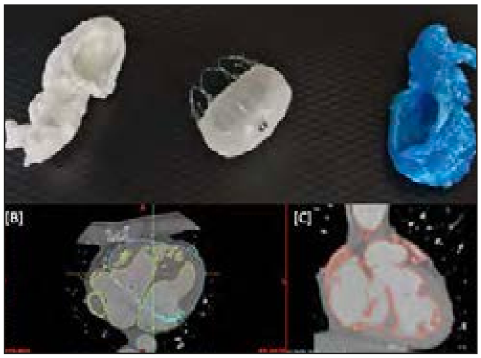
Advisor
Tony Pinar, Electrical and Computer Engineering

Sponsor
Systems Engineering Research Center (SERC) Capstone Marketplace

Project Overview
Our team is developing an Android app to aid in the training of Ground Force Commanders. Our app will be a sandbox style simulation that puts a Ground Force Commander instructor in an online lobby with a trainee. The instructor will be able to define a scenario for the trainee to run through, using elements such as a drag-n-drop menu and chat box.

SYSTEMS ENGINEERING RESEARCH CENTER

216
Use of Patient-Specific Geometry to Improve Interventional Structural Heart Procedures



3D printed LAA next to the Watchman device to be implanted

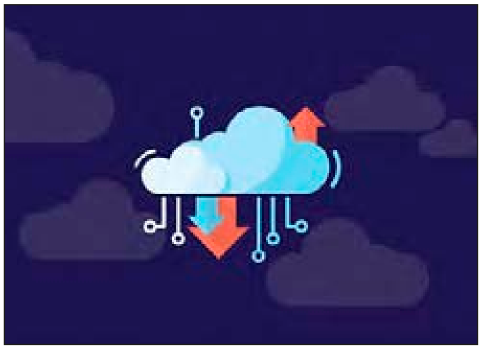
Team Members
Lydia Kugler, Allison Jager, Ryann Piotrowski, and Brennan Vogl, Biomedical Engineering

Advisors
Jingfeng Jiang and Smitha Rao, Biomedical Engineering

Sponsor
Munson Healthcare

Project Overview
Comparing the efficacy of open source 3D segmentation and modeling software to an approved payware software. Specifically, the use of patient CT scans converted to 3D models using 3D Slicer and Autodesk Meshmixer and 3D printed. 3D printed models allow the surgeon to predict the proper sized Watchman device to implant to the left atrial appendage (LAA) of the heart prior to procedure. Occlusion of the LAA reduces the risk of stroke in patients with atrial fibrillation.

217
Cloud Computing Cost Analysis



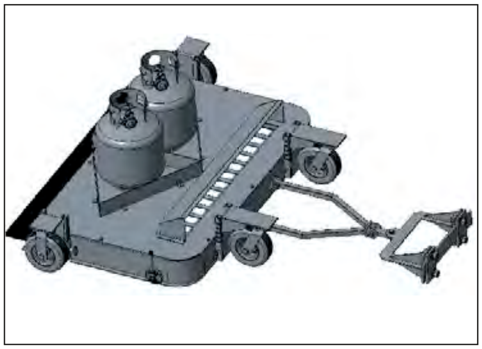
Antenna setup used for testing RF Explorer and WilsonPro Meter (Image Credit: Aaron Kramer)

Team Members
Alex Kuhn, Austin Walhof, Ryan Jacobson, and Stephen Grobbel, Computer Network and System Administration

Advisor
Todd Arney, College of Computing

Project Overview
Our team compared the cost of running services in a cloud environment between the three largest service providers: Amazon Web Service, Google Cloud Platform, and Microsoft Azure.

218
Ice Resurfacing Machine



Ice Resurfacer

Team Members
Kyle Archambeau, Jacob Anderson, and Sean Koster, Mechanical Engineering Technology

Advisor
John Irwin, Mechanical Engineering Technology

Sponsor
ArcelorMittal

Project Overview
Our team designed and built an ice resurfacing machine that can be pulled by hand or behind a lawn tractor and will be used on personal ice rinks.

ArcelorMittal

219
Extrusion Press Shear

Our team with the extrusion press

Team Members
Brook Phillips, Logan Mills, and Nick Morauske, Mechanical Engineering Technology

Advisor
Kevin Johnson, Mechanical Engineering Technology

Sponsor
Department of Materials Science and Engineering

Project Overview
We designed and built fixtures for stabilizing the carriage and tooling associated with the extrusion press in order to produce a clean shear of impure materials at the end of an extrusion. Our main goal is to produce sturdy mounts that are easy to operate and will not add unnecessary safety concerns when working around hot material. The solution must be designed and analyzed for stress concentrations as we will be working with high-output hydraulic rams.

Michigan Technological University
Materials Science and Engineering

220
Automated Distributed Configuration Management Systems

Senior Design II logo

Team Members
Andrew Hitchcock, Tim Graham and Derek Laker, Computer Network and System Administration

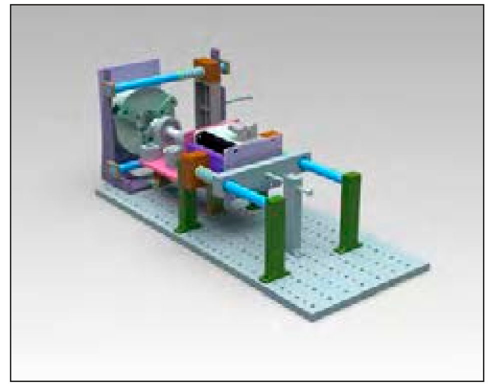
Advisor
Tim Wagner, College of Computing

Sponsor
College of Computing

Project Overview
Systems administrators working in environments of all sizes are rapidly adopting configuration management systems to automate provisioning and deployment, enforce system configuration, and streamline their work. However, it can be difficult to figure out which product to choose. Our project consisted of deploying three of the most popular products on the market today—Puppet, Ansible, and Saltstack—and comparing the computing resources that they used, their ease of use, and the scenarios that they would be most fit for.

Michigan Tech
College of Computing

221
Nexteer Bearing Noise Test Fixture



Rendered assembly of the test fixture

Team Members
Sascha Becker, Ben Hubbard, Matthew Jacobson, Jacob Lange and Al Ray, Mechanical Engineering

Advisor
James DeClerck, Mechanical Engineering-Engineering Mechanics

Sponsor
Nexteer Automotive, ArcelorMittal

Project Overview
Our project goal is to develop a fixture to profile the sound and vibration characteristics of ball bearings. The bearing under test will be driven at varying speeds and loading conditions to allow Nexteer's design engineers to select bearings for use in power steering systems. Ball bearings are used in power steering systems, which sit very close to the cabin of a vehicle. Vibrations from those bearings are amplified by the body panels of the vehicle, which can cause audible noise in the cabin. As vehicles get quieter with the advent of electric vehicles, it is becoming more important for Nexteer to be able to tune the noise that their systems produce in order to match the expectations of their customer.

nexteer AUTOMOTIVE

ArcelorMittal

222
Smart Pet Door

Senior Design Team Photo

Team Members
John Wyrzykowski and Theron Krapek, Mechanical Engineering; Robert Cheney, John Nowosad, and Sam Nowosad, Electrical and Computer Engineering

Advisors
Trever Hassell, Electrical and Computer Engineering; Janet Callahan, College of Engineering

Project Overview
Doors that allow pets to enter and exit houses at their will are popular products for those who wish their pets to have freedom to explore. A common implementation is a small hinged door located at the bottom of a conventional door that allows a pet to push through in either direction, at any time. One drawback, however, is that these pet doors are non-discriminatory, or in other words, any small animal is free to use the door if it wishes. Hence, these doors make it very easy for wild animals to compromise the perimeter of a home. Our objective is to create a smart pet door that allows entry to specific animals while blocking entry to others.

223
EMP Mitigation Testing Procedure for Enclosures

Mitigation testing inside MTU's anechoic chamber

Team Members
Addison Waege, Joshua Romanowski, Alexander Kellogg, Christopher Bousho, Jacob Phelan, and Darin Shillair, Electrical Engineering

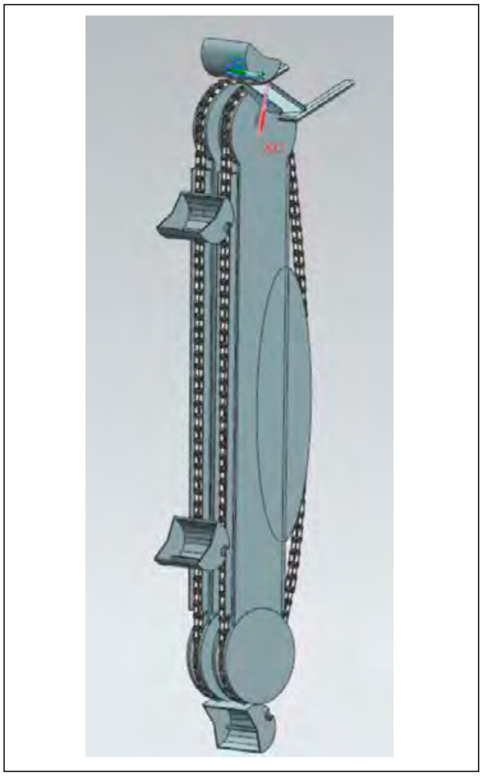
Advisor
John Lukowski, Electrical and Computer Engineering

Sponsor
Systems Control

Project Overview
A high-altitude nuclear detonation could generate an electromagnetic pulse (EMP) that has a catastrophic effect on the national electric grid, something that was learned during the Cold War. The EMP mitigation team was tasked with developing a method to measure the effectiveness of substation enclosures to mitigate this threat. Our team developed a method of testing in compliance with IEEE, military standards, and a recent study done by the Electrical Power Research Institute (EPRI). The test we developed makes use of several types of antennas to characterize the attenuation of the buildings. This characterization data was used to create a streamlined testing procedure to be carried out on a routine basis on newly constructed enclosures.

SYSTEMS CONTROL

224
Lunar Trencher



CAD design of Lunar Trencher created by Anthony Vivio

Team Members
Kamianna Piekarek, Aaron Kruzel, Anthony Vivio, Nick Veldt, Mark Chintu, and Zach Utecht, Mechanical Engineering

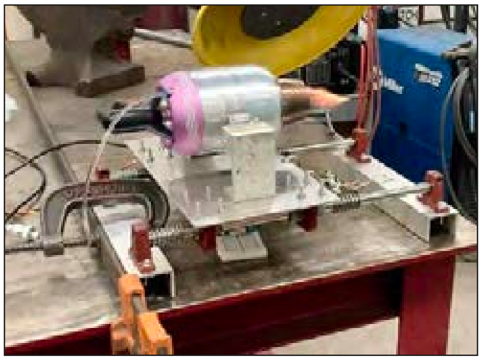
Advisors
Robert Page and Paul van Susante, Mechanical Engineering-Engineering Mechanics

Sponsor
Department of Mechanical Engineering-Engineering Mechanics

Project Overview
Our team is tasked with the design, construction, and testing of a lunar trencher, intended to dig trenches on the lunar surface to study the stratigraphy of the moon.

Michigan Technological University
Mechanical Engineering-Engineering Mechanics
1885

225
Turbine Engine Windmill Prevention and Thrust Vectoring



JetCat P100-RX engine firing

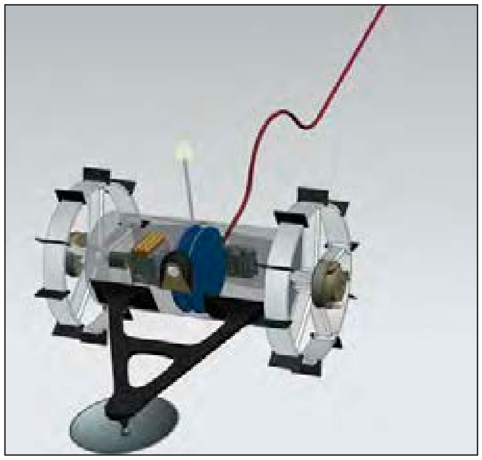
Team Members
Bobby Beggs, Allison Dorn, Mitchell Fitzpatrick, Joshua Gobrogge, Brendan Klynstra, and Benjamin Wiegand, Mechanical Engineering

Advisor
Jaclyn Johnson, Mechanical Engineering-Engineering Mechanics

Sponsor
Air Force Research Laboratory

Project Overview
The 2019-2020 Aerospace Propulsion Outreach Program (APOP) requires undergraduate students, working as a team, to research and develop a modification to the JetCat P100-RX engine that first prevents the rotor from free spinning at high Mach numbers and then gives the engine thrust vectoring capabilities. Our team modified the engine and demonstrated the ability to prevent windmilling in an engine exposed to high Mach number inlet conditions and provide a means of thrust vectoring. One of our goals was to make the device simple in nature, with a minimal amount of controls required.

226
Lunar Tech Development



CAD rendering of the Tethered-Shadowed Region Explorer (T-REX).

Team Members
Anthony Miller, Mark Wallach, Jacob Wolff and Alex Mathias, Mechanical Engineering; Alec Mitteer and Sam Lakenen, Electrical Engineering; Jon Fritsch, Computer Engineering

Advisor
Paul van Susante, Mechanical Engineering-Engineering Mechanics

Sponsor
NASA BIG Idea Challenge

Project Overview
We developed a system in support of NASA's goal to explore the Permanently Shadowed Regions (PSR) of the south pole of the moon in 2023. The team's prototype is a proof of concept of a system that will deploy a power and communications cable to the base of a lunar crater, serving as a recharging station and data transfer node for other systems operating in the PSR.

227
Eddy Current Inspection In-line Integration

Proposed eddy-current test design area for MacLean-Fogg

Team Members
Brett Hulbert, Austin Ballou, Britten Lewis, Nathan Beining, Philip Spillman and Sophie Pawloski, Mechanical Engineering

Advisors
Wayne Weaver, Mechanical Engineering-Engineering Mechanics

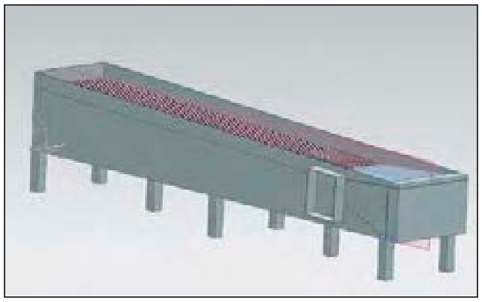
Sponsor
MacLean-Fogg Component Solutions-Metform

Project Overview
Our team was tasked with integrating an eddy current testing process into an assembly cell for MacLean-Fogg. The eddy current tester non-destructively tests the washer for surface cracks before it is assembled with a nut. We are creating a testing operation that spins, tests, and ejects washers based on whether they pass or fail. The assembly has to be contained within the existing assembly cell.

NASA

MacLean-Fogg
COMPONENT SOLUTIONS

228
Aqueous Washer Tank



Model of the washer tank prototype

Team Members
Dakota Lowrance, Mechanical Engineering Technology

Advisor
Scott Wagner, Manufacturing and Mechanical Engineering Technology

Sponsor
Selkey Fabricators LLC

Project Overview
I am working with Selkey Fabricators LLC to help design a washer tank for industrial hydraulic cylinders used for heavy equipment. This design must include a heating element to heat up the water and soap solution, and evaporate the water to eradicate the leftover oil and dirty mixture from cleaning the cylinders. Additionally, the design includes a pump that will be used to bring the water/soap solution from the tank to be sprayed on the cylinders. Lastly, the design will need a separate control panel to control all of the devices, as well as an emergency shutdown option. The successful implementation of the design will allow Selkey to acquire additional assets and grow their business.

229
Invasive Aquatic Plant Extractor

Solid model geometry of proposed effector

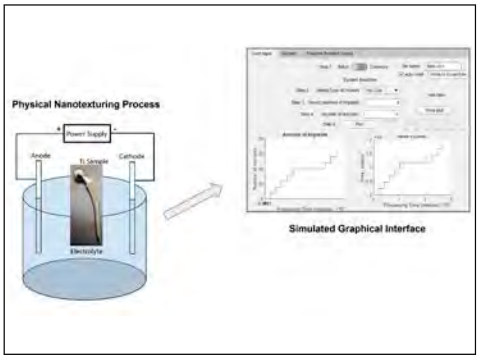
Team Members
Brad Baas, Eric Houck, Chance Miller, Thomas Page and Katie Winter, Mechanical Engineering; Max Thiele, Electrical Engineering

Advisor
Wayne Weaver, Mechanical Engineering-Engineering Mechanics

Sponsor
Patterson Marine & Storage, Great Lakes Research Center

Project Overview
We have been engaged to create an end effector that will attach to an aquatic platform with the purpose of removing invasive aquatic plants from lakes. Invasive species, particularly Eurasian Watermilfoil—found all over the continental United States—harm the ecosystem by decreasing biodiversity and crowding waterways used for boating and recreation. Current treatment options are cost prohibitive, ineffective, or negatively impact native species. The long-term project is to create a system that can identify and remove invasive aquatic species with minimal human input. Our part, the first phase, is to create the machine plant interface, to be attached to a waterborne platform at a later time. The end effector should be capable of fully removing invasive species to stop their spread, and waterproof to operate in an underwater environment. The control system should be designed to be compatible with a wide variety of potential control platforms.

230
Orthopedic Implant Nanotexturing Manufacturing System Simulation Tool



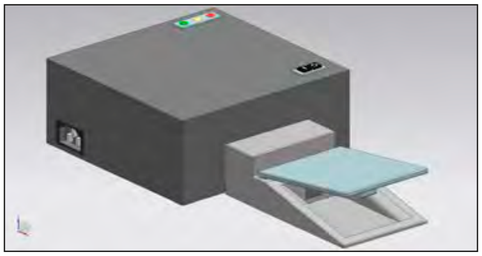
Physical manufacturing process with simulated graphical user interface setup/sample plots

Team Members
Erika Carne, Kristine Fink, Drew Marion, Kassity Swanson and Ben Wood, Mechanical Engineering

Advisor
Jaclyn Johnson, Mechanical Engineering-Engineering Mechanics

Project Overview
Our team was tasked to develop a manufacturing process simulation tool for nanotexturing the surfaces of titanium orthopedic implants. The tool will use many process parameters to determine the optimal manufacturing throughput of implants, cycle times, energy and material demands, control of process chemistry, and maintain process stability within acceptable limits to ensure FDA-quality results for a large number of implants. This virtual production system will show industry manufacturing feasibility.

231
Mission Trip High-Speed Drill System



3D model of foot pedal and electronics housing of portable high-speed drill system (Photo credit: Taylor Lasky)

Team Members
Makenzie Condit, Electrical Engineering; Taylor Lasky and Juergen Steupert, Biomedical Engineering; and Connor McIntyre, Mechanical Engineering

Advisor
Sangyoon Han and Rupak Rajachar, Biomedical Engineering

Sponsor
Stryker

Project Overview
Currently, high-speed drill systems are not constructed to be portable for traveling significant distances, limiting the help that surgeons and staff can provide to underserved populations. Modern high-speed drills are heavy and bulky, weighing up to 50 lbs. altogether between the drill and attachments, foot pedal, and intelligence/user interface system. Our team aims to increase the overall portability of high-speed drills by decreasing the weight and number of components in the system.

stryker®

232
Road Marking Reflectivity Evaluator

Team members from left: Brian Parvin, Paul Allen, David Brushaber, Alex Kirchner, Kurtis Alessi

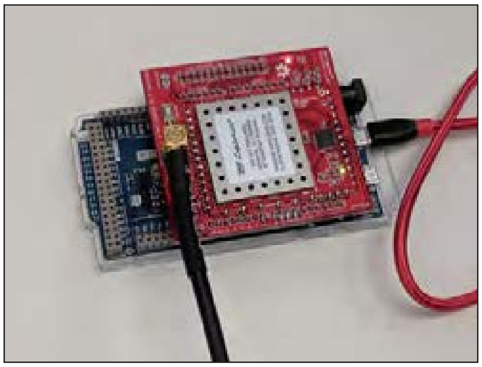
Team Members
Brian Parvin, Mechanical Engineering; Paul Allen, Electrical Engineering; and David Brushaber, Kurtis Alessi and Alex Kirchner, Computer Engineering

Advisor
Tony Pinar, Electrical and Computer Engineering

Sponsor
SICK, Inc.

Project Overview
Our team is participating in the TiM$10K Challenge, a national innovation and design competition, to develop a new product that features a lidar sensor provided by Sick Industries. Our team developed software that uses reflectivity values obtained by the lidar unit. The new software identifies deterioration of road stripes and recommends timely repainting to aid in the safety and reliability of self-driving and lane-assisted vehicles on the roadway. We constructed a prototype to demonstrate the functionality of our program that features a pushable cart to evaluate road markings. An intuitive user interface displays the markings that are being evaluated and indicates whether or not they meet the necessary levels of reflectivity.

233
ITC Cellular Signal Measuring Tool



Explorer spectrum analyzer

Team Members
Sean Moisan, Fernando Rubio, Aaron Kramer, Andrew Prescott, and Hannah Farrah, Electrical Engineering

Advisor
John Lukowski, Electrical and Computer Engineering

Sponsor
ITC Holdings Corp.

Project Overview
Many ITC substations are in remote locations that have very weak cell signals. A cell signal is required at substations for communication and transferring relay information. At substations with weak signal strength, a well-positioned directional antenna must be used to maximize signal strength. Currently, ITC engineers struggle to position antennas properly and often have to reposition antennas multiple times. To solve this issue, our team designed a portable device to measure cell signal strength from all major carriers simultaneously and directional data to fine-tune antenna position. The device consists of a handheld unit with a screen to display information and a lightweight antenna with an electronic compass on an extendable mast. It displays all relevant information on one screen so engineers can compare signal strength of different carrier frequencies in real time. In addition to the prototype device, we developed an instruction manual for the construction of duplicate devices. ITC engineers will be constructing their own cell signal measuring tools based on the design.

ITC

234
Tailstock Redesign For Tormach 15L Slant-Pro CNC Lathe

Team in front of the CNC lathes

Team Members
Walter Friesel, Ashley Chapa, Nathan Pennala and Dylan Erickson, Mechanical Engineering Technology

Advisor
David Labyak, Manufacturing and Mechanical Engineering Technology

Sponsor
Department of Manufacturing and Mechanical Engineering Technology

Project Overview
While larger and more capable than the previous CNC lathes in the Michigan Tech machine shops, the newly acquired Tormach 15L Slant-Pro CNC Lathes have a significant design flaw. Currently, the tailstock, a necessary device for the lathe used to stabilize work pieces when spinning, prohibits the cutting tool from traveling its full length down the work piece. It allows for only about four inches of travel when the machine should be capable of up to at least 12 inches. Therefore, a redesign of the tailstock is required to allow University students who use the lathes for projects to use the machines to their full capacity. The project will output a functional prototype of a new tailstock by December 2020. If successful, the tailstock will be adopted for production and use.

Michigan Technological University
Manufacturing and Mechanical Engineering Technology

235
Low-Cost Underwater Acoustic Modem Manufacturing

Acoustic transmission performance metric testing

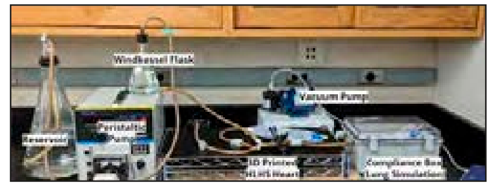
Team Members
Nick Lesko, Taylor Michels, and John Mortimore, Computer Engineering; Joey Dell'Anno and Travis Heller, Electrical Engineering

Advisor
Tony Pinar, Electrical and Computer Engineering

Sponsor
Zhaohui Wang

Project Overview
Underwater communication systems typically rely on large and expensive acoustic modems, hindering research and limiting the types of platforms on which they can be deployed. The goal of this project is to create a low-cost design of an underwater acoustic modem to promote research in the field.

236
Transcatheter Single Ventricle Device



Benchtop design simulates physiological conditions in HLHS patients for testing of our stent prototype

Team Members
David Atkin, Kelsey LeMay, and Gabrielle Lohrenz, Biomedical Engineering

Advisors
Smitha Rao and Jeremy Goldman, Biomedical Engineering

Sponsor
Spectrum Health–Helen DeVos Children's Hospital

Project Overview
Hypoplastic left heart syndrome (HLHS) is a congenital heart defect in infants that results in malformation of the left ventricle of the heart. With this defect, the heart is unable to pump oxygen rich blood throughout the infant's body. Currently, infants with HLHS are required to receive a series of three surgical procedures to reconstruct the heart. We are developing a transcatheter single ventricle device that will eliminate the first open heart surgery, the Norwood/Hybrid Procedure. This procedure occurs during the first three weeks of a patient's life, thus making the minimally invasive procedure increasingly valuable. This catheter deployable stent is inserted through the femoral artery into the ductus arteriosus (DA). The polymer-coated and shape-memory nitinol stent props open the DA while controlling blood flow through the pulmonary arteries. Our team designed a robust and repeatable system, which models physiologically relevant HLHS blood flow, allowing for the validation of an optimal polymer fenestration size and modulate blood flow under patient-specific conditions.

SPECTRUM HEALTH
Innovations

237
Mercury Marine Wire and Arc Additive Manufacturing

WAAM construction of a coupler for the die casting process

Team Members
Kurt Sollner and Greg Beaudoin, Material Science and Engineering; Oliver Schihl and Christopher Wallenfang, Mechanical Engineering Technology; Sidney Schroeder, Mechanical Engineering

Advisor
Paul Sanders, Materials Science and Engineering

Sponsor
Mercury Marine

Project Overview
Previously, a 1980s Bridgeport CNC mill was retrofitted with a MIG welding head. It is currently being used to produce parts and specimens through the wire and arc additive manufacturing (WAAM) process. Our team tested parts in various manners to compare their properties with those of parts produced with traditional manufacturing methods, such as casting and machining.

MERCURY

238
Connector and Coupling Actuator for Mobile Electrical Microgrids

Two UGVs connected by the coupling and actuating system

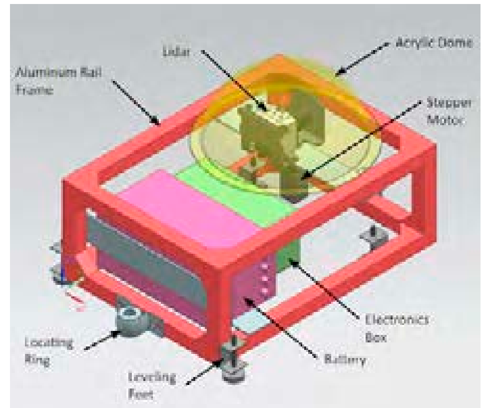
Team Members
Trevor Barrett, Nathan Bondi, and Sam Krusinski, Mechanical Engineering; Travis Moon, Electrical Engineering

Advisor
Cameron Hadden, Mechanical Engineering-Engineering Mechanics

Sponsor
Center for Agile and Interconnected Microgrids

Project Overview
Imagine how someone living through a natural disaster like Hurricane Katrina or Hurricane Dorian must have felt—scared and helpless, with no way to call for assistance or let loved ones know they were okay. It could be days or weeks before first responders are able to restore power to the area. That is where our project comes in. Our team was tasked to design, prototype, and test a connector and coupling actuator that can establish an electrical connection between two unmanned ground vehicles that will be used to build temporary microgrids in areas that desperately need it.

239
SICK LiDAR Bat Detection Device



Planned design concept

Team Members
Spencer Fata, Garrett Smith and Adam Persson, Mechanical Engineering; Ethan Baker, Electrical Engineering; Max Heidacker, Computer Engineering

Advisor
Wayne Weaver, Mechanical Engineering-Engineering Mechanics

Sponsor
SICK Inc.

Project Overview
Little brown bats are dying in mines and caves because of a fungus that affects them during hibernation. To better understand their struggle and to care for the important bat population, the DNR regularly and laboriously counts the bats during their hibernation. Our solution makes use of a LiDAR (manufactured by SICK AG, Waldkirch Germany) to provide 3D scans of the larger rooms of the mine or cave while pointing out individual bats for the DNR's population counts. The device will also be configurable to count the number of bats entering or exiting a given site.

240
Snap Ring Packaging Improvement

Nested clump of snap rings to a separated stack of sorted rings

Team Members
Adam Rusinowski and Adam Moeggenborg, Mechanical Engineering; Levi Tatrow, Electrical Engineering; Zach Smith, Computer Engineering

Advisor
Trever Hassell, Electrical and Computer Engineering

Sponsor
Hugo Benzing LLC

Project Overview
Hugo Benzing specializes in producing fasteners for industries ranging from aerospace to fine electrical mechanics. During the manufacturing of C-shaped snap rings, metal wire is cut and annealed, which causes a burr to form on the inner edge of the ring. This burr must be removed only on the small-sized snap rings in a deburring and washing/oiling process that causes the rings to form large inner-tangled nested clumps together. The snap rings are manually untangled while packaged in counted quantities. The goal of the project is to create a prototype machine that can untangle the nested clumps of snap rings and keep them separate. Our team discussed the detangling method with system builders to create specifications and requirements of a true, fully functioning snap ring detangling machine for future use in production. We also conducted a financial analysis of the new process, ensuring it is affordable.

241
Future Vehicle Stopping

Stop sign (Image Credit: Wikimedia Commons)

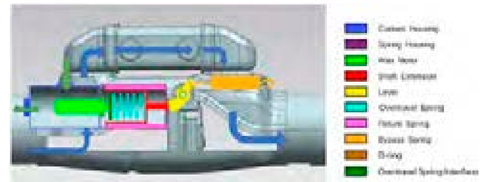
Team Members
Kelvin Kotancheck and Ian Blair, Mechanical Engineering; Adam Colvin, Alex Grant, and Charles Powell, Electrical Engineering

Advisor
John Lukowski, Electrical and Computer Engineering

Sponsor
SOCOM, contracted through Systems Engineering Research Center (SERC) Capstone Marketplace

Project Overview
The US military has had an ongoing need to secure individuals of interest from fleeing or attacking vehicles. Our Senior Design team was tasked with the project of researching and developing a variety of methods for remotely stopping the vehicle without causing catastrophic damage or injuring the occupants. We generated a wide range of possible solutions and made a suggestion of an existing net-based wheel restraining technology as well as a vision denial strategy that we built and tested. This method consisted of drone-delivered fluid dispersion onto the windshield for daytime operations and use of powerful strobe lights for night operation.

242
Thermal Actuation System for Exhaust Heat Recovery Application



3D CAD model cutaway showing our design mounted on Tenneco's EHRS. Green arrow indicates coolant flow, blue arrow indicates exhaust flow.

Team Members
Sean Luke, Ben Mahonen, Austin Scheerer, Matt Savage, and Breanna Blasius, Mechanical Engineering

Advisor
Fei Long, Mechanical Engineering-Engineering Mechanics

Sponsor
Tenneco, ArcelorMittal

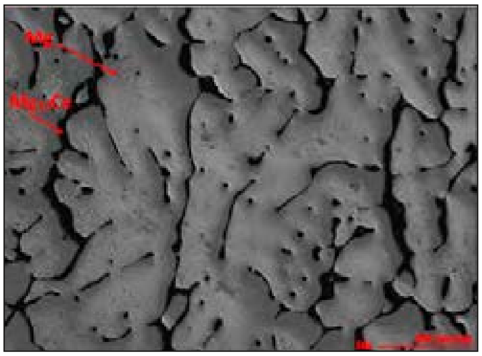
Project Overview
An exhaust heat recovery system (EHRS) uses exhaust gasses and a heat exchanger to warm up engine coolant, helping warm vehicle engines faster when started. EHRS are most commonly found in the hybrid and heavy-duty vehicle market. Tenneco tasked our team with helping them create their own EHRS to become competitive in the automotive market. Our team's job was to use a wax motor to design a thermal actuator and linkage to replace the electric actuator in Tenneco's current EHRS prototype. Our system, using only coolant temperature as an input, controls the valve that opens and closes the EHRS to exhaust gasses. Our main design objective includes creating an actuator system of less than $10 for bill of materials that would last the lifetime of a vehicle, passively relieve backpressure in the EHRS, and seal the EHRS off to exhaust gas when the warm-up period had concluded. We met those objectives by creating a system with a piston, lever, and springs to convert the linear motion of the wax motor into rotational motion on the EHRS valve.

BENZING
Retaining Rings Shaped Springs Precision Stamping Parts

SYSTEMS ENGINEERING RESEARCH CENTER

ArcelorMittal

243
Magnesium Alloy Extrusions with Improved Strength and Ductility



As-cast Mg12Ce microstructure etched to highlight Mg12Ce phase

Team Members
Brock Rudlaff, Allan Terry, Michael Kallenbach and Sean O'Connor, Material Science and Engineering

Advisor
Paul Sanders, Materials Science and Engineering

Sponsor
Lightweight Innovations for Tomorrow (LIFT), Loukus Technologies

Project Overview
The performance of current magnesium alloys can be improved by increasing both their ductility and strength. Additions of cerium in magnesium can increase both of these properties through formation of a secondary Mg12Ce phase that promotes grain refinement through constitutional supercooling. Alloying with zinc has also proven to solid solution strengthen the magnesium matrix. If zinc and cerium are added to magnesium and the effects of cerium additions are limited to grain refinement, then both the strength and ductility will increase because the zinc will solid solution strengthen the material and the refined grains impede dislocation movement and activate additional slip systems in the magnesium matrix. In this project, we explored the impact of varying amounts of cerium and zinc on magnesium alloys with the intent of developing an extrudable magnesium-cerium-zinc alloy with an elongation of 25 percent and an ultimate tensile strength of 210 MPa.

244
Achieving Solution-Strengthened Ferritic Ductile Iron (SSFDI) Chemistry and Properties in a Production Environment

Pouring SSFDI into one-inch Y-blocks in the Michigan Tech Foundry

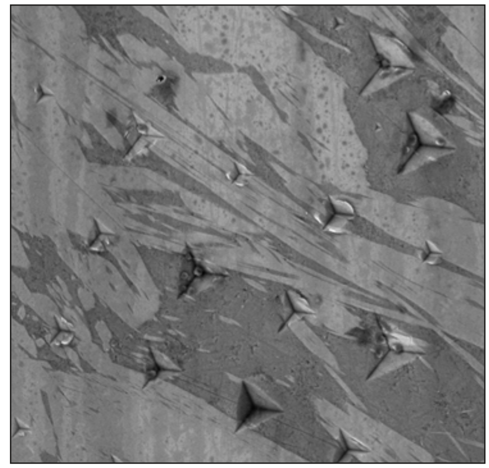
Team Members
Lauren Bushong, Drew Sexton, and Katherine Wendt, Material Science and Engineering; Matthew Hasbrouck, Material Science and Engineering and Mechanical Engineering

Advisor
Paul Sanders, Materials Science and Engineering

Sponsor
Waupaca

Project Overview
Ductile iron foundries face difficulties with transitioning from traditional pearlitic ductile iron to solid solution strengthened ferritic ductile iron (SSFDI) due to the different carbon and silicon requirements. Increasing the allowable carbon equivalent for SSFDI will allow for production of both pearlitic ductile iron and SSFDI. We conducted trials with 3.3-3.7 wt% carbon and 3.43-3.57 wt% silicon to quantify the effect of carbon equivalent on mechanical properties of SSFDI and identify an optimal transitional composition for SSFDI that meets tensile strength, yield strength, and elongation targets per EN-GJS-500-14.

245
Increasing the Young's Modulus of Cast Aluminum for Stiffness-Limited Applications



Master alloy nanoindentation array of Al25Mn

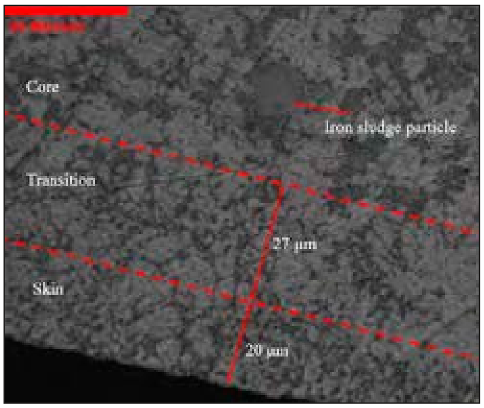
Team Members
Joel Komurka, Ryan Lester, Zeke Marchel, and Wyatt Gratz, Material Science and Engineering

Advisor
Paul Sanders, Materials Science and Engineering

Sponsor
Eck Industries

Project Overview
The present study investigates the incorporation of Be, Co, Li, Mn, Mg, Ni, and Si to A356 aluminum to develop a new cast-aluminum alloy with a target modulus of 80 GPa, starting from the characterization of binary master alloys. Eck Industries requested development of a higher-stiffness, cast-aluminum alloy with the following targets relative to an A356 baseline, due to their existing high-volume production of the alloy that will benefit lightweight applications. The elastic modulus is a property defined in the elastic region of a material's behavior, and is closely connected to the stretching of bonds under load. Our team introduced lattice strain as alloying elements as substitutional or interstitial atoms to increase bond strength, and to determine if the formation of intermetallics could bond strongly with the host lattice, or could even form double or triple bonds that were shorter and stronger.

246
High Pressure Die Cast Local Property Variation and Heat Treatment Optimization for Finite Element Analysis



Skin, core, and transition regions in high-pressure die-cast aluminum

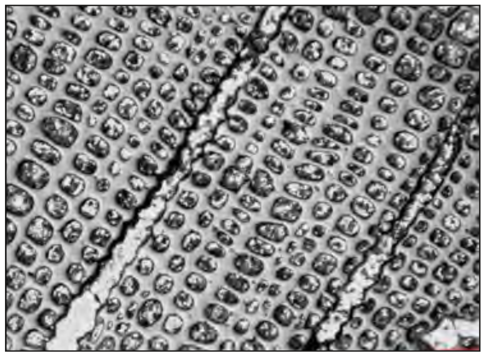
Team Members
Nicholas Richards, Max Akhmetov, Keaton Schmidt, and James Bonar, Material Science and Engineering

Advisor
Paul Sanders, Materials Science and Engineering

Sponsor
Eaton Corporation

Project Overview
Through this project, our team sought to understand the differences between skin and core regions of high-pressure die-cast aluminum. The two regions have different microstructures as a result of the variation in cooling rate as a function of depth from the free surface. This creates a gradient change in the hardness that can be measured through nanoindentation to create a more accurate model for finite element analysis. Additionally, various heat treatments were studied to identify an optimal treatment that increases the hardness and tensile strength while preventing blistering.

247
Magnesium Metal Matrix Composite with Carbonized Wood Reinforcement



Carbonized wood pores infiltrated with magnesium metal

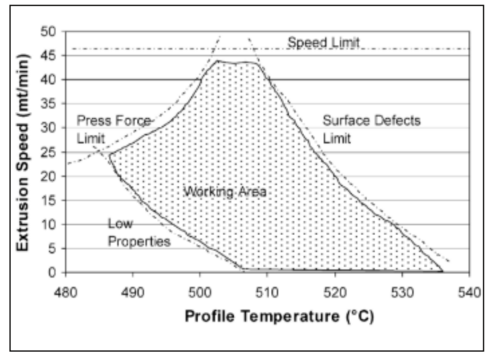
Team Members
Kiaya Caspers, Jared Harper, Jonah Jarczewski, and Pierce Mayville, Material Science and Engineering.

Advisor
Paul Sanders, Materials Science and Engineering

Sponsor
College of Forest Resources and Environmental Science

Project Overview
Carbon has extremely low coefficient of thermal expansion and significantly higher strength at elevated temperatures compared to metals. Carbonized wood retains the well-organized cellular structure of wood, which provides a natural porous carbon preform for infusion of metals to form carbon-metal composites. Our team worked to determine a metal alloy that would significantly benefit from the improved properties of carbon and determine a process to create the desired metal matrix composite.

248
Aluminum Extrusion Microstructure and Properties as a Function of Die Geometry



Extrusion limit diagram taken from Donati and Tomesani showing boundaries for hot tearing and poor mechanical properties

Team Members
Benjamin Gregory, Jarod Riemersma, Jake Beavers, and Caleb Quattrin, Materials Science and Engineering

Advisors
Paul Sanders and Tom Wood, Materials Science and Engineering

Sponsor
Hydro

Project Overview
In the aluminum extrusion process, hot metal is forced through a die to form a two-dimensional profile. The die's design affects the material properties of the extruded metal, but these effects are neither well understood nor statistically quantified. This lack of knowledge leads to manufacturers extruding at lower speeds or higher scrap rates than necessary. Our team examined the effects of two different dies on the final structure and properties of aluminum extrusions at different speeds. We quantify the effects of die design on material properties and propose an optimal die combination and extrusion speed for the most efficient manufacturing.

1885
Michigan Tech
College of Forest Resources
and Environmental Science

249
Flammability Reduction in Magnesium Alloys for Additive Manufacturing

Flammability test of a magnesium AZ61 alloy

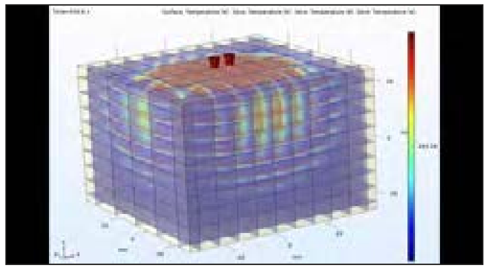
Team Members
Emily Tom, Brendan Treanore, Mike Millado, and Josh Jay, Material Science and Engineering,

Advisor
Paul Sanders, Materials Science and Engineering

Sponsor
United Technologies Research Center

Project Overview
Magnesium serves as a new potential material for lightweighting in the automotive and aerospace industries, but due to its highly reactive nature, magnesium alloys that are more resistant to reacting have been of recent interest. United Technologies Research Center (UTRC) is looking for a magnesium alloy with reduced flammability that is also capable of being welded with to use in wire-arc additive manufacturing (WAAM). WAAM using magnesium alloys with reduced flammability will allow faster and cheaper prototyping of parts that are lighter and safe for consumers.

250
Assessment of Stryker RF Forceps for Brain Tumor Treatment



Computation simulation of brain tissue damage using the forceps

Team Members
Maddie Steger, Electrical Engineering; Nicholas Turowski, Karl Schneider and Sarah Black, Biomedical Engineering

Advisors
Jingfeng Jiang and Sean Kirkpatrick, Biomedical Engineering

Sponsor
Stryker

Project Overview
The purpose of this project is to create models that are capable of evaluating the effects of multiple energy modalities (mechanical, electrical, thermal) for the new generation of the Spetzler-Malis Bipolar delivery system (Spetzler-Malis Non-Stick Bipolar Forceps, Stryker). The data received from these models will be used to convince surgeons that the new generation is better and more advanced than the last. The model created will be capable of evaluating effects on both targeted and non-targeted tissue surrounding the point of energy application and will have both a physical component and a computational component. Both the physical and computational model need to emulate the effects that the forceps have on brain tissue and brain tumor ablation specifically.

251
Midcontinent Independent System Operator (MISO) Emergency Demand Response (EDR) Proposal

Michigan Tech Energy Management Central Heating Plant

Team Members
Zoe Ketola, Natalie Green, Carl Swartzendruber, and Jon Pyles, Engineering

Advisors
Jon Sticklen and Michelle Jarvie-Eggart, Engineering Fundamentals

Sponsor
Michigan Tech Energy Management Central Heating Plant

Project Overview
Michigan Tech has an opportunity to reduce our electrical costs through Demand Response. Utilities must be able to generate and deliver the maximum amount of power that all customers need at any one time. Large commercial and industrial customers pay a 'Demand' charge based on their peak demand used at any one time during the month to offset the infrastructure needed to supply that demand. Demand response can benefit customers in two ways. A customer could shut off equipment or self-generate a portion of their power needs to minimize their maximum peak for the month. Michigan Tech could reduce our peak by better controlling HVAC equipment, or could run generators to shave the peak. MISO offers economic incentives to customers who are willing to reduce demand when asked, to help them better manage their system. Michigan Tech could potentially save between $100,000 and $150,000 per year by participating in demand response.

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252
Blubber Only Implantable Satellite Tag Anchoring System

Figure 01. of an implantable telemetry tag (bottom left), previous tag design fully implanted into a humpback whale (top left), and two critically endangered north Atlantic right whales (right).

Photo Credits: Dr. Rupak Rajachar and Dr. Alexandre Zerbini

Team Members
Alex Fetner, Samantha Dertinger, and Adam Brandmire, Biomedical Engineering; Aaron Streng, Mechanical Engineering

Advisor
Rupak Rajachar, Biomedical Engineering

Sponsor
National Oceanic and Atmospheric Administration (NOAA)

Project Overview
Satellite telemetry tags are currently being used by marine biologists and conservationists to track the migration patterns of whales in efforts to improve conservation practices. Our project aims to design a blubber-only implantable satellite tag with a longer retention time through a redesign of the tag and use of micro surface features.

253
Direct Casting with Additive Manufactured Patterns

3D-printed pattern cast in aluminum by Mercury Marine

Team Members
James Driesenga, Riley Simpson, Camden Miner, Zach Schwab, TC Swittel, and Sean Frank, Mechanical Engineering

Advisor
Bob Page, Mechanical Engineering-Engineering Mechanics

Sponsor
Mercury Marine

Project Overview
We have been asked by Mercury Marine to develop a lost-foam style casting process that uses a 3D printed pattern instead of expanded polystyrene. Expanded polystyrene allows for complete part filling, but the cost and time required to create a new pattern out of polystyrene are much too high due to the pattern tooling. 3D printing patterns would eradicate the need for pattern tooling and reduce the time required to produce a pattern significantly.

254
Radiofrequency Ablation Modeling and Validation in Non-Homogeneous Structures

Medtronic's radiofrequency ablation platform: Accurian System

Team Members
Clare Biolchini, Matthew Colaianne, and Ellen Lindquist, Biomedical Engineering; Samuel Miller, Electrical Engineering

Advisor
Jeremy Goldman, Biomedical Engineering

Sponsor
Medtronic

Project Overview
Predictable lesion formation during radiofrequency (RF) ablation is a function of many factors and the subject of decades of research. Of specific interest to Medtronic is lesion formation in non-homogeneous tissues and structures, such as the knee and shoulder. We are challenged to develop mathematical models and physical model validation for such treatment scenarios.

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255
Fluid Powered Vehicle Challenge

Eric, Will, Chandler and Jay

Team Members
Jay Kintner, Will Norton, Eric Pederson, and Chandler Zent, Mechanical Engineering Technology

Advisor
David Wanless, Manufacturing and Mechanical Engineering Technology

Sponsor
Parker Hannifin

Project Overview
Our team is taking part in the Fluid Powered Vehicle Challenge, which hopes to create an environment resulting in uncommon connections and breakthroughs. The challenge supports the learning and growth of fluid power industry knowledge through the combination of fluid power and human powered vehicles, in a competition which measures efficiency, power, and reliability.

256
Validation Test System for Boston Scientific Inflatable Penile Prosthesis (IPP)

First prototype

Team Members
McKenzie Hill, Ahmed Al Dulaim, Nathan Halanski, and Katherine Wang, Biomedical Engineering

Advisors
Orhan Soykan and Sangyoon Han, Biomedical Engineering

Sponsor
Boston Scientific

Project Overview
Our team performed analyses, simulations, and/or engineering calculations to estimate/predict the movement of the IPP cylinders and resulting stress/strain. We modified current or designed new test procedures to perform physical testing that can replicate these conditions and fabricate a physical test system.

257
Instrumented Mechanical Retractor

Thompson Surgical Instruments

Team Members
Colin Johnson, Juan Chica, Cole Enstad, and Jake Tuomi, Biomedical Engineering

Advisors
Sean Kirkpatrick and Orhan Soykan, Biomedical Engineering

Sponsor
Thompson Surgical Instruments

Project Overview
Our team sought to obtain the forces exerted on the blades of a mechanical retractor system with real-time and data logging capabilities.

Boston Scientific

Thompson SURGICAL INSTRUMENTS

258
Pond and Well Design for Increasing Fish-Rearing Capacity for the Keweenaw Bay Indian Community Hatchery

Analyzing data in the field as we conduct a seismic survey to try to locate the bedrock

Team Members
Allyson Hartz, Ginny Hemmila, Steve Wright, Donelle Auten, Tucker Scoville and Arie Ruiter, Geological Engineering

Advisor
John Gierke, Geological and Mining Engineering and Sciences

Sponsor
Keweenaw Bay Indian Community Natural Resources Department, Bureau of Indian Affairs

Project Overview
The Keweenaw Bay Indian Community Tribal Hatchery is looking to install a sixth groundwater production well, a new walleye rearing pond, and rehabilitate an existing well for increased fish-rearing capacity. Our Well Design team focused on determining a location for the new well and designing it to provide water for the hatchery and the new pond. Our Pond Design team investigated a recommended location for the new pond by conducting a watershed assessment and designed it for fish-rearing. By analyzing groundwater movement, aquifer properties, and local lithology through fieldwork and modeling, our groundwater engineering project will increase production and performance at the Tribal Hatchery.

259
Extrusion Cut and Drill Automation

Team Members
Skyler VanderBoegh, Melinda Henry, and Avery Yarbrough, Mechanical Engineering Technology

Advisors
Kevin Johnson, Manufacturing and Mechanical Engineering Technology; Russell Stein, Materials Science and Engineering

Sponsor
Donald Engineering, ArcelorMittal, Department of Materials Science and Engineering

Project Overview
The MSE department utilizes an extrusion press to extrude aluminum alloy billets through a tool to produce a UP-shaped cross section to create a bottle opener part. The aluminum billet is first extruded into a "log" approximately 36 inches long, which is then heat treated to T6. Currently, the manual process of creating the UP bottle opener is to cut the "log" into one-quarter inch thick pieces, sand the cut faces, drill the key ring mounting hole, and deburr. This process has proven to be tedious and inefficient due to the amount of manual labor required for each individual product. The sponsor would like an automated process of cutting, preferably eliminating the sanding process of the cut surfaces and drilling the key ring mounting hole. The goal of this project is to feed the "log" in one end of the system and have the finished bottle opener parts delivered at the end of the process ready for deburring, anodizing, and engraving. This will save students and faculty a great deal of time when producing large quantities of the bottle openers.

Michigan Technological University
Materials Science and Engineering

ArcelorMittal

260
Galvanically Induced Al Corrosion for Scuttling of Data Collection Buoy

NX model of housing design concept, created by Katie Kiser

Team Members
Katie Kiser, Olivia Clancy, and Anna Isaacson, Materials Science and Engineering

Advisor
Paul Sanders, Materials Science and Engineering

Sponsor
SENSE Enterprise, ArcelorMittal Steel Warehouse

Project Overview
DARPA has begun to initiate their "Ocean of Things" project, changing the way data is collected in the ocean. Instead of having a select amount of high-quality units deployed to be collected at the end of their use, the model is switching to thousands of low-quality devices that would remain in the ocean. Our team has worked to develop a low-cost, low-impact housing option for these buoys that uses galvanic corrosion of Al for controlled scuttling.

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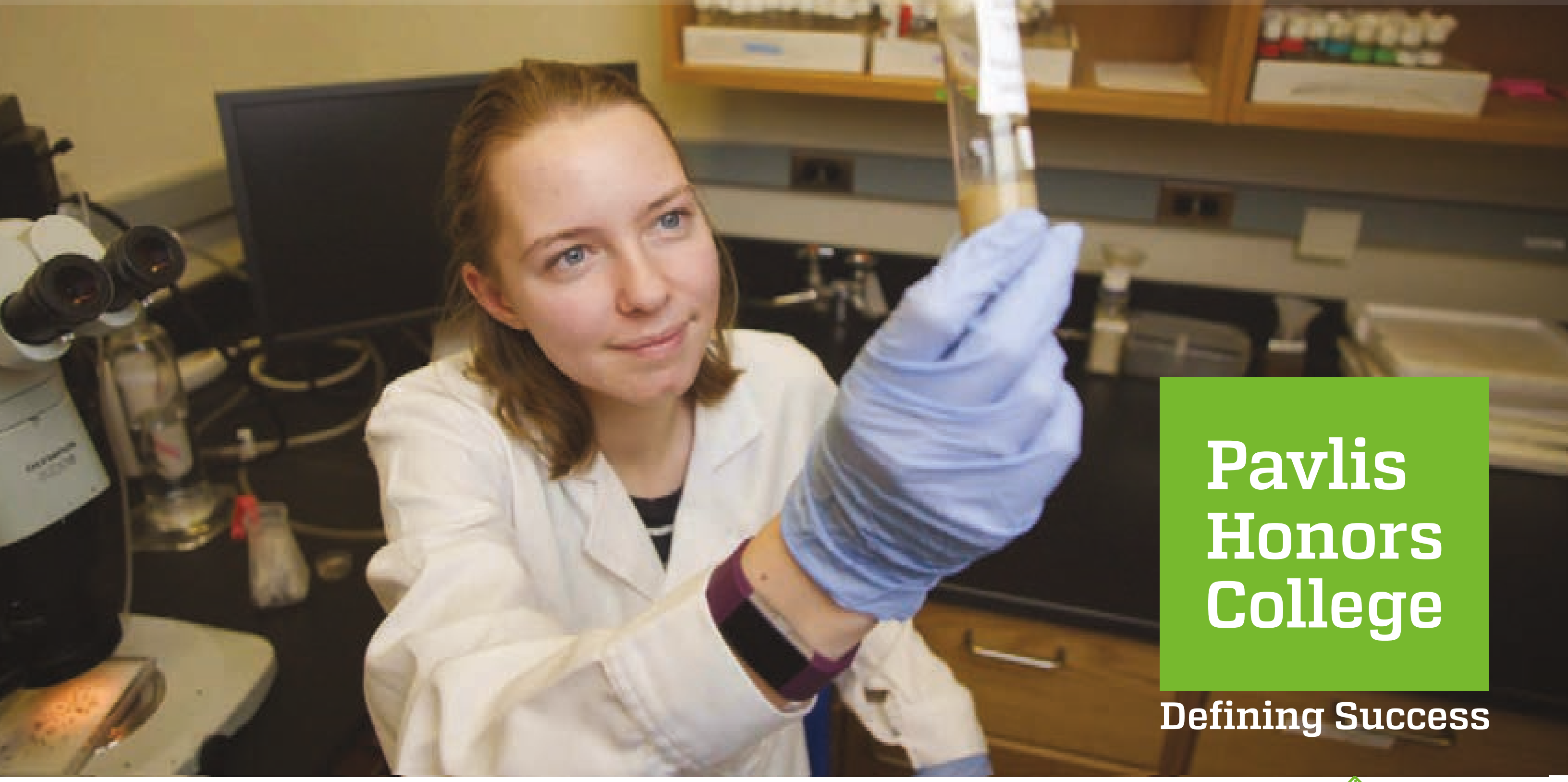

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Within one year at Michigan Tech, Tessa Steenwinkel went from working as an undergraduate research assistant in Thomas Werner's genetics lab to co-authoring their book, *Drosophilids of the Midwest and Northeast*. Now she's working on her own study that examines the effects of nutrition on fertility and life expectancy.

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