



**Michigan  
Technological  
University**

**DEPARTMENT REPORT 2021-2022**  
**ELECTRICAL AND COMPUTER ENGINEERING**





## From the Chair

### JIN W. CHOI, PROFESSOR AND CHAIR

Greetings from Michigan Tech! I am privileged to introduce myself to all of you. I joined the Michigan Tech community on July 1, 2022, as chair of the Department of Electrical and Computer Engineering. As you can see from my name, I am originally from South Korea and came to the US for graduate studies at the University of Cincinnati, where I received a PhD in Electrical and Computer Engineering in 2001. My BS and MS degrees, both in electrical engineering, are from Seoul National University.

Before joining Michigan Tech, I was a professor of electrical and computer engineering at Louisiana State University from 2003 to 2022. Although I am a pure electrical engineer, my research work spans from semiconductor microfabrication to healthcare technologies, covering interdisciplinary areas of ECE. I believe that my experience will help the department open up new collaboration opportunities, both within and beyond Michigan Tech.

The horizons of ECE stretch from power engineering to modern and future electronics, space technology, advanced communication, computing devices, healthcare, robotics, and even automobiles. ECE undoubtedly provides backbone technologies to modern society's Fourth Industrial Revolution. Contributing to both our society and the wellness of human beings, the ECE Department at Michigan Tech prepares the future workforce and promotes innovative research.

As the chair, my primary goals are continuously improving the quality of learning and exploring opportunities for students, assisting students and faculty in finding success, elevating alumni and stakeholder engagement with the Department, and promoting collaboration within the University and beyond. My secondary goals are for the Department to continue pursuing excellence in education, research, and service. Michigan Tech is patently where a better tomorrow begins, and I would like to build that better tomorrow together with the Department's motivated students, talented faculty, knowledgeable staff, and loyal alumni.

It was a huge transition from the Deep South to the Upper Peninsula of Michigan and I am still settling down in Houghton and on the Michigan Tech campus, which already makes me feel at home. This is a new endeavor for me. Someday, I hope to have the honor to meet all of our alumni and tell you stories of my first winter at Michigan Tech. Until then, I welcome hearing from you on any topic, including survival tips for the famous UP winters! I will certainly be in touch soon with updates and exciting news for the Department.

A handwritten signature in black ink that reads "Jin W. Choi". The signature is fluid and cursive, with a long horizontal line extending from the end of the name.

**Jin W. Choi**  
Chair, Department of Electrical and Computer Engineering

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### On the Cover

The NED Arm being used to complete a simple task.

### Electrical and Computer Engineering

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# ▶ Faculty Directory

**Glen Archer****Teaching Professor**

PhD, Electrical Engineering, Michigan Technological University  
Image processing, security information operations, electronic warfare, counter-terrorism, information operations

**Hongyu An****Assistant Professor**

PhD, Electrical Engineering, Virginia Polytechnic Institute and State University  
Neuromorphic engineering/computing, energy-efficient neuromorphic electronic circuit design for artificial intelligence, emerging nanoscale device design, spiking neural networks

**Paul Bergstrom****Professor**

PhD, Electrical Engineering, University of Michigan  
MEMS, nanotechnology, micro-electromechanical systems, inertial pressure, micromachining materials and process technologies

**Leonard Bohmann****Professor/Associate Dean, College of Engineering**

PhD, Electrical Engineering, University of Wisconsin  
Power systems, renewable energy, renewable energy generation and integration in power systems

**Jeremy Bos****Associate Professor**

PhD, Electrical Engineering, Michigan Technological University  
Atmosphere optics, autonomous vehicles and vehicular networks, industrial automation and controls, image and signal processing, machine intelligence, statistical optics, quantum optics

**Jeffrey Burl****Associate Professor**

PhD, Electrical Engineering, University of California-Irvine  
Adaptive control, robust control, image motion estimation, adaptive optics, intelligent control of automotive manufacturing systems, reentry body control

**Bo Chen****Professor of Mechanical Engineering and Electrical Engineering**

PhD, Mechanical and Aeronautical Engineering, University of California-Davis  
Intelligent mechatronics, embedded systems

**Tan Chen****Assistant Professor**

PhD, Aerospace and Mechanical Engineering, University of Notre Dame  
Legged locomotion, applied control, rehabilitation robotics, collaborative robots, learning-based control

**Jin Choi****Professor and Chair**

PhD, Electrical and Computer Engineering, University of Cincinnati  
BioMEMS, microfluidic devices and systems, and biomedical microdevices, sensors and sensor systems, bioelectronic and healthcare sensors and devices, flexible and printed electronics and sensors, healthcare sensors and devices

**Christopher (Kit) Cischke****Teaching Professor/Undergraduate Programs Committee Chair**

MS, Computer Engineering, University of Minnesota  
Parallel computing and UPC

**Flavio Bezerra Costa****Assistant Professor**

PhD, Electrical Engineering, Federal University of Campina Grande, Brazil  
Integration of renewable energy systems, power system protection, control and monitoring, power quality, power systems and electronics, AC/DC microgrids, high-voltage DC, electric power transmission systems, signal processing and machine learning in power systems

**Durdu Guney****Associate Professor**

PhD, Electrical and Computer Engineering, University of California-San Diego  
Metamaterials and plasmonics, metasurfaces, photonic crystals, quantum computing, communications and cryptography

**Trever Hassell****Associate Teaching Professor**

MS, Electrical Engineering, Michigan Technological University  
Power electronics, control systems, electric drives and machinery, hybrid and electric vehicle systems, microgrids

**Nagesh Hatti****Professor of Practice**

MS, Software Engineering, Birla Institute of Technological Sciences  
MBA, Texas Christian University  
Software development, supply chain management

**Yunting Liu****Assistant Professor**

PhD, Electrical Engineering, Michigan Technological University  
Power electronics and power systems

**John Lukowski****Associate Professor/Assessment Committee Chair**

MS, Electrical Engineering, Michigan Technological University  
Power, energy, factory automation, robotics

**Christopher Middlebrook****Professor/Associate Chair/Lab and Space Committee Chair**

PhD, Optics, University of Central Florida  
Electronic design and manufacturing, infrared detectors, optics, photonics, radiometry

**Bruce Mork****Professor**

PhD, Electrical Engineering, North Dakota State University  
Power systems transients (ATP/EMTP), nonlinear dynamics and chaos theory, power systems protection, smart grids, computer simulation, power quality, photovoltaics renewable energy, wind energy, solar energy

**Shane Oberloier**

**Assistant Teaching Professor**

PhD, Electrical Engineering, Michigan Technological University  
Open-source hardware, additive manufacturing, digital design, robotics design, engineering education

**Aurenice Oliveira**

**Associate Professor**

PhD, Electrical Engineering, University of Maryland, Baltimore County  
Optical fiber communications, wireless communications, signal processing, network security, intelligent transportation systems, communication networks and systems

**Anthony (Tony) Pinar**

**Associate Teaching Professor**

PhD, Electrical Engineering, Michigan Technological University  
Machine learning, signal and image processing, data fusion, electronic design

**Michael Roggemann**

**Professor/Graduate Programs Committee Chair**

PhD, Electro-Optics, Air Force Institute of Technology  
Adaptive and atmospheric optics, image reconstruction and processing, pattern recognition

**Timothy Schulz**

**Professor**

DSc, Electrical Engineering, Washington University, St. Louis  
Statistical signal processing, computational photography

**George Semouchkin**

**Instructor**

PhD, Material Science and Engineering, Saint Petersburg State Technical University, Russia  
Optics, photonics, signal and image processing

**Elena Semouchkina**

**Professor**

PhD, Materials (Engineering option), The Pennsylvania State University  
Electromagnetic metamaterials, computational electromagnetic analysis, resonance phenomena in complex media: metasurfaces, high-contrast materials integration for electronic and photonic systems, materials and device characterization to microwaves

**Chee-Wooi Ten**

**Professor**

PhD, Electrical Engineering, University College Dublin  
Power infrastructure cybersecurity, future control center framework, SCADA/EMS/DMS applications, smart home and robotic technologies, attack/defense combinatorics

**Zhaohui Wang**

**Associate Professor**

PhD, Electrical and Computer Engineering, University of Connecticut  
Communications, signal processing, communication networks, network security, underwater acoustic applications

**Kaichen Yang**

**Assistant Professor**

PhD, Electrical Engineering, University of Florida  
Network security, hardware security, cyber-physical system security, deep learning

**Lan (Emily) Zhang**

**Assistant Professor**

PhD, Electrical and Computer Engineering, University of Florida  
Wireless communications, reconfigurable intelligent surfaces, millimeter wave frequencies, cyber-physical systems and the Internet of Things, big data, machine learning, smart transportation, eHealth, cybersecurity and privacy, learning pipeline, blockchain



# Awards and Honors

**Hongyu An** received the Blackwell Award from Virginia Polytechnic Institute and State University on January 30, 2021.

**Jeremy Bos** was named to the Deans' Teaching Showcase at Michigan Tech on April 19, 2022. He also led Michigan Tech's student team in Years 3 and 4 of the inaugural AutoDrive Challenge, sponsored by the Society of Automotive Engineers (SAE) and General Motors. Michigan Tech's team, Prometheus Borealis, earned second- and third-place overall finishes during Years 3 and 4, respectively. The Year 3 Competition was held virtually October 15, 2020, and the Year 4 Competition was held in MCity, Ann Arbor, Michigan, on June 5-14, 2021.

**Trevor Hassell** was named to the Deans' Teaching Showcase at Michigan Tech on January 22, 2021.

**John Lukowski** received the Eta Kappa Nu Honors Society (HKN) Professor of the Year Award in 2022 and was named a finalist for the Michigan Tech Distinguished Teaching Award.

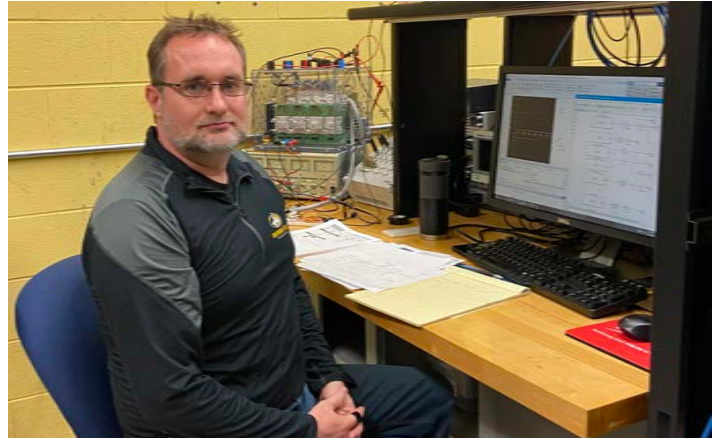
**Christopher Middlebrook** received the Gentec-EO Laser Lab Award, presented by Gentec-EO, in 2020; the HKN Outstanding Electrical Engineering Professor of the Year Award, presented by the HKN, in 2020; and the IPC Michael V. Carano Teacher Excellence Award, presented by IPC, in 2020.

**Shane Oberloier** received the HKN Professor of the Year, presented by HKN, in 2021; and the Oliver and Mary Winn Endowed Fellowship, presented by Oliver and Mary Winn, in 2021; the Outstanding Scholarship Award, presented by Michigan Tech Graduate Student Government (GSG), in 2021; and the Outstanding Graduate Student Teaching Award, presented by GSG, in 2020.

**Timothy Schulz** was named a Fellow of the International Society for Optical Engineering (SPIE); a Fellow of the Optical Society of America; and was inducted into the Tau Beta Pi Engineering Honor Society.

**Chee-Wooi Ten** was in the top 10 percent of instructors at Michigan Tech, based on teaching evaluations for the spring 2021 semester. Ten was recognized by the Office of the Provost and Senior Vice President for Academic Affairs on May 5, 2021.

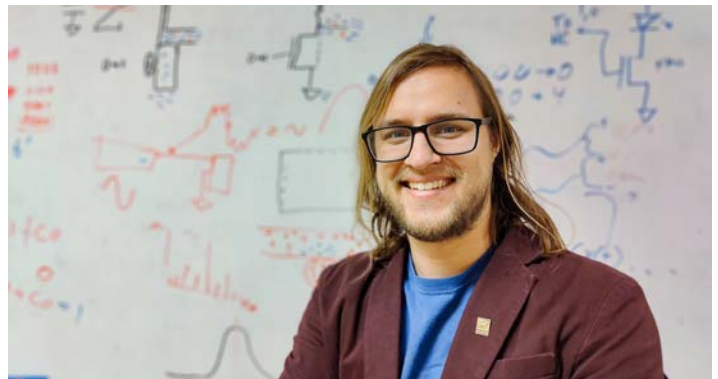
**Lan (Emily) Zhang** received the Michigan Tech Research Excellence Fund Award in 2021; a National Science Foundation (NSF) Software and Hardware Foundations (SHF) Medium Grant in 2021; and research funds from the Michigan Tech College of Engineering to study COVID-19 activity management in October 2020.



*Trevor Hassell is developing and integrating an inverter test bed system using a Semikron SemiTeach Inverter System and dSPACE MicroLab in conjunction with MATLAB/Simulink to control the system. The project supports electrical power and energy conversion research.*



*Pictured (from left): 2022 HKN Professor of the Year John Lukowski stands with HKN President Molly Baerman and ECE students Sophie Owen, Jenna McClintock, Mia Pudas, Alex Wilt, Tyler Hartman, Andrew Sizelove, Mason Smith, and Noah Hornfisher.*



*Shane Oberloier was presented with the Professor of the Year Award at the 2021 ECE Virtual Awards Ceremony and Reception for Graduates by Travis Momsen, the president of HKN.*



# Bos Leads Lidar Comparative Benchmarking Efforts

In April 2022, a group of researchers evaluated 10 lidar units aimed at the automotive market, highlighting performance differences and variation in order to motivate a framework of standards.

**Jeremy Bos** led the evaluations with Paul McManamon, the current CEO of Exciting Technology, a SPIE past president, and author of the books *LiDAR Technologies and Systems* and *Field Guide to Lidar*. The tests were conducted near Orlando, Florida.

The group used a set of calibrated targets provided by Labsphere, which were about the size of a toddler and reflected uniformly in all directions. Using a survey-grade lidar as a reference, they found that while each lidar remained generally representative of the manufacturer's stated specifications, performances between lidars were significantly different. And when a bright object was placed next to the target, performance fell steeply.

The effort was sponsored by SPIE and will be repeated annually for two years, with each year adding more tests, complexity, and lidar unity. The effort is chaired by Bos and McManamon, along with a group of volunteers from academia, government, and industry.



*Top: Graduate student Zach Jeffries prepares lidar equipment for testing. Middle: Team members troubleshoot a lidar driver at the evaluations with Jeremy Bos (seated at table in blue shirt). Bottom: Jeffries adjusts one of several calibrated targets during testing.*

## New Faculty Profiles



**Lan (Emily) Zhang** received her PhD in Computer Engineering from the University of Florida in 2020 and joined the Department as an assistant professor later that year. Her research, which is focused on distributed machine learning and wireless communications in various Internet of Things and cyber-physical systems (CPS) applications, is supported by awards from the National Science Foundation and Michigan Tech.

Since joining the Department, Zhang has mentored two PhD students, three master's students, and two undergraduates. She has taught three courses from senior to graduate level, including one developed new course, EE4370–IoT Application and Design.

Zhang has been an associate editor for IEEE Transactions on Vehicular Technology since 2021. She was a TPC member for IEEE GLOBECOM 2022, IEEE ICDCS 2022, IEEE INFOCOM poster/demo 2021 and 2020, NeurIPS-SpicyFL WH 2020, and IEEE ICNC 2019 and 2018. She has been an active reviewer and speaker for IEEE conferences and journals.

At MTU, Zhang has been a member on Department committees regarding diversity and outreach, faculty searches, and the Grace Hopper Celebration. She also served as a lecturer for Michigan Tech Summer Youth Programs electrical engineering courses for K-12 students in summer 2021.



**Hongyu An** earned his PhD in Electrical Engineering from Virginia Tech in 2020, and has a background in neuromorphic engineering/computing, energy-efficient electronic circuit design for artificial intelligence and medical applications, algorithms for spiking neural networks, and intelligent robotics.

An is a faculty member of the Michigan Tech Institute of Computing and Cybersystems, with current research projects including "Intelligent Robotics: Energy-Efficient Online Learning of Robotics through Spiking Neural Networks and Neuromorphic computing," "Neuromorphic Computing on Medical Applications," "Learning Algorithms for Spiking Neural Networks and Associative Memory Learning," and "Energy-efficient Neuromorphic Electronic Circuit Design for Artificial Neural Networks and Deep Learning."

His academic goal is to develop a "brain chip" with energy efficiency and intelligence comparable to the human brain.

He came to the Copper Country with his wife and two kids, and enjoys the snow and friendly community.



**Flavio Bezerra Costa** became an assistant professor in the Department in the spring semester of 2022. He teaches digital signal processing in power systems and advanced power electronics, and is a graduate student advisor. He is also a member of the ECE Undergraduate Programs Committee.

Costa earned his BSc, MSc, and PhD degrees in electrical engineering from the Federal University of Campina Grande (UFCG), Brazil, in 2005, 2006, and 2010, respectively. He was an associate professor at the Federal University of Rio Grande do Norte (UFRN), Brazil, from 2010 to 2021. He was a visiting fellow at KU Leuven, Belgium, in 2012, and at INESC Porto, Portugal, in 2014. He was a postdoctoral fellow at Rheinisch-Westfälische Technische Hochschule Aachen (RWTH Aachen) University, Germany, in 2015, and he was a visiting professor at TU Berlin, Germany, in 2019.

His research interests lie in generation, transmission, and distribution systems, including power system protection and control, real-time analysis of power quality disturbances and faults, integration of renewable energy systems, and smart grid solutions. He is also interested in digital signal processing and artificial intelligence.

Costa has served as a TPC member of the 2023 IEEE North American Innovative Smart Grid Technologies Conference (ISGT) and the 2023 International Conference of Power Systems Transients (IPST), and guest editor of the Elsevier journal *Electric Power Systems Research*.

## Faculty Profile



### Chris Middlebrook

Along with his roles as professor and associate chair, Chris Middlebrook serves the Department and its students as an active committee member, faculty advisor, and caretaker of the Plexus Innovation Lab, and created an undergraduate course in printed circuit board (PCB) design at Michigan Tech.

Middlebrook chairs the Department's Lab and Space Committee, and directed lab overhauls for courses EE 2174 Digital Logic and EE3171 Microcontroller Applications. Both labs now allow students to access critical lab technology—development boards and interface hardware boards, respectively—outside of lab times.

"The interface hardware boards were designed by Mark Sloat, built and donated by Calumet Electronics, and populated in collaboration with Rochester Institute of Technology," said Middlebrook.

He also led the revision of EE2180 Introduction to Robotics' lab component and created labs for a new course: EE3280 Robotic Operating Systems.

He advises two student organizations—Michigan Tech's chapters of SPIE/OSA and IPC & Electronics—and is a member of the IPC National Student Chapter Council. He supports SPIE/OSA's student members in organizing an annual Photonics Night, featuring technical presentations by industry reps. In February 2022, he hosted speaker Milea Kammer from Honeywell Aerospace, who presented a technical talk on lead-free parts and solders in aerospace electronics to IPC & Electronics students.

In the Plexus lab, Middlebrook ensures that the lab's resources and student coaches meet the needs of ECE students. He adds test and fabrication equipment and recruits student coaches, in addition to facilitating technical and safety training.

Middlebrook was selected for the Michigan Tech Center for Teaching and Learning (CTL) 2022 Deans' Teaching Showcase for growing his work with PCB design into something extraordinary. "He recognized a training need for electronic design engineers and put all the pieces in place to address a national security problem and offer employment opportunities for Michigan Tech students," wrote former CTL Director Michael Meyer.

If students liked building electronic circuits, Middlebrook thought they might enjoy designing PCBs. Gathering free materials and used equipment from local and national suppliers, he launched an undergraduate course in PCB design. It was a huge hit with undergraduates, and he worked closely with Calumet Electronics to offer the students an in-depth view of the design process, from schematic capture to tested and accepted final product.

## Sabbatical Activity

**Zhaohui Wang** visited the University of Alberta, Edmonton, Canada, from April to December 2021 for research on machine learning for communication systems. During this time, Wang and PhD student Li Wei presented "A Variational Auto-Encoder Model for Underwater Acoustic Channels" at the 15th International Conference on Underwater Networks & Systems (WUWNet) in November 2021—their work received the Best Student Paper Award. Wang also collaborated with researchers from the University of Alabama, Georgia Tech, and City University of New York on an NSF CCRI project: "mu-Net: Shared Infrastructure for Mobile Underwater Networks."





## Plexus Innovation Lab Opens

After a soft opening in the spring 2021 semester due to COVID restrictions, the Department held an official grand opening ceremony for its Plexus Innovation Lab during fall 2021.

The lab is a 1,230-square-foot electronics makerspace located in Michigan Tech's Electrical Energy Resources Center (EERC). Visit the lab's website at [makerspace.ece.mtu.edu](http://makerspace.ece.mtu.edu), and find it on Instagram: @eercmakerspace.

Prior to the grand opening, the lab had already been utilized for a National Science Foundation Research Experience for Undergraduates project; info sessions by representatives from Milwaukee Tool and Plexus; a two-day training event for the Michigan Tech Aerospace Enterprise; and a Christmas tree build event held jointly by the Department and IPC & Electronics Student Chapter at Michigan Tech—participating students built a blinking LED Christmas tree ornament for the holidays.



*The Plexus Innovation Lab provides students like Ian Mattson the space, equipment, and tools necessary to work on their electronics projects. Mattson is shown working on an underwater robot he created as a high school freshman. Mattson is an ECE double major at Michigan Tech and joined the lab as a maker coach.*



# ITC Learning Center Renovated, Active

Renovations on the newly created ITC Learning Center were completed during the 2020-21 academic year. The space's ceiling and lights were replaced, new carpeting was installed, and all-new furniture was brought in for student use. Glass whiteboards were also installed, as well as technology to support learning coaches.

In the 2021-22 academic year, more students returned to visiting the learning center in person, and it has resumed its role as an all-day student hangout and collaborative workspace. However, the Department has continued offering virtual coaching hours through Zoom.

The learning center had 10 coaches during 2021-22 (two undergrads and eight graduate students), and saw an exciting increase in the number of undergraduates applying to be coaches in summer 2022.



*Dylan Kangas tests a personal circuit project in the Plexus Innovation Lab.*

# ▶ Retirements and Emeritus Status

## RETIREMENTS

The Department would like to honor our retirees. We convey our gratitude and appreciation for their years of service.



**MICHELE KAMPPINEN**

Kamppinen was our longtime office assistant, and retired in January 2021. She worked at Michigan Tech for 30 years and spent 25 of those years in ECE, beginning her work in the Department in August 1995. It was almost impossible to picture anyone else sitting behind her desk, but we were very happy to wish her well in her future endeavors.

Kamppinen was a constant and reliable fixture in the Department's administrative staff, and her loyalty to our ECE motley crew was amazing and very appreciated. She was honored during our virtual graduation reception held in spring 2021, where Kit Cischke spoke about her contributions.

"For something like 25 years, Michele has been the one to greet people who walk into our main office. She's also probably the one who has kept the department from falling apart," remarked Cischke. "She got textbook orders out of faculty members who hate filling out paperwork, made sure we were all where we were supposed to be when we were supposed to be there, made (what felt like) approximately 87 million copies, 72,000 room reservations, and reimbursed countless students for Senior Design and Enterprise purchases. She was an endless fount of useful knowledge. If I didn't know the answer, I asked Michele."

Cischke closed his remarks by addressing Kamppinen directly: "May you never be asked to run a copier again—and may you be as appreciated in your home as you were in the EERC."

## NEW FACULTY EMERITI

Department faculty voted to request that the Michigan Technological University Board of Trustees name Warren Perger, Jeffrey Burl, and Michael Roggemann as professors emeriti. Voting was held January 19, 2021, for Perger; and April 5, 2022, for Burl and Roggemann.



**JEFFREY BURL**

Burl began his 29-year career at Michigan Tech as an assistant professor in 1993, shortly after his service at the Naval Post Graduate School in Monterey, California. He was promoted to associate professor in 1999.

He published the textbook *Linear Optimal Control* in 1999 (still in use today at Stanford University) and is the author of 42 refereed journal articles. He has served as principal investigator (PI) or co-PI on projects whose funding totals \$2.5 million, and was awarded the Erskine Fellowship to attend the University of Canterbury in New Zealand.

Burl advised the Department's first PhD in Electrical Engineering graduate at Michigan Tech and went on to successfully advise seven more PhD graduates. He was selected to be a member of the Michigan Tech Academy of Teaching Excellence in 2011 for his innovative multidisciplinary course, Hybrid Electric Vehicles. He advised the IEEE-Eta Kappa Nu electrical engineering honors society and served as director of the AMJOCH Observatory from 2009 to 2013. He also served as the Department's representative to the University Senate.

## WARREN PERGER

Perger began at Michigan Tech as a visiting instructor in 1981 after earning his master's in electrical engineering from the University of Wisconsin. He left to pursue his PhD in Physics at Colorado State University. After earning his doctorate, he rejoined the Department as an assistant professor in 1987, and was promoted to associate professor in 1995 and professor in 2005. He retired at the end of the spring 2021 semester having spent 34 years at Michigan Tech.

During his years at MTU, Perger authored 38 refereed journal articles, mentored four PhD graduates, and served on the committees of 22 other successful PhD candidates and 39 master's candidates.

He was a coveted E-mag instructor known by students for his ability to make the material accessible. Perger's deep knowledge of wide-band antenna design led him to become an expert witness whose testimony was pivotal in several international patent lawsuits. Within the Department, Perger will also be remembered as a dedicated and enthusiastic aviator, a relentless aeronautic experimenter, and an entrepreneur.



Warren Perger, right, talking with Mike Chase, former ECE research associate.



## MICHAEL ROGGEMANN

Roggemann began his 26-year career at Michigan Tech as an associate professor in 1997 shortly after his retirement from the US Air Force as a faculty member at the Air Force Institute of Technology. He was simultaneously tenured and promoted to professor in 1999.

He published the optics textbook *Imaging Through Turbulence* in 1996, which is still in use today, and is the author of 35 refereed articles. He also successfully advised 14 PhD graduates and 29 master's graduates, and has been the PI or co-PI on \$13.2 million's worth in projects for the US Department of Defense and other agencies.

Roggemann received the Michigan Tech Research Award in 1999 and was inducted into the University's Academy of Teaching Excellence in 2009. His efforts helped Michigan Tech receive recognition as an authority in the fields of atmospheric optics and image reconstruction. He also helped develop the University's photonics program and was featured on the Weather Channel for debunking the mystery of the Paulding Light in 2014.

# MTU Robotics Engineering: Building the Skills of Tomorrow

The BS in Robotics Engineering at Michigan Tech is a promising degree program with two years of growth under its belt.

**Glen Archer**, ECE teaching professor, developed the robotics engineering (RE) curriculum in academic year 2019-20 with William (Bill) Predebon, professor and chair of the Department of Mechanical Engineering-Engineering Mechanics, and Leonard Bohmann, ECE professor and associate dean of the College of Engineering. The program was implemented in 2020-21 after the State of Michigan granted approval.

In its first semester, with COVID protocols in place across campus, the program had six students enrolled. In spring 2021, it added four more. By fall 2021, there were 33 students, growing to 37 by spring 2022.

Recruitment efforts include a texting campaign and department visits with lab tours, in addition to Michigan Tech's fall and summer Open Houses, and spring Preview Day for admitted students and their guests.

RE students at Michigan Tech learn electrical engineering, computing, and mechanical engineering. "It is truly a multidisciplinary degree, providing students the cutting-edge knowledge and skills needed to research and develop robust autonomous systems that

work in all environments," said **Jeremy Bos**, ECE associate professor and advisor of the Robotic Systems Enterprise.

Students complete a capstone project in Michigan Tech's Senior Design or Enterprise Program. The Robotic Systems Enterprise has proven especially beneficial, letting students work hands-on with industry partners—and compete in the AutoDrive Challenge sponsored by SAE International and General Motors.

Students with skills in robotics and autonomous systems are in very high demand, according to Bos. "We are fulfilling an urgent industry need, providing students with relevant education and experience," he said. "This is a one-of-a-kind RE program with a focus on building the skills of tomorrow. Traditional RE focuses on robotic applications in manufacturing. Our program includes these topics, but also prepares students for the jobs of the future."

"Students have the opportunity to work with advanced robot platforms and sensors available at few other colleges and universities," said Bos, who listed ground robots, drones, autonomous surface vessels, underwater autonomous vehicles, and autonomous on-road and off-road vehicles as examples.

Advanced driver assistance systems, autonomous vehicles, robots working in fulfillment centers, and co-robots working closely with humans are some of the fields Bos expects to see students go into. "Our students will engineer autonomy," he said. "These are the jobs of tomorrow, part of the Fourth Industrial Revolution."

ROBOTICS ENGINEERING ENROLLMENT TREND



## BACHELOR OF SCIENCE IN ROBOTICS ENGINEERING

### Semester 1: 14 credits

- Calculus with Technology I
- Engineering Analysis & Problem Solving
- Introduction to Programming in C/C++
- Physics by Inquiry I Lab
- Composition

### Semester 2: 17 credits

- Calculus with Technology II
- Engineering Modeling and Design
- University Physics I - Mechanics
- University Chemistry I and Lab
- Global Issues

### Semester 3: 14 credits

- Multivariable Calculus with Technology
- Statics - Strengths of Materials
- Linux System Administration
- Physics by Inquiry II Lab
- Circuits and Instrumentation

### Semester 4: 16 credits

- Elementary Linear Algebra
- Elementary Differential Equations
- Introduction to Robotics
- University Physics II
- Dynamics
- Critical & Creative Thinking course

### Semester 5: 14-15 credits

- Digital Logic and Lab
- Dynamic Systems or Signals and Systems
- Math/Science Elective
- Social Responsibility/Ethical Reasoning course
- Enterprise Project Work III (if doing ENT option)

### Semester 6: 16 credits

- Design Fundamentals
- Control Systems
- Robot Operating Systems
- Mechanical System Design & Analysis
- Microcontroller Applications for CPS
- Enterprise Project Work IV (if ENT option)

### Semester 7: 17 credits

- EE Senior Design Project I or Enterprise Project Work V Capstone
- Intro to Programmable Logic Controllers
- Sensing & Processing in Robotic Applications
- RE Approved Elective
- HASS Social Behavioral Science course
- HASS Comm/Comp course

### Semester 8: 16 credits

- EE Senior Design Project II or Enterprise Project Work VI Capstone
- Choice of advanced course or set of courses
- RE Technical Elective
- HASS Humanities/Fine Arts course
- HASS course

## Staff Profile



### MARYANN WILCOX

Maryann Wilcox is the Department's office manager and technical communications specialist. She provides administrative support to the Department chair and oversees administrative processes within ECE, including Human Resources functions, payroll and all accounting functions, and the faculty promotion and tenure processes.

Wilcox also supervises the functions of the ECE main office, and oversees and coordinates Department communications, such as our social media efforts, departmental brochures, and outreach to alumni and donors. She also edits and proofreads our communications, serves as chair of the Department's Communications Committee, and is a member of the ECE Executive Committee.

Wilcox said some ECE processes look a lot different today than they did before the pandemic.

"The pandemic forced us to make changes that weren't easy at first, but they were good changes—and sometimes long overdue—and we have since adopted them," she said. "Many processes were streamlined or even eliminated; many processes that used to be done in person with paper are now done completely online."

She said personally, she learned to be more patient with herself as she adapted to working from home, and more patient and understanding with others as well.

"Throughout the pandemic, I felt gratitude for everything I had, and gratitude for the measures the state, country, and this community were taking to slow the spread of COVID," she said. "And also gratitude to the University for the measures they took to keep faculty, staff, and students safe."

## Staff Directory

**Judy Burl**  
Undergraduate Advisor,  
EE and RE

**Liz Fujita**  
CpE Undergraduate Advisor and  
Outreach Specialist

**Sarah Oberloier**  
Administrative Aide/Graduate  
Program Assistant

**Andrew Gross**  
Managing Director,  
Microfabrication Facility

**John Pakkala**  
Graduate Academic Advisor

**Chuck Sannes**  
Laboratory Supervisor

**Mark Sloat**  
Research Associate

**Maryann Wilcox**  
Office Manager/Technical  
Communications Specialist


# Microfabrication Shared Facility

The Microfabrication Shared Facility (MFF) is located on the fourth floor of Michigan Tech's Minerals and Materials Engineering Building. It occupies six lab spaces, including a Class 100 cleanroom housing our photolithography systems and wet chemical processing equipment. Process capabilities include thin film deposition and plasma etch systems, thermal oxidation and diffusion, and metrology and test systems.

The MFF recently acquired a Nanoscribe Photonic Professional GT2 high-resolution 3D printer through a major research instrument grant from the National Science Foundation. The Nanoscribe will enhance Michigan Tech's lithography capabilities by enabling 3D printing of features as small as 150 nanometers, as well as 3D lithography features. The device can also be used for developing photonic devices and microfluidic features.

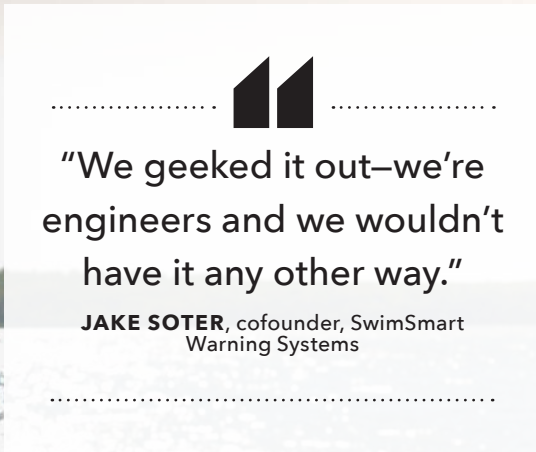
The MFF's managing director, **Andrew Gross**, joined the ECE Department in July 2022 and is now available to train users and teach them more about the MFF's specific capabilities. Prior to coming to Michigan Tech, Gross held a remote position as a lead research engineer with Avegant Corporation of San Mateo, California. He graduated from Michigan Tech in 2004 with a BS in Electrical Engineering, and holds MS and PhD degrees in electrical engineering from the University of Michigan.

Michigan Tech shared facilities are available to researchers across campus and external users in the greater community. The MFF's processes support researchers in many disciplines, including materials science, biomedical engineering, physics, and mechanical engineering.



*Graduate and postdoctoral students in the Medical MicroDevice Engineering Research Laboratory are one of several groups on campus that use the clean lab to conduct their research. In this picture, Managing Director Andy Gross holds up a wafer that tests ABO Rh blood types using dielectrophoresis.*

## Undergraduate Profile



### Jake Soter

Michigan Tech EE graduate Jake Soter '19 '20 cofounded SwimSmart Warning Systems, an autonomously operated instantaneous warning system that tells beachgoers whether it's safe to swim.

In many Great Lakes shoreline communities, firefighters or other municipal employees are in charge of monitoring National Weather Service (NWS) beach forecasts and changing warning flags on the beach to indicate whether the water is safe.

“As engineers, we thought, ‘There’s got to be a better solution than changing these flags,’” Soter said. “What we came up with is essentially using a 5G cellular network to change the flags automatically. It can be controlled with your phone or any computer.”

Soter earned his bachelor’s in ECE and MBA at Michigan Tech, and SwimSmart

got its start in Tech’s SENSE (Strategic Education through Naval Systems Experiences) Enterprise. Soter took it on as his Senior Design project and entered the idea in pitch contests, winning prizes and innovation awards.

SwimSmart is modeled after the familiar traffic light. Green indicates low-hazard conditions. Yellow means conditions are considerably rougher, with extra precautions needed—especially for inexperienced or weaker swimmers. Red signals high danger, and flashing red means the beach is closed. The signal device can autonomously follow NWS beach forecasts or have its warning set by local beach managers.

“The safety system operates like a fire alarm system, allowing multiple lights, emergency buttons, call boxes, and buzzers to be linked to a single control panel,” Soter explained. Integrating weather stations and cameras allows the NWS to receive data from the beach, too, providing a closed-loop warning system

that can either be wired into a building or operated on a stand-alone solar-battery source.

“We geeked it out—we’re engineers and we wouldn’t have it any other way,” said Soter.

There are also numerous applications for additional connected beachfront technologies, including assessing climate resiliency markers like beach erosion.

Soter envisions a continuous loop where SwimSmart systems feed information back to NWS, making it possible to issue more frequent and accurate localized reports to the public. At present, NWS typically only makes a couple of daily updates.

“With sensor arrays on the buoys, there’s no reason we can’t send real-time data back to the Weather Service,” Soter said. “We can put a data point on the beaches. Then there’s no more guessing.”

## About the Skate Rental Center

Located on the ice level in the John MacInnes Student Ice Arena, the Skate Rental Center has a full inventory of skates and helmets in youth and adult sizes for use by the campus and the greater community.

**OCT  
2021**

the Skate Rental Center  
officially opened

.....

**1,075**

skate rentals  
in the first year of  
operation

.....

**25%**

of the skates  
used in MTU's  
PE courses are  
borrowed from the  
center for free



## Charlotte Jenkins

On January 16, 2021, Charlotte Jenkins, a computer engineering student, resident assistant, and active member of Michigan Tech's community, was killed in a car accident while returning to Tech for the spring semester. After receiving this difficult news, students shared stories about how Jenkins embraced and involved others, often inviting them to go ice skating. Since Jenkins loved winter sports and never wanted to leave anyone out of the fun, she kept a supply of ice skates in a variety of sizes on hand to loan out to others.

Jenkins will be remembered at Michigan Tech. An ice skate rental program was launched October 1, 2021, at Michigan Tech's Student Development Complex in her honor, and her family dedicated a bench near the campus center as a tribute to her memory.

## ► Senior Design Teams

### 2020-21 Larry Kennedy Industry Innovation Award Winner

#### ITC CELL SIGNAL MEASUREMENT TOOL (PHASE 2)

The team created a device that would scan the frequencies of all existing cellular service providers and identify the azimuthal angle of the highest-strength signal. This information will be used to aim booster antennas located within ITC substations that are in remote areas with poor cell coverage. The team also won second place at Design Expo.



*Above: The finished ITC Cell Signal Measurement Tool with wiring. Team members (clockwise from top left): Reed VanderBerg, Andrew Bratton (president), Ben Kacynski, and Noah Guyette. The team was advised by John Lukowski.*

# 2021-22 Larry Kennedy Industry Innovation Award Winner

**STROMBERG CARLSON  
ELECTRIC TONGUE  
JACK REDESIGN  
MICROCONTROLLER  
SUB TEAM**

Team members (from left to right): Jay Schimmoller, Jacob Kuca, and Ryan Beatley. This team was advised by Trevor Hassell.



Year	Project	Sponsor	Advisor
2020-21	<b>ITC Battery Scheduler:</b> Develop a software tool to automate a charge/discharge process for ITC battery banks based on external info (e.g., weather forecast, energy demands).	ITC Holdings	John Lukowski
2020-21	<b>ITC Cell Signal Measurement Tool (Phase 2):</b> Develop a tool to determine cell signal strength and directivity in real time, allowing ITC technicians to place cellular antennas appropriately at remote substations.	ITC Holdings	John Lukowski
2020-21	<b>Systems Control EMP Mitigation Testing (Phase 2):</b> Develop a testing procedure to evaluate electrical enclosures' and buildings' ability to attenuate electromagnetic radiation, specifically at the appropriate frequency bands related to EMPs.	Systems Control	John Lukowski
2020-21	<b>Stromberg Carlson Electrical Tongue Jack Redesign (Teams 1 &amp; 2):</b> Redesign the tongue jack with domestically sourced components and the ability to accommodate smart features (auto-level, increase/decrease by set increments).	Stromberg Carlson	Trevor Hassell

# Senior Design Teams

Year	Project	Sponsor	Advisor
2020-21	<b>SERC/NSWG DCS Regenerative Charging:</b> Evaluate the possibility of implementing a regenerative charger to harness energy created by dry combat submersible (DCS) propellers freewheeling with water currents when at rest; develop a prototype design to aid the evaluation.	SERC	Trever Hassell
2020-21	<b>ECE Underwater Acoustic Modem (Year 2):</b> Develop a low-cost and small-footprint underwater acoustic modem. Year 2 goals are further implementation and development of communication algorithms on an embedded system (either microcontroller or FPGA) and the first-iteration design of a highly efficient power amplifier for driving an underwater transducer.	ECE Department	Tony Pinar
2020-21	<b>SERC Hedgemony Online:</b> Develop a web-based, multiplayer version of RAND Corporation's Hedgemony: A Strategic Game of Choices, a physical board game used by US defense strategists to simulate strategic decision-making at the global level.	SERC	Tony Pinar
2020-21	<b>SERC/SOC Object Obscuration:</b> Evaluate methods for fooling image and audio recognition systems into completely missing a target (in an image or audio recording) or misclassifying targets; recommend fruitful avenues for potential Department of Defense use.	SERC	Tony Pinar
2020-21	<b>SICK Lidar Challenge:</b> Develop a ground-based robot that uses a lidar for object detection and avoidance.	SICK Inc.	Mike Roggemann
2020-21	<b>CECH On-Site Installation and Mechanical Connection Improvements for Panelized Net-Zero Construction:</b> Analyze CECH's current panel designs and assemblies to provide recommendations/redesign of various infrastructure within the panels/walls (ductwork, plumbing, and electrical wiring) to improve the fabrication and installation process.	CECH Manufactured Homes	Tony Pinar
2020-21	<b>LBWL Substation Transformer Monitoring System:</b> Determine a remote method of transformer health evaluation and recommend a transformer type and life cycle stage for modeling; develop a prototype for proof-of-concept (optional).	Lansing Board of Water and Light	John Lukowski
2020-21	<b>SERC/SOC Wearable Technologies:</b> Develop a small, lightweight, adjustable-output emergency battery pack that can tolerate harsh conditions (very cold to very hot ambient temperatures; both submersible and airworthy) for use with various mobile communication equipment and field electronics devices.	SERC	Tony Pinar

Year	Project	Sponsor	Advisor
2021-22	<b>Distribution Protection Coordination Modernization:</b> Evaluate LBWL's current protection system coordination and propose design additions or changes, including distribution automation technologies. Analyze costs vs. potentially reduced outage durations.	Lansing Board of Water and Light	John Lukowski
2021-22	<b>Advanced Battery Model Investigation:</b> Develop and validate battery models for full-vehicle simulation. Implement them in TAItherm and/or CoTherm as FMUs. Scale the study for xEV batteries. Create a battery characterization data library for xEV modeling.	ThermoAnalytics Inc.	Paul Bergstrom
2021-22	<b>Electric Tongue Jack Redesign Phase 2: Microcontroller Team:</b> Improve Stromberg Carlson RV Electric Trailer Tongue Jacks by improving microcontroller design, developing power electronics, and creating a functioning app.	Stromberg Carlson	Trever Hassell
2021-22	<b>LEED Metering:</b> Design, install, and commission a gas, electric, and/or water metering system for the Novi headquarters, integrating complete data collection into the existing building management system.	ITC Holdings	John Lukowski
2021-22	<b>Lens Cleaning for Imaging Systems on Autonomous Applications:</b> Design an automatic system to keep sensing equipment clean and operating effectively in rough, irregular, and precipitous environments.	Caterpillar Inc.	Tony Pinar
2021-22	<b>Portable Off Board Power Conditioner Converter Phase 2:</b> Create a proof-of-concept power offboarding implement that can be used to provide grid-quality power in a variety of configurations.	John Deere	John Lukowski
2021-22	<b>Self Contained Water Filtration System in a 10-ft. Shipping Container with Alternative Energy:</b> Design a shipping container-based water filtration system. A stand-alone concept for placement at any generic location can be the focus. Consider shore/generator power options.	Britten / BoxPop	Tony Pinar
2021-22	<b>Electric Tongue Jack Redesign Phase 2: App Development Team:</b> Improve Stromberg Carlson RV Electric Trailer Tongue Jacks by improving microcontroller design, developing power electronics, and creating a functioning app.	Stromberg Carlson	Trever Hassell
2021-22	<b>Electric Tongue Jack Redesign Phase 2: Power Electronics Team:</b> Improve Stromberg Carlson RV Electric Trailer Tongue Jacks by improving microcontroller design, developing power electronics, and creating a functioning app.	Stromberg Carlson	Trever Hassell

# Enterprise Teams

## OPEN SOURCE HARDWARE ENTERPRISE

Advisor: Shane Oberloier

OSHE specializes in leveraging open-source technology to rapidly iterate and create new electronic devices that solve a multitude of problems. Students typically employ distributed manufacturing methods to keep our products low-cost and replicable by the broadest audience. Our projects range from scientific instrumentation to robotics and consumer products.

Year	Project	Sponsor
2021-22	<b>Growbot:</b> Create an open-source automated robotics platform for data collection and commercial farming and gardening.	General Motors
2021-22	<b>Glucose Meter:</b> Design a glucose meter using a colormetric type system, testing strips of various porous paper, and a 3D printer.	General Motors
2021-22	<b>3D Print Automation:</b> Design a mechanism and accompanying process for automating the print removal from a Lulzbot Taz, enabling continuous autonomous manufacturing.	General Motors
2021-22	<b>Broadly Reconfigurable and Expandable Automation Device (BREAD):</b> A low-cost alternative to automation platforms like the National Instruments cDAQ platform. Includes a broad range of functionality ranging from motor control to off-grid data acquisition.	ECE Department
2021-22	<b>Near Field Audio Speaker:</b> Create an open-source wireless speaker leveraging near-field technology.	General Motors
2021-22	<b>Camera Quadcopter:</b> A low-cost, robust, 3D-printable quadcopter that is being optimized as a scientific platform.	ECE Department
2021-22	<b>Recycle Bot:</b> An easy-to-replicate and easy-to-tune filament extruder that can turn waste plastic into new, usable parts.	General Motors
2021-22	<b>Lasersauer</b>	-
2021-22	<b>Kewee-Meters:</b> A low-cost power monitoring system.	ECE Department

## WIRELESS COMMUNICATION ENTERPRISE

Advisor: Kit Cischke

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 for them to gain technical skills, business presentation skills, and leadership experience.

Year	Project	Sponsor
2020-21	<b>Aural Signal Analytics:</b> Create an application for an Android tablet that analyzes a signal to locate the position and distance of an incoming sound.	SERC / US Department of Defense
2020-21	<b>Camera Repeater:</b> Split a single video feed into several receivers for use by an autonomous vehicle.	ECE Department
2020-21	<b>Drive-By-Wire Interface:</b> Developing an interface with an existing dSpace platform to a pre-installed Drive-By-Wire system, including CAN communication.	APS LABS
2020-21	<b>Wireless Battery Monitoring System:</b> Develop and build a battery monitoring system for the high-voltage batteries in EVs and HEVs.	FCA
2020-21	<b>LED Fan:</b> Design and fabricate a system that spins a three-bladed fan with multiple LEDs on each blade to display various images.	ECE Department
2020-21	<b>Motion Tracking:</b> Develop a stand-alone system to track the motion of any arbitrary object and analyze the data to calculate distance, acceleration, and other parameters in multiple dimensions.	ECE Department
2020-21	<b>Motor Drive Simulation:</b> Model the high-frequency response of a motor drive filter to create a 3D model that captures the parasitic effects of the capacitor and choke simulations.	Nexteer
2020-21	<b>Peace of Mind:</b> Develop a leak detection and hose blockage detection system for installation on Whirlpool washing machines.	Whirlpool Corporation
2020-21	<b>Wi-Fi Bridge:</b> Develop a generic radio-wave to Wi-Fi bridge.	ECE Department
2021-22	<b>Washing Machine Failures:</b> Develop a method for predicting the failure of certain components on Whirlpool washing machines.	Whirlpool Corporation
2021-22	<b>Battery Communication Module:</b> Implement a wireless battery management module that allows for the communication of multiple batteries without wiring them into a central unit.	Stellantis
2021-22	<b>Laser Images:</b> Focusing lasers in order to generate images.	ECE Department
2021-22	<b>Drone Project:</b> Development of autonomous control schemes for drones.	ECE Department

# Enterprise Teams

## BLUE MARBLE SECURITY ENTERPRISE

Advisor: Glen Archer

BMS Enterprise focuses on securing the future through the thoughtful use of technology. The team specializes in engineering design and product development. BMS 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, corporate economy, and personal well-being of the nation and all its people.

Year	Project	Sponsor
2020-21	<b>Autobot:</b> Design, build, program, and test an autonomous ground vehicle to compete in the annual Intelligent Ground Vehicle Competition (IGVC).	ECE Department
2020-21	<b>Deringer-Ney Slip Ring Test Bed:</b> Design, prototype, and test a system for evaluating and recording the performance of electromechanical slip ring disks and brushes under simulated operating conditions.	Deringer-Ney
2020-21	<b>Dry Combat Submersible (DCS):</b> Design, build, and evaluate an engineered solution to monitor, condition, and purify internal air in a Dry Combat Submersible; develop and maintain a project plan, communication plan, and budget.	SERC
2020-21	<b>GM Cost Effective Vision PickPoint System (CEVPPS):</b> Using commercial off-the-shelf cameras and other components, make a bench-scale pickpoint system.	General Motors
2020-21	<b>MTU Library Moving Bookshelves:</b> Identify failure modes in the design of MTU's current SpaceSaver high-density moving bookshelf system, then create a simple fix for the common failures; recreate the system entirely; or design a new system with similar functionality and reliable performance.	Michigan Tech Library
2020-21	<b>Oshkosh:</b> Conduct research, design, manufacture, testing, and analysis around the Oshkosh Defense LCTV (Light Concept Test Vehicle).	Oshkosh
2020-21	<b>Pressure Measurement of Blank Ammunition:</b> Research, design, and prototype a system to measure and evaluate the pressure behavior of blank munitions of various calibers, with a particular focus on the Soviet 7.62x39mm cartridge; evaluate various blank firing adapters in use by the US military.	SERC
2020-21	<b>UP Community Energy:</b> Using MatLab, determine appropriate application of renewable and fossil fuels to make the best economic choices to sustain Michigan's Upper Peninsula.	Kurt Lehmann
2021-22	<b>UP Community Energy:</b> Determine appropriate application of renewable and fossil fuels to make the best economic choices to sustain the Upper Peninsula. Use MatLab to get inputs from the user, then use functions that will return the best return on investment.	Kurt Lehmann
2021-22	<b>High Density Mobile Shelving Unit Redesign:</b> Design and implement a cost-effective and sustainable solution to the current shelving units on the Garden Floor of the MTU Library. This includes a redesign of the current electronic and controls system and creation of a mechanical override in case of power failure.	ECE Department
2021-22	<b>GM Cost Effective Vision Pick Point System:</b> This is a continual project for General Motors developing and innovating a vision system to work with COTS parts. Using a robotic arm, train a vision system to identify and pick objects in a workspace at different depths autonomously.	General Motors

## ROBOTIC SYSTEMS ENTERPRISE

Advisor: Jeremy Bos

RSE 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. RSE produces solutions that contribute to industry, recreation, and medical research.

Year	Project	Sponsor
2020-21	<b>GM/SAE AutoDrive Challenge:</b> Build, design, and document a Level 4 autonomous vehicle system over four years.	General Motors / SAE International
2020-21	<b>US Army/GVSC - Leader-Follower Robot:</b> Control two Clearpath Jackal robots in a leader-follow configuration where the lead vehicle is driven by a human operator and the follower attempts to maintain a fixed distance relative to the leader.	US Army CCDC Ground Vehicle Research Center
2021-22	<b>SAE AutoDrive Challenge II:</b> Create an SAE J3016 Level 4 autonomous vehicle (AV) over the course of a four-year competition. In Year 1, our team divided themselves into five subteams: Perception, Simulation, Software, Innovation, and Project Management. The year-end goal is to outfit a tool chest with AV sensors to simulate real-world perception challenges in an urban environment.	General Motors / SAE International
2021-22	<b>GVSC Leader-Follower:</b> Create a partially manned, autonomous, leader-follower convoy using Clearpath Jackals Unmanned Ground Vehicles (UGVs) as our robotic platform. By automating convoys, our sponsor hopes to reduce the risk to human life. We have transitioned from a simulated system to physically implementing our code on the UGVs with IMU, GPS, and lidar sensors paired with cross-vehicle communication. We will use several different UGVs to demonstrate a pure convoy in a turn-key demo.	US Army CCDC Ground Vehicle Research Center
2021-22	<b>Niryo Ned Arm:</b> Use a six-axis robotic arm to create a demonstration using custom-made tools and a computer vision upgrade kit to analyze, move, and transform objects for the ultimate goal of learning about robotic systems and their applications.	ECE Department
2021-22	<b>T-Shirt Cannon:</b> Use a Pioneer robot chassis to mount and transport a custom-designed pneumatic barrel for the goal of firing T-shirts at Michigan Tech sporting and promotional events.	ECE Department

## IT OXYGEN ENTERPRISE

Advisor: Nagesh Hatti

IT Oxygen is dedicated to developing student skills through real-world industry experience. We provide the experiences necessary to progress in the ever-changing worlds of cutting-edge software development, networking, security, system administration, and business. This includes problem-solving, teamwork experience, and sharpening communication skills. IT Oxygen seeks to provide the best environment for students to learn, grow, and produce great work, both professionally and as individuals.

Year	Project	Sponsor
2020-21	<b>Compliant Database and Customer Portal:</b> Develop a mobile website that creates an environment for patients to register and order their medicine remotely online.	Northern Specialty Health
2020-21	<b>Automotive OEM Purchasing Strategy (Year 2):</b> Develop a predictive model for use in guiding decisions in the bulk purchasing of semiconductors.	ECE Department (previously Denso)
2020-21	<b>Enterprise Team Project Management Solution:</b> Create a digital solution to manage Enterprise projects.	ECE Department
2020-21	<b>Emojis in Context:</b> Define, design, build, and evaluate an engineered solution enabling the capability for real-time language and emoji translation for ISO operational requirements; develop and maintain a project plan, communication plan, and budget.	SERC

# Enterprise Teams



*Top left: Open Source Hardware Enterprise team.  
Top right: Wireless Communication Enterprise team.  
Middle left: Blue Marble Security Enterprise team.  
Middle right: Robotic Systems Enterprise team.  
Bottom right: IT Oxygen Enterprise team.*

# Undergraduate Awards



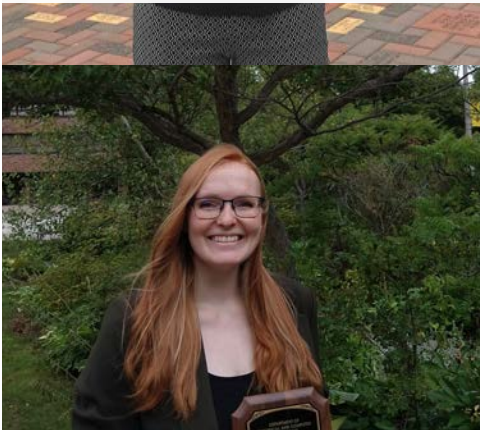
**SOPHIE OWEN**  
2021 DEPARTMENTAL SCHOLAR



**HANAN ALATTAR**  
2022 DEPARTMENTAL SCHOLAR



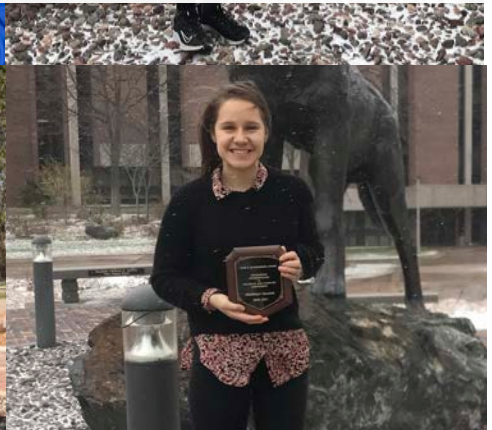
**KAYLYNN FOSTER**  
2021 WOMAN OF PROMISE



**MIKALAH BROCK**  
2022 WOMAN OF PROMISE



**JOSHUA LANGLOIS**  
2021 CARL S. SCHJONBERG  
OUTSTANDING UNDERGRADUATE



**MADELYN VEURINK**  
2021 CARL S. SCHJONBERG  
OUTSTANDING UNDERGRADUATE



**JAY SCHIMMOLLER**  
2022 CARL S. SCHJONBERG  
OUTSTANDING UNDERGRADUATE

These awards are presented annually to undergraduate students in the ECE Department:

- Departmental Scholar—Presented to a student with senior status who best represents student scholarship at MTU, not only by academic standards, but also for participation in research scholarship activity, level of intellectual curiosity, creativity, and communication skills.
- Woman of Promise—Awarded to a woman who goes above and beyond what is expected of them in terms of being a well-rounded student, and demonstrating academic achievement, campus and community leadership, good citizenship, creativity, and more.
- Carl S. Schjonberg Award for Outstanding Undergraduate Student—Awarded to an outstanding undergraduate student who exemplifies a dedication to learning and a commitment to the University.

# AutoDrive Challenge

## SERIES II: YEAR 1

AutoDrive Challenge II has begun! Series II of this dynamic competition builds on the groundbreaking success of the original series.

Borealis Prime, Michigan Tech's Level 4 autonomous Chevrolet Bolt, took part in the AutoDrive Challenge II Year 1 Competition on June 6-12, 2022, at the MCity test facility in Ann Arbor, Michigan.

Led by Jeremy Bos, Tech placed fourth overall in Year 1, and finished third in the static events—earning one second-place and two third-place trophies. The University of Toronto took the overall win in Year 1, with Texas A&M and Ohio State placing second and third. Kettering University placed fifth overall behind Michigan Tech.

Rounding out the 10 teams competing in Series II are North Carolina A&T State University, Pennsylvania State University, University of Wisconsin, and Virginia Tech of the US; and Queen's University of Canada.

## SERIES I, YEAR 4

MTU's Team Prometheus Borealis closed out the inaugural AutoDrive Challenge in the Year 4 Competition at MCity on June 5-14, 2021.

Michigan Tech finished third overall in Year 4, placing higher than any other US team for the second year running. They earned five trophies in static events: first place in the Social Responsibility Report and second place in the Concept Design Report, Social Responsibility Event,

Concept Design Event, and MathWorks Simulation Challenge.

With six trophies in total for Year 4, Michigan Tech brought home the second-most trophies earned by a team—a statistic the team claimed for the Year 2 and Year 3 competitions as well. They were also the top team in Michigan for the third straight year.

With the official results in for all four years, Michigan Tech placed third overall in the inaugural AutoDrive Challenge. An awards ceremony followed the Year 4 Competition.

The eight AutoDrive Challenge Series I teams were: Michigan Tech, Michigan State University, Kettering University, University of Waterloo, University of Toronto, Texas A&M University, Virginia Tech, and North Carolina A&T State University.





*Pictured (from left): Jon Gohl (ECE alum and GM mentor), Jeremy Bos, Darrell Robinette (ME-EM faculty advisor), and Akhil Kurup '22 (PhD, computer engineering) at the Year 4 Competition.*



*Near Borealis Prime (from left): Akhil Kurup, Jeremy Bos, Darrell Robinette, and Jon Gohl listen alongside red-shirted Texas A&M team members as the next segment of the Year 4 Competition is explained.*



*Akhil Kurup sits in the driver's seat of Borealis Prime in the Year 4 Competition at MCity in Ann Arbor.*



*Prometheus Borealis team members at the Series II Year 1 Competition (from left): Suz Harris (they/them), Wei Weng (he/him), Mark Schmelzle (he/him), Ziyu Ke (he/him), advisor Jeremy Bos (he/him), and Nathan Sukaria (he/him).*





*Icelandic Moss, circa 2021. Brett Giem describes those pictured, from left to right: "My wife Bonnie, also an MTU grad; son Nathan, MTU grad 2020; daughter Emma, MTU second-year; me; and son Andrew, MTU grad 2022."*

## EAC Service is a Win-Win

**BY BRETT GIEM, FORMER CHAIR, EXTERNAL ADVISORY COMMITTEE**

Born and raised in Michigan, I attended Michigan Tech because of its reputation as an excellent engineering university that offered in-state tuition. I graduated in 1986 with a mechanical engineering degree, and my first job was to help develop the original passive restraint systems at Chrysler.

Circa 2009, I took a job with the advanced engineering team that had just completed designing and building several proof-of-concept fully electric vehicles (the Chrysler ENVI). As part of the move, I became part of Chrysler's MTU recruiting team, interviewing students and helping focus employment offers to those we felt were a good fit.

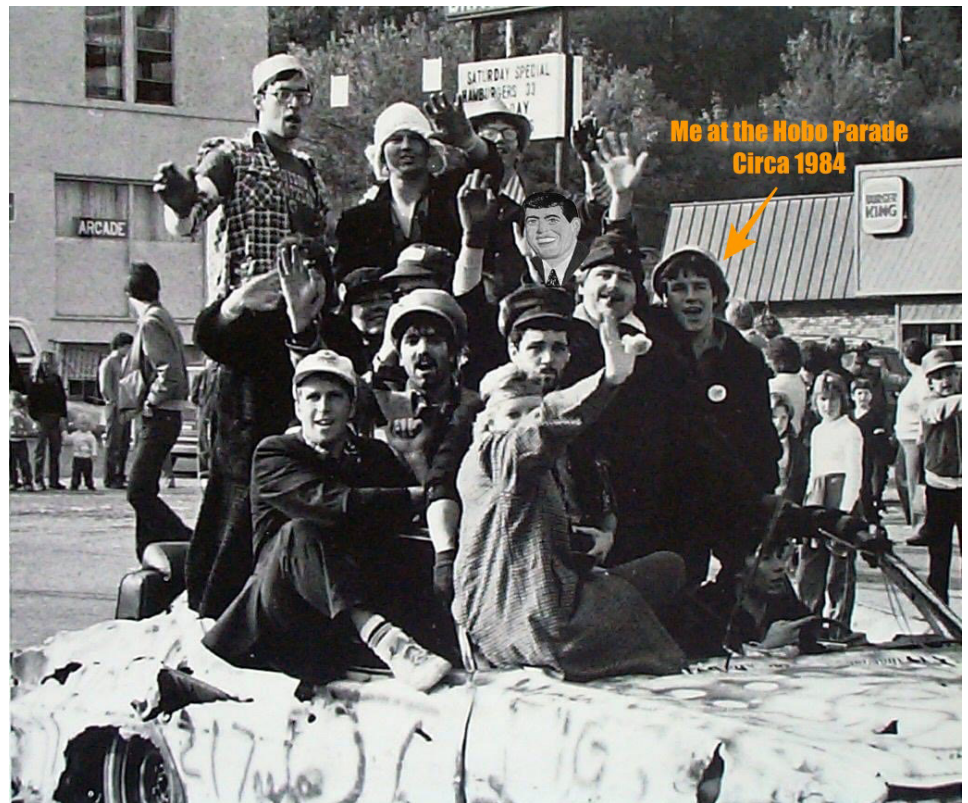
*Giem (pointed out by the arrow) at Michigan Tech's homecoming parade in 1984. "Wow, we were young!" he reflects.*

Getting back to campus was exhilarating, and when a vacancy on the ECE External Advisory Committee (EAC) developed, I jumped at the chance to strengthen my connection with MTU.

EAC work is fascinating. It ranges from meeting with students, to collaborating with industry peers, applying our "real

world" perspective to the academic environment, and providing feedback from our recruitment efforts to guide curricula—and even playing devil's advocate to ideas and proposals generated by the University.

I know the EAC adds value, and that MTU students are better prepared for industry because of our work.



## EXTERNAL ADVISORY COMMITTEE

The goal of the External Advisory Committee is to ensure the ECE academic program aligns with industry to produce graduates with skills desired by today's companies. Each year at their spring meeting, the EAC members—volunteers from many different industries—observe ECE's Senior Design and Enterprise team presentations and poster displays. They select the team showing the highest level of project management, applied engineering, and application to industry to receive the Larry Kennedy Industry Innovation Award.

### EXTERNAL ADVISORY COMMITTEE

<b>Dave Aho</b> Eaton	<b>Eric Johnson</b> Plexus	<b>Tim Obermann</b> Milwaukee Tool
<b>Ellen Bauman</b> IBM	<b>Steve Kennell</b> FMTCS	<b>Dave Perry</b> Retired
<b>Keith Behnke</b> Stryker	<b>Kurt LaFrance</b> CMS Energy	<b>Kevin Saari</b> Systems Control
<b>Scott Blecke</b> Great Lakes Energy	<b>Jon Larson</b> Schweitzer Engineering Laboratories	<b>Nathan Saliga</b> FCA
<b>Brent Carlson</b> 3M Engineering	<b>Eric Larson</b> 3M	<b>Nirmal Singh</b> DTE Energy
<b>Tony Champagne</b> Nexteer	<b>Ken Leisenring</b> Ford Motor Company	<b>Marc Sipe***</b> Dematic
<b>Rob Cooke</b> Calumet Electronics	<b>Bill Lepak</b> Arcelor Mittal	<b>Birgit Sorgenfrei**</b> Ford Motor Company
<b>Ben Galloway</b> Dematic	<b>Steve Mathe</b> Harris	<b>Rade Trimceski**</b> Meta
<b>Brett Giem*</b> FCA	<b>Matt Merry**</b> Microsoft	<b>Craig Zinser</b> General Motors
<b>Gordie Halt</b> ITC Transco	<b>Matt Nixon</b> Genlex	

\* former member, \*\* joined in 2021-22,  
\*\*\* joined in 2022-23

# A PREMIER TECHNOLOGICAL UNIVERSITY FOR MORE THAN 135 YEARS.



**Michigan  
Technological  
University**

# Contracts and Grants

TITLE	PI NAME	SPONSOR	AWARD
DURIP: Acoustic Sensing System and High-Throughput Computing for Environment and Threat	Timothy Havens	US Department of Defense	\$243,169
-	Michael Roggemann	-	\$71,200
Enterprise: EMC Simulation of Motor Drive Filtering Network and Structure	Christopher Cischke	Nexteer	\$15,000
Researching Capacitor Placement on Distribution System	Bruce Mork	DTE Energy	\$50,000
Enterprise: Connected Peace of Mind	Christopher Cischke	Whirlpool Corporation	\$8,625
Senior Design: Electric Tongue Jack Redesign	Tony Pinar	Stromberg Carlson	\$17,500
Senior Design: On-Site Installation and Mechanical Connection Improvements for Panelized Net-Zero Constructions	Tony Pinar	CECH Corp.	\$7,500
Enterprise: Interactive Website Design for Multiple Hospitality Venues	Nagesh Hatti	Destination Calumet LLC	\$17,500
-	Michael Roggemann	-	\$53,400
Senior Design: Substation Transformer Monitoring System	Tony Pinar	Lansing Board of Water and Light	\$17,500
Enterprise: Oshkosh Baja LCV Suspension Design - Phase IV	Glen Archer	Oshkosh Defense LLC	\$8,500
Senior Design: SERC Wearable Technologies	Tony Pinar	Stevens Institute of Technology	\$5,000
Senior Design: SERC Ground Force Commander Simulator Phase 2	Tony Pinar	Stevens Institute of Technology	\$3,488
Senior Design: SERC Facial Obscuration	Tony Pinar	Stevens Institute of Technology	\$2,500
Senior Design: SERC Dry Combat Submersible Regenerative Charging	Tony Pinar	Stevens Institute of Technology	\$2,500
Enterprise: SERC Aural Signal Analytics Library	Christopher Cischke	Stevens Institute of Technology	\$2,500
Enterprise: Robot Leader Follower Phase 2	Jeremy Bos	National Center for the Advancement of STEM Education	\$12,000
Enterprise: Real Time Wireless Data Streaming for In-Use Power Tools	Christopher Cischke	Milwaukee Tool	\$7,000
Enterprise: Market Analysis and Solar Design for Hybrid Storage Skid at Wastewater Treatment Plants	Christopher Cischke	Quantalux LLC	\$15,000
Enterprise: SERC Pressure Measurements of Blank Ammunition	Glen Archer	Stevens Institute of Technology	\$5,000
Enterprise: Dry Combat Submersible Atmospheric Monitoring Conditioning and Purification	Glen Archer	Stevens Institute of Technology	\$5,000

TITLE	PI NAME	SPONSOR	AWARD
NPT-03/04: Localization Tracking and Classification of On-Ice Underwater Noise Sources Using Machine Learning	Timothy Havens	US Department of Defense	\$103,098
Various Sponsor: EMI Testing & Validation	Tony Pinar	GS Engineering	\$1,303
-	Michael Roggemann	-	\$10,000
Researching Capacitor Placement on Distribution System	Bruce Mork	DTE Energy	\$50,000
Senior Design: Distribution Protection Coordination Modernization	Tony Pinar	Lansing Board of Water and Light	\$17,500
Senior Design: Lens Cleaning for Imaging Systems on Autonomous Applications	Tony Pinar	Caterpillar Inc.	\$17,500
Senior Design: Self Contained Water Filtration System in a 10' Shipping Container with Alternative Energy	Tony Pinar	Britten Studios	\$17,500
Senior Design: Electric Tongue Jack Redesign Phase 2	Tony Pinar	Stromberg Carlson	\$17,500
Senior Design: Advanced Battery Modeling Investigation	Tony Pinar	ThermoAnalytics Inc.	\$17,500
Multiscale Phase Retrieval	Timothy Schulz	University of Arizona	\$30,000
Enterprise: Oshkosh Baja LCV Suspension Design and Test - Phase V	Glen Archer	Oshkosh Defense LLC	\$8,500
Senior Design: Portable Offboard Power Conditioner/Converter - Phase II	Tony Pinar	John Deere Co.	\$14,340
Enterprise: Smart Diagnostic Monitoring System for Appliances	Christopher Cischke	Whirlpool Corporation	\$8,750
Enterprise: Smart Diagnostic Monitoring System for Appliances (Part 2)	Christopher Cischke	Whirlpool Corporation	\$17,500
Enterprise: High Voltage Battery Wireless Interchangeable BMS System	Christopher Cischke	FCA	\$17,500
Enterprise: Classification Model and Scorecard for Welding Performance	Nagesh Hatti	Miller Electric Manufacturing Co.	\$17,500
-	Michael Roggemann	-	\$55,000
Enterprise: Robot Leader Follower Phase 3	Jeremy Bos	National Center for the Advancement of STEM Education	\$7,500
Power Systems Transformation Summer School	Chee-Wooi Ten	Arizona State University	\$34,050
Enterprise: Dry Combat Submersible Atmospheric Monitoring Conditioning and Purification Phase 2	Glen Archer	Stevens Institute of Technology	\$5,000
Enterprise: Dry Combat Submersible Smart Tow Cable	Glen Archer	Stevens Institute of Technology	\$5,000
CRII: CNS: IoT-aware Federated On-Device Intelligence	Lan (Emily) Zhang	National Science Foundation	\$174,967

# ECE Doctoral Degrees

Year	PhD Graduate	Advisor(s)	Program	Dissertation Title
2020-21	Muhammad Fahad	Dan Fuhrmann	Electrical Engineering	Sensing Methods for Two-Target and Four-Target Detection in Time-Constrained Vector Poisson and Gaussian Channels
2020-21	Anindya Ghoshroy	Durdu Guney	Electrical Engineering	Superresolution Enhancement with Active Convolved Illumination
2020-21	Eassa (Eisa) Hedayati	Jeremy Bos	Computational Science and Engineering	Light Field Compression and Manipulation via Residual Convolutional Neural Network
2020-21	Kunle Olutomilayo	Dan Fuhrmann	Electrical Engineering	Estimation of Vehicle Trailer Rotation Using Calibrated Radars with Multiple Viewpoints
2020-21	Yongyu Wang	Chee-Wooi Ten and Zhuo Feng	Computer Engineering	High-Performance Spectral Methods for Graph-Based Machine Learning
2020-21	Adam Webb	Timothy Schulz and Timothy Havens	Electrical Engineering	Novel Methods in Computational Imaging with Applications in Remote Sensing
2020-21	Koji Yamashita	Chee-Wooi Ten	Electrical Engineering	Establishment of Cyber-Physical Correlation and Verification Based on Attack Scenarios in Power Substations
2020-21	Zhiqiang Zhao	Glen Archer and Zhuo Feng	Computer Engineering	High-Performance Spectral Methods for Computer-Aided Design of Integrated Circuits
2020-21	Bin Zhou	Jeffrey Burl	Electrical Engineering	Hybrid Electric Vehicle Energy Management Strategy with Consideration of Battery Aging
2021-22	Diego Andres Aponte Roa	Wayne Weaver and Chee-Wooi Ten	Electrical Engineering	Decision Support Tool for Service Restoration
2021-22	Mojtaba Bahramgiri	Glen Archer and Saeid Nooshabadi	Electrical Engineering	Trailer Articulation Angle Detection and Tracking for Trailer Backup Assistant Systems
2021-22	Jeff Beck	Jeremy Bos	Electrical Engineering	Saturation Behaviors in Deep Turbulence
2021-22	Madhur Jagtap	Bruce Mork	Electrical Engineering	Time-domain Simulation of Geomagnetically Induced Currents in Power Systems
2021-22	Saeid Jamilan	Elena Semouchkina	Electrical Engineering	Developing Electromagnetic and Photonic Devices by Using Artificial Dielectric Materials
2021-22	Akhil Kurup	Jeremy Bos	Electrical and Computer Engineering	Autonomous Perception in Unstructured Environments
2021-22	Mehdi Malekrah	Paul Bergstrom	Electrical Engineering	Process Development, Physical, and Electrical Characterization of Langmuir Blodgett Trough Deposited Polyaniline
2021-22	Shane Oberloier	Glen Archer and Joshua Pearce	Electrical Engineering	Open-Source TIG-Based Metal 3D-Printing
2021-22	Masoud Sarabi	Warren Perger	Electrical Engineering	The Application of Leaky Wave Antennas for Medical Hyperthermia Treatment and Beamformer in FMCW Automotive Radar Systems

## Graduate Awards



**Mehdi Malekrah**

2020 Jonathan Bara Award for Outstanding Graduate Teaching Assistant



**Koji Yamashita**

2020 Matt Wolfe Award for Outstanding Graduate Research Assistant



**Samantha Fincannon**

2021 Jonathan Bara Award for Outstanding Graduate Teaching Assistant



**Saeid Jamilan**

2021 Matt Wolfe Award for Outstanding Graduate Research Assistant

## Fellowships

**Samantha Fincannon**  
2021 Oliver & Mary Winn Endowed Fellowship

**Clarence E. Hardwick**  
2022 Earl R. & Ellanette F. Lind Memorial Endowed Fellowship

**Justin A. Kaster**  
2022 PERC–Consumers Energy Graduate Fellowship

## Publications

EXPLORE A SELECTION OF WORKS PRODUCED BY THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING AT MICHIGAN TECHNOLOGICAL UNIVERSITY.



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## Michigan Tech Joins PSERC

In June 2021, Michigan Tech joined the Power Systems Engineering Research Center (PSERC)—a collaboration of university and industry members started as the National Science Foundation’s Industry-University Cooperative Research Center in 1996.

Membership enables MTU to apply for seed grants with other university members. Chee-Wooi Ten, ECE professor, is Tech’s PSERC site director, and envisions Michigan Tech faculty members submitting seed grant proposals annually.

“The overall goal of joining PSERC is to catalyze transdisciplinary research by teaming up with other institutions and relevant industry partners for national grant competition,” said Ten. “PSERC membership will enable Michigan Tech to go beyond its traditional research boundaries.

“Historically, power area research at Michigan Tech focuses on the metering of electrical loads met by generation. We’ll see more opportunities that involve the intersection of new cross-disciplinary areas.”

Ten called national competition among power systems engineering research programs “fierce,” with funding often going to larger research programs. “But no university has the critical mass to hire all skillsets,” he said. “As site director, I attend all PSERC meetings and try to ‘matchmake’ the skillsets of the research-active faculty at MTU with researchers from PSERC’s 12 other universities.”

Researcher matches facilitate collegial and vibrant connections with research-active faculty from other PSERC university members. One of Ten’s priorities is preparing MTU teams across colleges to work with other PSERC institutions on these seed-funded projects.

Ten joined Michigan Tech in 2010 was recently promoted to full professor. He is pleased to direct the PSERC site for



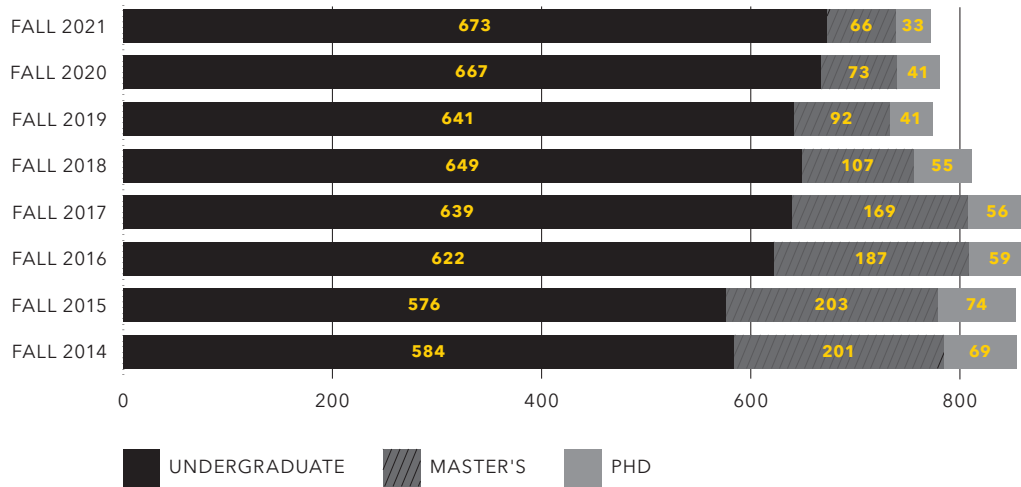
Michigan Tech. “PSERC has the best 13 research-active universities in power systems engineering,” he stated.

Michigan Tech is Ten’s first home in academia, and he is a committed and invested community member. Originally from Malaysia, he spent the first third of

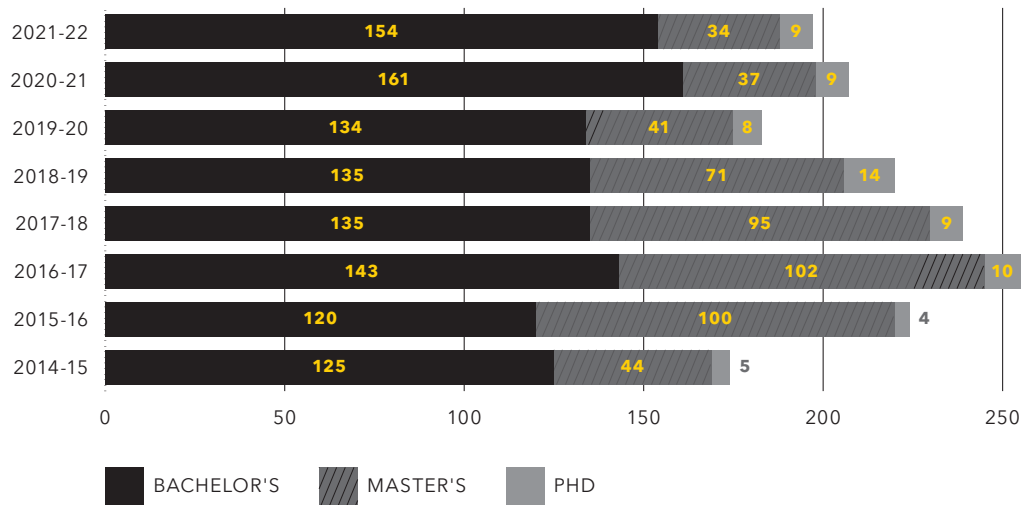
his life in tropical weather. “But I have gotten used to four-season weather and being surrounded by the pure water and hills,” he said. “And, I love to see a white Christmas every year.”

# Departmental Statistics

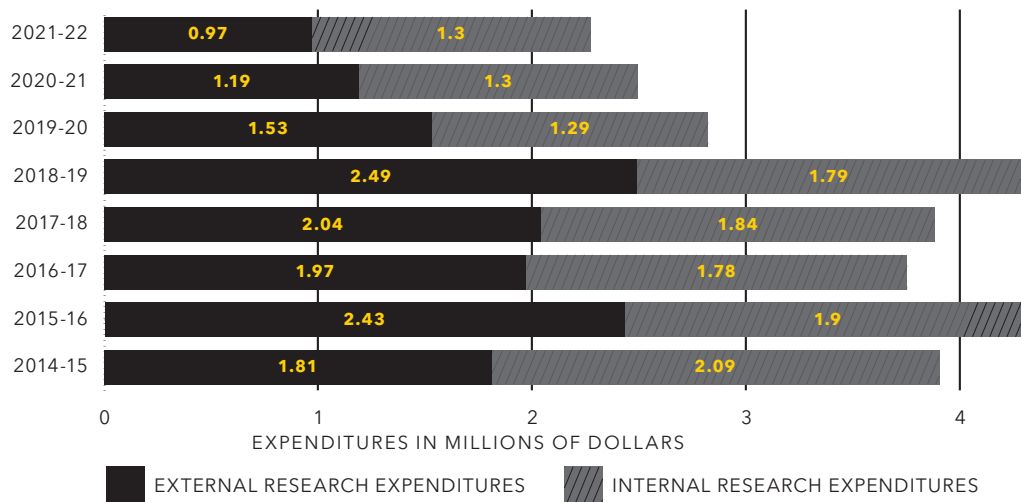
## ECE ENROLLMENT



## ECE DEGREES AWARDED



## ECE RESEARCH AND SPONSORED PROGRAMS



**Department of Electrical and Computer Engineering**  
**Michigan Technological University**  
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Houghton, MI 49931-1295  
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eceinfo@mtu.edu

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Support the electrical and computer engineers of tomorrow with a gift to the Michigan Tech ECE Department. Your generosity improves individual lives and helps build innovative programs that give our students an advantage. All gifts, large and small, are important to the Department.

**TOMORROW NEEDS ENGINEERS. TOMORROW NEEDS MICHIGAN TECH.**

[mtu.edu/ece/department/giving](https://mtu.edu/ece/department/giving)



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