

MICHIGAN STATE UNIVERSITY COLLEGE OF ENGINEERING **SPRING 2026**

DESIGN DAY



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UNIVERSITY



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RESEARCH FOUNDATION

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A Message of Congratulations from the MSU Research Foundation

On behalf of the Michigan State University Research Foundation, I am delighted to extend our warmest congratulations to the students, faculty, and staff participating in the Spring College of Engineering Design Day.

Design Day is a powerful celebration of creativity, collaboration, and problem-solving. It showcases the ingenuity and determination of MSU engineering students who have translated knowledge into action—tackling complex, real-world challenges with curiosity, rigor, and purpose. The projects presented today reflect not only technical excellence, but also a deep commitment to improving lives, strengthening communities, and shaping a better future.

The MSU Research Foundation is proud to support Michigan State University's culture of innovation and discovery. We believe that bold ideas, when paired with strong mentorship and interdisciplinary collaboration, can lead to meaningful impact well beyond the classroom. Design Day exemplifies this journey—from concept to creation—and highlights the entrepreneurial mindset that is essential to addressing society's most pressing needs.

We also commend the faculty, advisors, industry partners, and sponsors who have guided and supported these teams. Your mentorship and engagement play a critical role in preparing the next generation of engineers and innovators to lead with integrity and vision.

To the students: your hard work, resilience, and creativity are on full display today. We encourage you to continue asking big questions, exploring new possibilities, and pursuing ideas that make a difference. The skills and experiences you have gained through this process will serve you well as you move forward in your careers and communities.

Congratulations on an outstanding Design Day, and best wishes for continued success.

Sincerely,

David Washburn
Chief Executive Officer
MSU Research Foundation

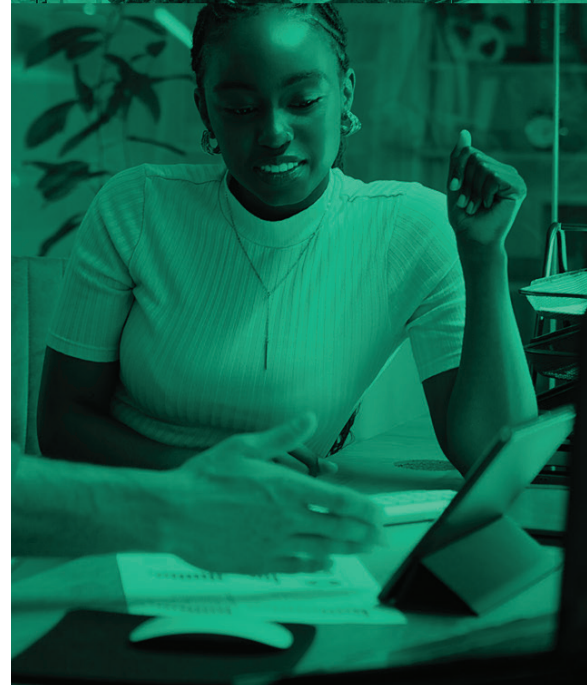
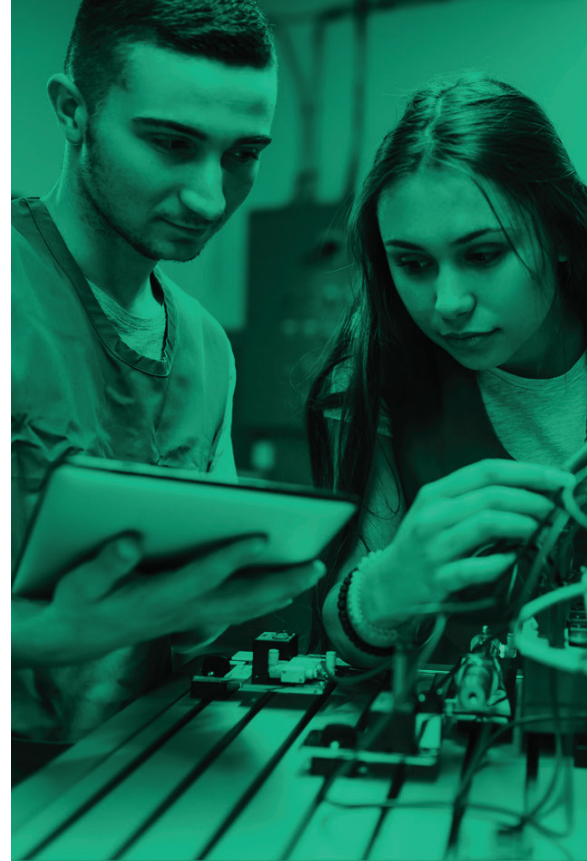


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Welcome from the Dean



**As Interim Dean of the College of Engineering,
on behalf of the entire faculty, staff and students,
I welcome you to Design Day!**

Since the first Design Day in 1994, it has grown into the premier undergraduate academic event of the semester, featuring over 160 capstone teams and 730 seniors from all 10 of the College's academic programs.

We are pleased to acknowledge MSU Research Foundation as our Design Day Executive Patron Sponsor and Delta Dental as our Design Day Directing Patron Sponsor. Our Design Day Supporting Patron Sponsors include Amazon, Anthropocene, Meijer, MSU Federal Credit Union, TechSmith, and Urban Science. We thank all of our sponsors for their generosity and their ongoing commitment to Design Day.

As you explore the exhibits throughout the Engineering Building and Anthony Hall, you are encouraged to take time to learn about the projects by talking with our students. They are an incredible group of people who love to share their enthusiasm for engineering.

The headliners of Design Day are our graduating seniors as they present their design projects through exhibits, posters, and presentations. Their projects represent the capstone of their educational career. You will see that our graduating MSU engineers are ready to lead, create and innovate. Be sure to stop by and see how they innovate, communicate, and perform at the highest levels in an increasingly global and demanding world.

Our capstone programs and Design Day would not be possible without the continued support of our capstone project sponsors who provide both funding and a professional experience for our capstone design teams. We appreciate their generosity and their time.

Please join us for the Design Day Awards Ceremony in Anthony Hall Room 1281 at 1:15 p.m. when we will honor all of our talented Spartans, the best of the best.

A handwritten signature in black ink, appearing to read 'Ioannis Papapolymerou', written over a horizontal line.

Dr. Ioannis (John) Papapolymerou

Interim Dean of the College of Engineering
MSU Research Foundation
Distinguished Professor of Electrical and Computer Engineering
Michigan State University



MICHIGAN STATE
UNIVERSITY
**RESEARCH
FOUNDATION**

Discover. Innovate. Connect.

The MSU Research Foundation supports what happens next. We fund research, help turn ideas into real-world solutions, and connect students and faculty with the capital, programs, and partners needed to advance those ideas. From prototype to application, we help turn engineering ideas into meaningful impact.

Learn more at msufoundation.org

Design Day Events Schedule:

Friday, April 24, 2026

EVENTS	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	Noon	1 p.m.
Audio Enthusiasts and Engineers		2nd Floor - Room 2228 8:00 a.m. – Noon					
Engineering Student Organizations		1st Floor - Lobby 8:00 a.m. – Noon					
ECE 410 Competition			2nd Floor - 2300 Hallway 9:00 a.m. – Noon				
ME 412 Competition		1st Floor - Room 1252 8:00 a.m. – 11:45 a.m.					
ME 470 Competition		1st Floor - Room 1345 8:00 a.m. – 11:45 a.m.					
ME 478 Competition						1st Floor Room 1240 11:30 a.m. 1:00 p.m.	

CAPSTONE COURSES							
All Capstone Posters for most projects, including BE485/487 and ChE 434		BE and ME on 1st Floor - 1200/1300 Hallways ECE on 2nd Floor - 2200 Hallway ChE on 2nd Floor - 2400 Hallway CSE on 3rd Floor - 3200/3300 Hallways 8:00 a.m. – Noon					
AESC 410/SCM 472 Project Presentations		Anthony Hall 1st Floor - Rooms 1255, 1257 8:00 a.m. – 11:30 a.m.					
CE 495 Project Presentations		2nd & 3rd Floors - Rooms 2205, 2320, 2400, 3400, 3540 8:00 a.m. - 12:10 p.m.					
ECE 480 Project Presentations		2nd Floor Rooms - 2245 & 2250 7:30 a.m. – 11:50 p.m.					
ME 481 Project Presentations		1st & 2nd Floors - Rooms 1202, 1220, 1225, 1300, 2243 8:00 a.m. – Noon					
MSE 466 Project Presentations			1st Floor - Room 1145 9:00 a.m. – 11:50 a.m.				

OPENING AND AWARDS							
MSU Awards						1st Floor - Anthony Room 1281 1:15 p.m. – 2:00 p.m.	

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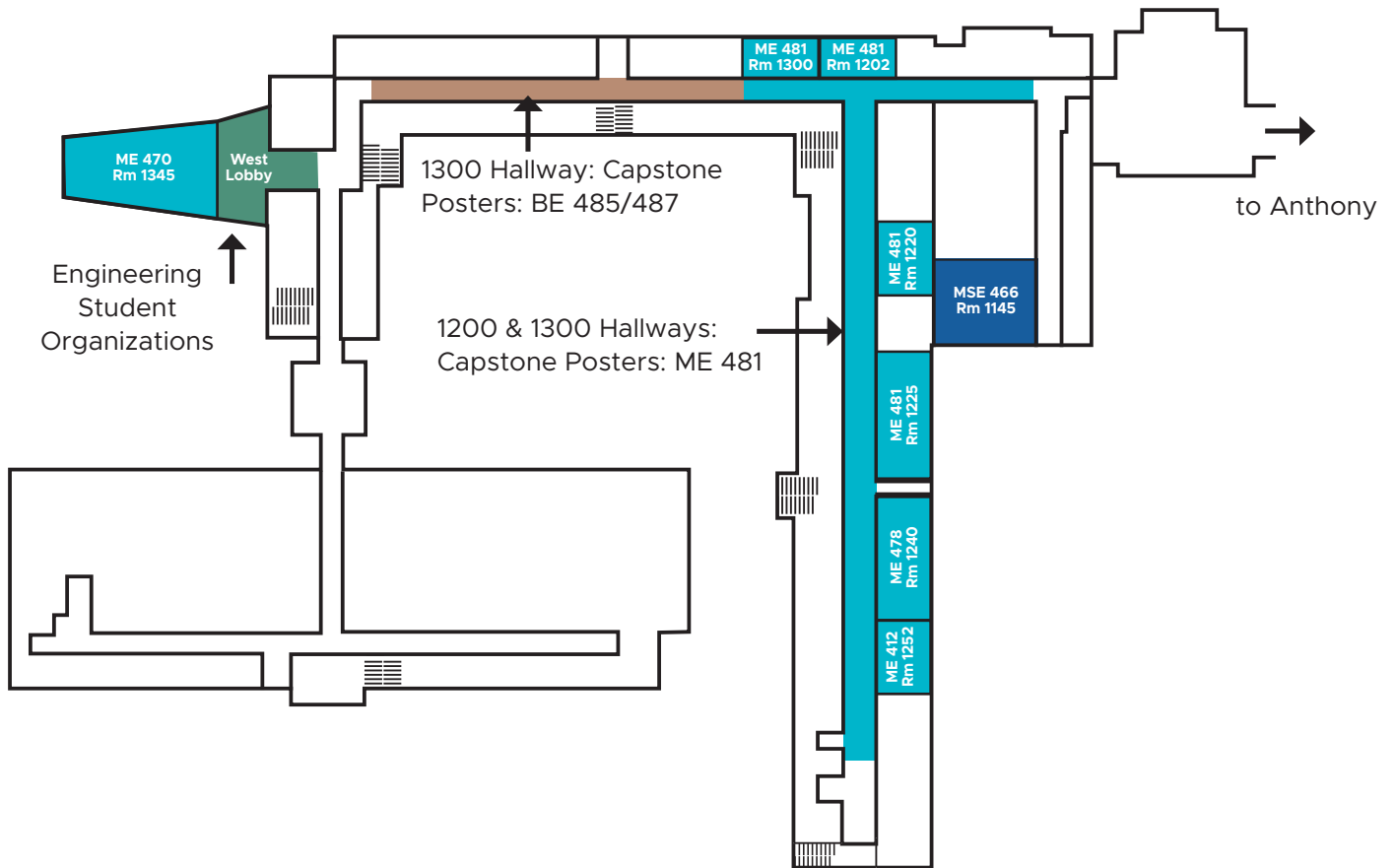
linkedin.com/company/msuegr/

To stay up to date w/Careers in Engineering:

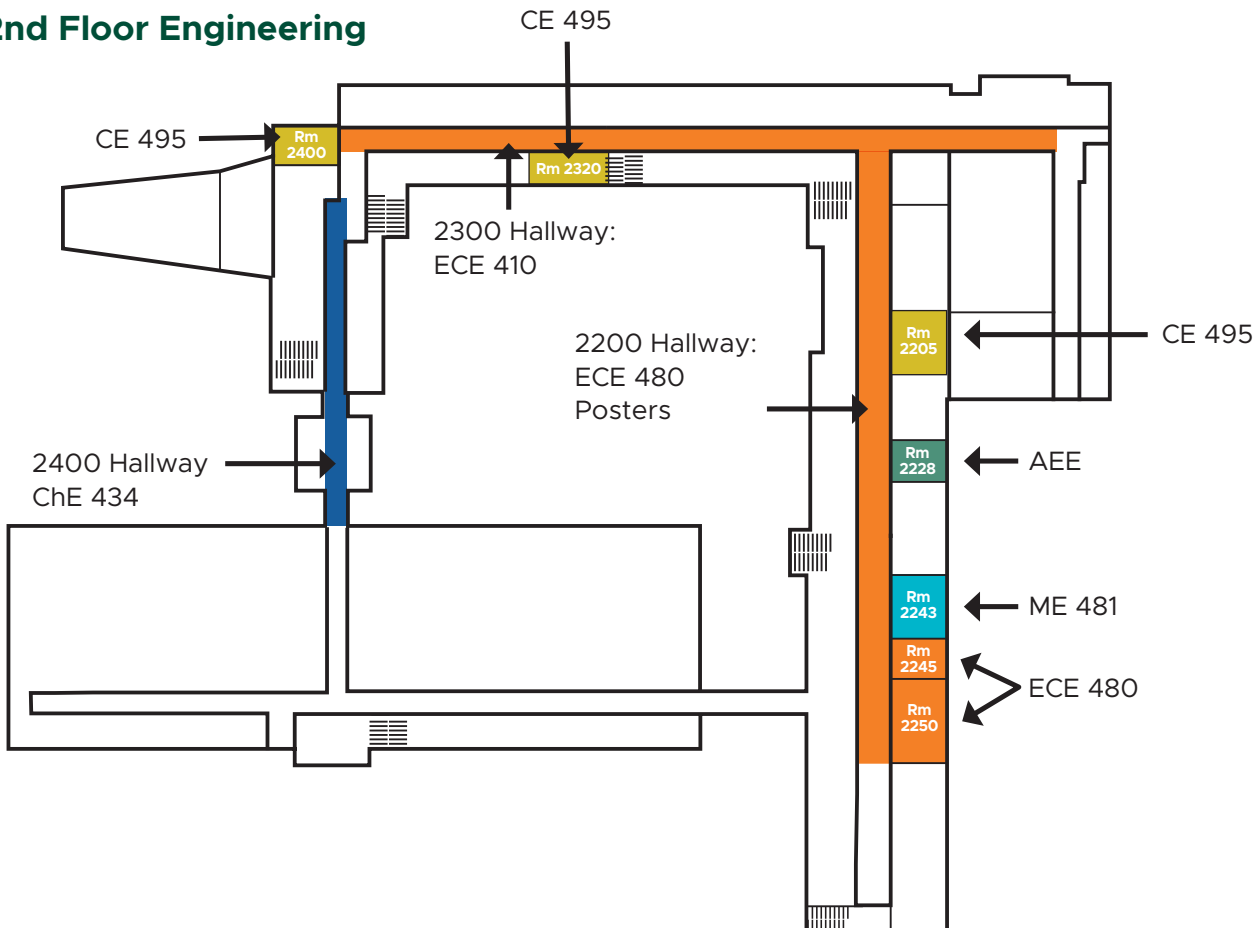


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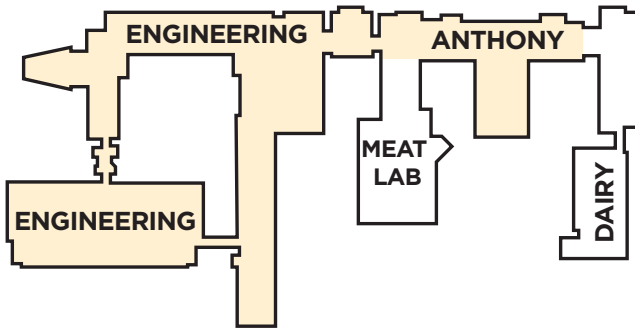
1st Floor Engineering



2nd Floor Engineering

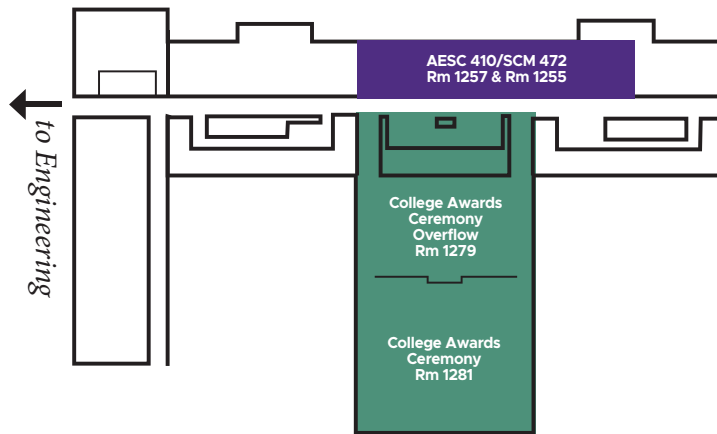


Overview



Design Day Floor Plans of the MSU Engineering Building

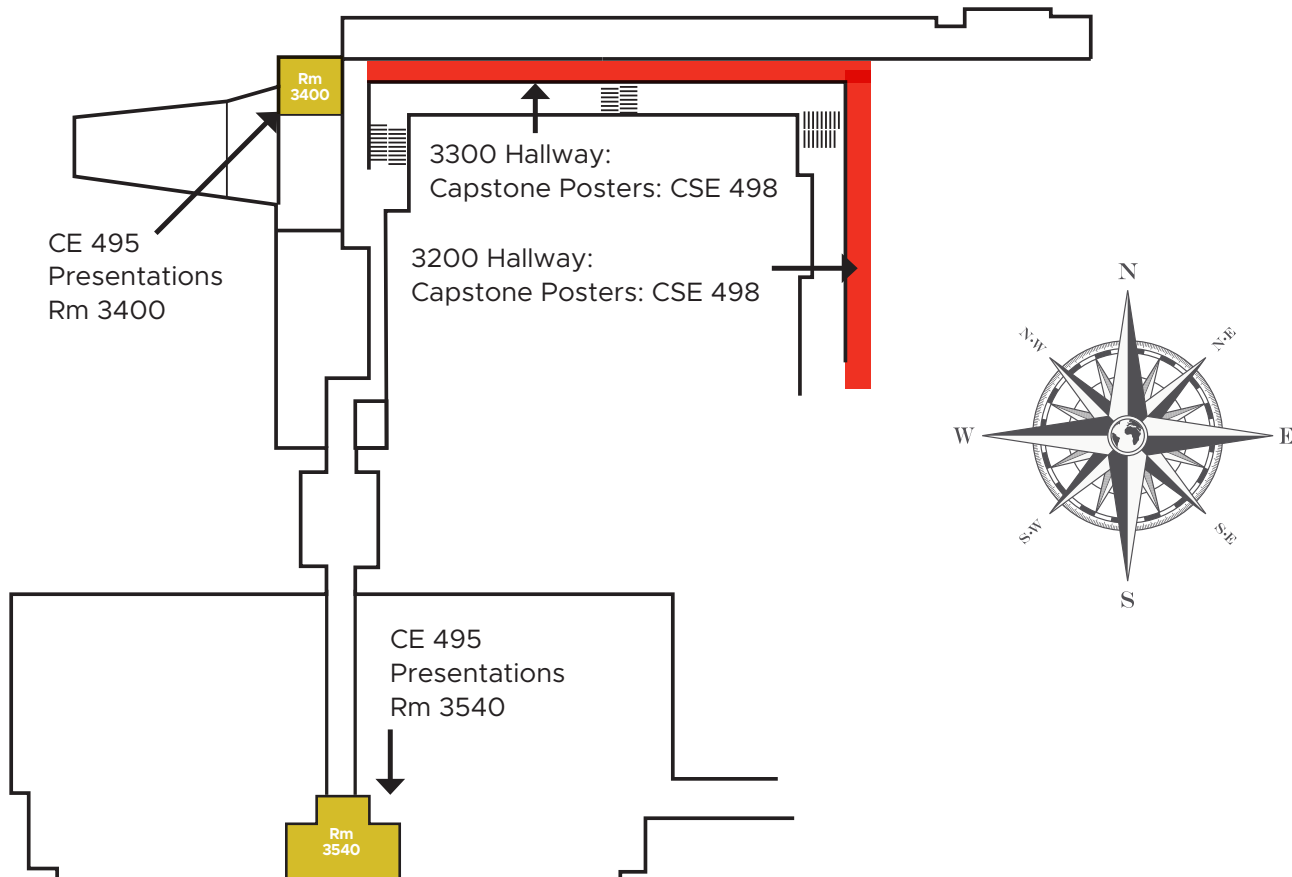
1st Floor Anthony



Color Legend:

	AESC/ SCM		CSE
	BE		ECE
	CE		ME
	ChE & MSE		Joint/ Other

3rd Floor Engineering





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Since 1937, MSUFCU has been an integral part of the MSU community. We believe supporting programs such as Design Day helps prepare students to achieve their goals and dreams.

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Applied Engineering Sciences

Capstone Course Sponsors

We thank the following sponsors for their generous support of the Applied Engineering Sciences senior capstone course. We gratefully acknowledge the Supply Chain Council for their project support.

Applied Materials



Joyn Collective



Bosch Mobility Platform & Solutions, LLC



MSU Assessment and Data Analytics



ClubUp LLC



MSU Residential and Hospitality Services



Ford Motor Company



Peckham, Inc.



Fraunhofer USA



Peckham-Revolution Farms



Henry Ford Health



The Capstone Projects



Dr. Laura J. Genik
Director, Applied
Engineering
Sciences



Dr. Sri Talluri
Professor of Operations
and Supply Chain
Management
The Eli Broad Graduate
School of Management



Pratik Bhattacharjee
MBA 2026



Josh Hong
MBA 2027



Nthanda Manduwi
MBA 2026



Ahmad Mutahhir
MBA 2027

Presentation Schedule – 1st floor Anthony Hall, Room 1255

Time	Team Sponsor	Project Title
8:00 a.m.	MSU Residential and Hospitality Services	Food Waste Quality Assurance
8:25 a.m.	Fraunhofer USA	Commercializing Polycrystalline Diamond Membranes
8:50 a.m.	Bosch Mobility & Platform Solutions, LLC	Target Commercial L.O.S. Markets Project
9:15 a.m.	ClubUp LLC	Automation of New Member Onboarding Process
9:40 a.m.	Break	
9:50 a.m.	Henry Ford Health	Colon Cancer Screening Project
10:15 a.m.	Henry Ford Health	Predictive Modeling for MRI Exam Duration and Scheduling Efficiency
10:40 a.m.	Henry Ford Health	Vendor Payment Hold Risk Identification
11:05 a.m.	Applied Materials	Research on Autonomous Negotiations & AI-Powered Contract Management

SCM 472 Experimental Learning with Industry Problems in Supply Chain Supply Chain Course

Since 2015, Supply Chain Management seniors in the Broad College of Business have had the opportunity to complete their capstone experience by enrolling in SCM 472, where they work on multidisciplinary teams alongside Applied Engineering Sciences students.

MSU Residential and Hospitality Services Food Waste Quality Assurance

Michigan State University's Residential and Hospitality Services (RHS) oversees one of the largest and most complex campus dining and housing operations in the country, serving tens of thousands of students, faculty, staff, and visitors every day. In addition to managing residence halls, dining facilities, and campus food production, RHS partners with MSU's Surplus & Recycling to increase sustainability efforts through its waste handling, recycling, and resource recovery programs.

Currently, pre-consumer food waste generated from campus kitchens cannot be sent to the anaerobic digester due to contamination from materials such as plastic films and kitchen utensils. Because of this, RHS must transport the food waste approximately 11 miles off campus, resulting in unnecessary transportation and tipping fees while also preventing the university from capturing the full energy potential of this waste stream.

The goal of this project is to develop an effective solution that removes contaminants from the pre-consumer food waste while improving the overall efficiency of the process, enabling the waste to be safely used for energy production. If successfully implemented, the anaerobic digester has the potential to power all of south campus farms, leading to significant energy savings and further supporting MSU's sustainability goals.



Residential and
Hospitality Services
MICHIGAN STATE UNIVERSITY



Michigan State University

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MSU Residential and Hospitality Services

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Nthanda Manduwi

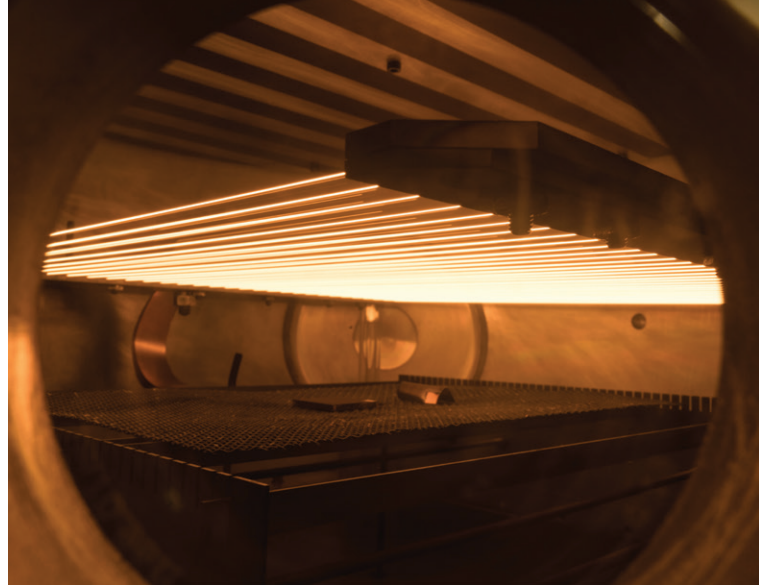
Fraunhofer USA

Commercializing Polycrystalline Diamond Membranes

Modern electronics power nearly every aspect of daily life, from smartphones and wearable devices to electric vehicle chargers, data centers, and communication networks. As these systems become smaller and more powerful, one physical limitation remains constant: heat. Excess thermal buildup reduces performance, shortens device lifespan, and in many emerging applications, prevents technologies from existing at all. In compact, high-power environments, efficient heat dissipation within extremely small spaces is essential.

Fraunhofer USA Center Midwest has advanced a novel polycrystalline diamond membrane technology designed to address this challenge. With exceptional thermal conductivity in ultra-thin configurations, diamond enables faster heat dispersion and creates opportunities for smaller, lighter, and more powerful electronic systems. However, technical performance alone does not ensure success. To enable next-generation technologies, diamond membranes must also be scalable, economically viable, and aligned with real market demand.

This project develops a comprehensive commercialization strategy for the diamond membrane platform. The team is conducting market and competitive analysis, performing customer discovery interviews, evaluating manufacturing scalability and production cost, and building a full business model outlining value propositions, revenue streams, and key partnerships. The final deliverable will provide an evidence-based go/no-go recommendation and, if viable, a clear commercialization pathway through licensing, strategic partnership, or new venture creation.



Michigan State University

Team Members (left to right)

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Bosch Mobility Platform & Solutions, LLC Target Commercial L.O.S. Markets Project

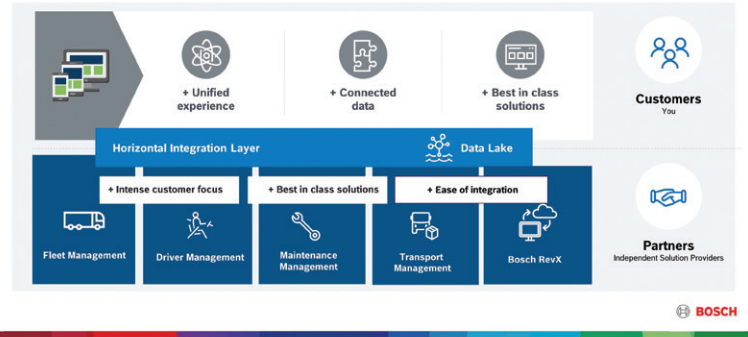
This project's primary purpose is to provide Bosch with a clear, evidence-based view of where value exists today and how to capture it tomorrow by combining rigorous market sizing, competitive intelligence, and actionable go-to-market (GTM) insights.

The team will quantify logistic market opportunities through TAM, SAM, and SOM estimates while documenting the assumptions and data sources behind those figures. Parallel qualitative work will produce SWOT profiles for major incumbents and challengers, revealing capability gaps, strategic positioning, and the competitive moves that have successfully driven adoption. A focused review of Go-to-Market approaches will parse distribution channels, pricing models, partnership structures, and service delivery designs to identify which/why tactics scale and which stall.

Research methods include structured industry-safe secondary data analysis, anonymized interviews with industry/logistics practitioners, and cross-case comparison of leading service providers. Additionally, fieldwork will follow standard security protocols and limit competitive exposure. Outputs will synthesize quantitative and qualitative findings into a concise strategic narrative that Bosch can use to prioritize investments.

Ultimately, the project will translate market intelligence into practical recommendations of suggested segments to target, GTM approaches worth testing, and metrics to monitor early traction. Emphasis will be placed on transparency (clear assumptions and reproducible methods), strategic relevance (alignment with Bosch's capabilities), and operational feasibility. Thus, the project is designed to help Bosch make superior decisions about entering, expanding, or optimizing offerings in the macro-logistics industry.

L.OS – Logistics Operating System Enabling your success



BOSCH



Michigan State University

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Farmington Hills, Michigan

Teaching Assistant
Ahmad Mutahhir

ClubUp LLC

Automation of New Member Onboarding Process

ClubUp LLC is a company based in Charlotte, North Carolina that develops cloud-based software solutions designed to streamline golf course management as well as internal club operations. The platform includes functions such as task management, workflow coordination, member management, and internal communications. ClubUp primarily serves private clubs and resort properties to help improve efficiency and overall member experience.

With a recent acquisition in July 2022 by Troon, a global force in golf and club management services, ClubUp has acquired the opportunity to be implemented in hundreds of Troon-managed properties. One of the features ClubUp brings to the table is their newest platform enhancement, Crew, which takes the company's caddie-based workforce coordination tactics to the staff inside the clubhouse. With this new expansion, efficient and user-friendly onboarding of new members has become significantly more important and more prominent at the forefront of the company's affairs.

Considering this recent expansion, our team was tasked with assisting ClubUp in streamlining and automating the new customer onboarding process. This project focuses on evaluating and presenting software solutions that will support an automated onboarding process to accommodate growth across Troon-managed properties. Multiple platforms were thoroughly researched and analyzed based on functionality, automation capabilities, and integration potential.

Following the selection of an onboarding platform, the team will develop a detailed implementation deliverable, clarifying the system configuration, integration with the current data structure, and defined performance metrics to evaluate onboarding success. The purpose of this project is to provide ClubUp with a clear, structured, framework to implement an automated onboarding system that supports growth, operational efficiency, and consistent customer experience.



Michigan State University

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ClubUp LLC

Project Sponsor

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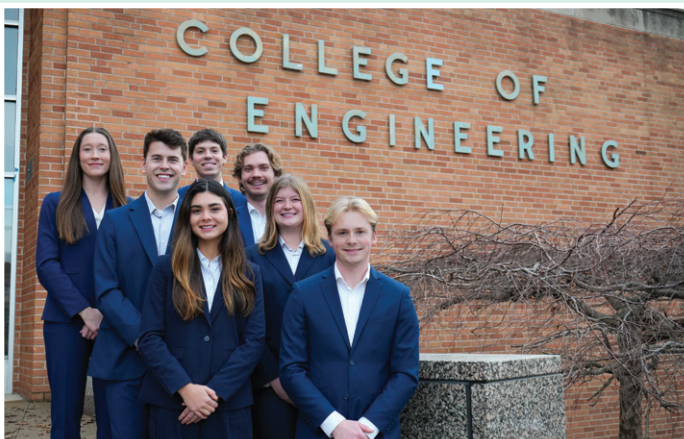
Josh Hong

Henry Ford Health Colon Cancer Screening Project

Founded in 1915, Henry Ford Health is a Detroit-based nonprofit integrated healthcare system serving communities across Michigan through more than 550 locations. The organization provides comprehensive care across primary, specialty, retail, virtual, and home health services and supports over 3,000 active research projects. Guided by its mission to improve people’s lives and its vision to shape the future of health, the organization seeks data-driven solutions to enhance preventive care for patients.

In recent years, the organization observed a decline in colon cancer screening rates, even among patients who attended routine wellness visits and received screening orders. This gap between provider recommendations and patient follow-through became especially concerning following the 2021 screening guideline updates from the U.S. Preventive Services Task Force and the American Cancer Society, which lowered the recommended screening age from 50 to 45 in response to rising early-onset cases. This shift further emphasized the need for improved engagement, particularly among younger populations.

To address this challenge, Henry Ford Health partnered with our team to analyze existing patient data and identify patterns associated with low screening adherence. We examined correlations across key demographic and utilization variables to determine which populations were least likely to complete screenings and explored why gaps persisted despite routine preventive care. The insights generated from this analysis informed targeted, evidence-based intervention opportunities aimed at increasing screening rates, reducing disparities, and supporting long-term population health.



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Henry Ford Health Predictive Modeling for MRI Exam Duration and Scheduling Efficiency

Henry Ford Health is an integrated healthcare system serving patients across Southeast Michigan through hospitals, outpatient centers, and specialty clinics. The organization prioritizes improving patient access while maintaining efficient and reliable clinical operations across high-demand services such as diagnostic imaging.

MRI scheduling presents a recurring operational challenge because exam durations vary widely depending on the protocol and patient needs. When scans take longer than expected, delays accumulate throughout the day, increasing staff overtime, reducing equipment utilization efficiency, and negatively impacting patient experience.

This project uses historical scanner utilization data along with scheduling information, including exam protocol, scanner location, appointment timing, and patient characteristics, to develop a predictive model that estimates exam duration and identifies scans likely to exceed their scheduled time slot.

By better aligning scheduled appointment length with actual scan time, the model aims to reduce delays, limit idle scanner time, and increase patient throughput. The project will deliver a predictive model, a performance dashboard to monitor outcomes, and supporting documentation describing assumptions and monitoring metrics.

Overall, this initiative supports more consistent MRI scheduling and greater predictability for staff and patients. More accurate appointment lengths can reduce staff overtime, minimize schedule adjustments, and improve communication around wait times, leading to smoother daily operations and a more reliable patient experience.



HENRY FORD HEALTH
Innovations



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Henry Ford Health Vendor Payment Hold Risk Identification

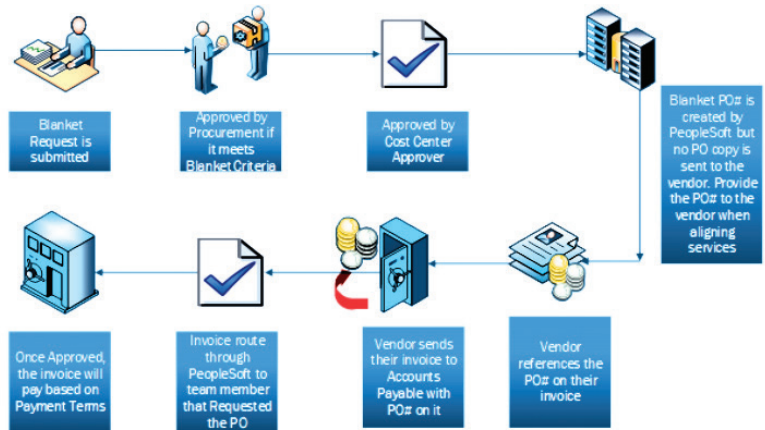
This project focuses on developing an analytical framework that proactively identifies vendors at risk of entering a payment hold scenario. Many organizations work with large, diverse vendor networks, each exhibiting unique invoicing patterns, payment behaviors, and operational sensitivities. Payment holds can emerge from procedural issues, data mismatches, approval delays, or accumulated unpaid balances, and early detection is essential for maintaining vendor relationships and supply continuity.

The objective of this initiative is to develop an analytical framework that identifies potential payment-hold risks for vendors based on historical payment activity, patterns of missed or delayed payments, and other relevant operational indicators.

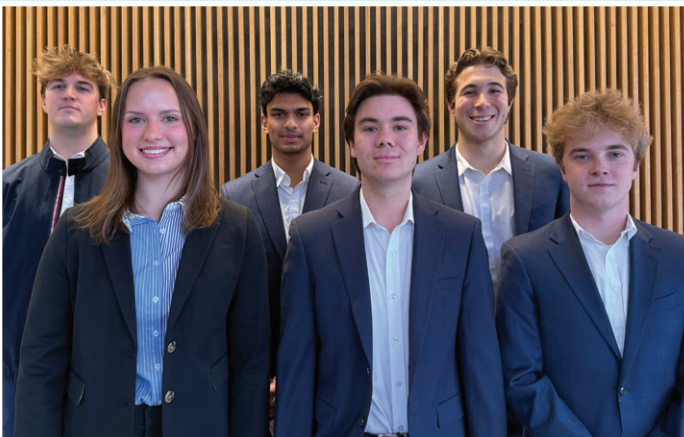
The solution will analyze historical invoice and payment data to uncover behavioral patterns such as invoice aging, late payments, payment velocity deterioration, and deviations from vendor specific baselines. These indicators will feed into a flexible risk scoring model capable of supporting rules based logic, statistical trend detection, anomaly detection, or machine learning approaches. Analysts will be able to configure thresholds—such as maximum aging or minimum on time payment percentages—to simulate scenarios and test sensitivity without modifying the underlying model.

The final output will provide vendor level risk scores, explanations of contributing factors, visualizations of payment trends, and scenario based comparisons. These insights will enable organizations to identify structurally sensitive vendors, prioritize monitoring efforts, and intervene before payment hold conditions materialize.

Blanket PO Workflow



HENRY FORD HEALTH
Innovations



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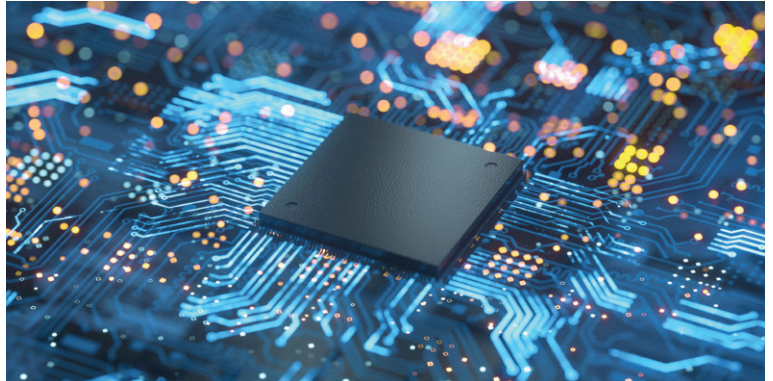
Applied Materials Research on Autonomous Negotiations & AI-Powered Contract Management

This project focuses on how artificial intelligence can improve the way large organizations handle contract negotiations and management. It specifically looks at contracts with suppliers, customers, and logistics providers, which often include complex terms like annual cost reductions, cybersecurity requirements, and tariff-related clauses. Right now, many of these processes are done manually, which takes a lot of time, increases the chance of mistakes, and makes it hard to keep up with changing business and legal needs.

The goal is to explore AI-powered tools that can support tasks like reviewing contract language, simulating negotiation strategies, and helping teams stay on top of key terms and risks. These tools could make contract work faster, more accurate, and easier to scale across the organization.

A big part of the project is comparing specialized contract AI platforms with general tools like Microsoft Copilot or premade models like Ironclad. This includes looking at how well each option fits with current systems, how much value they can deliver, and how much effort they would take to set up and use. The research also considers whether the company should buy a tool, build its own, or work with a partner to create something custom.

In the end, the goal is to recommend the best path forward based on the company's needs, resources, and risk tolerance. The ideal solution would help legal and procurement teams spend less time on repetitive work and more time making smart decisions. Overall, the project is about finding the right balance between automation and human oversight and helping the company modernize its contract strategy in a practical, effective way.



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HEALTH, WEALTH, CLIMATE, & SECURITY



Anthropocene Institute

anthropoceneinstitute.com

The Capstone Projects



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Pratik Bhattacharjee
MBA 2026



Josh Hong
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Presentation Schedule – 1st floor Anthony Hall, Room 1257

Time	Team Sponsor	Project Title
8:00 a.m.	Ford Motor Company	Ford Customer Service Division Profitability Framework
8:25 a.m.	Ford Motor Company	Strategic Supplier Capability Assessment
8:50 a.m.	Ford Motor Company	Tariff Mitigation
9:15 a.m.	Ford Motor Company	Third-Party Support STA
9:40 a.m.	Break	
9:50 a.m.	MSU Assessment and Data Analytics	Impact of In-person Advising on Student Success
10:15 a.m.	Joyn Collective	Data-Driven Impact Measurement for Transformation Work
10:40 a.m.	Peckham-Revolution Farms	Mobile Accessible Produce Packing and Adjustable Tote Lift System for Controlled-Environment Agriculture
11:05 a.m.	Peckham, Inc.	Integrated Production Intelligence and Supply Chain Visibility

AESC Engineering Program

Applied Engineering Sciences has attracted students from diverse backgrounds since its inception, producing graduates who combine engineering and business expertise in ways that employers highly value. AES students are heavily recruited across industries. The program culminates in a semester-long, industry- or nonprofit-sponsored Capstone project conducted in collaboration with Supply Chain Management, where students address real-world challenges at the intersection of engineering and modern business operations.

Ford Motor Company

Ford Customer Service Division Profitability Framework

Ford Motor Company, founded in 1903 by Henry Ford, is one of the world's most enduring automotive manufacturers, recognized for its engineering excellence, operational scale, and commitment to long term customer value. Central to this mission is the Ford Customer Service Division (FCSD), which manages the aftermarket supply chain and distributes genuine Ford and Motorcraft service parts. FCSD ensures that high quality replacement components remain accessible to customers, supporting vehicle reliability and strengthening Ford's reputation for durability and service. As Ford's vehicle population continues to grow, the importance of a robust and efficient service parts network becomes increasingly vital.

As the aftermarket landscape becomes increasingly competitive, FCSD is pursuing a more data driven approach to managing its extensive parts catalog. The division is working to identify cost inefficient components, highlight the most profitable parts, and improve warehouse storage and allocation strategies. With more than 2,000 new service parts planned for introduction next year, Ford aims to establish a repeatable, analytics based framework that evaluates profitability, pricing competitiveness, and obsolescence across its top product categories. This project will support that effort by developing a structured process that helps FCSD make informed decisions about pricing, part retention, and new product introduction. By integrating comprehensive data analysis into its decision making process, FCSD seeks to enhance operational efficiency, reduce unnecessary costs, and strengthen Ford's position in the aftermarket through a more strategic and sustainable service parts portfolio.



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Ford Motor Company Strategic Supplier Capability Assessment

Strategic Supplier Capability Assessments (SCAs) are critical to Ford Motor Company's ability to execute efficient decision-making within an increasingly complex global supply chain. As modern transportation solutions continue to evolve, the challenge of accurately evaluating supplier capability becomes more demanding, requiring adaptable and data-driven tools to ensure long term business viability and capacity.

Currently, Ford Motor Company and its cross functional teams rely on fragmented data sources to evaluate a supplier's ability to source. This creates inefficiencies and avoidable delays, particularly when sourcing a new supplier. The lack of unity between available data limits internal visibility into key supplier metrics that may place one supplier as more capable than another. In the flawed process of gathering the necessary information, valuable time is lost. Ford Motor Company requires a much more robust and streamlined approach to evaluating a supplier's capability to source a given commodity at a given time.

To address the needs of Ford Motor Company, the team's goal is to develop a platform that integrates and unites the data which defines a supplier, into one accessible and easy-to-use location. Using Power BI, this solution will establish a cross-functional scorecard framework, creating alignment between all internal teams at Ford Motor Company, Purchasing, Engineering, Finance, Legal, etc.

This approach carries the responsibility of reducing the amount of time required to locate supplier data and determine if that supplier is the best fit for the sourcing inquiry. By creating a standardized capability assessment tool, the scope of this project supports Ford Motor Company's broader objective of creating a supply chain that is a stronger, more reliable, and more responsive supply chain.



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Ford Motor Company Tariff Mitigation

Ford Motor Company is a global leader in automotive manufacturing and design with a footprint spanning all 50 U.S. states and more than a dozen countries worldwide. Ford strives to build a more sustainable world where everyone has the freedom to move and pursue their dreams.

Ford currently tracks tariff mitigation strategies and offset reimbursements through a manual, Excel-based system. This process lacks automated alerts and does not provide clear visualization to support executive decision-making regarding suppliers, commodities, tariff exposure, and mitigation efforts. This project will support Ford's Tariff Team in automating and improving these operations.

The team will develop a prototype using Microsoft Power Automate and Power BI to replace the existing process. A centralized data structure will consolidate inputs from the Tariff Team and Buyers to track suppliers, mitigation types, reimbursement status, and key deadlines. Power BI dashboards will provide real-time visibility into tariff exposure, mitigation progress, and supplier-level performance, while Power Automate will initiate the flow and collection of data, generating alerts for deadlines and status changes to increase internal transparency.

This approach will maximize cost savings by simplifying the process of managing ongoing tariff mitigation strategies, enhancing timeline visibility, automating alerts, and streamlining offset implementations. Success will be measured by increased reporting accuracy, reduced manual data handling, and implementation of a fully autonomous alert system. These outcomes will be evaluated through improved data consistency, reduced reliance on spreadsheet tracking, and stakeholder validation that the tool enhances visibility and decision-making efficiency.



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Ford Motor Company Third-Party Support STA

Born in Michigan, Ford Motor Company revolutionized the automotive industry. Ford continues to uphold their legacy as a leading automotive manufacturer, dominant in truck manufacturing and American performance vehicles. Ford operates in highly complex supply chains and has operations across North America in over 125 countries worldwide, giving it a truly global manufacturing and distribution footprint. With the success that Ford has had over the last century, they have juggled relationships with a multitude of suppliers to ensure quality performance in all vehicles.

During critical situations or high-risk scenarios, Ford will send quality engineers, technical specialists, and senior leadership to support supplier development and operational processes. In most cases, these resources are provided at Ford's discretion. This leads to incurring hidden costs for Ford that lack a standardized documentation process. Due to this, Ford is forced to assume responsibility for these hidden costs.

Currently Ford's only supplier chargeback framework is direct component nonconformance, where Ford is allowed to debit the cost of the part with the supplier when that part fails during assembly. Moving forward, the Ford Third-Party Support STA project aims to standardize frameworks that can be used across all suppliers to ensure Ford is no longer freely providing their resources for supplier development without supplier compensation. The constructed framework takes into account that expectations may vary from supplier to supplier due to the component volume and process complexity. This project will build stronger relationships with suppliers and hold them accountable to quality standards.



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MSU Assessment and Data Analytics

Impact of In-person Advising on Student Success

Michigan State University invests significant institutional resources in providing in-person academic advising during New Student Orientation (NSO). Academic advising serves as one of the earliest structured interactions students have with the university, helping them select courses, understand degree requirements, and clarify expectations. While advising is offered through both in-person and remote formats, the relative effectiveness of these modalities has not been systematically evaluated.

This project examines whether students who receive in-person advising during NSO demonstrate improved outcomes compared to those who receive advising remotely or through online formats. The analysis focuses on three key metrics: melt, defined as students who indicate intent to enroll but do not ultimately matriculate; retention measures across academic years; and six-year graduation rates. Because students who receive in-person advising may differ in meaningful ways from those who receive remote advising, the analysis will account for differences in student demographics, academic preparations, and program participation to ensure meaningful, valid comparisons.

Understanding the relationship between advising modality and student success is critical for institutional decision-making. If in-person advising does not produce measurable improvements in melt, retention, and graduation outcomes, MSU may be able to reconsider resource allocation without negatively affecting student success. Conversely, if in-person advising demonstrates significant positive impacts, particularly for specific student populations or equity-focused groups, the additional investment may be justified. Assessing these potential benefits, costs, and risks will support evidence-based decisions regarding the structure, delivery, and strategic prioritization of academic advising during New Student Orientation.



MICHIGAN STATE
UNIVERSITY



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Joyn Collective

Data-Driven Impact Measurement for Transformation Work

Joyn Collective is a Grand Rapids, Michigan based consulting firm that works alongside small to mid-sized organizations. Their approach centers on building the strategy, structure, and momentum behind transformation, helping clients navigate change in a way that is practical and built to last. Whether the work involves rethinking operations, strengthening the client experience, or mapping out an AI strategy, Joyn Collective serves as a hands-on partner through every step of the process.

As organizations increasingly invest in transformation initiatives, one question continues to surface: how do you know it is working? For many consulting firms, demonstrating the tangible outcomes of their work remains a significant challenge. Cultural shifts and operational improvements are real, but without a structured way to measure them, their value can be difficult to articulate to clients and leadership alike. Joyn Collective recognized this gap as an opportunity to sharpen how they communicate impact and build deeper trust with the organizations they serve.

This project focuses on developing two interconnected deliverables to address that challenge. The first is a data-driven measurement system built around key performance indicators rooted in Joyn Collective's core business domains of culture and technology. The second is a visual framework that contextualizes those KPIs for clients, clearly illustrating why each metric is relevant and how tracking it leads to meaningful business improvement. Together, these tools will give Joyn Collective a credible and repeatable way to demonstrate the value of their transformation work, strengthen client relationships, and communicate impact clearly, compelling, and grounded in data.



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Peckham-Revolution Farms

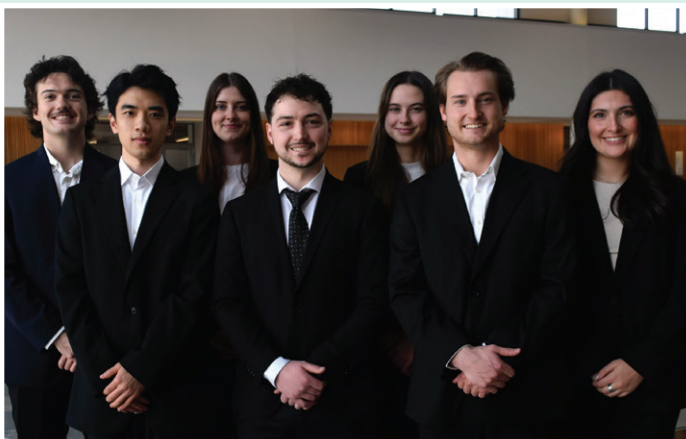
Mobile Accessible Produce Packing and Adjustable Tote Lift System for Controlled-Environment Agriculture

Peckham-Revolution Farms is a Michigan-based controlled environment agriculture (CEA) producer operating a large-scale indoor hydroponic facility that enables year-round production of salad greens and fresh produce. Established in 2018 and acquired by Peckham in 2025, Peckham-Revolution Farms is committed to creating a supportive work environment that accommodates a diverse workforce. This commitment drives continuous improvement efforts focused on accessibility, ergonomics, and safe material handling practices within its operations.

Current packing and tote handling workflows rely heavily on fixed-height surfaces and manual tote handling. These limitations increase ergonomic risk, restrict accessibility, and reduce flexibility during sanitation and line reconfiguration. With Peckham's mission in mind, our team was asked to evaluate current workflows and develop engineering design solutions to improve accessibility, ergonomics, and material handling efficiency while maintaining food safety and operational consistency.

Our team is focusing on three key areas: (1) improving the retrieval and transportation of product totes from storage to packing stations, (2) redesigning the system used to store and dispense bulk and retail plastic containers for salad packaging, and (3) optimizing the integration and positioning of the weight scale within the packing workflow. Proposed solutions include mobile, height-adjustable systems designed to reduce manual lifting, improve operator posture, increase workstation flexibility, and enhance process repeatability.

Through workflow analysis, ergonomic evaluation, and engineering design validation, this project aims to deliver a practical, food-safe, and adaptable system that supports workforce accessibility while improving overall operational efficiency within the controlled-environment agriculture facility.



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Peckham, Inc.

Integrated Production Intelligence and Supply Chain Visibility

Peckham, Inc. is a manufacturing leader of military apparel for the United States Department of Defense. The apparel manufactured is extremely complex and there is a strict set of quality compliance and delivery standards within the contract. As production expands, certain garments are sent to a third-party treatment facility in Mississippi for insect-repellant coating, which is then shipped in the original packaging to the Department of Defense.

Currently, Peckham lacks real-time visibility within the third party's system. This results in the Department of Defense shipments producing about a 5% difference in the expected and actual quantity. The issue stems from reporting from the external partner being delayed and delivered in inconsistent formats which causes late identification of the variation issues.

In this project the team will develop an integrated production intelligence system between the two partnering companies to improve supply chain transparency and reduce variance risk. This will be done through consolidating ERP data, supplier treatment reports and the production metrics into a centralized analytics dashboard. The solution that we present relies heavily on data integration between Peckham and its treatment provider to ensure accurate, and timely viability. This project will enable early variance detection, automated discrepancy flagging, and improved decision making.

The goal of this project is to create a proactive system driven by data to reduce waste from the operation and strengthen the performance on critical U.S. military contracts.



PECKHAM



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AESC 410 Awards 2025



As punter for Michigan State University's football team, Mike Sadler was well known for giving his team a competitive edge by

flipping the field with perfect punts that pinned the opponents back near their own end zone.

In addition to being well known as an outstanding punter, Mike was also well known for being an outstanding scholar, exemplifying what it means to be a true student-athlete. Mike was the first football player in Spartan history to

earn Academic All-America honors four times. He was a two-time first-team Academic All-American, a National Football Foundation Scholar-Athlete, and a William V. Campbell trophy finalist.

Mike completed an undergraduate degree in Applied Engineering Sciences in just three years and then went on to earn a master's degree in Public Policy. After graduating from MSU in 2015, he was excited to begin Stanford Law School.

The Mike Sadler Competitive Edge Award is presented annually to the Applied Engineering Sciences capstone team that strives to achieve the

highest possible outcome in order to attain the next level of success. The winning project is considered to have "flipped the field" with an innovative and creative solution that results in a competitive edge that not only solves the problem but distances itself from the competition.

"I am very proud to call myself an Applied Engineering Sciences alumnus. The program has fostered within me maturity, discipline, leadership, and a worldly sense of systems thinking."

- Mike Sadler



The AESC 2025 Mike Sadler Competitive Edge Award

Alro Steel Corporation:
Maximizing Fiber Laser Offloading and Processing

Left to right: Chloe Casenave, Sienne Prideaux,



The AESC 2025 Most Impactful Award

MSU College of Nursing
College of Nursing Scheduling Assistant

Left to right: Lilly Kuberski, Josh Sullivan, Collin Reardon, Cassandra Telley, Cate Kovacic

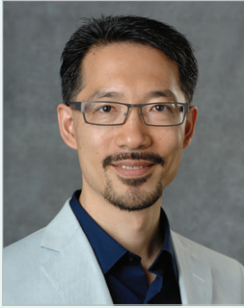


The AESC 2025 Most Sustainable Award

Michigan State University
College of Engineering
Evaluating the Environmental Effects of a Food Hub

Left to right: Matthew Nguyen, Deisi Bartolon, Dalety Aveiro (not pictured: Madhav Aggarwal, Tanvi Gadamssetti)





Dr. Sanghyup Jeong, PE
Assist. Professor
of Biosystems
& Agricultural
Engineering



Dr. Luke Reese
Assoc. Professor
of Biosystems &
Agricultural
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About the Program

Graduates of the MSU Biosystems Engineering (BE) Undergraduate Program are expected to succeed in diverse careers where they integrate and apply principles of engineering and biology to a wide variety of globally important problems. MSU Biosystems Engineering graduates are expected to attain that success by:

- identifying and solving problems at the interface of biology and engineering, using modern engineering techniques and the systems approach,
- analyzing, designing, and controlling components, systems, and processes that involve critical biological components,
- demonstrating a professional foundation that includes vision, adaptability, creativity, a practical mindset, effective communication skills, continuing professional growth, and ethical conduct, and
- working inclusively and equitably in diverse, cross-disciplinary environments towards sustainable solutions.

BE 485 / BE 487 Courses

Biosystems Engineering student teams, enrolled in the two-semester biosystems design capstone experience, BE 485/487, develop, evaluate, and select design alternatives to solve real-world problems. Projects are diverse, but each reflects systems thinking by integrating interconnected issues affecting the problem, including critical biological constraints. The engineering design process is documented in a detailed technical report. Teams present project designs to engineering faculty and a review panel of professional engineers for evaluation. Each BE 485/487 capstone design team prepares and presents a design solution in report, poster, and oral formats to industry, faculty, peers, and the public that:

- Requires engineering design
- Combines biology and engineering
- Solves a real problem
- Uses a holistic approach
- Interprets data
- Evaluates economic feasibility

2025/26 Projects

Full descriptions and project posters are at:
<https://canr.msu.edu/bae/senior-design-2026>



Public presentations (April 24, 2026, 1:30 p.m.)
116 Farrall Hall or <https://msu.zoom.us/j/97714737403>

Restoration and Improvements of MSU Stormwater Bioretention Basin

MSU Infrastructure, Planning, and Facilities
Team MSU Bioretention - Miles Morman, Neha Patel,
Joseph Pelkey, Megan Ransler, & Ryan Wrublewski
Faculty Advisors - Dr. Dawn Dechand &
Dr. Subhasis Giri

Addressing Harmful Algal Blooms in the Soldan Dog Park Pond

Ingham County Parks – Soldan Dog Park
Team Soldan Paw Patrol - Truman Bauer, Cody Fisher,
Ethan Hartwig, & Drew Kraemer
Faculty Advisors - Dr. Dawn Dechand &
Dr. Subhasis Giri

Implementing Phosphorus Mitigation Technologies for Algal Blooms in Duck Lake (Allegan County)

Duck Lake Water Quality Committee
Team Duck Lake - Jaclyn Cool, Leah Jarmolowicz,
Jayden Schmaltz, & Stewart Tucker
Faculty Advisor - Dr. Ehsan Ghane

Evaluating the Feasibility of Corn Stover-Manure Anaerobic Digestion

Consumers Energy (*project under Non-Disclosure Agreement*)
Team Consumers Energy - Patrick Brennan, Josie Cayen,
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Supporting Sustainability: Organic Patient Food Waste Digester for Henry Ford Health – Destination Grand

Henry Ford Health (*project under Non-Disclosure Agreement*)
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Maria Sufyan Abbasi
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Non-Invasive Frameless Immobilizer for MRI Guided Focused Ultrasound

Henry Ford Health (*project under Non-Disclosure Agreement*)
Team Henry Ford Health - Amber Boomer, Nicholas
Bray, Sydney Chapman, & Clayton Whetstone
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Using Fluorescein Sodium for Real-Time Identification of Cerebrospinal Fluid Leaks in Saline

Stryker (*project under Non-Disclosure Agreement*)
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Faculty Advisor - Dr. Vangie Alocilja

Ensuring Ice Cream Quality Through Palletization Management

Tillamook (*project under Non-Disclosure Agreement*)
Team Tillamook - Katherine Heinecke, Kealey Kolp,
Summer Luick, & Carter Ostrowski
Faculty Advisor - Dr. Kirk Dolan

E.W. Grobbel Temperature Control Chamber for Pickle Fermentation

E. W. Grobbel (*project under Non-Disclosure Agreement*)
Team Pickle Pals - Gianna Fiore, Gillian Kuehnle,
David Lau, & Sophie McCowan
Faculty Advisor - Dr. Kirk Dolan

Automation of COD and TOC Waste Stream Monitoring for Proper Disposal

Perrigo (*project under Non-Disclosure Agreement*)
Team Perrigo - Luke Caruso, Varshitha Korivi, Evan
Malbouef, & Sasha Stoyanovich
Faculty Advisor - Dr. Yan “Susie” Liu

Optimizing Agrivoltaic System Design for Michigan Farmer Income

MSU Extension
Team Mitten Solar - Joshua Dixon, Danielle Edington,
Miguel Martinez-Garcia, & Diana Mejia
Faculty Advisors - Dr. Ajit Srivastava & Aluel Go

Industry Advisory Board

The purpose of the Industry Advisory Board is to facilitate the exchange of ideas between Board members, faculty, and students of the BE program. Its function is to improve continuously the BE program quality by keeping it current and relevant to industry needs. Regular and adjunct board members also serve as external project evaluators.

Board

Ellen Bornhorst, PhD ~ PepsiCo
Holly Bowers ~ Consumers Energy
Jessica Bruin ~ Mars Snacking
Lisa Buchholz ~ Corteva Agriscience
Matt Burt (Chair) ~ AbbVie
Shelley Crawford ~ Jiffy
Michelle Crook, PE ~ MDNR
Laura Doud, PE ~ MDOT
Cassandra Edwards ~ Tillamook Creamery
Gene Ford ~ Standard Process
Jeremy Hoeh, PE ~ EGLE
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Mitch Miller ~ Lactalis USA
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Rob Yoder ~ BDI, Inc.
Dave Young ~ Perrigo

Board (Ex-officio)

Todd Forbush ~ Techmark, Inc. (ASABE MI Section)



BE Showcase Evaluations & Public Presentations



BAE Industry Advisory Board Meeting & Evaluators

BE Showcase 2025, see www.canr.msu.edu/bae/senior-design-2025

If you are interested in sponsoring a BE 485/487 capstone project for the 2025_26 Senior Design teams, please contact Dr. Sanghyup Jeong at jeongsa1@msu.edu or Dr. Luke Reese at reesel@msu.edu.

ChE Process Design and Optimization



Dr. R. Mark Worden
Class Instructor and
Professor of Chemical
Engineering



Khushi Pandey
Ph.D. Student and
Teaching Assistant of
Chemical Engineering

Course Description

The Chemical Engineering Program's capstone design sequence includes Process Design and Optimization I and II (433 and 434, respectively). In these courses, students integrate content from earlier courses to solve complex, open-ended design problems. As the students progress through CHE 433, completion of their assignments requires increasingly more effort, initiative, knowledge and individual responsibility. In CHE 434, students typically design an entire commercial-scale chemical plant and perform detailed economic analyses to assess and optimize the plant's profitability.

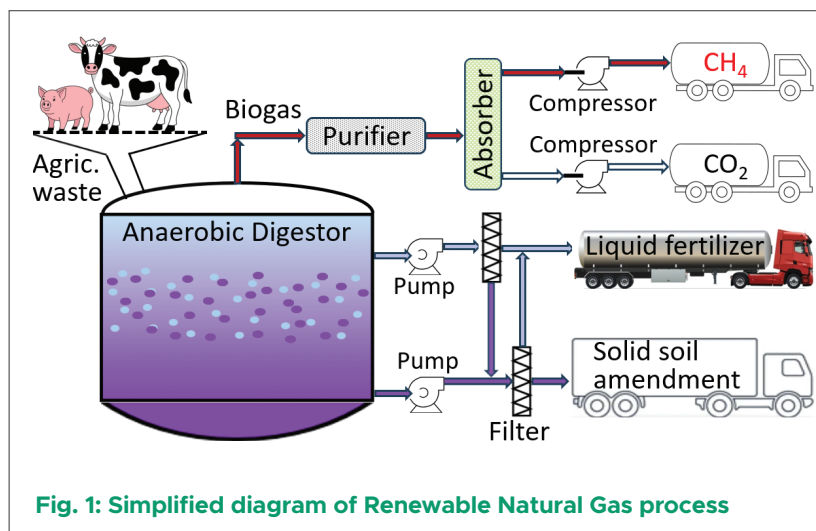
For over 50 years, MSU's CHE 434 students have worked intensively for one to two months solving the annual American Institute of Chemical Engineering (AIChE) Student Design Competition problems, which vary from year to year. CHE 434 uses these realistic, industry-based problems to enhance Chemical Engineering students' capstone design experience in three ways: 1) the AIChE problems provide real-world, open-ended design experiences typical of what students are likely to face after graduation; 2) the AIChE problems require students to do self-directed, active learning, including project-specific independent research, to solve the problem; and 3) the AIChE problems serve as a national benchmark for MSU's Chemical Engineering students to demonstrate excellence in their professional skills.

As the Chemical Engineering program's contribution to the College of Engineering's Design Day, several CHE 434 students typically present posters describing their solutions to the current year's AIChE Student Design Competition problem. Names and pictures of this year's presenters are provided at the end of this article.

2026 Design Competition Problem: "Renewable Natural Gas"

The 2026 Renewable Natural Gas (RNG) project is motivated by the simultaneous needs to generate more energy in the form of a renewable natural gas and to eliminate agricultural waste products. The proposed solution is to develop an efficient biological process to convert the agricultural wastes into methane and other salable products, including purified carbon dioxide (CO₂), a liquid fertilizer, and a solid soil amendment.

Fig. 1 is a simplified flowsheet of the RNG process. Agricultural wastes, including farm-animal manure, are collected from a farm co-op and shipped to a centralized RNG plant, where they are fed continuously to an anaerobic digester. There, microorganisms dissolve the waste and then convert it into a biogas consisting of primarily methane (CH_4) and carbon dioxide (CO_2). Impurities, including sulfur-containing gases, are removed, and the



purified CH_4 and CO_2 gases are compressed and pumped into high-pressure gas trucks for delivery to customers. The CH_4 serves as a substitute for natural gas as a fuel, and the CO_2 is used to carbonate beverages and to help grow hydroponic plants.

In addition to biogas, the anaerobic digester also produces continuous liquid and solid product streams that are separated using filters. The liquid, which is rich in plant nutrients, is used as a liquid fertilizer, and the solids are dried and used as a soil amendment that, like compost, improves soil quality.

The design process involves: (1) considering alternative process flowsheets, including the type of equipment needed for each flowsheet; (2) selecting the optimal flowsheet based largely on safety and economic factors; (3) calculating the flowrates of mass and energy through each branch of the flowsheet; (4) determining the size and cost of all equipment items; (5) calculating the overall cost of fabricating and operating the plant, as well as its expected product-sales revenues and profit; and (6) using comprehensive process-simulation software (e.g., Aspen) to determine process variables that maximize the plant's profit. Finally, the students write a comprehensive report up to 50 pages in length that describes the optimal design's underlying assumptions, calculations, and results. These reports include details of the manufacturing plant's equipment, operating conditions, personnel needs, capital investment, fixed costs, variable costs, and profitability (e.g., discounted cash flow rate of return).

The CHE 434 reports are graded on both their technical quality and their communication effectiveness. Because decisions on whether to build a new chemical plant are made by stakeholders having diverse academic backgrounds, these reports are expected to be understood by a wide range of audiences.

National Award in 2025 AIChE Design Competition



Mia Vollkommer

Since 1968, MSU has had the best record nationally for winning awards in the AIChE Student Design Competition, and our win streak continued in 2025. MSU Chemical Engineering senior Mia Vollkommer received first place in the individual category for designing a “Blue Hydrogen” process that cost-effectively converts a fossil fuel (e.g., natural gas) into clean-burning hydrogen gas while capturing the byproduct CO₂, rather than releasing it into the atmosphere.

In addition to this national award, Mia Vollkommer, a member of MSU’s Honors College, also received an MSU Board of Trustees’ Award in recognition of her 4.0 GPA. After graduation, Mia joined Nestlé Purina in Iowa as a chemical engineer and management development associate.

In 2025, MSU’s Chemical Engineering program was honored to host the 2025 AIChE North Central Regional Conference. Participants included over 400 students and faculty from 22 universities, along with many industrial representatives. Students’ design knowledge and skills were judged in the conference’s Chemical Engineering Jeopardy games and a Chem-E-Car competition. Students also showcased their engineering skills in a Research Poster Competition and a Technical Presentation Competition, both of which were judged by a panel of faculty members and industry experts.

Student Poster Presenters on Design Day

The nature of Chemical Engineering students’ capstone design experience is not compatible with small-scale, hands-on models for Design Day demonstrations. Instead, Chemical Engineering seniors’ Design Day contribution consists of presenting a lay-level poster of their solution to the AIChE Design Competition problem, and discussing with prospective students, current students, parents, and others the nature and advantages of careers in Chemical Engineering. Some of this year’s presenters include Shubhan Nagarkar (left) and Thilini Aberatne (right).



Shubhan Nagarkar



Thilini Aberatne

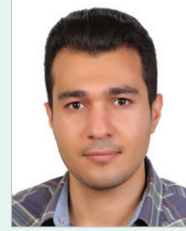
The Capstone Projects



Dr. Martin Crimp
Professor of Chemical
Engineering and
Materials Science



Dr. Tyler Johnson
Teaching Specialist
Chemical Engineering
and Materials Science



Amir Mirtaleb
Graduate Teaching
Assistant

Course Description

MSE 466 is a senior level course for Materials Science and Engineering majors that provides students with a team-based capstone design experience. A major aspect of this course is having the students apply their course-learned background knowledge and critical thinking skills in materials science and other disciplines to real-life material/component failure problems. Such failures are a major motivating factor for promoting more innovative designs or design changes. A failure analysis investigation provides a unique platform to design and solve real-world engineering problems via a systematic engineering approach. By focusing on specific component failures, the student teams learn how to confront open-ended problems that require them to develop a strategic design plan and to execute the methodology for assessing how and why the failure occurred. These open-ended studies are conducted using established investigative procedures and constraints for carrying out failure analysis. This semester there are four teams carrying out investigations on real material/component failures.

Presentation Schedule – 1st Floor Room 1145

Time	Team Name	Project Title
9:00 a.m.	The Hunks of Steel	Failure Analysis of Ring Roller Mandrel
9:40 a.m.	The Best of Both Brackets	Failure of Two Cartridge Style VP-BC73 Bottom Brackets
Break		
10:30 a.m.	Pinhole Pirates	Failure Analysis of High-Pressure Steam Blowdown Pipes
11:10 a.m.	The Spring Breakers	Failure Analysis of a Mazda CX9 Coil Spring

Team Name: The Hunks of Steel

Project Name: Failure Analysis of Ring Roller Mandrel

Time: 9:00-9:40 a.m.

Industrial ring roller machines are specialized metalworking equipment used to shape metal ingots into larger radius components essential for aerospace and structural applications. The mandrel is an 8-foot, 6-inch diameter cylindrical component of the ring roller machine that experiences large bending and torsional loads. Due to the extreme operating conditions, the life cycle of the mandrel is less than four months. To determine the cause of fracture and propose longer lasting alternatives, a comprehensive failure investigation using multiple material testing techniques was performed. Initial crack position was examined with stereomicroscopy and pulse echo ultrasonic tests.

This was followed by extensive metallographic analysis to understand the microstructure; while tensile testing, Charpy Impact, Rockwell Hardness, and DSC were conducted to understand the mechanical and thermal properties. The fracture surface was characterized by Scanning Electron Microscopy (SEM) to observe any microscopic features that indicate the fracture mode and initiation site. Additionally, chemical analysis was outsourced to obtain the composition. Understanding the failure of the mandrel can be used to design and engineer mandrels with longer life expectancy leading to minimized risks and economic loss.



(Left to right) Alex Duke, Teoman Ekim, Aiden Niemiec, Rabul Gopalakrishnan



(Left to right) Saira Mir, Laurel Seidensticker, Hannah Wright

a boron steel spindle, which is covered by a hollow aluminum sheath to protect the part from debris and damage. The ends of the sheath are covered by threaded phosphate cups which protect the internal bearings. Two bottom brackets with similar fracture surfaces were analyzed to determine the root cause of the spindle fracture. Fracture surfaces were analyzed via optical microscopy and scanning electron microscopy (SEM) to ascertain the microscopic and macroscopic failure modes, respectively. Metallographic preparation was done on cross sections of the spindle to analyze the microstructure and possible defect present. Dye penetrant testing, Rockwell and Vickers hardness, energy dispersive X-ray spectroscopy (EDS), and other analytical techniques, including an element analysis, were performed to evaluate the material properties and possible originations of the failure.

Team Name: The Best of Both Brackets

Project Name: Failure of Two Cartridge Style VP-BC73 Bottom Brackets

Time: 9:40-10:20 a.m.

The bottom bracket in a standard bike connects the crankset to the bike frame and allows for the pedals and chainrings to spin freely. The bottom bracket is vital to smooth performance, and failure of this part results in reduced efficiency to pedals, wobbly crank arms, and further damage to components. The manufacturer, VP Components, stated that the VP-BC73 cartridge style bottom bracket consists of

Team Name: Pinhole Pirates

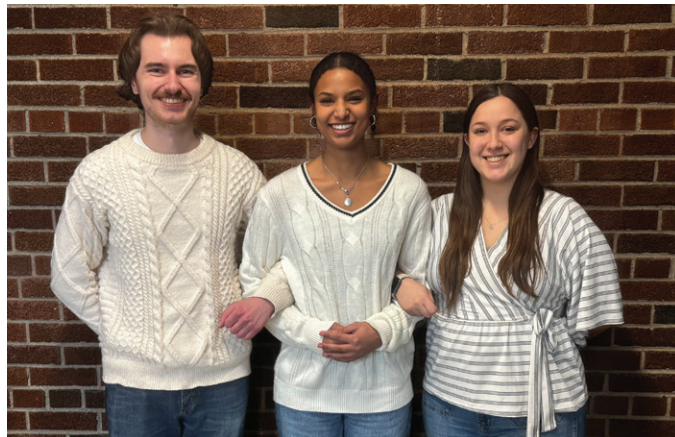
Project Name: Failure Analysis of High-Pressure Steam Blowdown Pipes

Time: 10:30-11:10 a.m.

In a combined-cycle gas-fired power plant, blowdown pipes allow high-pressure steam drums to continuously remove fluid impurities that accumulate during operations. On one such steam tank in a Pennsylvania power plant, the same section of a blowdown pipe immediately downstream of a needle valve, has failed and been replaced several times since the plant began operations in 2010. Two such failures, removed during planned outages in 2022 and 2025, were taken for failure analysis. Upon removal, evidence of internal erosion and resultant pinholes were discovered. Methods including stereomicroscopy, scanning electron microscopy, chemical analysis, and microstructural characterization were performed to elucidate likely causes of failure. These discoveries were imperative to determine how the pinhole leaks formed to recommend prevention measures and service lifetimes.



(Left to right) Bradley Gerwig, Ella Fledderjohann, Ethan Stull



(Left to right) Zachary Christiansen, Zaria Ali, Angelyn Wiedyk

Team Name: The Spring Breakers

Project Name: Failure Analysis of a Mazda CX9 Coil Spring

Time: 11:10-11:50 a.m.

Coil springs play a crucial role in vehicle suspension systems. They provide vehicle load support, road impact absorption, and vibration isolation. The front-right coil from a daily driven 2008 Mazda CX9 GT failed at 132,000 miles while the vehicle was in motion after unexpectedly encountering a surface defect on the road; the failure occurred in cold, snowy weather. Due to the snow and wet storage conditions, the fracture surface became partly rusted. The coil resided on a MacPherson strut, a type of independent suspension

system known for its lightweight and compact design. To determine the root cause of the fracture, various destructive and non-destructive materials testing techniques were employed. First, the entire strut tower was extensively imaged with macrophotography and 3D photogrammetry techniques, capturing all visual details. The coil was then removed from the strut tower and was sectioned into multiple pieces. Through hardness and tensile testing, scanning electron microscopy, chemical analysis, metallography, Raman spectroscopy, and X-Ray diffraction, each section was analyzed to gather the defining details that characterized the failure. Overall, a comprehensive analysis of the evidence gathered led to a thorough and complete evaluation of the coil failure.



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The Capstone Projects



Dr. Anthony Ingle
Senior Teaching Specialist

Faculty Advisors: Professors Cetin, Engle, Haider, Hashsham, Ingle, Joshi, Li



Cetin



Engle



Haider



Hashsham



Ingle



Joshi



Li

Presentation Schedule

Room	Time	Team
Room 2205 2nd Floor	8:00 a.m.	Team 1 - Atlas Engineering
	9:20 a.m.	Team 2 - KITCAL Associates
	10:40 a.m.	Team 3 - Great Lakes Engineering Group
Room 2320 2nd Floor	8:00 a.m.	Team 4 - Spartan Core Engineering
	9:20 a.m.	Team 5 - Mitten State Engineering
	10:40 a.m.	Team 6 - Going Green Consulting
Room 2400 2nd Floor	8:00 a.m.	Team 7 - Green & White Engineering
	9:20 a.m.	Team 8 - Capital Area Consultants
	10:40 a.m.	Team 9 - Spartan Consultants
Room 3540 3rd Floor	8:00 a.m.	Team 10 - Beaumont Engineering
	9:20 a.m.	Team 11 - Sparta Engineering Solutions
	10:40 a.m.	Team 12 - Crunch Engineering Consulting
Room 3400 3rd Floor	8:00 a.m.	ENE Team 1 - KVC Engineering Consultants
	8:25 a.m.	ENE Team 2 - Envirosense
	8:50 a.m.	ENE Team 3 - V&C Solutions
	9:15 a.m.	ENE Team 4 - Red Cedar Springs
	9:40 a.m.	ENE Team 5 - JSN Engineering
	10:05 a.m.	ENE Team 6 - Erie Environmental
	10:30 a.m.	ENE Team 7 - AMW Environmental
	10:55 a.m.	ENE Team 8 - Goward, Gioppo, & Todd, Ltd.
	11:20 a.m.	ENE Team 9 - ReNu Water Systems
	11:45 a.m.	ENE Team 10 - MPPSAS Engineering

CE 495 Senior Design in Civil & Environmental Engineering

Undergraduates in civil and environmental engineering must take CE 495. This capstone course prepares students for the workplace by providing an experience with the following challenges:

- A project with multiple issues that must be resolved using civil and environmental engineering knowledge;
- Formulation of conceptual solutions and resolution of conflicting design elements;
- Development of plans that comply with regulations and provide a basis for cost estimates;
- Balancing individual responsibility and group participation in a team based effort;
- Preparation of written reports and oral presentations.

CE 495 SENIOR DESIGN CIVIL ENGINEERING PROJECT

The Leinweber Center for Engineering and Digital Innovation



Aerial photo site location.

The Leinweber Center for Engineering and Digital Innovation site is in the central academic district in direct proximity to the Engineering Building and STEM Teaching and Learning Facility. Proximity to the functions that occur in these existing buildings in the central academic district is critical to the collaborative nature of the teaching, learning, and research. The new building site is envisioned to comprise two components. One component would be dedicated to digital learning with active classrooms, teaching laboratories, student project studios, and e-sports. The other part would be dedicated to laboratories supporting experimental and computational research, core facilities, clean rooms, and flexible modular research units; and vibrant community spaces to support informal gathering and collaboration.

The new building will support an increase in enrollment of new undergraduate students in computational sciences and digital literacy disciplines and in graduate related programs. This helps to prepare MSU graduates with skills in computational sciences and digital literacy necessary for postgraduate success. The Leinweber Center for Engineering and Digital Innovation is expected to become MSU's hub for excellence in advanced manufacturing, materials science, ultrafast science, and quantum computing including heterogeneous micro-electronic technologies.

The project emphasizes implementation of green infrastructure. Green infrastructure refers to systems and practices that use or mimic natural processes to infiltrate, evapotranspire, or harvest stormwater at its source. The project includes demolition of the Urban Planning and Landscape Architecture building and the abandoned water reservoir. Additionally, Red Cedar Road between S. Shaw Lane and Wilson Road will be closed and converted into green space. The project is expected to begin construction in 2026 and be completed in two years. Specific aspects of the design for this project apply to various civil and environmental disciplines represented as: pavements, transportation, geotechnical, structural, hydrology, and project management.



Architectural rendering of building concept.

"I truly believe in the power of education to change the trajectory of a person's life, as I experienced as a college graduate from MSU."

— Larry Leinweber

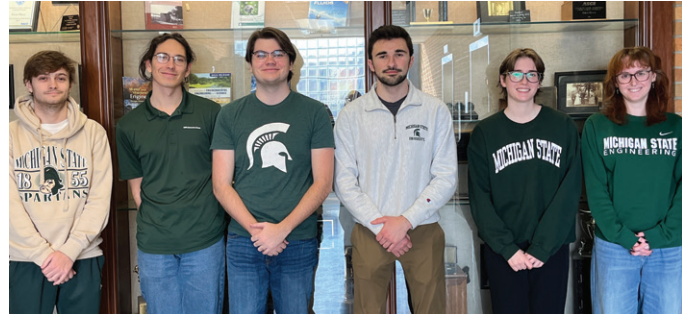


Exterior rendering of the Leinweber Center for Engineering.



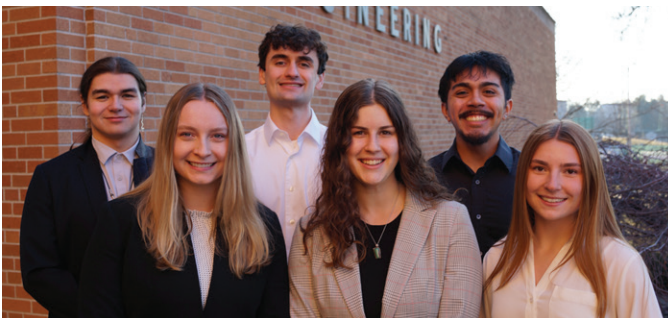
Team 1: Atlas Engineering

Left to right: Grace Gerrits (H), Zachary Franz (T), Gabriella Murray (P), Alberto Naccarato (S), Kiah Ellis (G), Jacob Thome (PM)



Team 2: KITCAL Associates

Left to right: Austin Waller (S), Topher Haymond (T), Calder Munro (G), Landon Gardella (P), Kylie Camman (PM), Isabelle Brissette (H)



Team 3: Great Lakes Engineering Group

Left to right: Keenan Hoffman (S), Claire Stelmaszek (P), Ryan Loverich (T), Emily Kuznar (H), Aidan Flores (PM), Abigail Newcombe (G)



Team 4: Spartan Core Engineering

Left to right: Trevor Wabbi (P), Daniel Wenk (T), Daniel Kurian (G), Griffin Gathen (H), Billyjoe Crow (S), Evan Budd (PM)



Team 5: Mitten State Engineering

Left to right: Sofia Beerworth (P), Franziska Winkler (G), Levi Cowan (S), Rachel Huyser (T), Bryce Krupp (H), Maya Burlak (PM)



Team 6: Going Green Consulting

Left to right: Bradley Corteville (T), Liv Robins (P), Vincente Pham (H), Gabrielle LaCrosse (PM), Thomas Randall (S), Ethan Pratt (G)

KEY TO TEAM ROLES

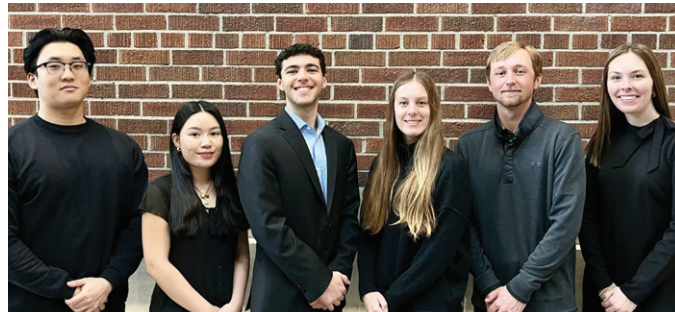
E = Environmental
G = Geotechnical
H = Hydrology
P = Pavements

PM = Project Manager
S = Structures
T = Transportation



Team 7: Green & White Engineering

Left to right: Dylan Martini (H), Finn Tobiczky (S), Peter Swanson (P), Josh Filippetti (PM), Jacob Klingler (G), Bryan Kaempfer (T)



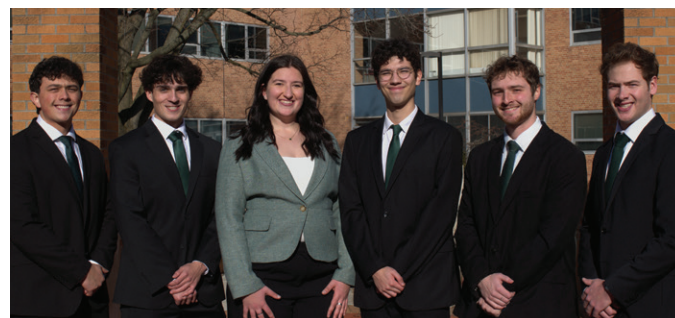
Team 8: Capital Area Consultants

Left to right: Minseo Lee (P), Kelly Wong (T), Jonah Cohen (S), Audrey Williamson (G), Benjamin Bocian (H), Amelia Mills (PM)



Team 9: Spartan Consultants

Left to right: Micheal Wasniewski (H), Justin Allison (G), Eric Coronado (PM), Ali Al-Kuwari (T), Jessica Boulard (P), Donovan Russell (S)



Team 10: Beaumont Engineering

Left to right: Nathan Denning (PM), James Richards (H), Kelly Couvreur (S), Benjamin Jacobson (T), Ian Henke (G), Benjamin Carter (P)



Team 11: Sparta Engineering Solutions

Left to right: Andrew Swanson (H), Allison Tol (T), Ethan West (PM), Chaka Kone (S), Ryan Meyer (P), Ethan Bailey (G)



Team 12: Crunch Engineering Group

Left to right: Grant Males (G), Christopher Pieprzak (H), Ethan Kelley (T), Lewis Thiedeman (S), Alexander Duda (PM), Joshua Aleva (P)

KEY TO TEAM ROLES

E = Environmental	PM = Project Manager
G = Geotechnical	S = Structures
H = Hydrology	T = Transportation
P = Pavements	

CE 495 SENIOR DESIGN

ENVIRONMENTAL ENGINEERING PROJECT

The Detroit Water Resource Recovery Facility (DWRRF)

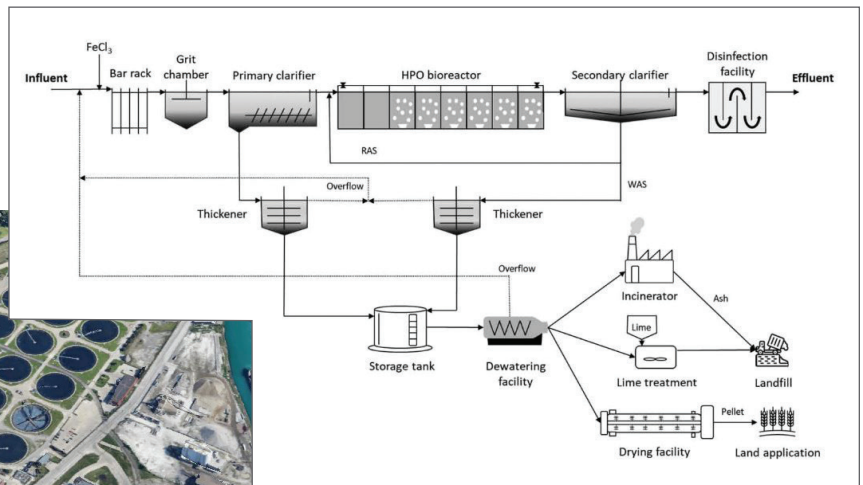
The Detroit Water Resource Recovery Facility (DWRRF) is the largest single-site wastewater treatment plant in the United States. Wastewater treatment and collection improvements implemented over the last 50 years have profoundly advanced regional water quality. In this senior capstone project, the environmental engineering students are tasked with developing next-generation nitrogen removal strategies for the existing DWRRF. This evaluation is intended to assess the technical feasibility and implications of achieving a targeted reduction in effluent nitrogen under more stringent future conditions.

As a part of this design, students evaluate the technical feasibility and cost-effectiveness of emerging approaches that maximize total nitrogen removal while minimizing capital and operational and maintenance costs. Students analyze a model-based simulation of the modified plant operations to evaluate the alternatives with respect to nitrogen removal performance, costs associated with supplemental organic carbon, energy recovery through methane production, and implications of sludge management.



Site plan Detroit Water Resource Recovery Facility.

Source: Great Lakes Water Authority Wastewater Master Plan, CDM Smith, June 2020



Existing layout of unit operations.



Aerial photo Detroit Water Resource Recovery Facility.



ENE 1: KVC Engineering Consultants

Left to right: Ashlyn Kuta and Bruno Valion



ENE 2: Envirosense

Left to right: Seth Besson and Emma Simon



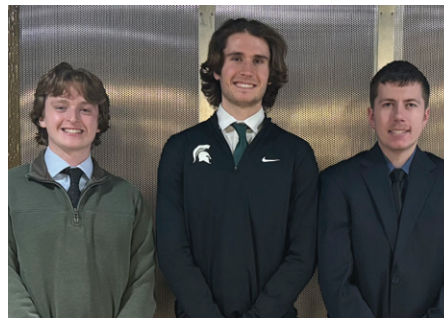
ENE 3: V&C Solutions

Left to right: Ashton Vogel and Trevor Cool



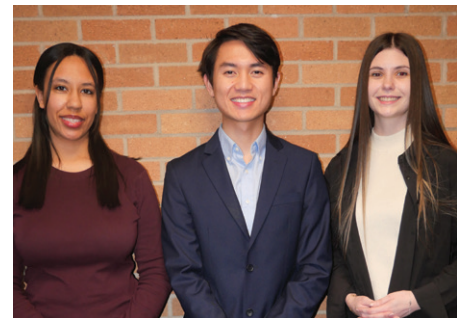
ENE 4: Red Cedar Springs

Left to right: Michael Wholihan, Talena Monasmith, Makiyah McIver



ENE 5: JSN Engineering

Left to right: Sean Fleming, Jack Pennewell, Nathan Simmons



ENE 6: Erie Environmental

Left to right: Morgan Smith, Dylan Rian Gong, Riley McGaughey



ENE 7: AMW Environmental

Left to right: Avery Cain, Wayne Meech, Mackenzie Voss



ENE 8: Goward, Gioppo, & Todd, Ltd.

Left to right: Zachary Gioppo, Ruby Todd, Calista Goward



ENE 9: ReNU Water Systems

Left to right: Sushen Loya, Quan Nguyen, Anmol Viswanath



ENE 10: MPPSAS Engineering

Left to right: Mina Park, Addison Swanson, Parker Salciccioli

CE 495 SENIOR DESIGN IN CIVIL & ENVIRONMENTAL ENGINEERING

PROFESSIONAL SEMINAR SPEAKERS

Talia Bellil, P.E.

Michigan Dept. of Transportation

Michele Buckler, P.E.

Diamler Automotive Group

Jon Harden, P.E.

Michigan Dept. of Transportation

Megan Jacobs, P.E.

Soil & Materials Engineers, Inc.

Steve Minton, P.E.

Michigan Dept. of Transportation

Nolan Pacitto, P.E.

OHM Advisors

Leanne Panduren, P.E.

Rowe Professional Services

Kristin Schuster, P.E.

Michigan Dept. of Transportation

Alex Sherman, P.E.

Nicholson Construction

Brian Smith, P.E.

Clark Dietz Inc.

Roy Townsend, P.E.

Washtenaw County Parks and Recreation

PROFESSIONAL EVALUATORS

Engineers and scientists associated with the following firms, municipalities, and companies donated time to provide students with a practicing professional's perspective. We gratefully acknowledge their generous contributions.

Sam Baushke, P.E.

Michigan Dept. of EGLE

Ryan Butler, P.E.

Consumers Energy

Erik Carlson, P.E.

Michigan Dept. of Transportation

Dan Christian, P.E.

Tetra Tech MPS

Jim Corsiglia, P.E., S.E.

Carnaghi Structural Consulting

Ihab Darwish, P.E., S.E.

Benesch

Tyler Dawson, Ph.D., P.E.

NTH Consultants

Jordan Doddie, P.E.

HNTB

Farsad Fotoouhi

Marvin

Adam Gerlach, P.E.

C2AE Atkins Realis

Brian Gombos, P.E.

Wade Trim

Jayson Graves, P.E.

Soil & Materials Engineers, Inc.

David Hayden, P.E.

Mannik and Smith Group

Amanda Herzog, Ph.D.

City of Royal Oak, MI

Michael Kaminski, P.E.

Wade Trim

Fritz Klingler, P.E.

FK Engineering

Scott McQuiston, P.E.,

PMP

Westinghouse Electric Co.

Brian Merk, P.E.

Prein & Newhof

Cole Moody, P.E.

HNTB

Jon O'Brock, P.E.

Materials Testing Consultants

Marc Rasmussen, P.E.

Soil & Materials Engineers, Inc.

Lauren Roller, P.E., S.E.

Harley Ellis Devereaux

Sarah Ross, P.E.

Practical Engineers, Inc.

Hailey Savola, P.E.

ROWE Professional Services Co.

Bill Seeger, P.E.

Michigan Dept. of Transportation

Paul Sgriccia, P.E., FESD

PTS Consulting LLC

Brandon Simon, P.E.

Progressive AE

Steve Sorensen, P.E.

PEA Group

Doug Strauss, P.E.

Benesch

Kyle Wilson, P.E.

Soil & Materials Engineers, Inc.

Design Day Awards Fall 2025

Rolla C. Carpenter Senior Design Award

The Rolla C. Carpenter Senior Design Award (\$250 per student and medallion) is presented to the best team as judged by the faculty and a panel of practicing engineers.

Rolla C. Carpenter, Renaissance Engineer, was a graduate of The State Agricultural College in 1873 with a Bachelor of Science degree. After earning a Master of Science in Civil Engineering, he was appointed professor of the Department of Mathematics and Civil Engineering at The State Agricultural College, which would later become MSU. He designed bridges, built ice houses, taught students French, astronomy, mathematics, mechanical drawing, hydrostatics, hydraulics, survey, and civil engineering. He prepared the design and working drawings for the Farm Lane Bridge, laid a water supply pipe to Williams and Wells Halls, and designed a pile driver for a dam built across the Red Cedar River. He later designed several buildings on campus, including the Mechanical Building, which was constructed in 1885. Throughout all of his work on campus, he involved students throughout the analysis, design and construction, forming what was essentially the first senior capstone design class.



The faculty and students of the Department of Civil and Environmental Engineering gratefully acknowledge the generous contributions from Rowe Professional Service Co. and Wade Trim.

Rolla C. Carpenter Senior Design Award Winners, Fall 2025

Team 2: Red Cedar Civil and Environmental

Left to right: Brandon Bardhollari, Kayleigh Barricklow, Tim Bradford, Grace Millbauer, Josh Rayl, Amelia Cooper,
Not pictured: Michael Memering



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The Capstone Projects



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James Mariani
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Griffin Klevering



Jared Singh Sekhon



Luke Sperling

Graduate Teaching Assistants

CSE 498 Collaborative Design

CSE 498, Collaborative Design, provides the educational capstone for all students majoring in computer science. Teams of students build software systems for a variety of clients.

During the capstone experience, students

- design, develop, debug, document, and deliver a comprehensive software system,
- work in a team environment,
- become proficient with software development tools and environments,
- develop written and oral communication skills,
- build and administer computer systems, and
- consider issues of professionalism and ethics.

Our clients are local, regional, and national including Ally Financial, Amazon, Anthropocene Institute, Apple, Auto-Owners Insurance, Bosch, Corewell Health, Delta Dental, General Motors, Google, HAP, Henry Ford Health, Kohler Co., Launch, Lockheed Martin, Ludus, Magna, Meijer, Microsoft, Mozilla, MSU Federal Credit Union, NetJets, PACE of Southeast Michigan, PS Technology, Stripe, Stryker, TechSmith, United Airlines, Urban Science, Volkswagen, Whirlpool, and WK Kellogg Co.

AkzoNobel

Smart Manufacturing Equipment Monitoring

AkzoNobel is a Dutch multinational company that produces performance coatings for industries and consumers worldwide. The modern-day AkzoNobel came about in 1994 through the merge of the Dutch Akzo and the Swedish Nobel Industries, creating one of the leading coatings companies in the world.

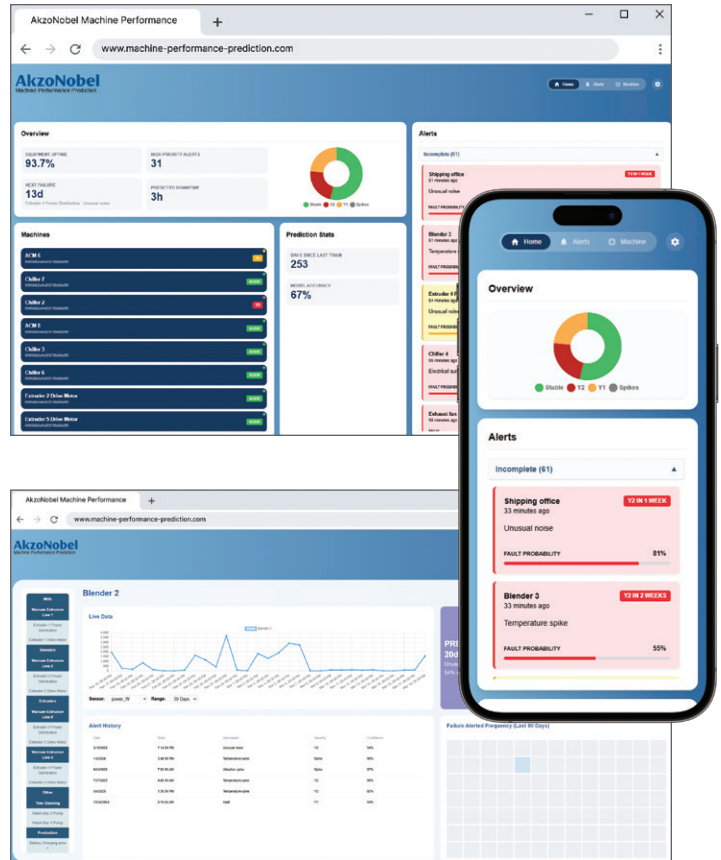
To produce coatings on a global scale, AkzoNobel has an armada of machines and a team of engineers that work to deploy, maintain, and upgrade them. To meet their production needs, AkzoNobel needs to ensure these machines run without unexpected breakdowns. Due to the complexity of the machines, detecting these errors early can be a highly difficult task.

Our Smart Manufacturing Equipment Monitoring is a web application that assists AkzoNobel engineers in discovering machine failures before they happen. Our software alerts engineers about potential failures in real time by using machine learning algorithms to analyze data from sensors installed on machines in AkzoNobel's plant in Warsaw, Indiana.

Our web application provides an easy breakdown of each machine in the plant, displaying a graph of historical sensor data and detailed prediction information, including estimated time until breakdown and prediction confidence level. If an incoming breakdown is predicted or an abnormal sensor reading is observed, an alert is sent to the user through phone and email.

Machine status, alerts and predictions are consolidated into a dashboard that provides a live overview of each machine's health. This enables proactive maintenance rather than reactive repairs.

Our product's front end and back end are built using Next.js. We ingest machine sensor data using VictoriaMetrics. Data for our application is stored in a PostgreSQL database. Our breakdown predictions are made using a Robust Continuous Learning model powered by TensorFlow.



AkzoNobel



AkzoNobel Student Members

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Canton, Michigan
- Julieta Lopez**
Carrollton, Texas
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- Hector Loyola**
Warsaw, Indiana
- Ricardo Olmenta**
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- Carl Rivir**
Warsaw, Indiana

Ally Financial Fraud Transaction Monitoring Dashboard

Ally Financial, headquartered in Detroit, Michigan, is a technology-driven bank holding company. Ally provides auto financing, digital banking, mortgage services, and consumer lending to their millions of members.

The shift towards online financial services complicates the already difficult process of detecting unusual transactions. To effectively monitor banking fraud, analysts spend hours combing through transaction data to flag suspicious trends or data.

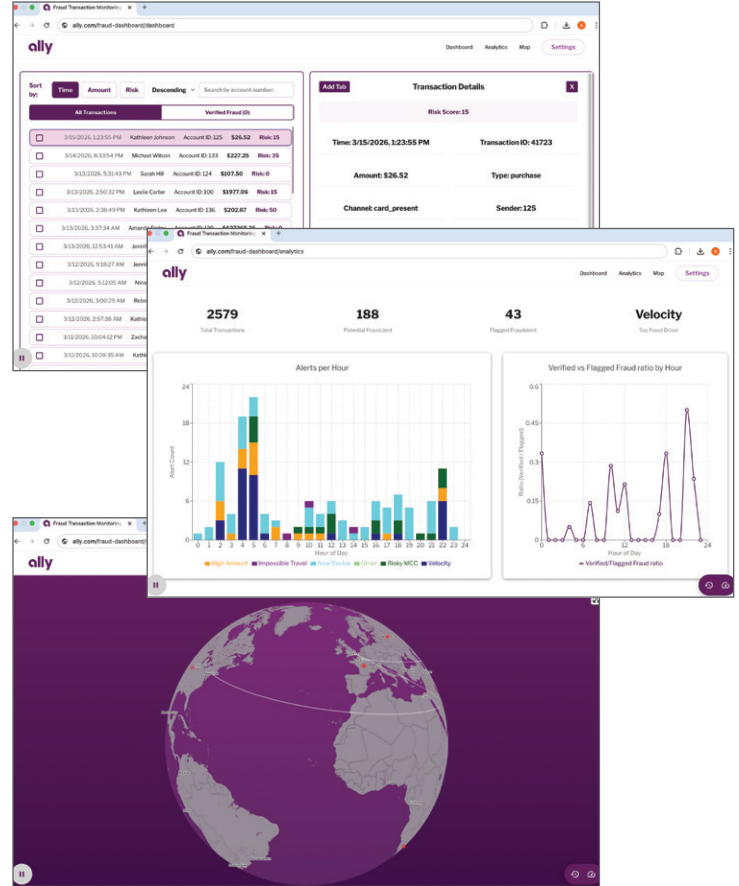
Our Fraud Detection Monitoring Dashboard automatically identifies potential fraud in real time. Each flagged transaction is assigned a risk score and provides a plain-language explanation of the factors that triggered the alert, giving analysts a head start.

Ally analysts review a transaction page that brings together key details in one place, including account history, merchant information, device details, time, and location. A short summary is generated for the analyst that explains why the transaction is marked suspicious. Analysts manually review the information, add comments and make final determinations directly in the dashboard.

To support workflows, our system helps analysts sort and filter alerts and compare similar transactions, focusing on the highest-risk activity first. Our system contains both an analytical view, showing the broad trends in the set of transactions, and a table view, which facilitates studying individual transactions, giving analysts an easy way to monitor both the fine-grained and overall fraud activity.

This tool reduces the effort needed by Ally analysts to identify fraud, and helps teams document decisions, saving time and money.

The front end is implemented in React, TypeScript, JavaScript, and Tailwind CSS. The back end is implemented in Python using the Flask web framework with PostgreSQL for relational data storage. The system uses Ollama to support AI-powered analyses.



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Amazon Smart Dashboard Monitoring Platform

Amazon, headquartered in Seattle, Washington, is a global leader in technology and e-commerce. Founded by Jeff Bezos in 1994 as an online bookstore, Amazon has expanded into one of the world's most influential technology companies, pioneering innovations in cloud computing, artificial intelligence, and digital services.

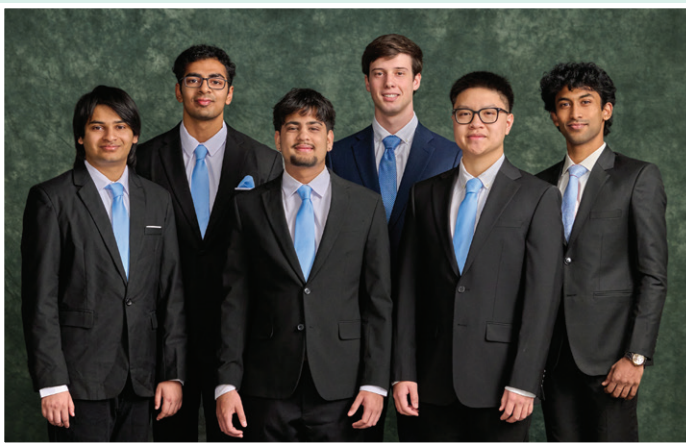
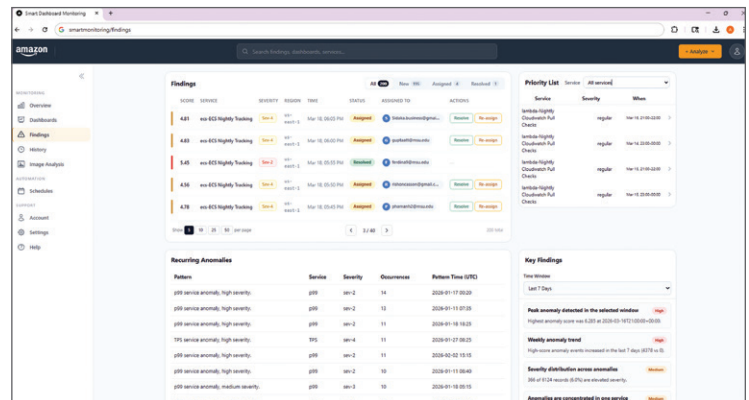
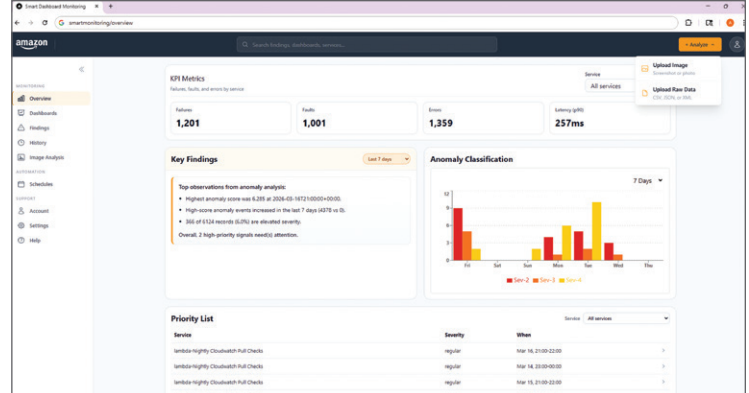
Engineering teams at Amazon and similar tech companies spend 10-15 minutes per person during standup meetings manually reviewing critical dashboard metrics and searching for system anomalies that could damage the user experience. This manual process is currently long and difficult, taking valuable development time and creating the opportunity for human error.

Our Smart Dashboard Monitoring Platform automates this through computer vision and machine learning, enabling engineers to locate data anomalies or errors early.

Our software provides a simple dashboard for analysis management. The system supports multiple inputs for analysis, including screenshot uploads for visual analysis, raw data file support for CSV, JSON and XML formats, and scheduled automatic metric ingestion using CloudWatch. Our system identifies visual anomalies in graphs, analyzes time-series patterns, detects spikes, drops, and unusual trends.

Each analysis generates findings that are saved and organized by dashboard, dataset, and service. Users view the results within an easy-to-use dashboard, enabling engineers to get insights and find issues at a glance. Our software records and visualizes historical patterns, enabling engineers to identify recurring issues.

The front end uses Next.js with TypeScript and Tailwind CSS. The back end leverages FastAPI with AWS services including Cognito, Rekognition, SageMaker, Lambda, CloudWatch, S3, EventBridge, DynamoDB and API Gateway.



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Anthropocene Institute Visualizing Nuclear Energy in Michigan

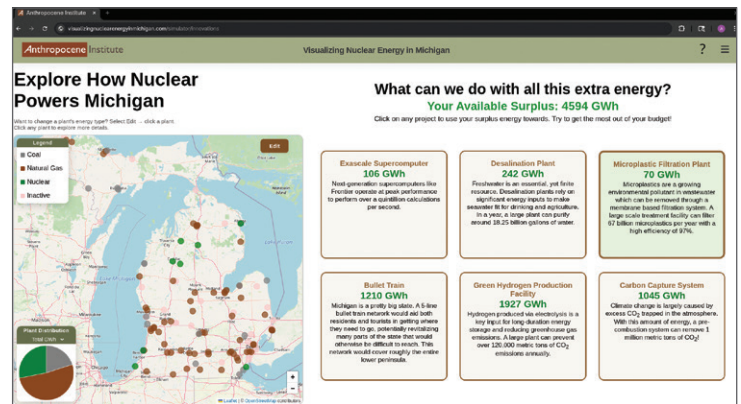
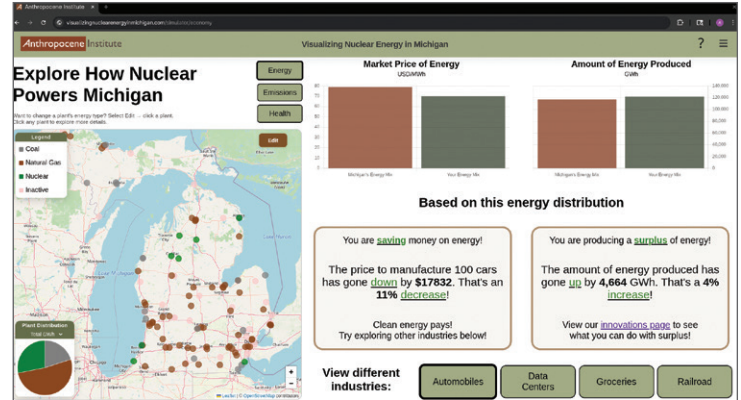
The Anthropocene Institute is a non-profit organization founded by Carl Page that is committed to improving human well-being through affordable and sustainable energy solutions. The Anthropocene Institute conducts research, engages policymakers and educates the public on nuclear and other clean energy sources that reduce emissions while strengthening the economy.

Nearly every industry of the economy is affected by energy prices, including data centers, housing, manufacturing and transportation. The Anthropocene Institute examines how replacing coal and natural gas plants with nuclear facilities can lower costs while improving environmental outcomes. Clearly communicating these trade-offs to business leaders and policymakers in a digestible manner remains challenging.

Visualizing Nuclear Energy in Michigan is an interactive web application that enables users to explore alternative energy scenarios and immediately see projected economic effects across the state. Users adjust the coal, natural gas and nuclear generation mix on a map of Michigan, then compare current and projected energy prices, production levels and industry-specific costs. An additional innovations feature suggests how abundant electricity can support future investments such as data centers and desalination plants.

The platform emphasizes transparency through definite comparisons, documented data sources over both conservative and optimistic scenarios, giving users the tools to evaluate outcomes for themselves. By translating complex models into accessible visualizations, the system helps stakeholders better understand how clean, reliable power can shape Michigan's economic future.

The front end is built with ReactJS and the back end uses Python FastAPI with SQL storage. Machine learning models developed in PyTorch generate price projections. Docker containers deploy the system to Google Cloud.



Anthropocene Institute



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- Carl Page**
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Apple Setup Assistant for MLX Mac Cluster

Founded in 1976 and headquartered in Cupertino, California, Apple is one of the largest technology companies in the world. Its products are renowned for their seamless integration of hardware and software.

In recent years, Apple has released powerful custom silicon processors for Mac devices. To support machine learning development on this new hardware, Apple also released MLX, an open-source framework built to streamline the process of running complex machine learning models on M-series chips.

Because some models require large amounts of computing resources, MLX supports clustering, enabling multiple Mac devices to connect and share resources. This is a powerful tool, but the complex setup process can be a roadblock for inexperienced users.

Our Setup Assistant for MLX Mac Cluster simplifies this process by providing users with an intuitive visual guide and robust troubleshooting experience.

The application features an automated device discovery system that detects and adds Mac devices to the cluster, a device connection diagram that seamlessly illustrates the cluster's connections, and comprehensive diagnostic information to help users understand and optimize their Mac clusters. Informative error screens are used to guide users when failures occur. The result is a lower barrier to entry for the cluster setup process.

The system works by detecting nearby Mac devices and identifying Thunderbolt connections between them. Once the connections are made, the diagram visual is generated and relevant device details are displayed. Error monitoring takes place at every step, ensuring the user doesn't get lost during the setup process.

The app is written in Swift, and uses the SwiftUI framework. Bonjour, TCP, and Thunderbolt are utilized for device connection and discovery.



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Auto-Owners Insurance Code Quality Intelligence System

Auto-Owners Insurance is a Fortune 500 company that provides automotive, home, life, and commercial insurance to nearly 3 million policyholders in 26 states. They have been headquartered in Lansing, Michigan since 1917, and are represented by 48,000 licensed agents.

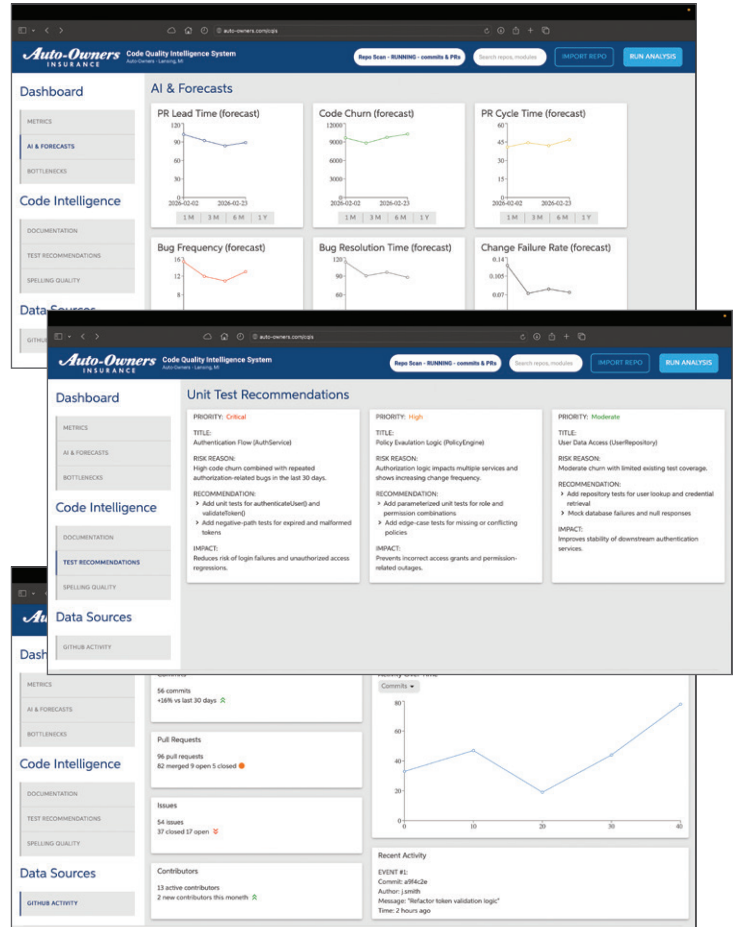
Auto-Owners employs multiple software teams that develop applications in support of their operations and infrastructure. A major focus of Auto-Owners is in streamlining the analysis of their codebases to further optimize their software development process.

The Code Quality Intelligence System analyzes code quality and displays it through an interactive dashboard. Developers are provided with information on where their code is inefficient or buggy. Suggestions to improve their development process, as well as actionable fixes, are automatically generated for developers.

Our system connects to Auto-Owners' software code and tracks key metrics such as code churn, pull request timing, bug frequency, and change failure rate. We use machine learning to predict trends and potential risks for each metric. The system highlights testing blind spots, bottlenecks, and provides documentation checks utilizing large language models.

By providing early warnings and data-driven recommendations, our system enables teams to improve their development process. Instead of reacting to failures after deployment, teams can now anticipate risk and improve the most vulnerable parts of their codebase and maintain delivery quality through our Code Quality Intelligence System.

Our website is built using Vite.js and FastAPI. It is containerized using Docker. Statistical data models are used to generate forecasts and large language models are used to generate test recommendations and documentation. Data is stored using a SQL database.



Auto-Owners INSURANCE



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Corewell Health

An AI Tool for Enhancing Medical Education 2.0

Corewell Health is a nonprofit health organization based in Michigan that was formed in 2022 from the merger of Beaumont Health and Spectrum Health. Today they operate 21 hospitals and have over 300 outpatient locations.

Electronic health records are a critical part of healthcare, providing crucial data about patient medical history, enabling medical staff to make informed decisions. Today, medical education does not include a curriculum for the use of electronic health records, nor does it offer training with patient communication, creating a blind spot in an essential area of patient care.

Our AI Tool for Enhancing Medical Education 2.0 helps medical students to learn these critical skills by enabling them to navigate a realistic health record system and communicate with artificially generated patients. Our software enhances the previous version, adding in numerous new critical features.

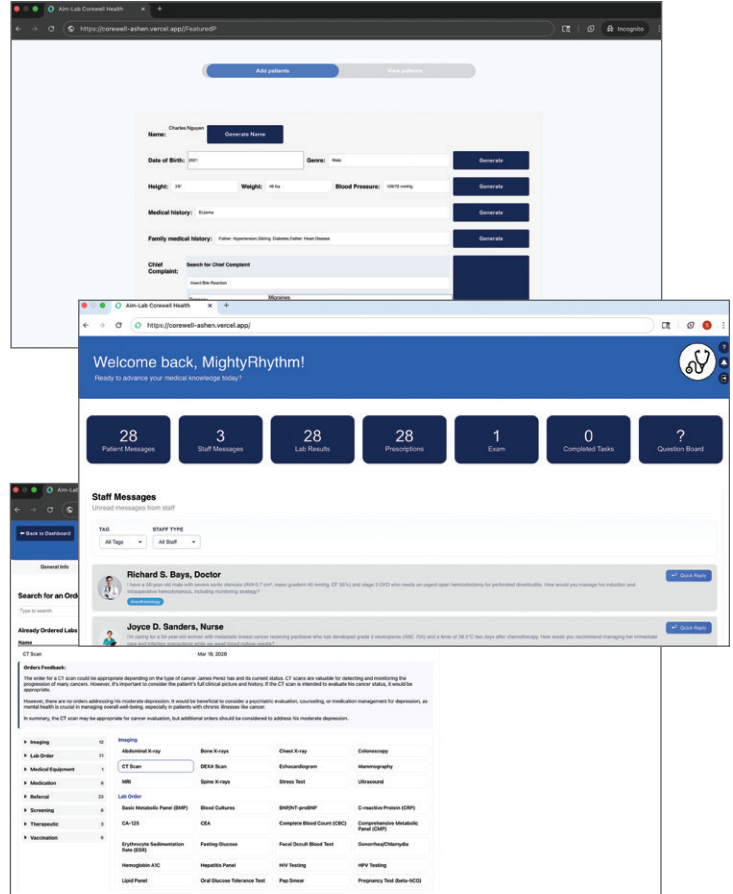
Patients can be generated either by AI or manually by an instructor. This process creates patients with unique symptoms and problems for students to learn from.

Besides realistic patients, AI staff members such as doctors and nurses are generated for students to interact with. Our system also generates AI feedback to guide students through interactions.

Students get an improved experience filing orders with a more complex and realistic experience that includes AI feedback for common errors for order entries.

The platform also features a rating system for users to leave feedback on their AI experience. This feedback is used to further improve the AI's performance and is viewed through a dashboard.

The front end is written with ReactJS, and the back end is written in Golang. The database is PostgreSQL and managed by Supabase. Lastly, our AI microservice is dockerized, and uses Flask and OpenAI's API for text generation.



Corewell Health Student Members

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Delta Dental of Michigan, Ohio and Indiana Dynamic 3D Mouth Model

Delta Dental provides dental insurance to over 85 million Americans. Based in Okemos, Michigan, they are the largest dental insurance provider in the nation. Over the past 15 years, Delta Dental companies and their foundations have invested over \$2.3 billion to improve the oral and overall health of our communities.

Delta Dental processes millions of insurance claims per year. As claims go through Delta Dental’s processing system, further human review by adjudicators may be required to validate the claim, based on existing patient information.

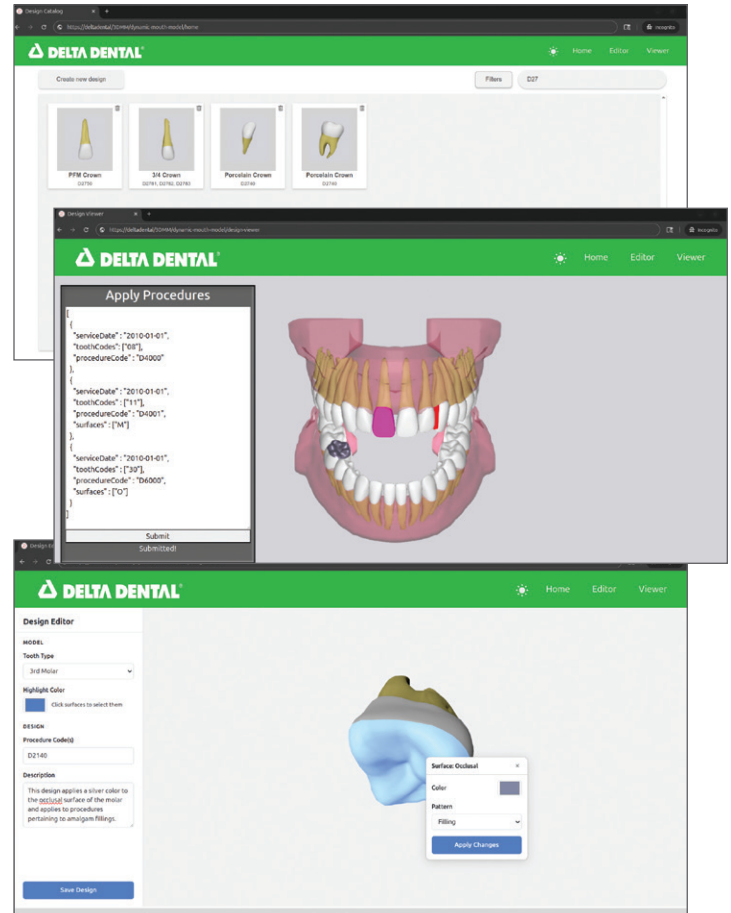
The Dynamic 3D Mouth Model is an interactive tool for exploring a patient’s dental history, helping Delta Dental adjudicators. Our tool helps users visualize a patient’s dental history with user-specific designs (shown on the right) populating a personalized mouth model for each customer.

Claims specialists can create their own tooth designs representing dental procedures, varying in shape and color. When a procedure is performed on a tooth, the corresponding tooth design is applied to it in the mouth model. With the teeth varying in appearance, it is easier to visualize the history of a patient’s mouth.

Our software features a homepage where Delta Dental experts explore all of their created designs, create new designs, or edit an existing design. Design editing is facilitated by an intuitive 3D editor. In the editor, users can reshape and color the surface of any tooth. Finally, the viewer tab displays the full mouth model visualization of the curated designs.

The Dynamic 3D Mouth Model streamlines Delta Dental’s claim review process by consolidating entire dental histories in a single place with clear visualization, saving valuable time for users.

The web application is developed using Angular and Three.js, enabling visualization through a 3D interface. The back end integrates SQLAlchemy with FastAPI to implement endpoints.



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Delta Dental of Michigan, Ohio and Indiana Context-Driven UI Framework

Delta Dental was founded in 1966 as a non-profit organization, motivated to make dental coverage more accessible and affordable. Since then, it has grown into the leading dental insurance provider, serving millions of people across the United States.

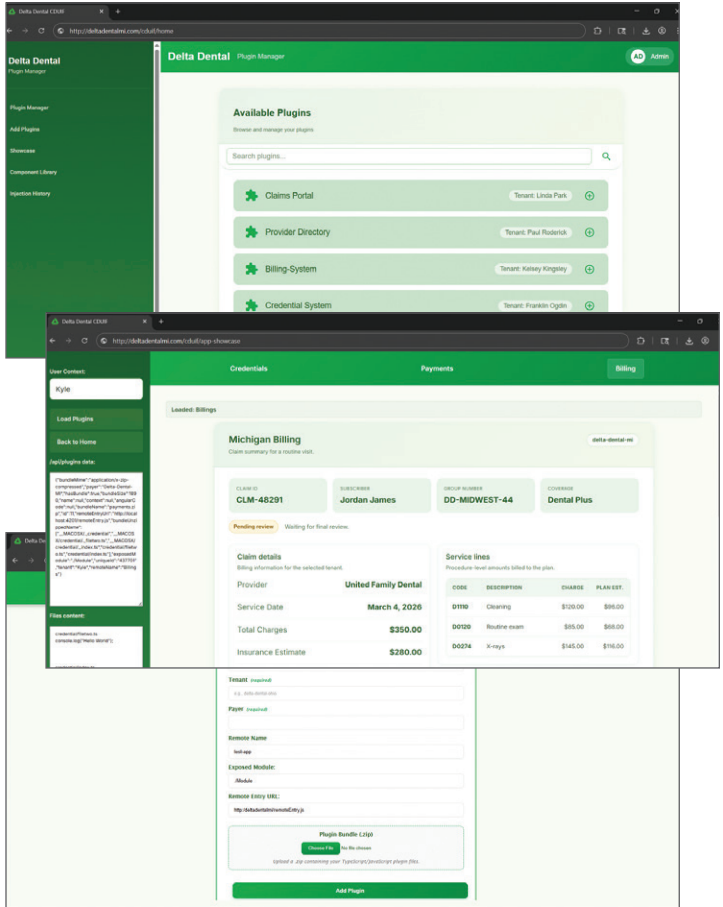
As multi-user applications become more common, the ability to serve different customers within a single application presents new opportunities for providing efficient services to customers. The Knowledge Science team at Delta Dental develops and maintains several customizable applications that dynamically alter the application's behavior based on the user. This application design significantly streamlines Delta Dental's development process and improves scalability.

Our context-driven UI framework provides a centralized plugin management system where developers create, register and update software plugins while automatically injecting them into applications at runtime based on each user. Our system ensures consistent styling and behavior across all plugins, guaranteeing identical user experiences for all customers.

To simulate what the end-user sees, this software dynamically loads various plugins into the core application. Instead of building every feature into the main application, plugins load into a specific page in the application. This framework provides a scalable foundation that enables Delta Dental applications to adapt without rewriting core systems.

The CDUIF system eliminates the complexity of maintaining separate codebases for each customer, providing the Delta Dental Knowledge team the flexibility to add new functionality without the need to redeploy or reconfigure the host application.

The front end of our web application is built with Angular. The back end is built on Quarkus with a PostgreSQL database that is containerized with Docker.



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General Motors EV Charging Infrastructure Application

General Motors (GM) is one of the largest automotive manufacturers in the world with headquarters located in Detroit, Michigan. Founded in 1908 by William C. Durant, GM has been a global leader in the automotive industry and continues to expand its electric vehicle technology.

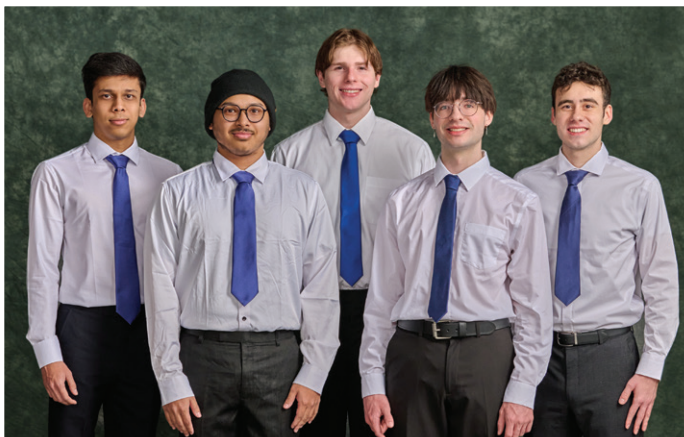
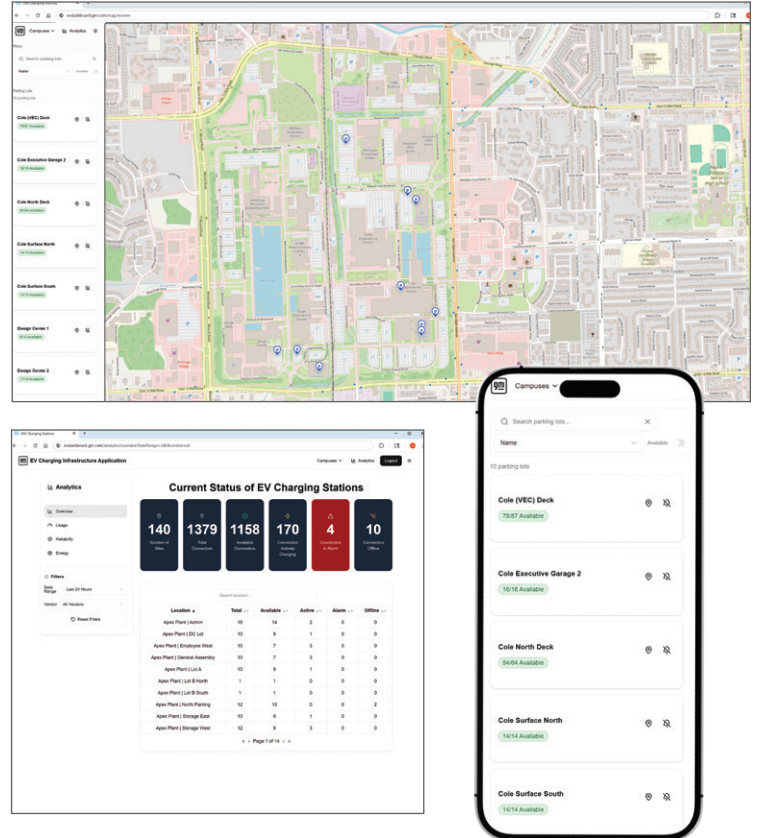
As more employees transition to electric vehicles, on-campus charging stations are getting busier and harder to come by. Charger information is distributed across multiple vendors, making it difficult for employees and administrators to determine availability and analytics. This creates inefficiencies and reduces productivity.

Our EV Charging Infrastructure Application provides a centralized web platform that combines charging data from multiple vendors into one interactive dashboard. The system displays different charger locations on a parking lot map with colored pins and shows real-time status of each charger. By centralizing charger data, the system reduces downtime, improves transparency, and enhances overall operational efficiency.

After selecting a charger, employees get detailed information such as power output and availability. After logging in, they can join a queue and opt in to receive notifications, such as when chargers become available or charging is complete. This reduces idle parking on chargers, improving charger throughput.

The analytics dashboard shows usage trends over time, connector status, and performance ranges. Users can filter and sort data by date, location, and charger type to better find the best charging station for their trip. Administrators use this data to monitor trends and support future planning.

The front end of our system is written in Next.js and React, while the back end is developed in Python and FastAPI. The PostgreSQL database stores real-time and historical data. Docker is used to deploy our system.



GM

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HAP

AI-Powered Video Creator Tool

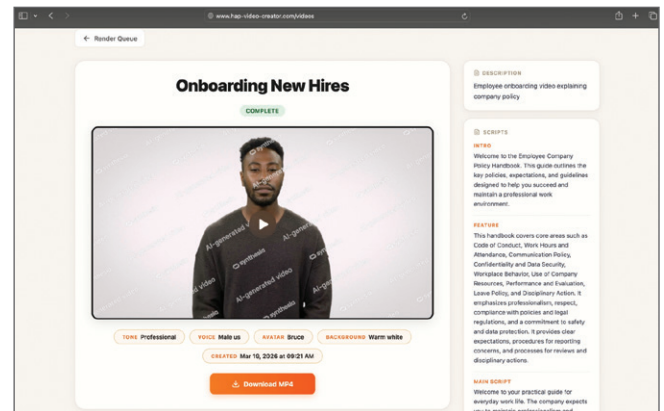
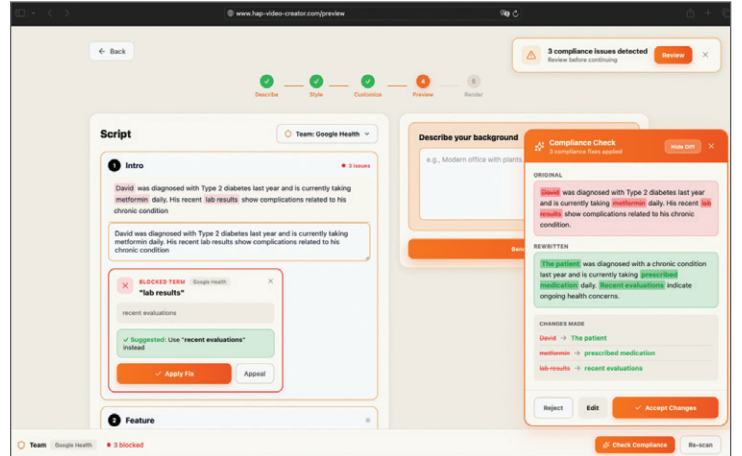
Health Alliance Plan (HAP) is a Michigan based nonprofit health insurer dedicated to improving access to care and enhancing the member experience through digital innovation. HAP has supported Michigan individuals, families and employers for decades and, as of 2026, serves more than 500,000 members statewide.

Clear communication is essential across the organization. Video plays a key role in training, education and internal messaging, yet producing professional content at scale is often time-consuming, costly and difficult to maintain, especially under strict organizational standards and industry regulations. As demand for timely, accurate communication grows, traditional production methods struggle to keep pace.

Our AI-Powered Video Creator Tool is a web-based platform that transforms structured input into complete videos. Users define a video's purpose and select options such as the style, tone, AI avatar, and voice. The system then generates a script and produces a finished video without requiring cameras or external editing software.

Content is screened before reaching the AI. Sensitive information is removed, redacted or transformed to meet policy requirements. The system flags policy issues and removes or anonymizes personally identifiable information, personal health information, trade secrets and other company-sensitive data. A manual review ensures quality, privacy and compliance before publishing.

The platform organizes content by teams, projects and roles, using versioned, reusable videos to support collaboration and prevent editing conflicts. Built with a ReactJS and TypeScript front end and a Python FastAPI back end, the system uses asynchronous processing, PostgreSQL and secure cloud storage to enable scalable, efficient video production.



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Henry Ford Innovations Faith-Based Community Medical Database

Henry Ford Health is the second largest healthcare system in Michigan, with over 55,000 employees and 13 hospitals, bringing clinical innovation and research to healthcare since its beginning in 1915. The Henry Ford Health Faith Community Nursing Network is a leader in innovative Faith Community Nursing (FCN) and health practices, modeling whole-person care through spiritual, physical, mental and relational support.

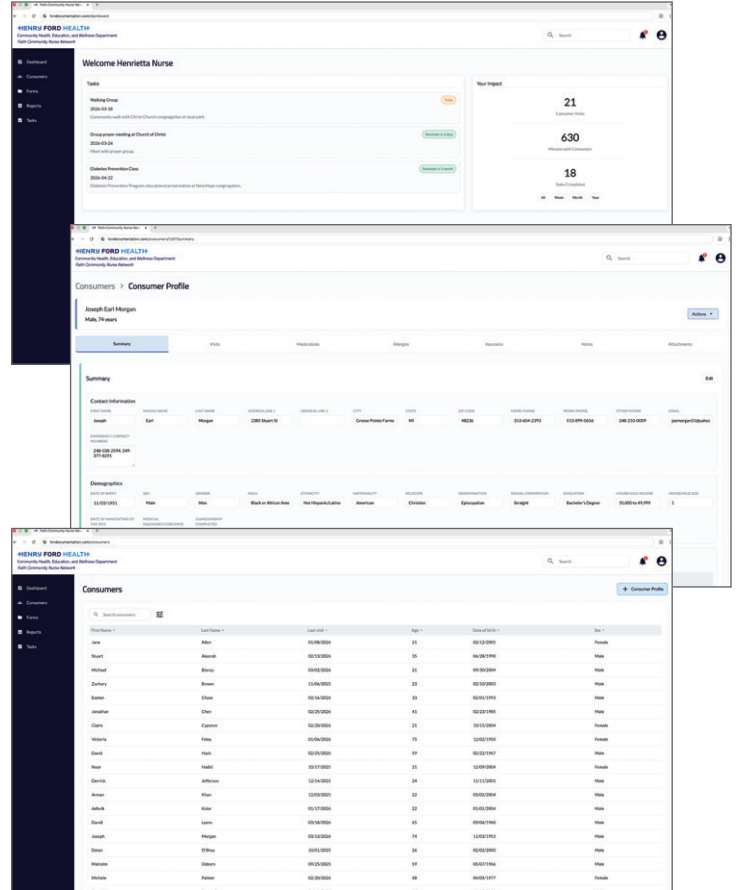
Members of faith-based communities need a place where they are comfortable inquiring about their medical needs. FCN nurses need to be able to document consumer information in an easy-to-use software which meets up-to-date security guidelines to provide the best possible care. The current system used by FCN has not had a modern overhaul, necessitating a new system built from the ground up to improve both usability and security.

Our new Faith-Based Community Medical Database offers a stylish interface and updated features, providing FCN nurses with a more user-friendly experience. It facilitates nurses navigating the application with ease to efficiently track consumer progress and medical details. Additionally, nurses create tasks and set reminders, so consumers' needs are kept a priority.

Given the sensitivity of the information being stored, our system implements robust security and privacy protocols at every level. Data is encrypted both at rest and in transit. Access control protects consumer information by ensuring nurses are only able to view or edit the information of consumers for which they are responsible.

Our system furthers the goals of Henry Ford Health with the FCN Network to provide better overall care for all consumers.

Our web application is built using AngularJS with HTML, CSS and TypeScript for the front end and Node.js for the back end. Azure SQL Database is used for secure data storage and management along with Google OAuth 2.0 for secure authentication.



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Kohler Co.

Multi-Agent AI Ecosystem to Optimize Purchasing

Founded in 1873 and headquartered in Kohler, Wisconsin, Kohler Co. is a global leader in manufacturing kitchen and bath products, with major, sustainable operations in hospitality.

With so many products and customers, it can be difficult for Kohler to manage purchase orders and inventory. Due to this, Kohler's goals are to streamline the way they access information and interact with transactional systems, most importantly their Enterprise Resource Planner.

Our Multi-Agent Buying Assistant is a Microsoft Teams App that streamlines the inventory stocking process by supplying clients with real-time data analysis to aid in the decision making that comes with filling inventory.

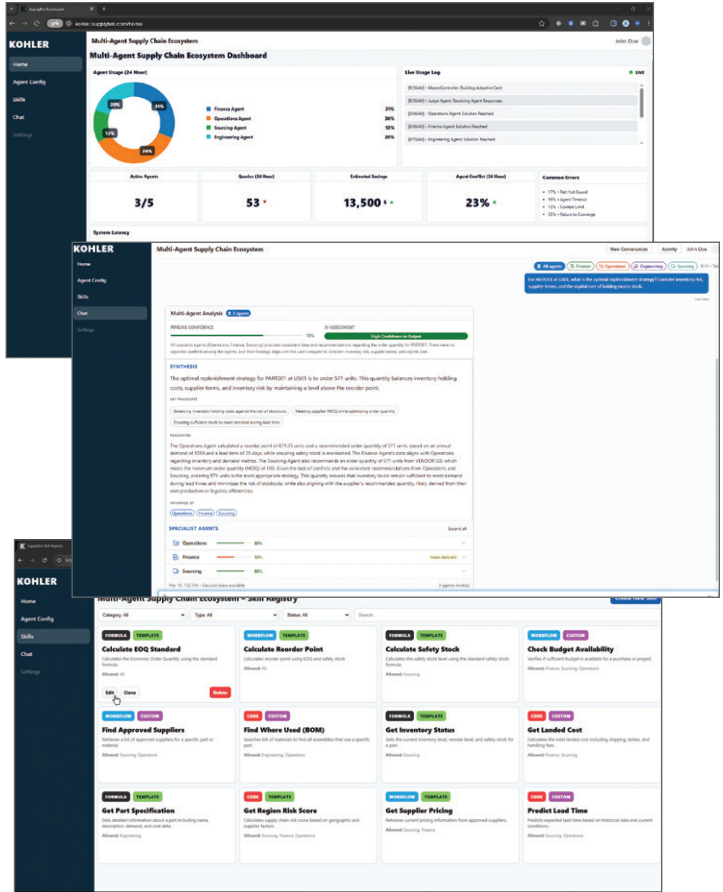
Our ecosystem supports purchasing managers' decision-making by coordinating multiple specialized AI agents that analyze a multitude of factors that contribute to Economic Order Quantity.

Through a centralized Copilot experience, users query the entire supply chain ecosystem using natural language instead of manually referencing the spreadsheets and databases.

The application has numerous pathways for employees to explore. Upon asking the agent a question, multiple specialized agents with specific, tailored skills each generate a personalized response that is evaluated by our judge, who presents a final culmination and optimal solution.

The custom-made dashboard provides a general system overview and is also accessible in the Teams apps, where employees generate designable skills for the AI agents through a familiar and easy-to-use interface.

Our system utilizes a front end built with ReactJS and TypeScript, and a back end built with Python, PostgreSQL, Uvicorn, Fabric, and FastAPI. Our AI agents are built using Microsoft Copilot Studio with Direct Line API communication.



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Launch by NTT DATA Smart Personal Trainer

Launch is a digital development company within NTT Data, a top 10 global IT provider. Launch partners with industry leaders to transform emerging technology into scalable, real-world products, working with a wide range of companies such as Jeep and DTE Energy.

Beginning a fitness journey can be overwhelming. Many people are unsure how to perform exercises correctly, and without guidance, it is easy to build poor habits or lose motivation. Personal trainers offer valuable feedback, but they are not always accessible, especially for beginners or people on a tight budget.

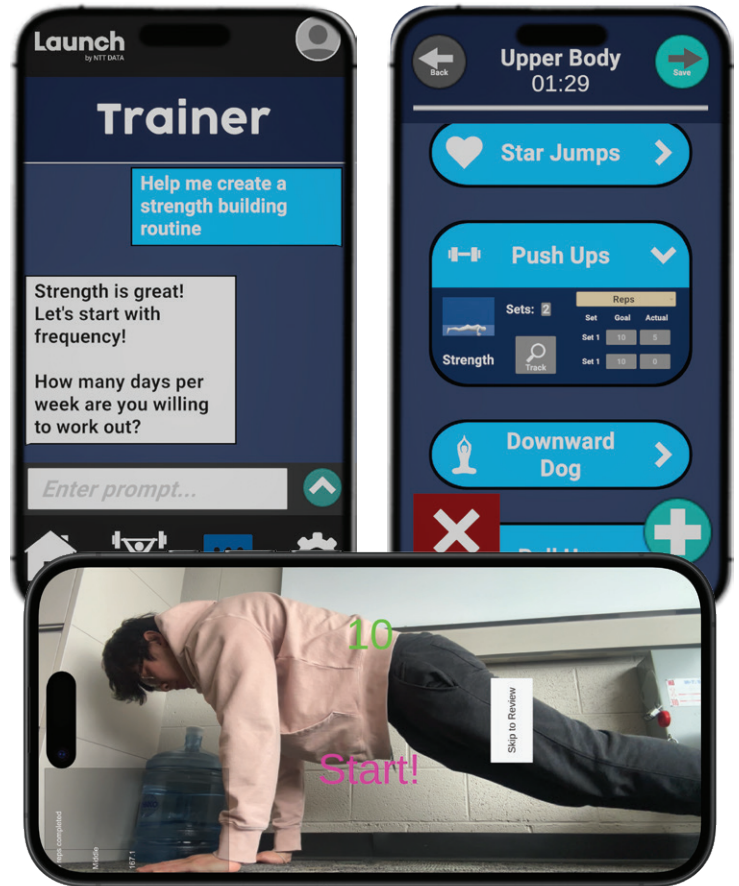
Our Smart Personal Trainer is a mobile application that provides users with guided workout tracking and personalized feedback using only a phone and its camera. After the workout is complete, users receive a performance score calculated from a pose tracking model along with clear feedback on how to improve.

The app also includes a conversational AI trainer that users interact with through a chat window. This trainer reviews workout results and adjusts future routines by recommending changes to exercise selection, intensity, and overall workload, much like a real personal trainer.

The feedback is based on the user's workout history, supporting beginners as they build consistency while helping more experienced users refine technique and progress safely.

Our application helps novice and experienced exercisers alike build muscle and improve their health safely at low cost.

Our software is built for the iOS and Android mobile platforms, utilizing the Unity game engine in C#. The back-end services are written in Python using a Flask API. Real-time pose estimation is performed using MediaPipe BlazePose, which tracks 33 key points on a user's body. The system includes a Llama 3.1 model through Ollama to generate workout feedback.



Launch by NTT DATA



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Lockheed Martin Space Networked CV Algorithm Testing Harness

Lockheed Martin Space, one of the four business areas within Lockheed Martin, is headquartered in Littleton, Colorado. The organization designs, builds, and operates spacecraft and satellite systems that support space discovery and exploration.

Space domain awareness, the ability to detect and analyze objects in space, is a key problem for Lockheed Martin Space. Prior to a satellite launch, extensive testing ensures that the system works properly under a variety of conditions. Much of this testing evaluates computer vision algorithms using synthetic imagery.

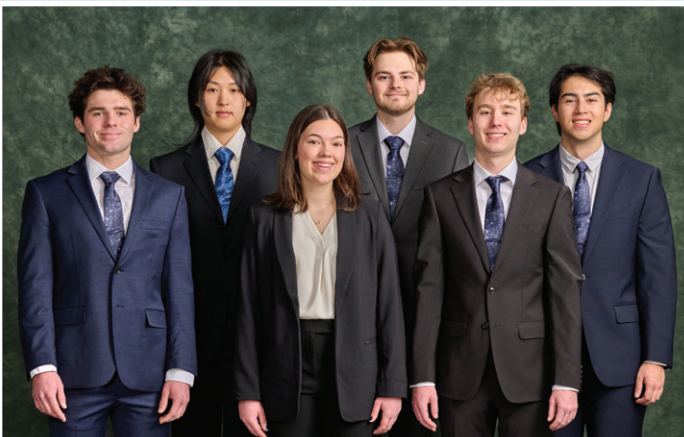
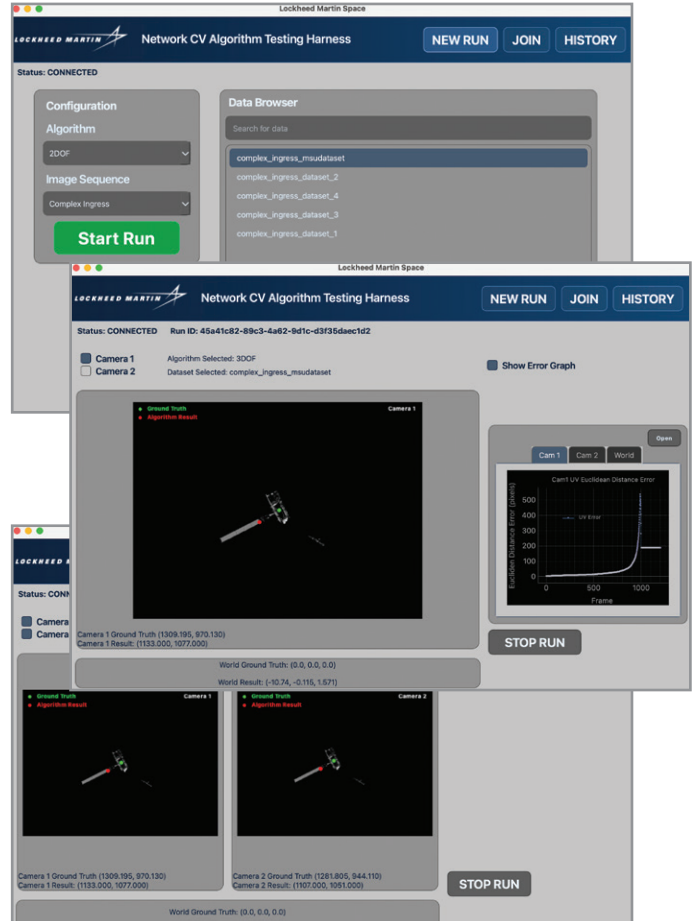
Engineers use synthetic imagery and sensor data to validate that these algorithms perform as expected across diverse conditions. However, the infrastructure to set up and test these algorithms requires a high upfront cost.

Our Networked CV Algorithm Testing Harness reduces these high testing costs by providing a simple and unified environment for testing computer vision algorithms on synthetic space imagery.

Our application enables users to execute multiple algorithm types on image sequences that a centralized server provides. The client provides real-time playback with an overlaid estimate of the space object's position. The server computes results of position, range, and orientation to compare with the real data to evaluate algorithm performance.

Our software also enables streaming of the algorithm results in real time to other users, enabling Lockheed Martin Space engineers to share critical results quickly and easily.

The system back end is a FastAPI REST with a PostgreSQL database for datasets and algorithm results. UDP streaming transmits data between the server and client, while control and event messaging occurs over HTTP and WebSocket. Algorithm processing uses OpenCV, NumPy and PySLAM. The user interface uses PyQT for real-time data visualization.



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Ludus

Real-Time Seating Chart API, Builder, & Viewer

Ludus was founded in 2016 by a theater director and student team, offering a platform that provides ticketing, marketing, fundraising, and much more to their clients all in one place. To date, Ludus has serviced more than 4,800 organizations and is continuing their growth after recently opening their newest office in Grand Rapids, Michigan. Ludus is expanding their influence in the world of performing arts, offering more than just a ticket platform.

A major pillar of Ludus' platform is box office and online ticketing, where organizations can build seating charts, and users can view and select seats. Ludus is looking to modernize their seating chart system by providing users with a seating chart experience that drives the entire industry forward.

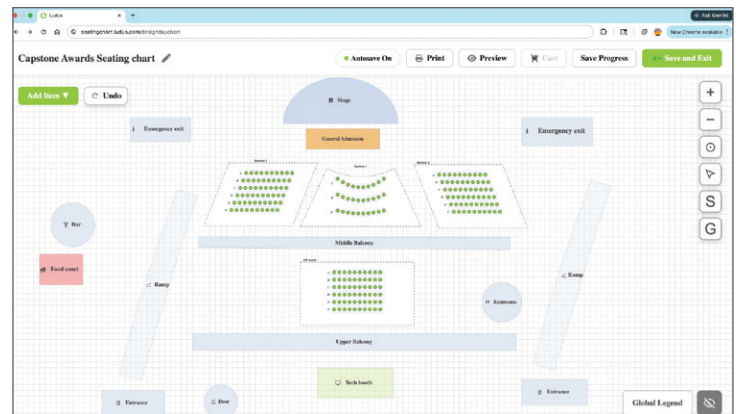
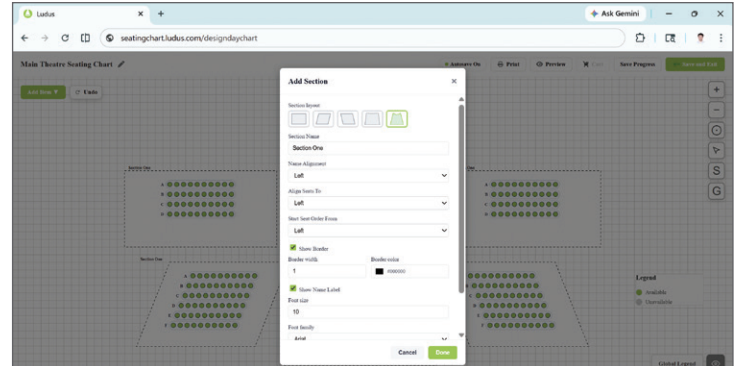
Our Real-Time Seating Chart innovation powers both the builder for seating chart creators, as well as the viewer for customers to select tickets. It is customizable, optimized, easy to use, and able to integrate with other ticketing platforms, improving Ludus' efficiency and their customers' experience.

Our software offers users a clean user interface to facilitate event creation without the need for a technical background, so venues can focus on the performance rather than the setup.

With this easy-to-use interface, users create and map large-scale venues without the worry of performance or errors during bookings. Users are also able to select different preset shapes for sections, tables, and other components to offer a deeper level of customization and to fit each venue's unique needs.

Once a venue is mapped, tickets are offered to customers who use our application to seamlessly purchase and view offerings.

The software runs with Vue.js, along with Scalable Vector Graphics. The backend is built with Node.js, PostgreSQL, and Redis, to enable builders to save countless seating charts and customers to concurrently book seats without collision.



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Magna

ML/AI Pipeline for Condition-Based Maintenance 2.0

Magna is a leading global automotive supplier with operations in 28 countries and a workforce of 164,000 employees. They are dedicated to innovating and delivering reliable, high-quality products that support mobility for all.

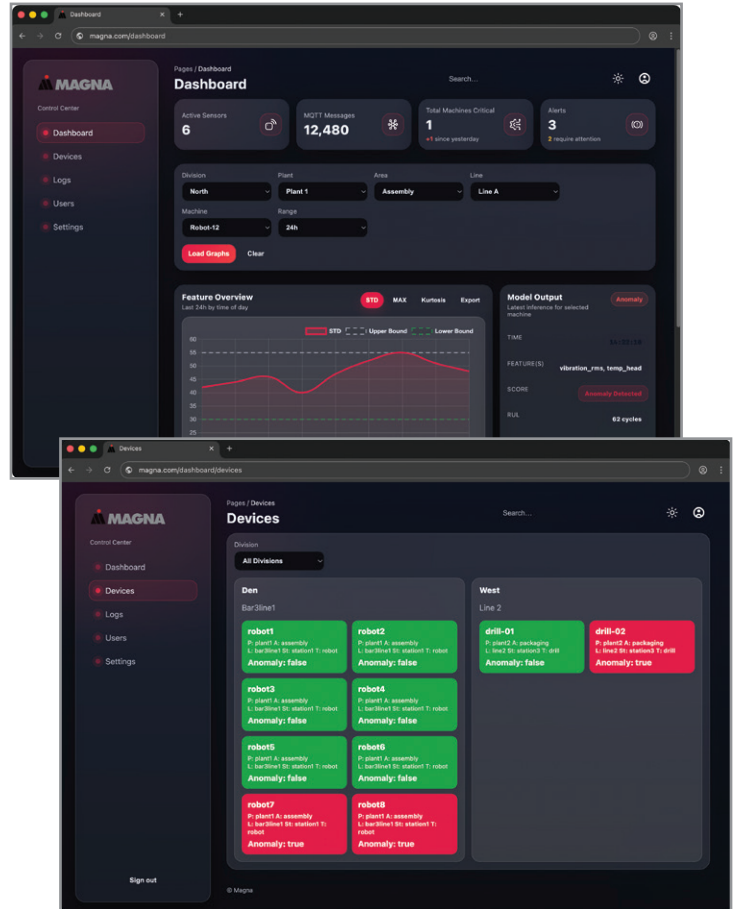
Unplanned machinery downtime is expensive. Critical machinery stopping can lead to delays in production, schedule overhauls, and unexpected maintenance. Continuous monitoring of machinery produces early warning signals, cuts cost, sustains production and extends equipment life.

Our ML/AI Pipeline for Condition-Based Maintenance 2.0 uses real sensor readings connected to machinery to detect early warning signals. The 2.0 system expands monitoring beyond vibration alone by adding audio signals and clearer, faster alerts for operators.

Each machine is equipped with a dedicated audio and vibration sensor that captures data. The software continuously monitors the machine's behavior and flags patterns that suggest developing issues. When readings deviate from a normal baseline, the dashboard highlights the machine and sends an alert. Our system translates complex signals into simple operator views. A dashboard shows clear health status indicators, live trends and alerts so technicians can decide when to inspect or service equipment.

The system studies vibration and audio measurements to capture subtle changes indicating mounting problems. Machine learning models analyze signals to predict when a machine failure is going to occur before it happens, saving money and reducing unexpected maintenance.

The front end is built on Django, while the back end uses Python and PostgreSQL for data storage. The pipeline runs in Python with ROS 2, uses MQTT for publishing and subscribing message payloads, and is containerized with Docker for deployment on an NVIDIA Jetson.



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Magna Generative Multi-Modal CAD AI Assistant

Founded in 1957, Magna is a global parts supplier in the automotive industry, operating for over 65 years. Magna is headquartered in Aurora, Ontario, with worldwide locations, with a particularly large presence in North America. Magna has more than 164,000 employees globally.

Computer-aided design (CAD) is an intensive process due to the complex geometry involved and the need for high accuracy. Consequently, developing CAD models is a time-consuming process when only a quick prototype is necessary.

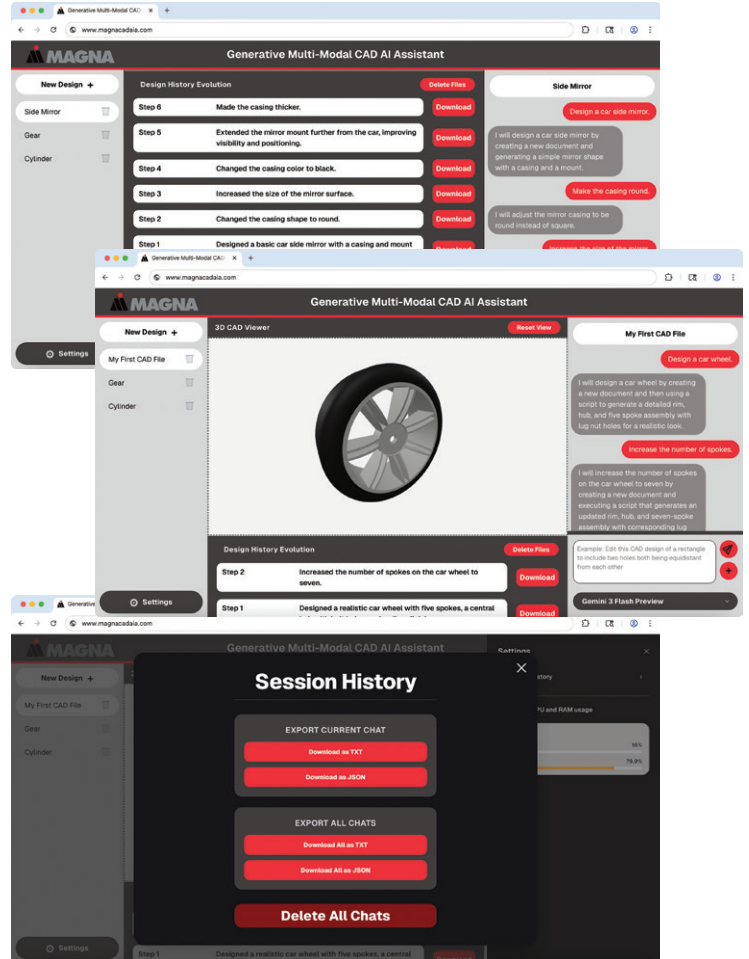
Our Generative Multi-Modal CAD AI Assistant streamlines the CAD designing process by leveraging the power of a multi-modal large language model (MLLM) to generate and edit CAD models.

Our web application provides an interface that enables users to modify CAD models seamlessly via text and visual input sent to the assistant which develops those CAD models accordingly. This enables a more efficient process for CAD, cutting down the massive amounts of time spent through the manual, traditional approach within CAD.

Our software also provides an iterative design process, where users can download CAD models at every step of the way based on every change the assistant performs on the model. Notably, the ability to see changes completed by the assistant in the 3D CAD viewer and conversations saved in the current session facilitates a comprehensive, smooth experience.

Our system also supports rolling back to previous versions and switching between AI conversations, making it more accessible to beginners or those without extensive CAD knowledge.

Our system incorporates Next.js for our web application interface and Three.js for CAD visualization. Our back end comprises of FastAPI for a client-server connection and FastMCP, facilitating communication between the MLLM and FreeCAD.



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Meijer mFuel Application Development and Dispenser Integration

Meijer is a prominent supercenter chain based in the Midwest, headquartered in Grand Rapids, Michigan. Along with over 500 supercenters, grocery stores, markets, and express locations across six states, Meijer also offers convenient gas stations.

The process of pumping gas must be quick and efficient. To facilitate this, Meijer is exploring ways to offer a fast and personalized experience at the pump connected to their existing mPerks platform for user-specific offers and promotions.

Our Meijer mFuel application brings a customer-centric loyalty experience to the fueling process. Customers simply scan a QR code with the mFuel app and pay through their mobile device, minimizing fraud and improving security.

Currently, customers at Meijer Express must use separate transactions at the pump and accompanying convenience stores, often missing out on personalized offers. Our integration of the Meijer fueling process and a user's mPerks profile bridges this gap, providing more personalized offers to shoppers.

During the fueling process, users gain loyalty points for mPerks based on the amount pumped. Using purchase history and real-time inventory data, the platform generates personalized, time-sensitive offers on the dispenser screen and mobile app to promote in-store purchases. The customer then receives their receipt after the transaction ends, completing the fueling process.

Our innovations help further Meijer's goal of providing the best experience to their customers. Meijer shoppers get significant savings and discounts, driving customer retention and loyalty.

The mFuel Application and Dispenser Integration system is a mobile application built with React Native and Expo. The back end utilizes C# and ASP.NET Core API frameworks with a microservice architecture and is hosted on Microsoft Azure. Data is managed with Microsoft SQL Server.



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MSU Federal Credit Union Member-to-Member Payments with Blockchain Settlement

Established in 1937, MSU Federal Credit Union (MSUFCU) has served Michigan State University and the greater Lansing area for over 88 years. With 36 branch locations and over 389,000 members, MSUFCU helps its local communities thrive.

Currently, there is a gap in digital banking platforms regarding auditable transaction workflows for member-to-member (M2M) payments. M2M payments today often rely on an internal centralized system that limits transaction traceability.

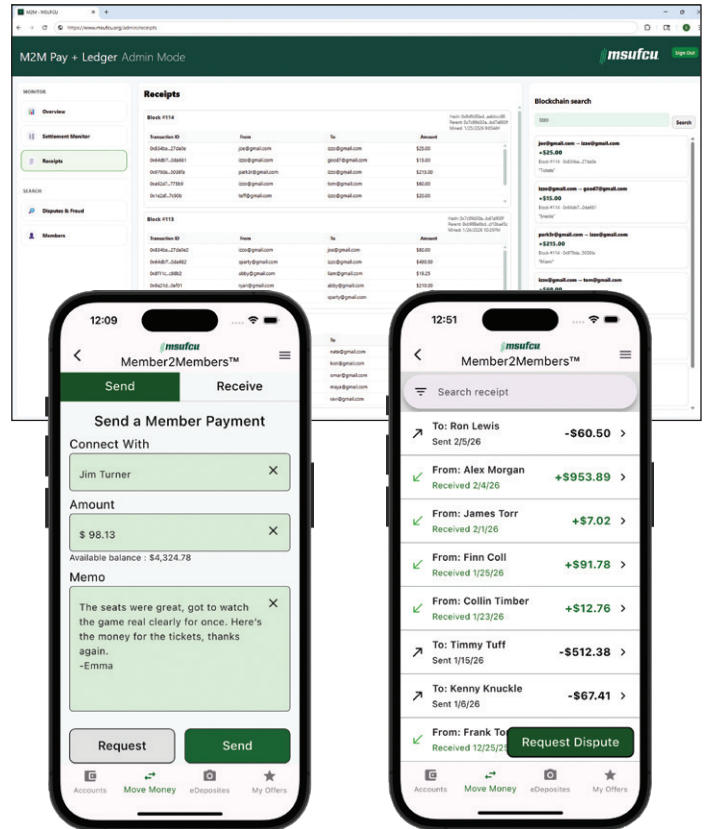
Our Member-to-Member Payments with Blockchain Settlement implements existing M2M payments over blockchain for better traceability. Our application offers an intuitive and familiar mobile or web interface for transactions and provides administrators with unfettered access to pending and blockchain-settled transactions for the purpose of solving user disputes.

Through the website or mobile app, members access pages to send, request, or accept transactions with other members. Users also view pending or settled transactions with the option to dispute transactions and view the status of any of their submitted disputes.

Administrators are presented with a systematic overview of the audit platform, providing auditors with efficient access to pages they need to manage member activity. Auditors access pages where they view and filter through pending or recently settled transactions alongside inspecting and searching through the blockchain, viewing and managing ongoing disputes, and reviewing specific members and their activity.

Using our system, customers have greater faith in M2M transactions, and MSUFCU employees have an easy-to-use system to facilitate this trust.

Our application uses Flask to route data between a PostgreSQL server and a Hardhat blockchain environment, delivering to a React web and a Flutter mobile front end.



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NetJets

Aviation Maintenance & Ground Ops Simulation

NetJets is the world leader in private aviation, having pioneered the fractional ownership model. Today, NetJets operates the largest and most diverse fleet of private jets, and safety is their top priority.

With an operation as large and fast-moving as NetJets, ground handling and maintenance events naturally carry a high level of risk. Learning by mistake is not an option and errors can lead to safety incidents, equipment damage, or costly delays. After gaining initial qualifications, crew members are required to retrain annually to ensure that they are kept prepared.

Our Aviation Maintenance & Ground Ops Simulation is a virtual reality representation of ground operation and maintenance procedures, helping to reduce costs associated with training. High fidelity 3-D models are used to recreate NetJets' terminal in White Plains, NY. Our simulation has a maintenance, an operation, and a technical scenario, each with a training and evaluation mode.

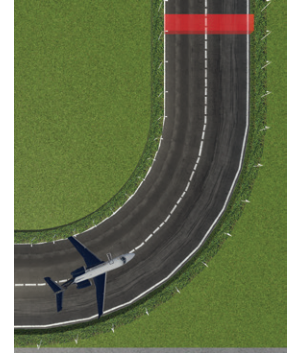
The Tire Change scenario is one of the most common maintenance procedures. The user changes aircraft tires based on the reference manual and is scored accordingly.

The Marshalling scenario is the most common ground operation event. The user guides an incoming aircraft to park at a designated parking spot.

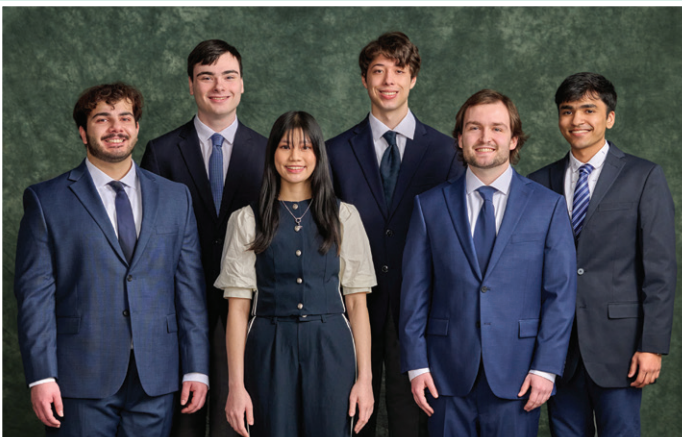
The Wing Growth scenario is an educational scenario for the user to look at how the aircraft can run into obstacles present around a tight runway.

The user starts in training mode with assistive visuals guiding them on the procedures and how to operate within VR. The evaluation mode has no visual guides and scores the user based on their performance and official procedure compliance.

The application is built using Unity game engine with SQLite as the back-end database to store user scores and login data. The VR headset is using VIVE Hub as a connecting layer to the local server.



NETJETS®



NetJets

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PACE of Southeast Michigan Community Giving Fund Database and AI Workflow

PACE of Southeast Michigan is a unique health insurance plan and health care provider, offering comprehensive, wrap-around medical services for their older adult participants. Through their interdisciplinary team, PACE provides a broad range of services that are medically necessary for a participant's well-being. These include at-home healthcare, mental health services, and even transportation.

One of PACE's key support programs is the Community Giving Fund, which provides emergency financial assistance to PACE participants. Currently, the Community Giving Fund requests are being managed through spreadsheets, email communication, and manual reconciliation.

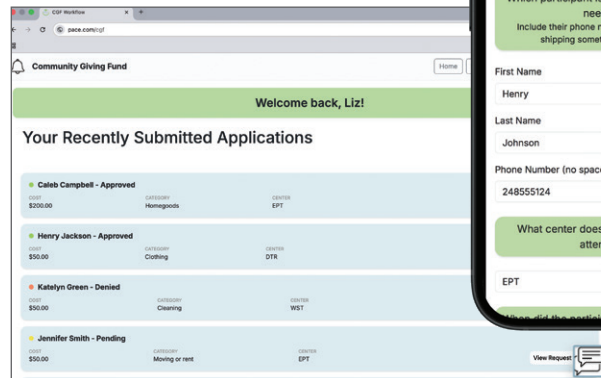
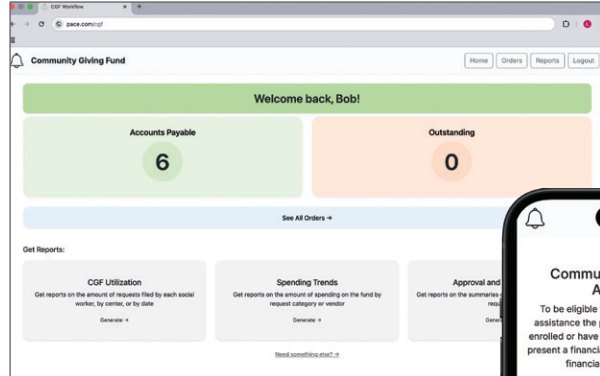
Our Community Giving Fund Database and AI Workflow automates the process through an easy-to-use internal web application. Our software enables PACE employees to distribute help and care to people who need it easier than ever before.

When social workers log in to the system, they submit requests using the intake form and view a dashboard of their most recent applications. Once the request is submitted, an approver logs in to approve it on their application page.

Similarly, when finance staff log into the system, they view a dashboard of requests that need action. Additionally, they can generate audit-ready logs as necessary from an internal reporting system.

Our software enables employees to ask questions about participants using the AI chatbot and receive clear and accurate answers from a centralized database.

The front end of our web application uses React, TypeScript, Vite and Bootstrap. The back end is built on Django using Python with PostgreSQL managing the requests database and a local LLM powering the chatbot.



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PS Technology Shoving Moves

PS Technology has been delivering innovative simulation solutions to the rail industry for over three decades. Headquartered in Louisville, Colorado, the company develops advanced technologies that support the day-to-day operations of over 100,000 employees nationwide.

Train shoving is a common, yet potentially dangerous, move performed daily within railyards all around the world. Shoving is a railroad operation where a locomotive pushes a car or a “cut” of cars from behind, rather than pulling them. During a shove, railcars weighing hundreds of thousands of pounds are pushed along the track, with a conductor guiding the movement. Without proper training and experience, these movements can lead to serious injuries, equipment damage, and operation disruptions.

To better train rail conductors, our Shoving Moves VR Training program provides an immersive and realistic simulation enabling users to practice shoving movements in a safe and controlled environment. Utilizing the Meta Quest 3 headset, trainees enter a virtual railyard where they work through a series of scenarios that teach how to safely perform shoving movements. As the user completes these scenarios, the system actively monitors the user’s actions and progress, delivering real-time feedback.

Integrated on-device voice recognition and motion tracking is supported, using real communication protocols. Users have the option of practicing shoving movements from multiple positions, such as on the ground, or riding equipment. In addition to the VR experience, a separate non-VR input system enables desktop and web builds.

This program is developed in C# using the Unity game engine and is optimized for the Meta Quest 3 platform. On-device voice recognition is handled by VOSK, a small language model, for secure, offline voice processing.



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RPM

Carrier Performance Index Engine (CPIE)

RPM is an international logistics and supply chain company based in Birmingham, Michigan. RPM specializes in freight transportation and vehicle logistics across North America and Europe. As a non-asset-based logistics company, RPM invests heavily in modern technologies and automation solutions.

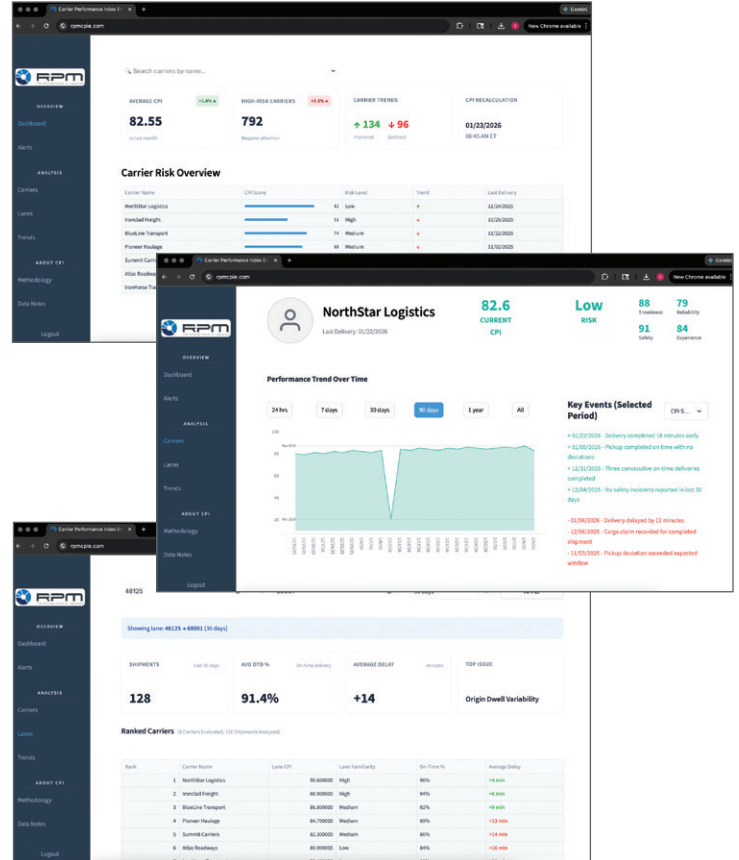
RPM connects business clients with carriers to complete vehicle deliveries. RPM manually selects which carrier they choose to use for delivery. This is a time-consuming and complex decision process due to the large amount of data pertaining to carriers.

Our Carrier Performance Index Engine provides RPM employees with an intuitive web application dashboard that displays a performance score for each carrier. When a decision is made to select a carrier for a delivery, the Carrier Performance Index Engine uses available carrier data for an encompassing score grading how well the carrier performs.

The dashboard also includes different pages detailing individual carrier data, performance for each delivery made and an alerts page for monitoring risks and performance. RPM leverages our collected data to make reasoned decisions about carriers, mitigating potential failures during this process.

The details page shows which carriers have been improving over time and quantifies both risk and performance, using historic data to visualize the data for easy analysis at a glance.

Our web application deploys Streamlit for the front end and back end. The carrier and the delivery information is stored within a Sqlite3 database in tandem with NumPy and Pandas for data processing. The new stream of data is sent to the machine learning component which leverages scikit-learn and PyTorch. This data is run through our machine learning layer which calculates the Carrier Performance Index score for each carrier. Each of these components form the Carrier Performance Index Engine.



RPM
Student Members
(left to right)

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- Charles Napierala**
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- Binu Panicker**
Birmingham, Michigan
- Anna-Marie Swierkosz**
Birmingham, Michigan

Stripe Stripe Business Portal

Stripe is a technology company that builds infrastructure to run financial transactions via the internet. Stripe's software helps businesses of all sizes accept payments, manage subscriptions and grow their revenue across key financial metrics.

Many businesses use separate tools for payments, customer management and reporting, which can make it difficult to see the full picture of their operations in one place.

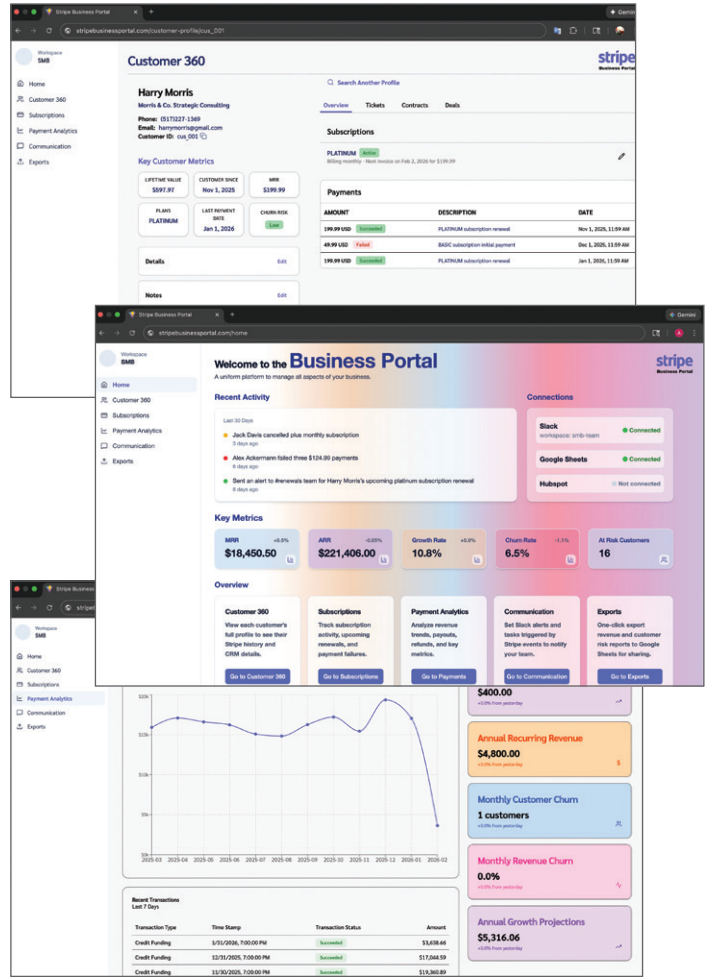
Our Stripe Business Portal provides a centralized hub that combines Stripe and customer data into one easy-to-use platform, enabling Stripe users to make important decisions easier than ever.

The portal tracks customer payments, subscription renewals, subscription plan upgrades, invoice settlements, churn rates, and recurring monthly and annual revenue metrics. These insights are recorded and updated in real time, giving business owners immediate visibility and control over their business.

Stripe Business Portal integrates with HubSpot, Slack, and Google Sheets, which are updated in real time when customer data changes. Business owners generate and export Google Sheets reports for deeper analysis and recordkeeping. Teams set up financial thresholds as events and receive Slack alerts when those events occur.

Stripe Business Portal creates financial and business clarity using charts, graphs and quantitative metrics. Through the Stripe Business Portal, decision-making becomes faster and revenue activity remains transparent, creating a better business experience for all Stripe users.

Stripe Business Portal uses a Django REST back-end framework with a React and TypeScript front-end interface. Internal token management and secure OAuth authentication support protected third-part integrations. Stripe webhook event processing enables near real-time data synchronization.



**Stripe
Student Members**
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- Augustine Adomako**
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**Stripe
Project Sponsors**

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- Colton Weaver**
New York, New York

Stryker Labor and Delivery Assistant

Stryker is one of the world's largest medical technology companies, offering a wide range of products with a primary focus on surgical tools, joint replacements, and closed waste management systems. Its products impact over 150 million patients each year across 75 countries.

Labor can be long for many patients, and often nurses are caring for more than one patient concurrently. It can be challenging for a nurse to support the unique needs of each patient in a different stage of labor, especially if the nurse is early in their career.

Our Labor and Delivery Assistant provides real-time, workflow-aware clinical support. Our software tracks the patient's past medical history, gestation history, and stage of delivery, helping the nurse through every step of delivery.

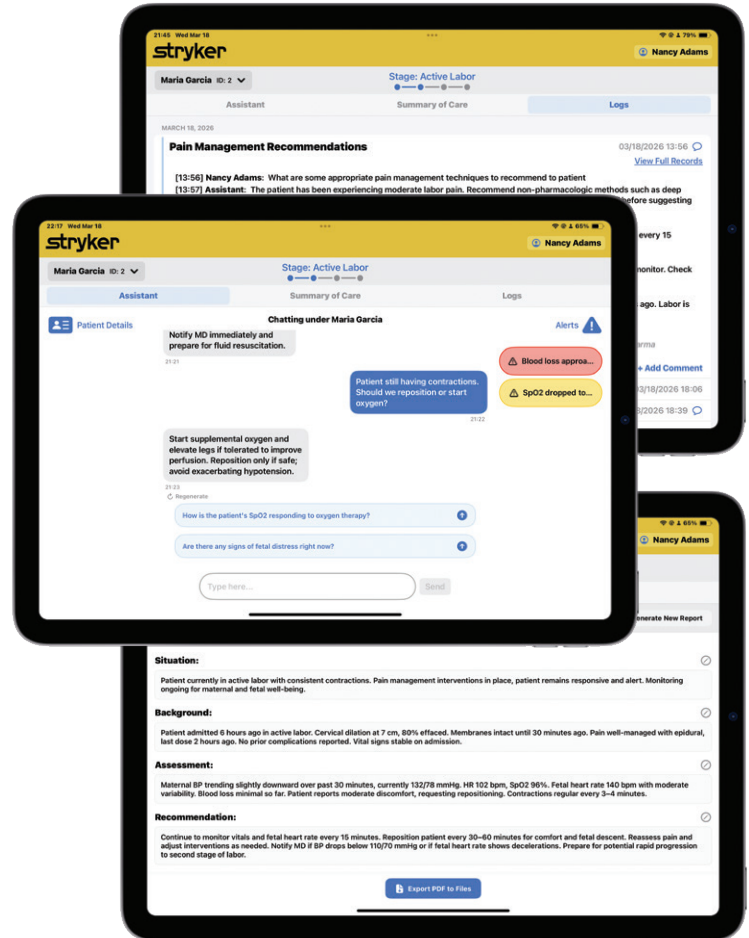
The dashboard shows the patient's current stage of delivery and reminds the nurse of the next necessary step of treatment. Alerts pop up to warn the nurse of possible dangers, medicine allergies, and other possible problems before they become an issue.

Our software introduces an AI assistant to aid with the childbirth process. It provides a summary of the patient's care based on their health records provided by Stryker.

To reduce errors from our AI model, our system has many verification steps in place and performs an in-depth analysis to provide citations for all claims.

Our system provides quick and easy-to-use resources for labor and delivery nurses to improve patient safety and reduce errors. This saves crucial time and prevents mistakes during the potentially dangerous process of childbirth.

Our front-end software is written with Swift, and our back end is written in Python. We use FastAPI to build the application, LangGraph with an Ollama engine for AI infrastructure, and a PostgreSQL database to store all of the data.



stryker



**Stryker IST
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Portage, Michigan

TechSmith UserClarity

TechSmith's mission enables users to communicate and share their message through media capture and editing software. Founded in 1987, TechSmith creates products, notably Snagit and Camtasia, that are employed by over 70 million users worldwide and all Fortune 500 companies.

Creating intuitive and effective user interfaces is essential when software serves millions. Product teams record usability sessions to observe user interaction and collect feedback to identify pain points.

Unfortunately, manually reviewing these recordings is time-consuming. Teams spend hours searching for moments of confusion, hesitation and task completion successes.

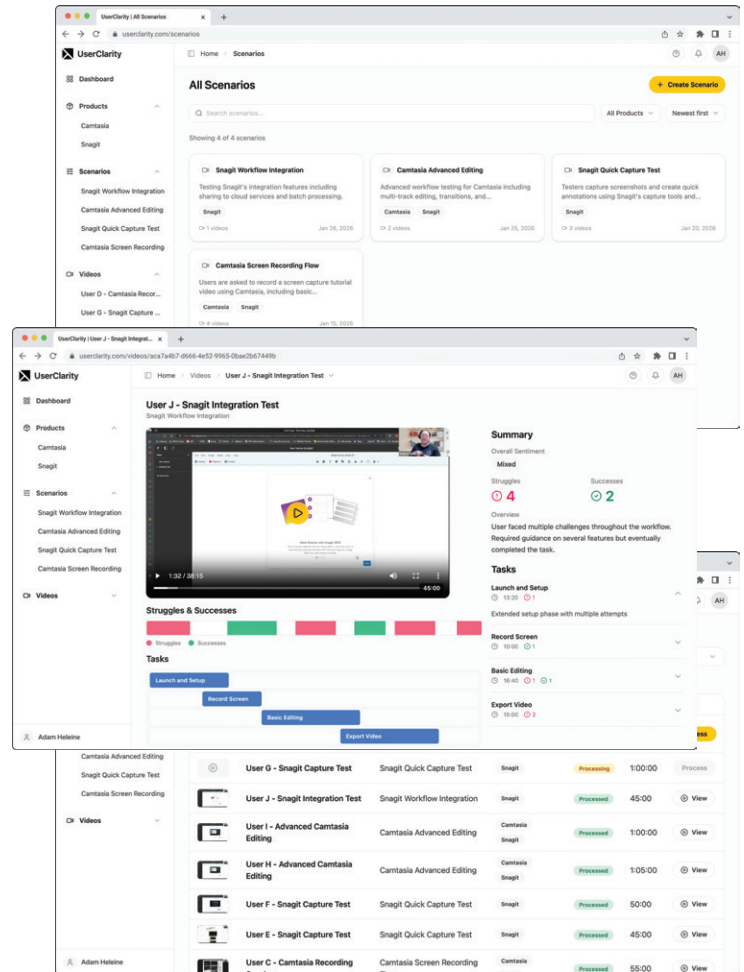
Our UserClarity software automates this analysis of usability recordings with artificial intelligence, finding actionable insights from hours of footage within minutes. Users simply upload session videos and click a button to process them.

The software first analyzes sentiment, facial expressions, phrases and other behavioral data from the recordings. A large language model then identifies moments of struggle and success which are timestamped and categorized under tasks completed.

Users get results as visualizations highlighting key moments of user interaction. A timeline displays task segments overlaid with periods of struggle and success. Summaries and detailed evidence appear alongside for quick review.

The dashboard enables filtering video results by products and scenarios tested. Users click a button to generate PDF reports aggregating findings, or export video highlight reels of key moments, streamlining the review process.

The front end of our software is written with Next.js. The back end uses Azure Functions with Azure Video Indexer analyzing video content and Azure OpenAI Service powering features with a large language model.



**TechSmith
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- Michael Malinak**
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Urban Science

Optimizing OEM Parts Sales Using AI-Powered Analytics

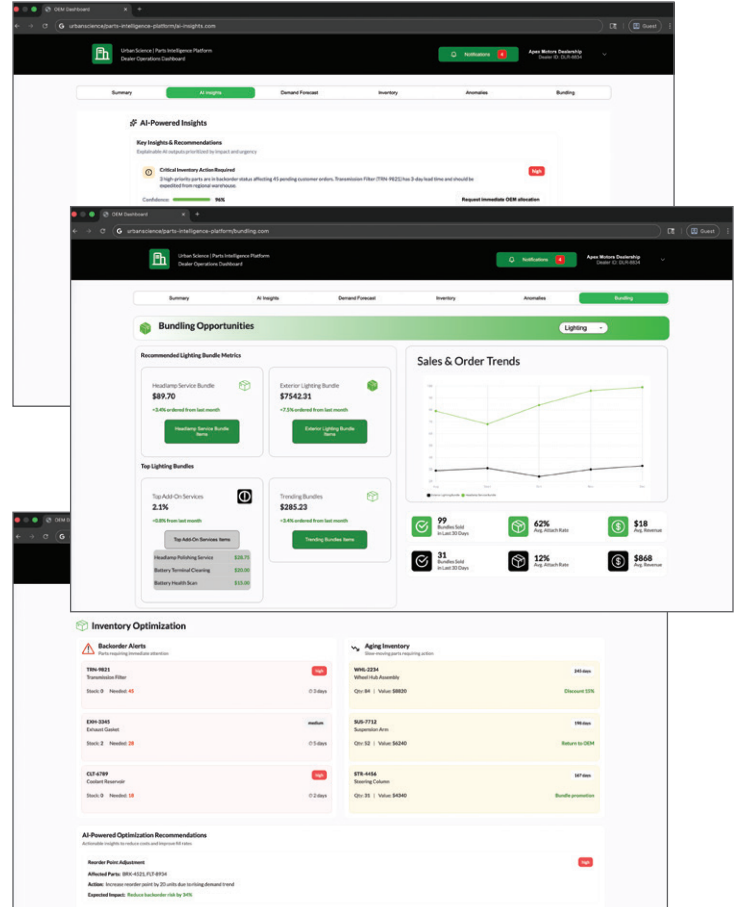
Headquartered in Detroit, Michigan, Urban Science is a global automotive consultant and technology provider that delivers data-driven solutions for original equipment manufacturers and dealerships. Since its founding in 1977, the company has utilized and leveraged data science, analytics, and software to help automotive brands optimize performance and make smarter market decisions.

Dealerships and parts manufacturers often face challenges ingesting and interpreting sales data and transforming it into actionable steps. Predicting key sales metrics, individual dealership anomalies and per-part demand is very challenging but important to price parts effectively.

Our Optimizing OEM Parts Sales Using AI-Powered Analytics project delivers AI-driven executive dashboards and prioritized visual summaries that highlight performance trends, operational risks, growth opportunities, and inventory gaps across regions. AI-generated insights interpret key changes in demand, inventory and pricing, translating complex data into clear, actionable recommendations that support faster and more confident decisions.

Instead of relying on intuition to guide demand and inventory decisions, clients are presented personalized bundling opportunities based on individual and regional sales performance. Price history and predicted trends are viewable at a glance on the predictions page. Dealerships experience less backorder and dead stock based on customized, data-driven inventory optimization recommendations.

The system uses a client-server architecture with an Angular front end and a .NET web API back end connected to a Microsoft Azure SQL database. Predictive models run in Azure Machine Learning, AI-driven insights are generated using Azure OpenAI and an Azure AI Foundry agent. These services produce explainable recommendations from sales, inventory and pricing data.



Urban Science Student Members

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Urban Science Project Sponsors

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- Pierre Gilbert**
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- Majd Nashwati**
Detroit, Michigan

Whirlpool Corporation One Button Laundry

Whirlpool Corporation is a global home appliance company with an impressive range, focusing on laundry and kitchen solutions. Headquartered in Benton Harbor, Michigan, as one of the only major United States-based manufacturers, they made \$16 billion in annual net sales in 2025, with approximately 30 manufacturing and technology research centers worldwide.

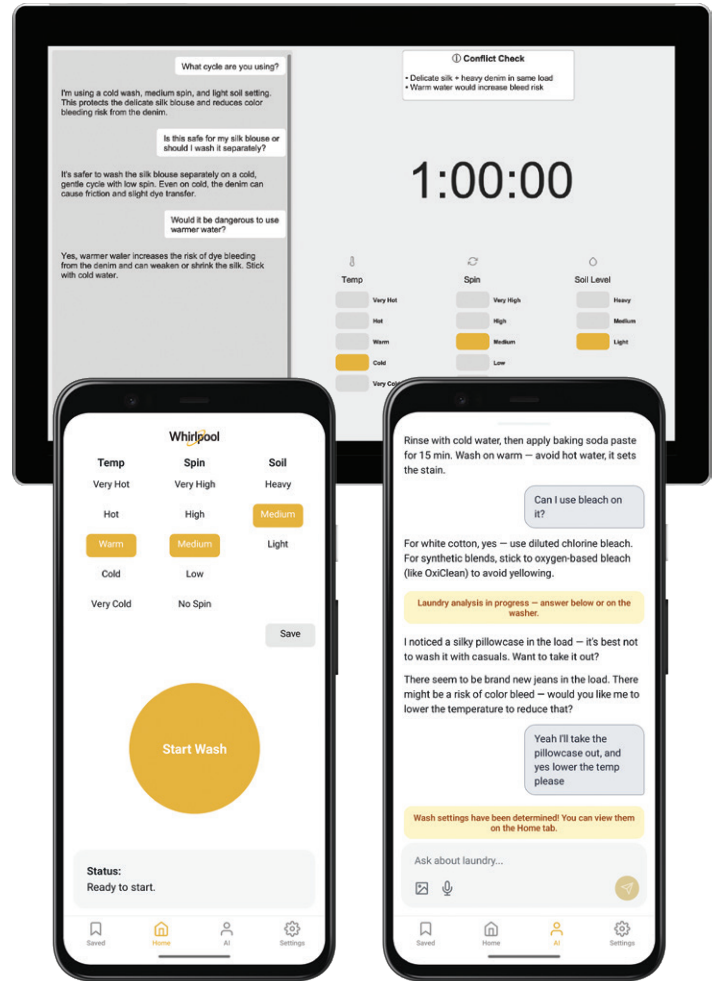
Whirlpool smart washers have many options for washing clothing. Modern washers support many settings to support any type of fabrics, dyes, and stains. This can be overwhelming for consumers.

Our One Button Laundry proof-of-concept selects the perfect settings for any load of laundry automatically at the push of a button. Our system uses the built-in camera of smart washers to detect the proper settings. This mitigates the time wasted, user frustration, and need for guesswork. By intelligently identifying fabrics and soil level, One Button Laundry determines the single, best-fit wash cycle for ideal results.

Our software emphasizes accessibility by enabling voice commands- both on the washer, and on our mobile app. Users chat with the AI from the app to adjust the cycle. Additionally, the app uses a wireless connection to enable remote monitoring of the current wash. The user can view or override the recommended wash settings, which may be saved as presets for repeat loads and specialty items.

Our system ensures superior care for clothing items and unlocks all the capabilities of the washer with a single, intuitive button. This saves time and effort for Whirlpool customers.

The system runs on a Raspberry Pi 5 using Python for hardware control and integrates core sensors and display components. The mobile app uses React Native, with a FastAPI back end deployed via Docker on Railway and AI powered by the Gemini API.



Whirlpool Student Members

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Cassinetta, Italy
- Jackie Li**
Benton Harbor, Michigan
- Victor Jafet Vargas**
Benton Harbor, Michigan

WK Kellogg Co Agentic Concierge

WK Kellogg Co is a leading food company whose brands are found in homes across the United States. With thousands of employees supporting manufacturing, supply chain, sales and corporate operations, the company depends on a wide range of internal and third-party technology systems each day.

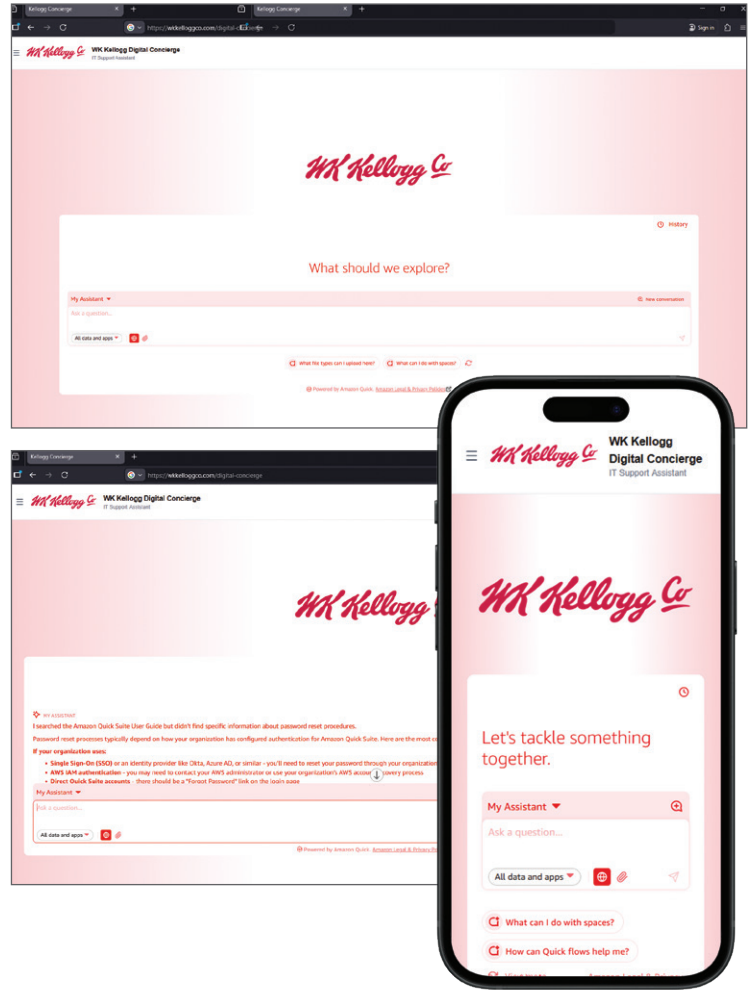
When employees encounter technical or procedural issues, they submit a service desk ticket and wait for assistance. Support specialists then search through internal knowledge articles, policy documents and records of past incidents to identify a solution. Much of this information exists in Word and PDF files across different systems. Finding the right answer can take time, and employees may need to engage in several correspondences before their issue is fully understood and solved.

Agentic Concierge provides a chat-based support portal that helps employees quickly find approved guidance. The system searches company-written Word and PDF documents, alongside previous case fixes, to compare a user's issue with known incidents. It asks simple follow-up questions such as device type, error message and steps already attempted. Based on this information, the portal highlights the best next step, links directly to the source document and records what the user has tried.

If the issue cannot be resolved, the system generates a detailed summary that is sent to the service desk. All responses follow approved guidelines without exposing sensitive information, and an audit trail is maintained for troubleshooting and accountability.

Agentic Concierge helps streamline the support process by cutting down on waiting time and providing quick solutions for frequently encountered issues.

Our application uses Amazon Web Services for document storage and retrieval. The front end uses React and Tailwind CSS, and the back end uses Node.js.



WK Kellogg Co Student Members

(left to right)

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- Aayushi Malhotra**
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- Jack Nowicki**
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- Suchit Thummalapally**
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- Randy Bhattu**
Farmington Hills, Michigan

WK Kellogg Co Project Sponsors

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- Federico Conde**
Battle Creek, Michigan
- Danae Rocha**
Battle Creek, Michigan
- Adolfo Vazquez**
Battle Creek, Michigan

Design Day Awards

CSE 498, Collaborative Design, is the senior capstone course for students majoring in computer science. Teams of students design, develop and deliver a significant software system for corporate clients. The CSE capstone teams compete for four prestigious awards. Here are the winners from the fall of 2025.

Auto-Owners Insurance Exposition Award



CSE 498 capstone teams present their projects on Design Day in a variety of ways. Teams create and set up an exhibit where they demonstrate their software systems and answer questions from Design Day attendees including the Design Day judges.

The CSE capstone team with the best overall Design Day performance is honored with the Auto-Owners Exposition Award, which is sponsored by Auto-Owners Insurance Company of Lansing, Michigan.

Team Corewell Health

An AI Tool for Enhancing Medical Education



Tri Khuc, Chase Grove, Toan Pham,
Noah Austad, Sabrina Lee, Graham Parker

Presented by Ross Hacker, Brad Shafer and Julie Wilkinson
of Auto-Owners

MSU Federal Credit Union Praxis Award



One of the hallmarks of CSE 498 capstone projects is that of praxis, the process of putting theoretical knowledge into practice. Teams apply a wide variety of information technologies to produce solutions to complex problems in areas such as business, engineering, computing, and science.

The CSE capstone team that engineers the software system that is the most technically challenging is recognized with the MSU Federal Credit Union Praxis Award, which is sponsored by MSU Federal Credit Union of East Lansing, Michigan.

Team Ludus

Web-Based FGL Ticket Emulator & Interpreter



Isabella Nelsen, Abhay Saji, Umut Temel,
Zakariya Sattar, Nicholas Seals, David Oh

While each of the awards has a principal focus, every winning team is required to deliver a comprehensive software system, and to demonstrate outstanding communication skills by presenting, demonstrating and defending their work.

TechSmith Screencast Award



Each CSE 498 capstone team produces a video that describes and demonstrates their software product. Starting with a storyboard and a script, teams use Camtasia Studio to synthesize screen recordings, video, audio and other multimedia to produce their project videos.

And the TechSmith Screencast Award goes to... the CSE capstone team with the best project video. The award is sponsored by the creators of Camtasia Studio, TechSmith of East Lansing, Michigan.

Team Launch
My VR Language Tutor



Nolan Jolley, Anh Dao, Evan Fioritto,
Molly Thornber, Joseph Pacentine, Caleb Flosky
Presented by Wendy Hamilton of TechSmith

Amazon Sigma Award



The CSE 498 experience represents the capstone of the educational career of each computer science major. An intense semester of teamwork produces impressive deliverables that include a formal technical specification, software, documentation, user manuals, a video, a team web site, and Design Day participation. The resulting sum, the capstone experience, is much greater than the parts.

The capstone team that delivers the best overall capstone experience is recognized with the Amazon Sigma Award, which is sponsored by Amazon of Seattle, Washington and Detroit, Michigan.

Team Amazon
Seller Agent Management Platform



Ethan Tunney, Jiwoo Jeong, Meet Patel,
Daniel Berezovsky, Ziad Bakki, Tyler Nguyen
Presented by Ryan Johnson and Derek Gebhard of Amazon

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Make history.

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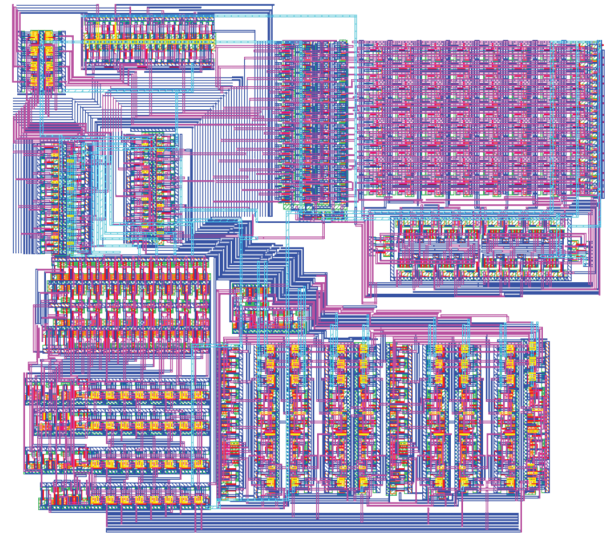




ECE 410

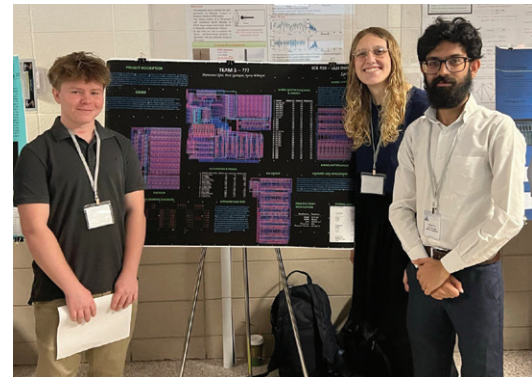
Instructor: Prof. Shannon Nicley

**TA Staff: Steve Zajac,
Shivanshu Ojha, Avery Wicklund**



Design and Characterization of a CMOS 8-bit Microprocessor Data Path

Students in ECE 410 were challenged to design the schematic and physical layout of an 8-bit microprocessor data path, including an Arithmetic Logic Unit (ALU), a barrel shifter, and a register file, using CMOS circuitry and Cadence Virtuoso VLSI design tools. The resulting microprocessor datapath projects will be judged on their ability to satisfy several competing goals, including speed, minimization of area, number of operations and difficulty of the operation set. The Outstanding Project Award will be awarded to the team that produces the best overall project, as judged by a panel of experts from industry and academia. The top five projects will be recognized, and their posters will hang in the hallways of the Engineering Building for the next year in acknowledgement of their excellence.



*2025 Outstanding Project Award Winners:
Shivanshu Ojha, Rose Spangler, Avery Wicklund*

Team 1

Ainsley Bronk
Kyler Dollinger
Nicholas Wasielewski

Team 2

Taylor Borowski
Richard Rezanka
Edgar Vega Estrada

Team 3

Nate Curcuri
Michael Hitchme
William Legg
Andrew Williams

Team 4

Liam Fitzpatrick
Matthew Schulte
Braxton Worth

Team 5

Caroline Huang
Eric Qin
James Verrico

Team 6

Suyog Khatiwada
Daniel Liu
Ramee Shatawi

Team 7

Flynn Anthony Joseph
Carlos Nava-Gonzalez
Riley Steinhebel

Team 8

Joshua Brott
Derek Doan
Jack Fazio

Team 9

Kuan-Lun Chiu
Will Darner
Hunter Lincoln

Team 10

Arjun Gupta
Nishan Heer
Lucas Hill
Chenxin Zhang

Team 11

Joe Borngesser
Parker Wdowiak
Maya Weisberger

Team 12

Casey Carr
Abdallah Daha
Dakota Farwell

Team 13

Yashvardhan Govind
Hyunwoo Kim
Nathaniel Wang
Dorothy Wu

Team 14

Ayman Berdai
Brett Roek
Parteek Sidhu

Team 15

John Fischer
Nathan Massengill
Mananya Patel

Team 16

Alen Hamidovic
Sarvesh Kumar
Krishnakumar
Senthilkumar

The Capstone Projects



Dr. Yiming Deng
Professor of Electrical
and Computer
Engineering



Ayres



Bopardikar



Gebara



Grotjohn



Han



Harokopus



Hogan



Mitra



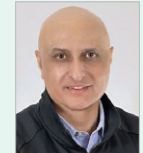
Morris



Purcell



Sepúlveda
Alancastro



Yazdi

Project Facilitators: Virginia Ayres, Shaunak Bopardikar, Edward Gebara, Tim Grotjohn, Ming Han, William Harokopus, Tim Hogan, Joydeep Mitra, Daniel Morris, Erin Purcell, Nelson Sepúlveda Alancastro, Navid Yazdi

Presentation Schedule – Engineering Building, Room 2245

Time	Team Sponsor	Project Title
7:30 a.m.	Han Research Group	Fiber Optic Acoustic Emission Sensor
7:50 a.m.	CANVAS Research Group	Multimodal Vehicle Sensor Gateway
8:10 a.m.	MSU Electromagnetic Research Group (EMRG)	Dual-Band 5G Secured Wireless Communication System
8:30 a.m.	MSU Indy Car Team	Autonomous Vehicle Stack
8:50 a.m.		Break
9:00 a.m.	MSU Formula Racing Team	Component Load and Direction Sensing System Validation and Testing
9:20 a.m.	Eisthen Laboratory MSU	IR Monitor for Electrophysiological Experiments
9:40 a.m.	Escapes Unlocked Escape Rooms	Portable “Escape Room in a Box” Puzzle System
10:00 a.m.	Kent Consulting, Inc.	Large Optics Telescope Auto Leveling Platform
10:20 a.m.		Break
10:30 a.m.	Smart Sensing Lab	Microphone Positioning System
10:50 a.m.	Burke Porter Group, an Ascential Technologies Company	Automated Ingestion of OEM ADAS Calibration Procedures
11:10 a.m.	Wyatt’s Creative Works, LLC.	Isn’t It LIFELY?
11:30 a.m.	GenoPalate	Personal Genetic Nutrition Summary — Powered by AI

ECE 480 Senior Design

ECE 480 is required of all electrical engineering or computer engineering majors at MSU. It prepares students for the workplace, or for graduate school, including:

- Putting into practice the technical skills learned in the classroom, on industrially sponsored team projects, under faculty guidance, doing open-ended design, giving them experience in teamwork, project management, product life cycle management, intellectual property, accommodation issues and entrepreneurship;
- Polishing their communication skills ~ individual and team ~ on proposals, reports, resumes, evaluations, posters, web pages, and oral presentations; and
- Requiring each student to complete four individual hardware/software laboratory assignments.

Han Research Group

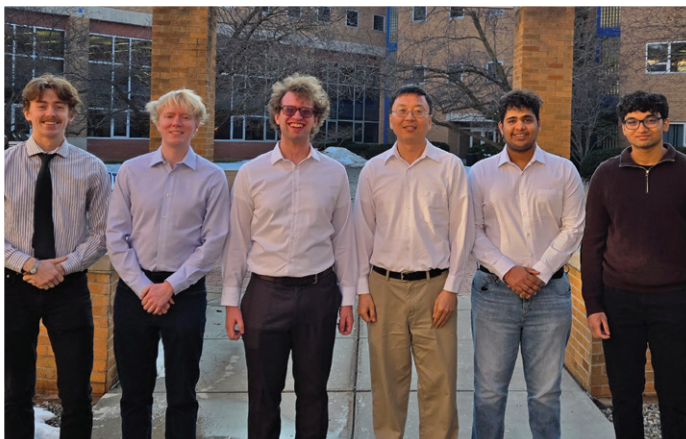
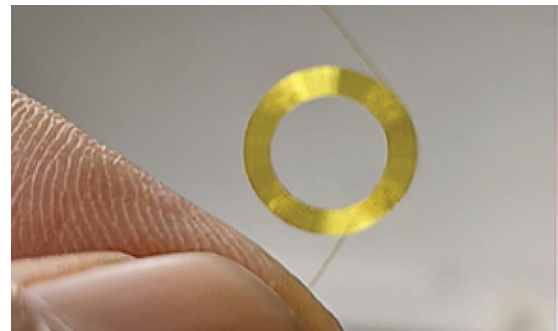
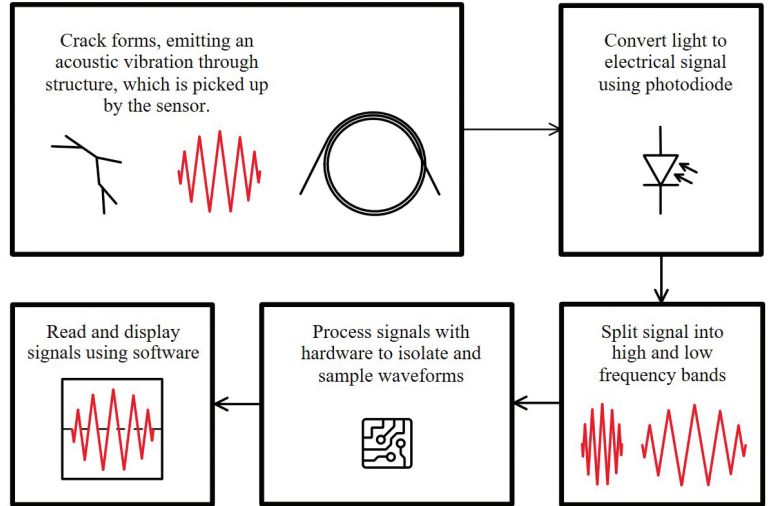
Fiber Optic Acoustic Emission Sensor

The Han Research Group tasked our team with reducing the size and cost of an existing optical emission sensor while improving manufacturability through modular printed circuit board design and updated component selection. The project also included redesigning the analog front end and digital processing structure to better leverage the sensor's dual-frequency sensitivity.

The original system was fully functional but occupied two shoebox-sized desktop enclosures, making integration and use increasingly difficult. To address this, the redesign implemented a stacked multi-board architecture, improving internal packaging efficiency and enabling a self-contained prototype. The transition from discrete components to surface-mount devices reduced overall footprint while improving long-term manufacturing feasibility and cost.

Digital processing improvements included scanning both primary frequency bands and applying a calibrated normalization process, enabling the system to select the band with the highest sensitivity using industry-standard frequency analysis methods. In addition, the software interface and processing pipeline were migrated from LabVIEW to Python to improve maintainability and long-term usability.

Overall, the redesign modernized the system architecture, reduced physical footprint, and produced a more maintainable and production-ready sensing platform.



Michigan State University

Team Members (left to right)

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- Soren Gaw**
Harrison Twp., Michigan
- Maxwell Scott**
Kalamazoo, Michigan
- Ming Han** (Sponsor)
- Arjun Gupta**
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- Anwarul Amin Omio**
Faridpur, Bangladesh

Han Research Group

Project Sponsor

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Project Facilitator

Dr. Ming Han
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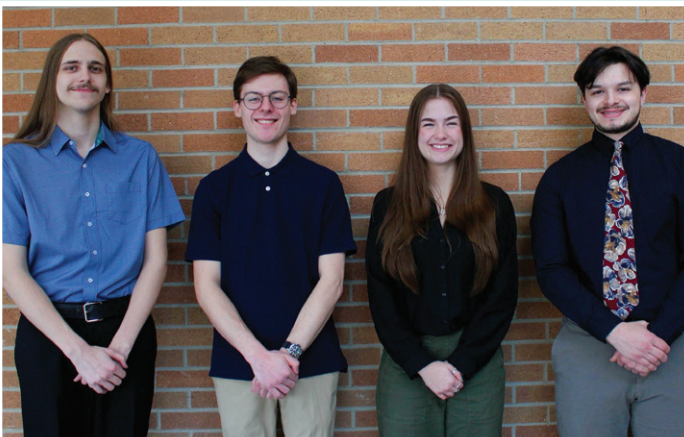
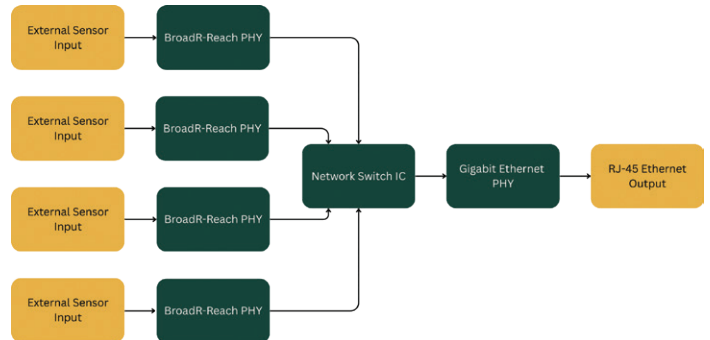
CANVAS Research Group

Multimodal Vehicle Sensor Gateway

Modern autonomous vehicle platforms rely on a growing number of high-bandwidth sensors, including cameras, LiDAR, and radar systems, many of which communicate using the BroadR-Reach standard of automotive Ethernet. While BroadR-Reach is well-suited for in-vehicle communication, due to its robustness and automotive compliance, interfacing these sensors with conventional networking equipment typically requires individual media converters for each device. This approach increases system cost, cable routing complexity, power consumption, and physical volume, making it difficult to scale and integrate into tightly constrained vehicle environments.

The CANVAS group has challenged us with a project that focuses on the design and development of a compact, automotive-grade hardware gateway that aggregates four BroadR-Reach sensor inputs into a single standard Gigabit Ethernet output. The system is implemented on a custom multilayer printed circuit board and integrates Ethernet PHYs, a gigabit Ethernet switch IC, and onboard power regulation capable of operating across a wide automotive voltage range. The design prioritizes signal integrity, electromagnetic compatibility, and thermal reliability to ensure stable operation in harsh automotive environments.

In addition to functional performance, the gateway is designed to significantly reduce physical footprint and wiring complexity compared to existing solutions. By consolidating multiple sensor connections into a single Ethernet output, the system improves packaging efficiency and simplifies vehicle installation.



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Project Facilitator

Dr. Nelson Sepúlveda Alancastro

MSU Electromagnetic Research Group (EMRG) Dual-Band 5G Secured Wireless Communication System

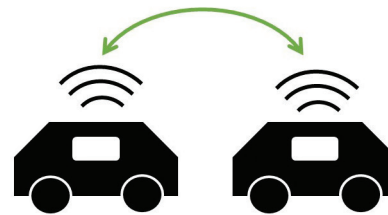
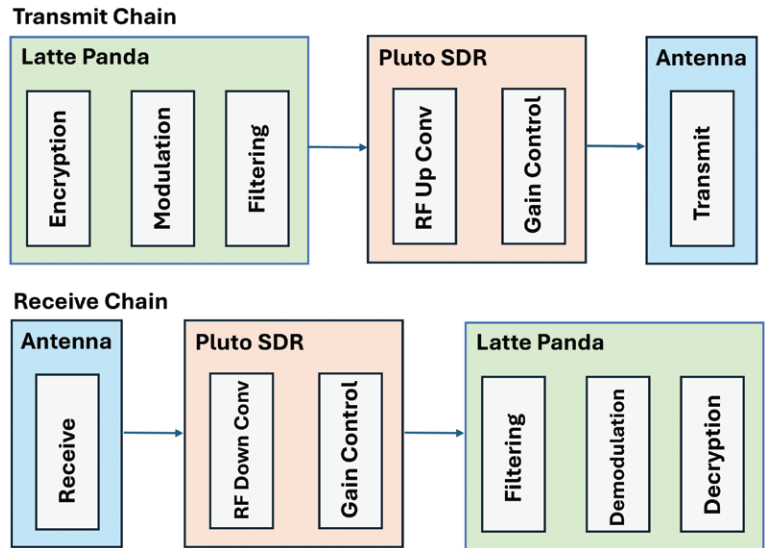
Distributed antenna systems have demonstrated that spatially separated but synchronized radios can function as a virtual antenna array, significantly improving reliability and interference resilience. However, current research relies on high-end software-defined radios (SDR) that are expensive. This cost and hardware complexity severely limit accessibility for this application.

The goal of this project is to develop a programmable wireless system that serves as a node for distributed antenna research using low-cost commercial SDRs. Our current system utilizes a \$200 ADALM-PLUTO SDR along with a LattePanda mini-computer for signal processing to demonstrate that these affordable hardware platforms are capable of supporting such applications.

This technology can be implemented in V2X (Vehicle-to-Everything) applications, as V2X requires reliable communication links between vehicles and infrastructure. These characteristics make V2X an ideal testbed for distributed antenna techniques.

The product consists of two nodes for transmitting and receiving signals, each supporting dual-band operation at 2.4 GHz and 5 GHz. To meet the physical requirements, our design uses a 3D-printed housing with a maximum system weight of 1.5 kg. The total power consumption must be kept under 45 W. Additionally, the device transmits at a maximum of 0 dBm, ensuring compliance with FCC regulations.

Lastly, the system can support up to 2.5 Mbps of data throughput, which is sufficient to support live 720p video streaming. In addition, to ensure secure communication, the signal processing chain implements AES encryption and decryption.



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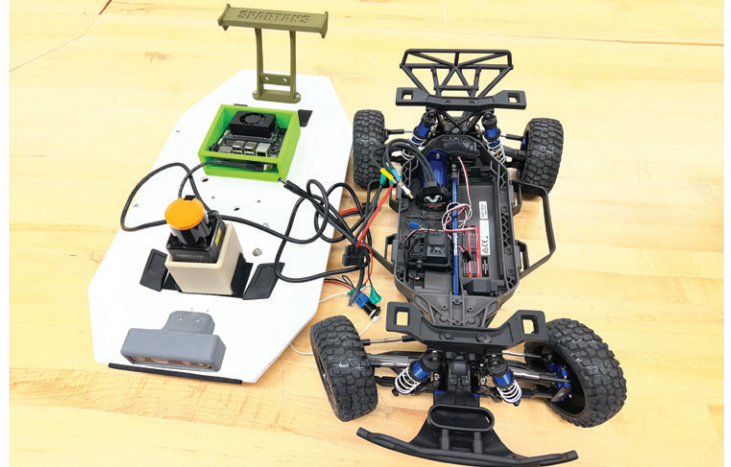
MSU Indy Car Team Autonomous Vehicle Stack

Formula 1 is an expensive and potentially dangerous sport due to the high speeds and precision required. This project focuses on developing a reliable and high-performance autonomous racing system using a 1/10th-scale F1 vehicle. The smaller scale provides a safer and more cost-effective platform for testing critical technologies such as camera and LiDAR-based perception, object detection, and lane tracking.

This project is sponsored by the MSU Indy Car team. The sponsor is requesting a smaller scale car on which to test new autonomous driving software. This car will need to be able to complete laps in standard times and be able to navigate the track autonomously. This requires the car to implement lane following, obstacle avoidance, and path optimization algorithms.

This project is going to build upon the existing F1-Tenth platform and autonomous software developed by the Fall 2025 ECE 480 team. This requires our team to verify all onboard hardware components and evaluate current software performance for active pathfinding and obstacle avoidance.

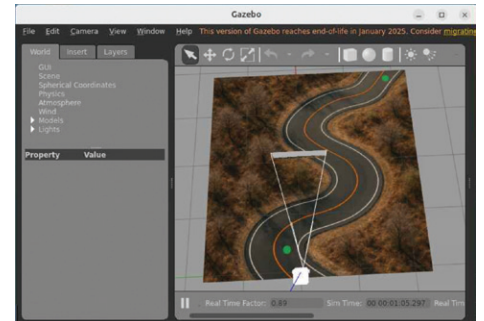
The main project objective is to add additional racing features to the software, including calculating racing lines and active avoidance of other moving cars, enabling full racing capabilities. These additions will be tested in a Gazebo simulation before deployment on the physical vehicle. The complete ROS-based autonomous driving stack will consist of SLAM, path planning, navigation, and obstacle avoidance. All software and hardware additions and testing will be thoroughly documented for any future additions or debugging of the system.



F1-10th Vehicle



Code for Imu-Bridge



Curvy road image from Gazebo



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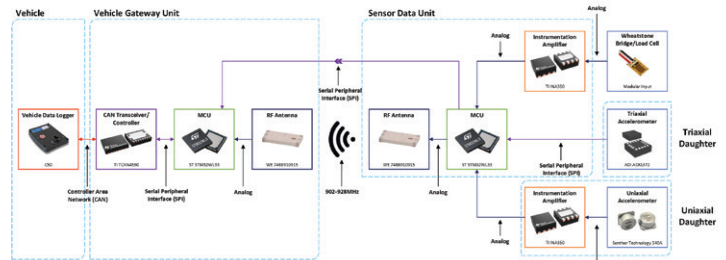
MSU Formula Racing Team Component Load and Direction Sensing System Validation and Testing

The MSU Formula Racing Team designs and builds a new racecar each year to compete against universities from around the world. To achieve maximum performance and reliability, every vehicle component must be carefully analyzed and validated under real-life operating conditions. Understanding the forces experienced by individual components is critical to improving durability, safety, and overall vehicle performance.

This project focuses on the development of a compact, vehicle-ready load-tracking system capable of measuring both the magnitude and direction of applied forces in real time. The system integrates strain-based load sensing with inertial measurements to provide a more complete picture of how loads are applied and transmitted through suspension and chassis components. By capturing both static and dynamic force behavior, the system enables deeper insight into component loading during acceleration, braking, cornering, and impact events.

Sensor data are processed by an onboard electronics module and transmitted through wired or wireless communication. The measurements are converted to CAN format, enabling seamless integration with existing vehicle networks and data-logging systems used by the Formula Racing Team.

By providing reliable, high-quality load and direction data, this system supports performance analysis, durability testing, and design validation. The flexible and modular design enables deployment on a wide range of vehicle components, making it a valuable tool for both on-vehicle testing and off-vehicle experimentation.



Michigan State University
Formula Racing Team



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MSU Formula Racing Team
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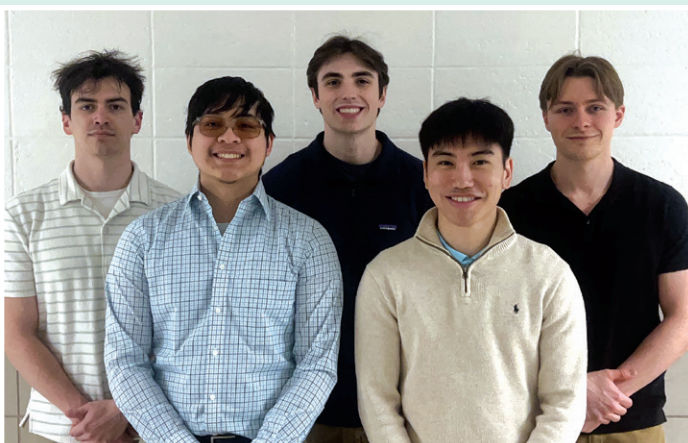
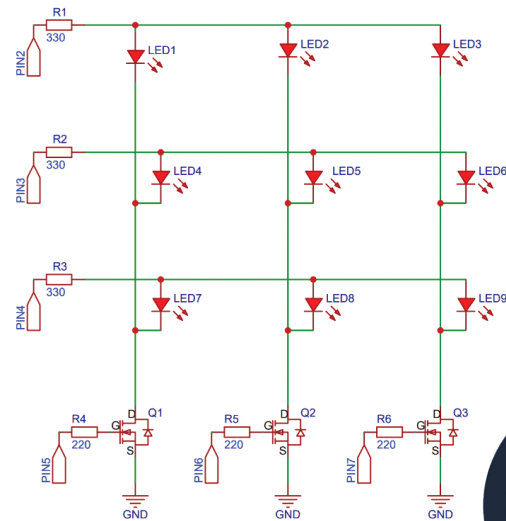
Project Facilitator
Dr. Joydeep Mitra

Eisthen Laboratory MSU IR Monitor for Electrophysiological Experiments

Eisthen Laboratory in the Department of Integrative Biology at Michigan State University investigates evolutionary changes in physiology and behavior, with the goal of understanding how these changes occur and how behavior changes as the brain evolves. Historically, Eisthen Lab's research has focused on chemical senses and chemical ecology in vertebrates, including studies involving amphibians and fish. More recently, the lab has expanded research into infrared sensing in ball pythons (*Python regius*), which detect infrared stimuli using specialized heat-sensitive pit organs, called labial pits, rather than traditional vision.

This project supports that work by developing a custom infrared monitor prototype capable of generating simple spatial IR stimuli for neurophysiological experiments. The monitor will enable coordinated control of IR LEDs to produce basic patterns, interface with OpenEphys electrophysiology toolbox for synchronized triggering, and be electrically shielded to minimize noise during recordings. The goal is to deliver a functional prototype IR monitor and basic control software, providing foundation for future development of a full-scale IR display system.

To accomplish this, the team will evaluate infrared emitters and LEDs across different wavelengths and intensities to determine which devices produce the strongest neural responses. Although long wavelength infrared in the approximate 8-15 μm range is expected to be optimal, alternative wavelengths will also be tested. After selecting the most effective components, a custom IR LED array will be designed with independent microcontroller control of each LED. Firmware will enable spatial pattern generation and integration with OpenEphys system for synchronized experimental control.



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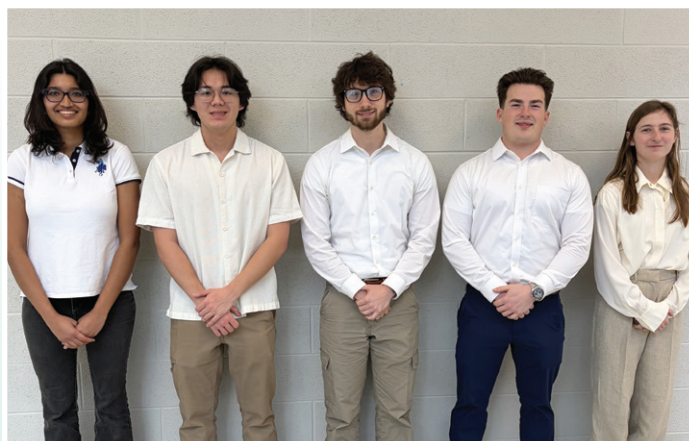
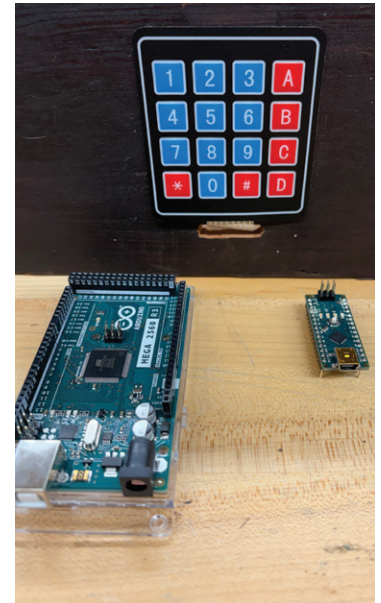
Dr. Erin Purcell

Escapes Unlocked Escape Rooms

Portable “Escape Room in a Box” Puzzle System

Escapes Unlocked is a locally owned escape room company in Okemos, Michigan, founded by two local entrepreneurs in 2023. Their passion for puzzles and customer experience enabled them to design most experiences to be tailor-made for local audiences. The company offers family-friendly themed escape rooms, along with party packages and team-building events.

This project aims to design and prototype a portable escape room system integrating electronic control to improve flexibility and reliability. The system uses a finite state machine to manage puzzle progression and restrict access to one challenge at a time. A keypad, push buttons, LEDs, and servo-driven locking mechanisms are integrated within a secure enclosure. The control logic verifies inputs, prevents incorrect progression, and opens compartments when a puzzle has been solved. The design will prioritize portability, ease-of-reset, and scalability for future expansion or modification without physical redesign.



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Escapes Unlocked

Escape Rooms

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Kent Consulting, Inc.

Large Optics Telescope Auto Leveling Platform

Kent Consulting has tasked our team with advancing the functionality of a telescope transport platform system by transforming it from a manually adjusted cart into an automated telescope deployment platform. The current platform supports a 12-inch Schmidt-Cassegrain telescope but requires extensive manual leveling and directional alignment prior to observation. The setup process is time-intensive, physically demanding, and dependent on user precision, leading to variability in alignment accuracy.

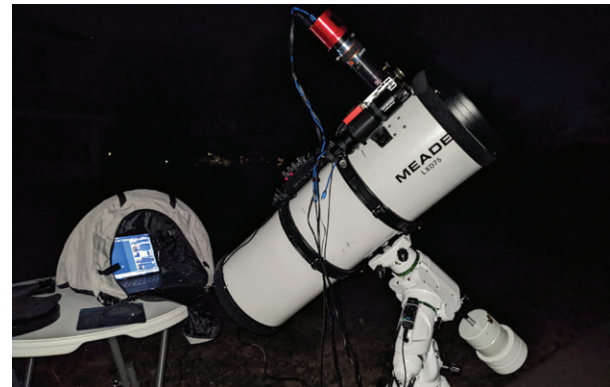
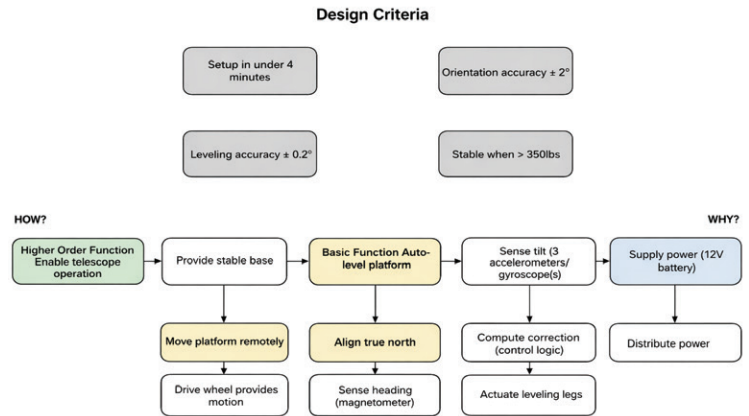
This project proposes an embedded sensing and control architecture that automates the necessary activation phase of the telescope deployment. The system will focus on mechanical leveling, motorized mobility, and platform orientation. In addition, the platform system will be able to execute necessary adjustments using real-time feedback to improve precision and repeatability.

The modifications made to the existing design focus on increasing the accuracy and precision of the automated leveling system, implementing a battery-powered drivetrain system, and adding a north-seeking compass module which can direct the user where to face the telescope via an onboard LCD display panel.

More improvements are to be made to create a more simplistic and robust wiring structure, custom casements to hold all vital electronic components, and varnish to improve the longevity of the wooden components.

The platform is designed to operate as a self-contained unit powered by a 12V battery supply with regulated power distribution to sensing, control, heating, and driving systems. Electrical protection and fault monitoring mechanisms will be incorporated to ensure safe operation.

By integrating sensing, control, and motorized assistance into a unified architecture, this project aims to reduce setup time, minimize user error, and establish a scalable foundation for future enhancements in automated telescope deployment.



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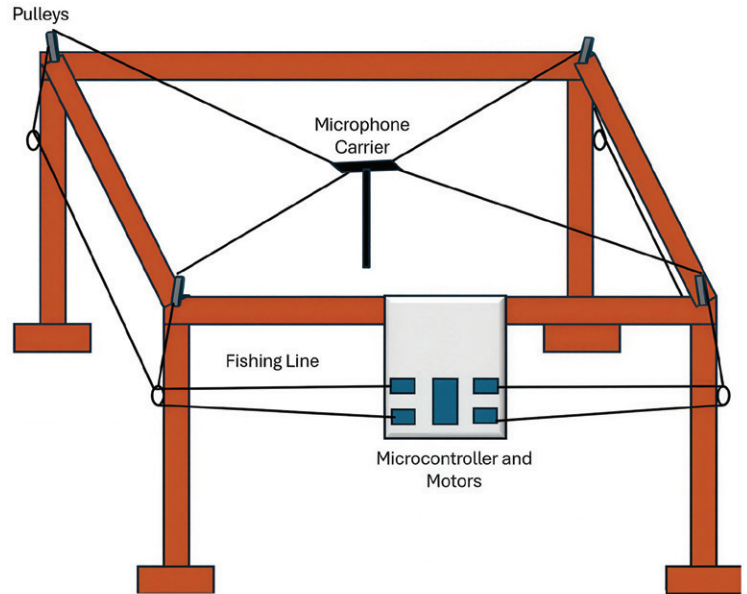
Project Facilitator
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Smart Sensing Lab Microphone Positioning System

The Smart Sensing Lab collaborates with Michigan State University's pig barn to study swine behavior and welfare, including position tracking, posture classification, and gilt behavior analysis. Recent efforts have expanded to monitoring the respiratory rates of sleeping pigs as early indicators of stress, illness, or environmental discomfort. Because pigs are highly alert and social animals, collecting consistent respiratory data in a barn environment requires remote collection without a human present.

Our team developed a remote-controlled microphone positioning system to enable repeatable, non-invasive respiratory data collection. A microcontroller operates four motors that adjust fishing lines to precisely position a 3D-printed microphone carrier anywhere within the 8 ft × 16 ft pen. Using a joystick and video feed, researchers in a separate room can remotely place the microphone at nostril level while minimizing disturbance and improving data consistency.

The wooden support structure provides a modular, low-cost platform to test the system before implementation in the barn. Guidance pulleys improve cable routing and positioning accuracy. The system will be evaluated for positional accuracy, repeatability, and robustness under realistic barn conditions to ensure reliable three-dimensional positioning for high-quality respiratory data collection.



Cable System Components	Description	Function
Cables	Holds Carrier	Secondary
Carrier	Holds Pole	Secondary
Pole	Holds Microphone	Secondary
Pulleys	Guide Cables	Secondary
Electric Motors	Rotate Reels	Secondary
Reels	Hold Cables	Secondary
Frame	Supports Components	Secondary
Microcontroller	Controls Electric Motors	Secondary
Power Supply	Powers Microcontroller	Secondary
Wireless Microphone	Records Data	Basic

SMARTS



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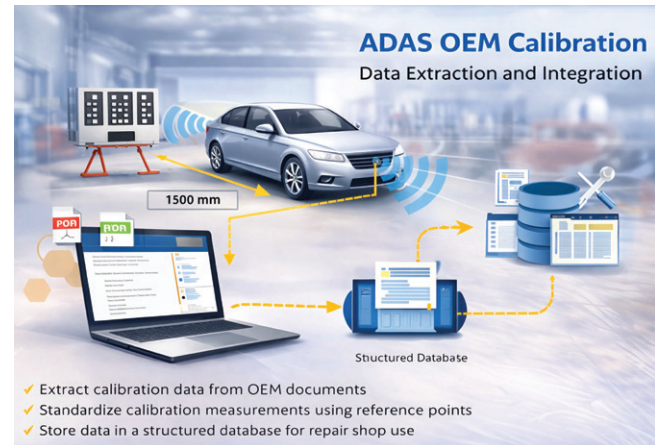
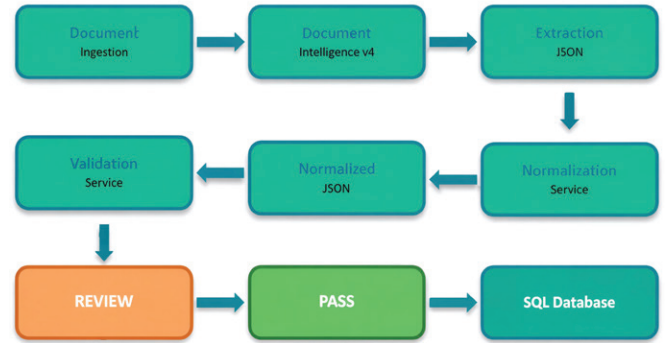
Burke Porter Group, an Ascential Technologies Company

Automated Ingestion of OEM ADAS Calibration Procedures

Burke Porter, an Ascential Technologies Company, supports ADAS (Advanced Drivers Assistance Systems) Solutions in managing calibration procedures required for modern vehicle repairs. These procedures ensure vehicles are properly positioned relative to sensors and cameras during ADAS calibration. However, the required measurement and reference data are stored in OEM PDF and HTML documents and must be manually extracted and entered into internal databases. Because formatting, terminology, and document structures vary widely across manufacturers, this process is time-consuming, repetitive, and prone to human error.

Our Automated OEM ADAS Ingestion System addresses this challenge by automatically analyzing and extracting structured calibration data from OEM documents and inserting it into a secure SQL database. The system performs OCR (Optical Character Recognition) and data extraction, normalizes terminology and measurement fields across OEMs, validates outputs against predefined schemas and confidence thresholds, and securely writes approved data via authenticated APIs with built-in retry and logging mechanisms. Low confidence or ambiguous cases are flagged for human review to maintain high data quality and reliability.

By transforming a manual workflow into an intelligent, automated pipeline, the system significantly reduces processing time while improving accuracy and consistency. The solution is designed to scale across additional OEMs and support measurable performance metrics such as processing latency and extraction accuracy. Built using Azure AI services, Python-based parsing logic, Azure SQL, and integrated monitoring tools, the platform enables faster, more reliable, and scalable ingestion of ADAS calibration procedures.



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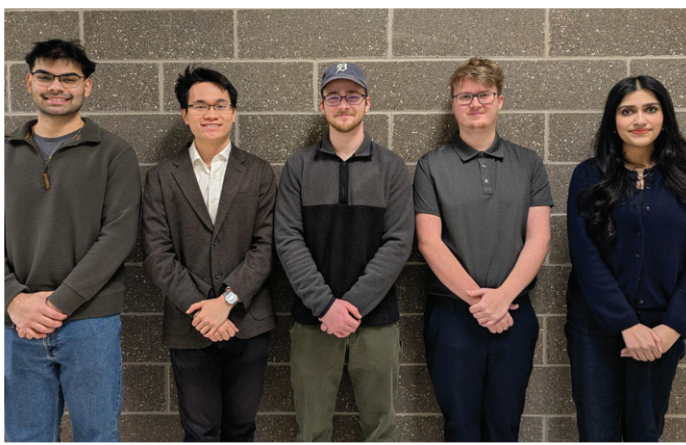
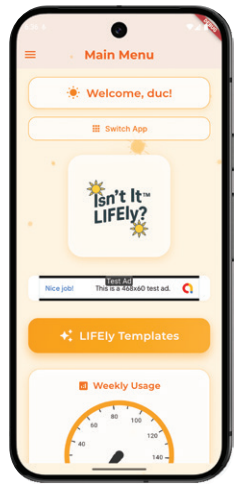
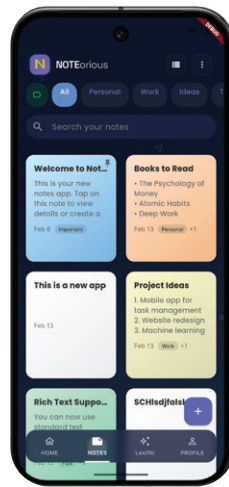
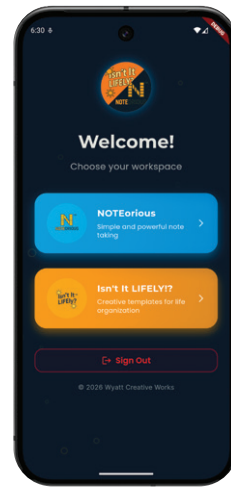
Project Facilitator

Dr. Tim Grotjohn

Wyatt's Creative Works, LLC. Isn't It LIFEly?

W Wyatt's Creative Works is an exciting startup headquartered in Grand Blanc, Michigan. Building upon the company's foundation in creative content development, including book publishing and innovative digital products, Wyatt's Creative Works is expanding its presence in the digital space through the development of a comprehensive mobile application designed to enhance personal and professional organization. Organizational tools play a critical role in structuring professional, personal, and academic responsibilities; however, many existing applications on the market suffer from limited customization, inconsistent performance across operating systems, and/or a narrow focus on a single function. These shortcomings require users to rely on multiple disconnected platforms, reducing overall efficiency and productivity (while increasing frustration).

Wyatt's Creative Works envisions a convenient digital workspace with a floating toolbar that consists of a pen, pencil, and highlighter tools, including a flipbook-style design to increase usability. The user should be able to write on the application with a stylus but have the option for conventional typing as well. Furthermore, customers value a reliable application that can perform consistently across all their devices. The application needs to work on iOS, Android, and Windows platforms. Ease-of-use and stable performance are important customer requirements. Finally, meeting format requirements for future sales through Apple Store and Google Play is key to Wyatt's Creative Works business success. Our team takes pleasure in building on past ECE 480 projects to provide the finishing expertise that will combine these functions into a single application.



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- Ben DeRosier**
Royal Oak, Michigan
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Wyatt's Creative Works, LLC.
Project Sponsor

Marquonda Wyatt
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Project Facilitator
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GenoPalate

Personal Genetic Nutrition

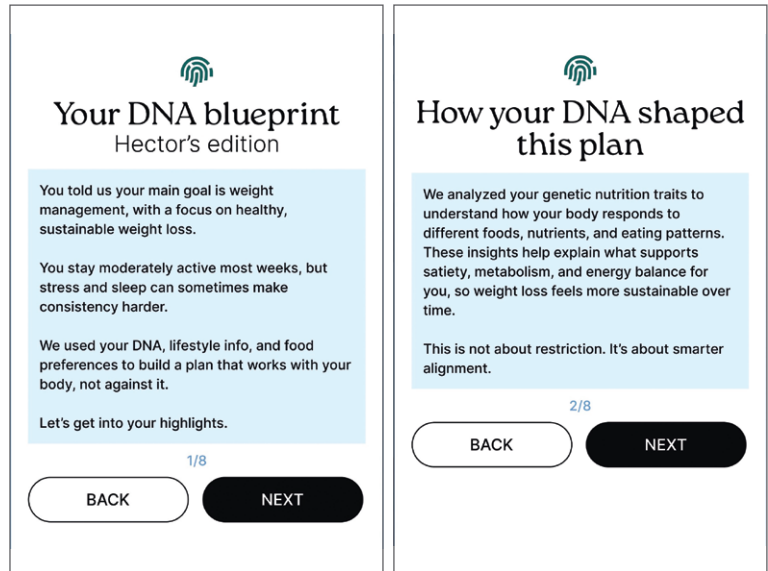
Summary — Powered by AI

GenoPalate, Inc. is a nutritional genomics company, based in Milwaukee Wisconsin, focused on advancing personalized nutrition. The company provides innovative at-home DNA testing, individualized online nutrition programs guided by registered dietitians, and custom-tailored supplements. GenoPalate helps individuals achieve their best health through nutrition specifically designed for their genetic profile.

The project is to implement a carousel style modal summary of users' genetic information within the company's mobile app, giving them a starting point to the large amount of information a new user would otherwise be presented immediately. Our solution will provide users with an organized, interactive introduction, enabling them to engage with and explore their data in a manageable and intuitive way.

Each summary prompt contains eight sections, covering user routines, DNA influences, macronutrients, micronutrients, sensitivities, recommended foods, foods to avoid, and next steps. The API facilitates secure and accurate transfer of this data from the GenoPalate platform to the modal, while the back end ensures proper display and validation of all fields.

The modal will present the summary across eight interactive screens with navigation buttons, titles, icons, and page numbers, including scrollable views for longer content. Edge cases are handled to prevent errors, such as regenerating prompts or providing default alternatives. Testing will include unit, integration, and UI testing to ensure functionality, transitions, and styling meet requirements.



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Dr. Navid Yazdi

ENGINEERING AT



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The Capstone Projects



Dr. Yiming Deng
Professor of Electrical
and Computer
Engineering



Aviyente



Baryshev



Ben-Idris



Chahal



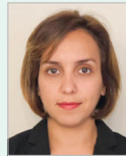
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Clark



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Li



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Project Facilitators: Selin Aviyente, Sergey Baryshev, Mohammad Ben-Idris, Premjeet Chahal, Sunil Chakrapani, Thomas Clark, Mauro Ettore, Bahare Kiumarsi, Tongtong Li, Shannon Nicley, Jian Ren, Nelson Sepúlveda Alancastro

Presentation Schedule – Engineering Building, Room 2250

Time	Team Sponsor	Project Title
7:30 a.m.	MSU Nondestructive Evaluation Laboratory, and National Science Foundation	3D-Printed Flexible Sensors for Multi-Modal Sensing to Enable Digital Twins
7:50 a.m.	Henry Ford Health Innovations	Autonomous Pathology Specimen Transport Robot
8:10 a.m.	Ascential Technologies	Extended Reality
8:30 a.m.	Physical Ultrasonics, Microscopy and Acoustics Lab	Impedance Matching Networks for EMAT Sensors
8:50 a.m.		Break
9:00 a.m.	MSU Bikes Service Center	Intelligent Alert System for Red-Light Runners
9:20 a.m.	MSU Composite Vehicle Research Center (CVRC)	Design of a Prototype DFOS-Based Data Acquisition and Visualization System for SHM
9:40 a.m.	Unluturk Laboratory for Molecular Communication	Molecular Communication System Via a Wind Tunnel
10:00 a.m.	Texas Instruments, and FRIB	RF Integration for SEE Radiation Testing on Amplifiers
10:20 a.m.		Break
10:30 a.m.	MSU Nondestructive Evaluation Laboratory	High-Voltage Electric Boiler Testing Chamber
10:50 a.m.	MSU Composite Vehicle Research Center (CVRC)	Design of a Secure Platform for NDE Data Management
11:10 a.m.	Texas Instruments	ECG Signal Acquisition and Display System
11:30 a.m.	Texas Instruments	RC Car Speed Demo System with Power Module

We gratefully acknowledge the support of this semester's project sponsors: Ascential Technologies, Burke Porter Group an Ascential Technologies Company, CANVAS Research Group, Eisthen Laboratory, Escapes Unlocked Escape Rooms, FRIB, GenoPalate, Han Research Group, Henry Ford Health Innovations, Kent Consulting, Inc., MSU Bikes Service Center, MSU Composite Vehicle Research Center (CVRC), MSU Electromagnetic Research Group (EMRG), MSU Formula Racing Team, MSU Indy Car Team, MSU Nondestructive Evaluation Laboratory, National Science Foundation, Physical Ultrasonics, Microscopy and Acoustics Lab, Smart Sensing Lab, Texas Instruments, Unluturk Laboratory for Molecular Communication, and Wyatt's Creative Works, LLC.

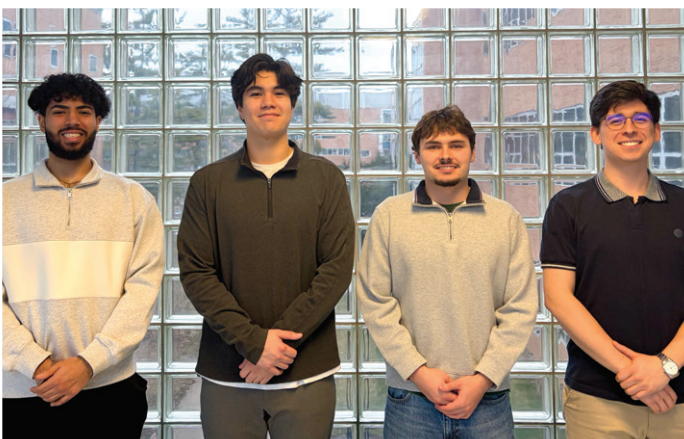
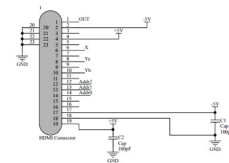
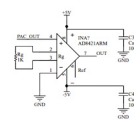
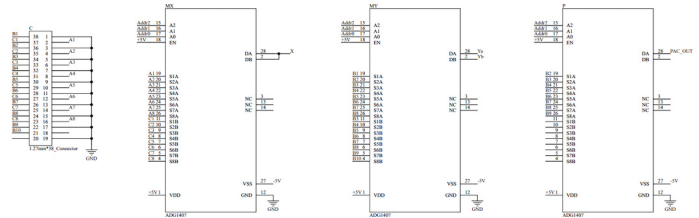
The ECE Project Facilitators who supervised ECE 480 teams this semester are: Selin Aviyente, Virginia Ayres, Sergey Baryshev, Mohammad Ben-Idris, Shaunak Bopardikar, Premjeet Chahal, Sunil Chakrapani, Thomas Clark, Mauro Ettore, Edward Gebara, Tim Grotjohn, Ming Han, William Harokopus, Tim Hogan, Bahare Kiumarsi, Tongtong Li, Joydeep Mitra, Daniel Morris, Shannon Nicley, Erin Purcell, Jian Ren, Nelson Sepúlveda Alancastro, and Navid Yazdi.

MSU Nondestructive Evaluation Laboratory and National Science Foundation 3D-Printed Flexible Sensors for Multi-Modal Sensing to Enable Digital Twins

The Michigan State University Nondestructive Evaluation (NDE) Laboratory develops advanced sensing systems to assess structural integrity and detect damage in infrastructure. This year's project advances the prototype by redesigning and upgrading a 3D-printed, pipe-traversing flexible sensor module for multimodal NDE inside transport pipelines. The primary objective this year is to achieve reliable data from the flexible sensors instead of just the microcontrollers. Our goal is to move from a proof-of-concept design to a repeatable, testable platform that produces higher-quality multimodal datasets for future analysis and digital-twin modeling.

Key improvements focus on sensor integration and data reliability. Mechanically, we are refining the module to maintain stable motion and consistent sensor contact while traversing pipe surfaces, which is critical for repeatable flexible-sensor measurements. The overall build layout is being updated to be used for pipes with diameters of 4-10 inches.

On the electronics and software side, we are prioritizing the full sensing chain required to collect flexible-sensor signals: evaluating controller and interface components for synchronized multimodal acquisition, improving wiring and connector durability for repeated deployment, and strengthening integration of the flexible sensor interfaces to reduce noise and failure points. A major upgrade from last semester is moving beyond SD-only logging by implementing a more real-time oriented data pipeline (where feasible), enabling faster testing, debugging, and verification that flexible-sensor data is being captured correctly. The resulting platform will provide a more reliable multimodal inspection tool and a stronger data foundation for the NDE Lab's future visualization and digital-twin simulation work.



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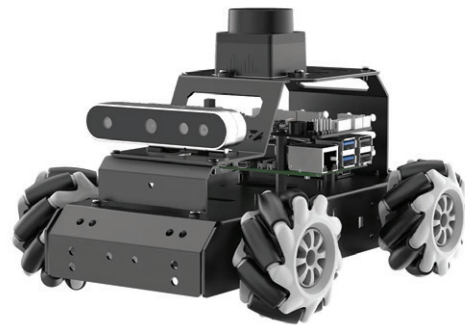
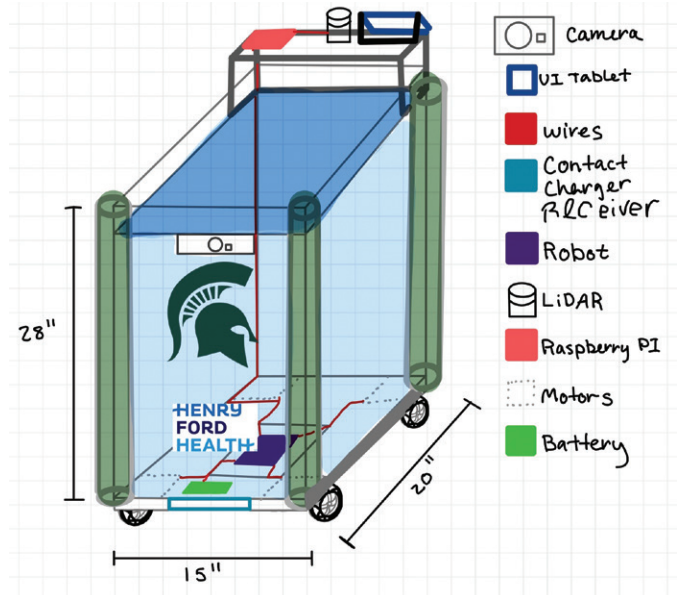
Dr. Nelson Sepúlveda Alancastro

Henry Ford Health Innovations Autonomous Pathology Specimen Transport Robot

Henry Ford Health is preparing for the development of Destination Grand, a state-of-the-art medical facility that will incorporate advanced technologies to improve hospital operations. One key area of focus is the use of autonomous robotic systems to enhance the efficiency, safety, and reliability of transporting pathological specimens within laboratory environments.

To support this vision, this project evaluates and advances an autonomous robotic delivery system within an existing hospital setting. Building on prior capstone work, the current phase emphasizes improving system reliability, enhancing navigation performance through LiDAR-based mapping and waypoint control, and refining user interaction within a real-world clinical lab environment.

This project represents an important step toward integrating robotics into everyday hospital workflows, helping lay the foundation for more efficient, consistent, and technology-driven healthcare operations in future facilities.



HENRY FORD HEALTH
Innovations



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Henry Ford Health Innovations

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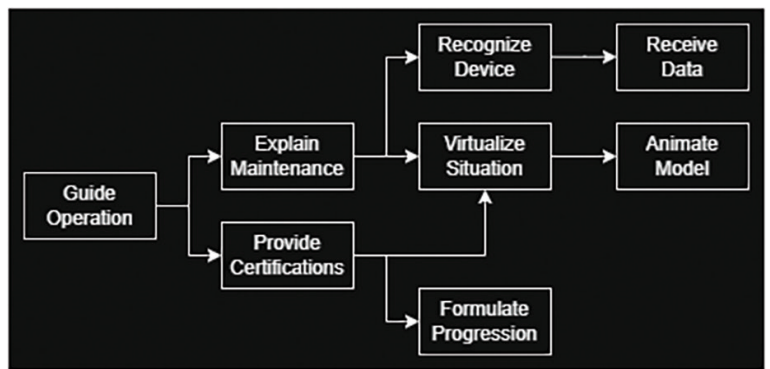
Dr. Mauro Ettore

Ascential Technologies Extended Reality

Extended Reality (XR), including augmented reality (AR), is being explored as a way to improve service workflows, reduce troubleshooting time, and introduce modern digital support tools at Ascential Technologies. This project focuses on developing XR pilots that demonstrate how immersive technology can assist technicians during real service tasks. Early research and feasibility analysis helped identify areas where AR could add value without disrupting existing workflows.

The main demonstration is an AR-guided field support experience delivered through a headset that assists technicians through structured repair and troubleshooting scenarios. The system provides step-by-step visual guidance within the workspace and includes a conversational AI interface for additional support. A key part of the project explores how printer system information, such as cartridge levels, connectivity status, and error conditions, can be displayed inside the XR environment to provide real-time assistance. Instead of relying on external screens or manuals, information is integrated directly into the user's field of view to create a more intuitive process.

These pilots aim to reduce downtime, improve troubleshooting consistency, and demonstrate how AR could lower travel needs through more effective remote guidance. The final outcome delivers a functional AR field support demonstration along with technical recommendations for expanding XR-based service tools in future maintenance and engineering workflows.



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Physical Ultrasonics, Microscopy and Acoustics Lab

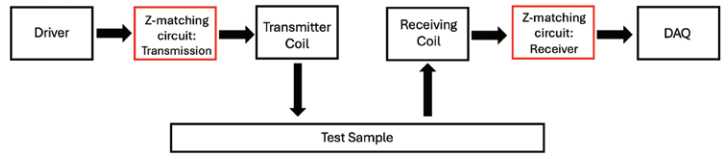
Impedance Matching Networks for EMAT Sensors

MSU's Physical Ultrasonics, Microscopy and Acoustics (PUMA) Lab is a part of the Nondestructive Evaluation (NDE) laboratory and focuses on the development of sensors and systems for monitoring and evaluating the structural integrity of materials and components. This project is focused on the optimization of Electromagnetic Acoustic Transducer (EMAT) sensors via impedance matching. EMATs generate ultrasonic waves within a conductive test material through Lorentz forces. While EMAT technology offers significant advantages in challenging environments, it presents challenges due to the inherently reactive and frequency-dependent impedance of the EMAT coil.

The primary objective of this project is to design and implement two impedance matching networks to maximize power transfer between the EMAT sensors and the associated amplifiers. Proper impedance matching reduces reflected power and improves signal integrity.

Our team began by reviewing the theoretical foundations of impedance matching and characterizing the complex impedance of the EMAT coil to determine its resistive and reactive elements. Using this data, we designed two L-matching circuits for the transmission and receiving networks. Component values were selected to compensate for the reactive elements of the EMAT and transform the load impedance into a more desirable impedance. These networks were constructed and experimentally validated to confirm the impedances closely matched.

In conjunction, we investigated transformer-based impedance matching techniques as an alternative solution for the transmission circuit. By analyzing both L-matching and transformer techniques, we aim to determine the most effective method for improving EMAT system performance.



College of Engineering
MICHIGAN STATE UNIVERSITY



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Dr. Sunil Kishore Chakrapani

MSU Bikes Service Center Intelligent Alert System for Red-Light Runners

The MSU Bikes Service Center has been promoting healthier and environmentally friendlier methods to get around campus for 20 years. However, sharing the road has been increasingly dangerous as red-light running continues to be a safety threat to pedestrians and bicyclists throughout the campus. The solution to this is the Intelligent Alert System (ITAS).

The system consists of three subsystems that autonomously detect signal transitions, identify approaching vehicles that may run a red light, and alert pedestrians via audio and visual cues.

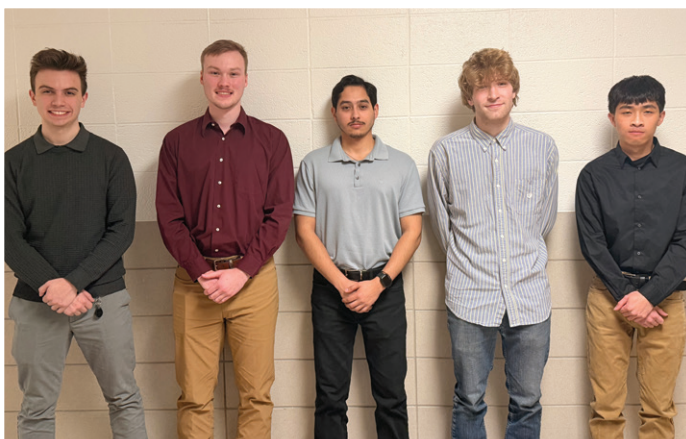
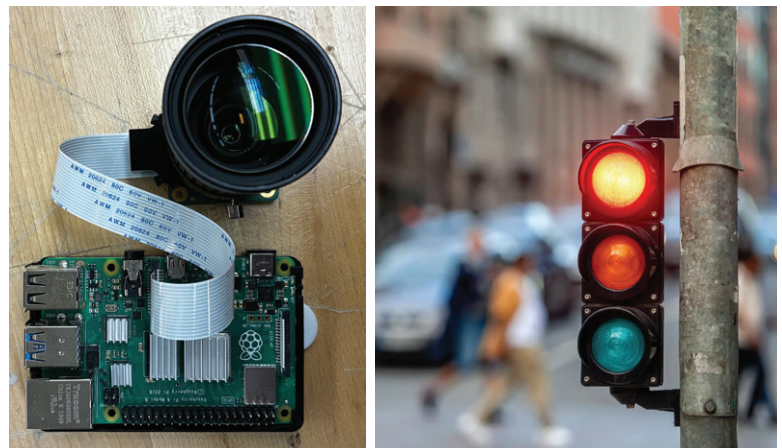
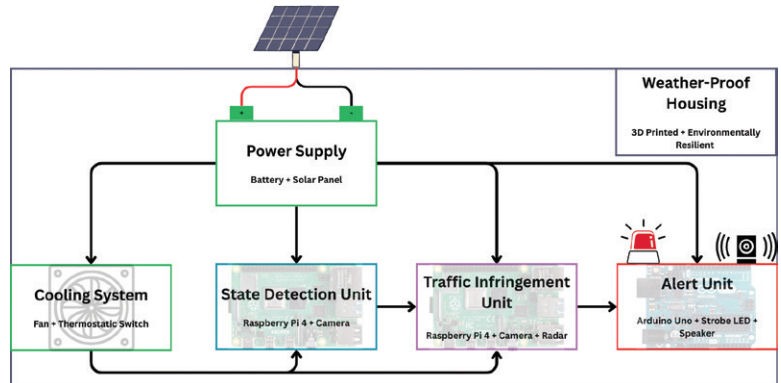
The first subsystem, State Detection Unit (SDU), uses a camera to detect the real-time traffic light state via adaptive HSV calibration. If the light is yellow or red, it will communicate with the second subsystem, the Traffic Infringement Unit (TFU).

The TFU uses a camera paired with radar that applies YOLO-based object detection and pixel tracking to monitor approaching vehicles and predict potential red-light violation. If a violation is detected, the TFU signals the Alert Unit (ALU).

The ALU is the third and final subsystem that serves as the final checkpoint of the whole system. It provides pedestrians warnings through audible and visual signals. The ALU verifies the red-light violation signals from the TFU using Doppler radar sensors.

Due to high power consumption of the subsystems, the ITAS needs to be a power-efficient and reliable operation. A 12V battery will be the primary power source with an additional solar panel to charge the battery.

Lastly, the system needs to be environmentally resilient to prevent fail components. A system housing was designed to provide slots for all necessary components and protection from environmental phenomena.



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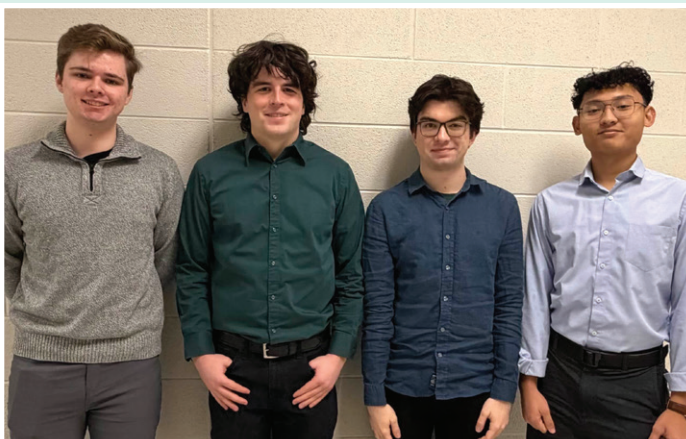
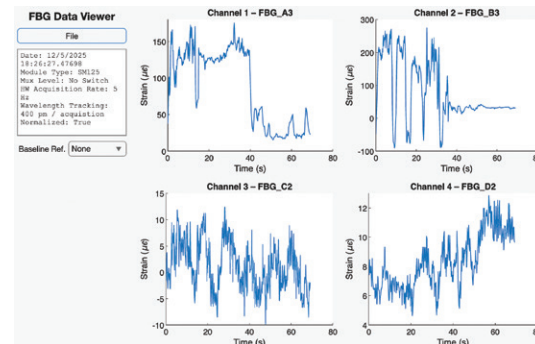
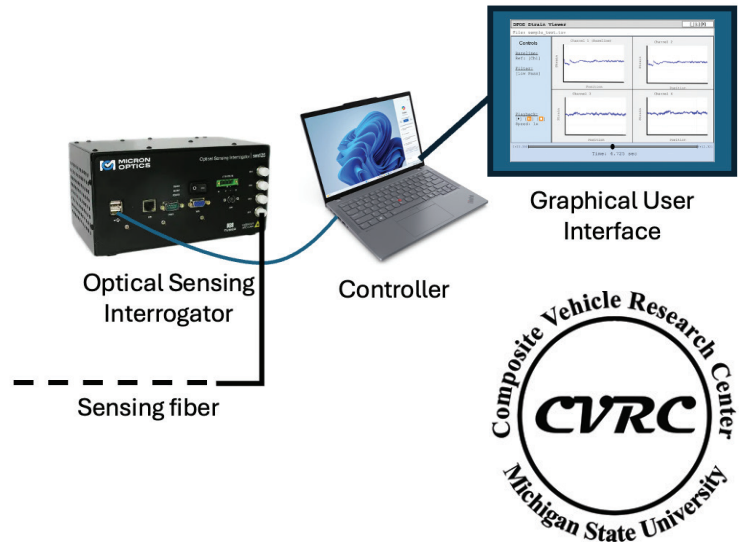
MSU Composite Vehicle Research Center (CVRC)

Design of a Prototype DFOS-Based Data Acquisition and Visualization System for SHM

Founded in 2006, MSU's Composite Vehicle Research Center (CVRC) has a focus on investigating composite components. Distributed fiber optics sensing (DFOS) systems are used in monitoring composite structures under mechanical, thermal, or vibrational excitation. These systems consist of optical distributed sensor interrogators, optical fibers, and a computer. Interrogators acquire strain and temperature data from the optical fiber and send the data to a computer. Current applications for displaying strain and temperature data are provided out-of-the-box by the interrogator manufacturers. However, these applications do not provide any advanced functionality besides displaying the collected data.

This project aims to develop a prototype integrated DFOS system capable of data collection, signal conditioning, and real-time visualizations. The software developed by the team will run on a computer in the lab and interface with an interrogator. Software will receive the data over a TCP/IP connection. Data will be processed and corrected against a baseline using MATLAB. A graphical user interface will be developed using the MATLAB App Designer and will be capable of displaying past data and real-time data, which can be up to four channels. Newly detected events will be displayed on a part of the GUI as well.

The major advantage of this system over its competitors will be the real-time detection of events as the data is being displayed over the graphical user interface (GUI). This feature will provide a better understanding of the effects of changes applied to the specimens.



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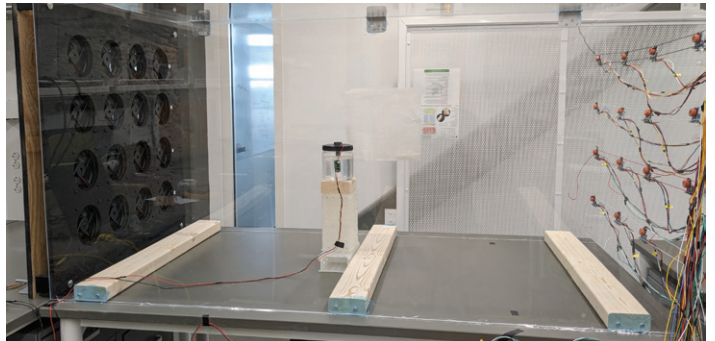
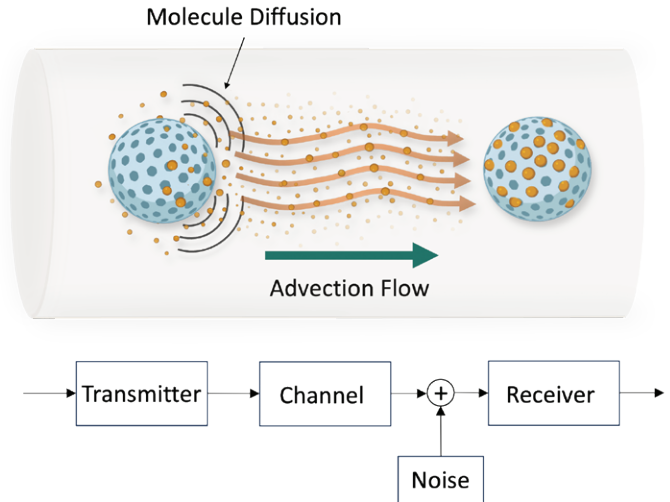
Unluturk Laboratory for Molecular Communication

Molecular Communication System Via a Wind Tunnel

Molecular communication (MC) is a bio-inspired system by which cells transmit information through chemical signals. Unlike traditional devices that use electromagnetic waves, MC relies on molecules to carry encoded information through a medium until they reach a receiver. This process is governed by bulk flow of the medium (advection) and molecular diffusion. This technology has many exciting applications in biomedical engineering, such as targeted drug therapy.

In this project, we use a wind tunnel platform with a controllable fan array to generate airflow, alcohol atomizers to transmit chemical signals, and a sensor array to detect them. While previous teams developed this physical system, the channel remains open-loop and relies on detection methods that degrade under complex conditions.

Our team's goal is to develop an adaptive, end-to-end communication system for this macroscale channel. We plan to implement a physics-based model to accurately model and characterize molecule transport. To improve reliability, we will develop a machine learning detector that analyzes signal patterns, like rise time peak amplitude, rather than relying on basic thresholds. Additionally, we will implement an adaptive link strategy to manage the trade-off between transmission speed and accuracy. By characterizing the channel impulse response, the system will automatically adjust its parameters, such as signal duration or detection thresholds, in response to changes in airflow. In doing so, we aim to reduce bit errors and improve the overall communication reliability.



Institute for Quantitative Health Science & Engineering
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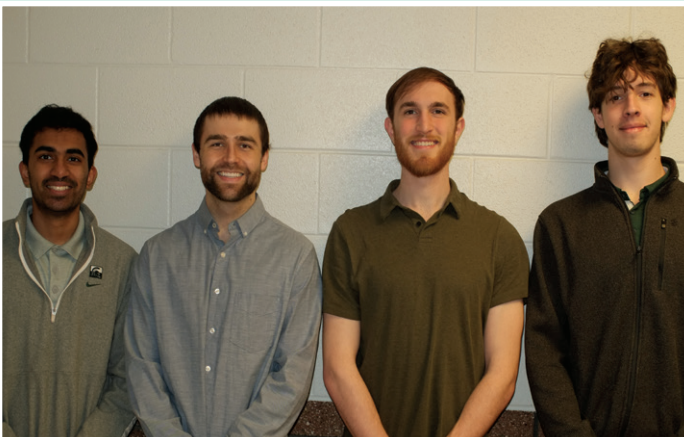
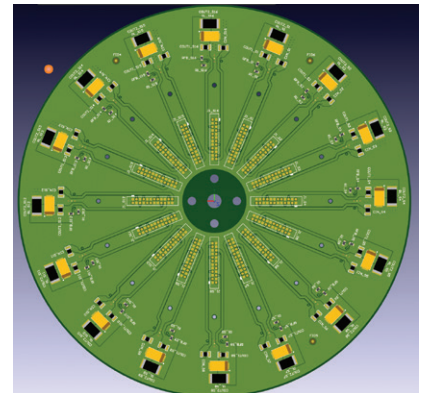
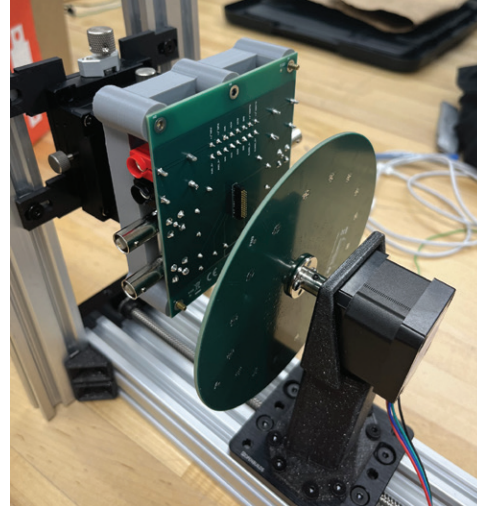
Dr. Tongtong Li

Texas Instruments and FRIB RF Integration for SEE Radiation Testing on Amplifiers

As one of the forefront semiconductor manufacturers in the world, Texas Instruments designs and manufactures an extensive array of chips. Among the nearly 80,000 products made by Texas Instruments, Radio Frequency Fully Differential Amplifiers (RF, FDAs) are extremely important. Their implementation in systems such as radars is critical thanks to their ability to enable wider ranges of freedom. However, these devices can be affected by radiation, which is especially a concern in space exploration where all manners of radiation are incident on the chips. Thus, these chips require extensive radiation testing to ensure their functionality and reliability in the harsh environment of space exploration.

Texas Instruments has worked with the Facility for Rare Isotope Beams (FRIB) at Michigan State University to test their chips for space exploration. The primary concern with radiation on these chips is Single Event Effects (SEE). SEE occurs on microelectronic chips when exposed to ionizing radiation. This radiation is capable of temporarily disrupting the functionality of these devices, and on occasion permanently damaging them.

Testing for such a wide range of phenomena is a time-consuming process which Texas Instruments has been hoping to automate. The team's goal is to expand the SUNDIAL device to support the testing of amplifiers at Radio Frequencies up to 16 GHz. A PCB-based solution will be matched at 50 Ohms, complete with a four-layer PCB stack design and integrated RF connectors and pogo pin connections to transmit DC and oscilloscope data.



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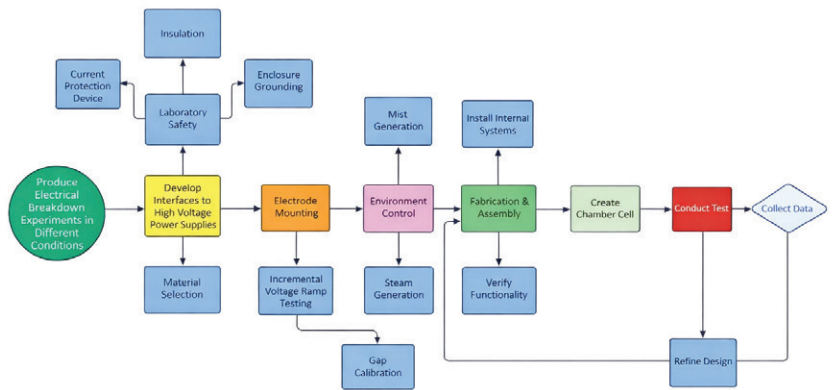
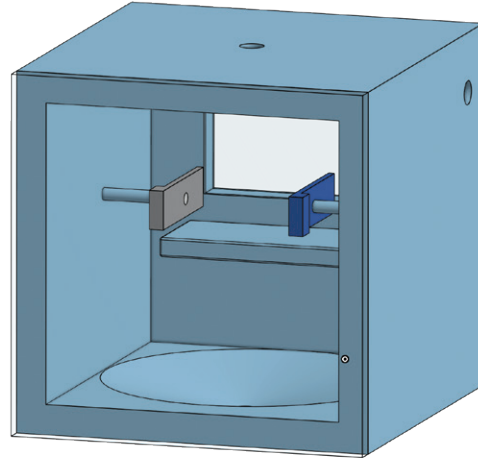
Dr. Sergey Baryshev

MSU Nondestructive Evaluation Laboratory High-Voltage Electric Boiler Testing Chamber

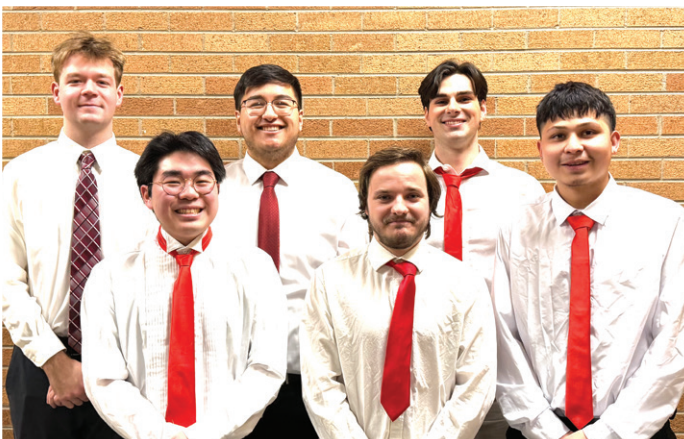
This project focuses on the engineering design, fabrication, and validation of a laboratory-scale high-voltage electric boiler testing chamber intended for advanced experimental research on electrical breakdown phenomena in multiphase environments, including air, saturated steam, and water-mist conditions. The system is being developed in collaboration with the MSU Nondestructive Evaluation Laboratory to support ongoing research into very high voltage (VHV) electric boiler technologies operating at voltage levels significantly exceeding current commercial systems.

The primary objective is to create a modular, safe, and highly configurable experimental platform capable of generating controlled electric fields while enabling precise adjustment of electrode spacing up to 10 inches. The chamber incorporates a rigid aluminum structural frame with interchangeable dielectric panels, optical observation windows for high-speed imaging and diagnostics, and an integrated grounding and insulation architecture designed in accordance with high-voltage laboratory safety standards. The non-pressurized chamber operates at ambient pressure while supporting controlled introduction of water mist or steam to replicate realistic operating environments encountered in industrial electric boiler applications.

Upon completion, the chamber will serve as a reusable and extensible research platform for future experimental endeavors, enabling systematic investigation of dielectric behavior in complex environments and supporting both academic research and industrial innovation in electrified thermal systems.



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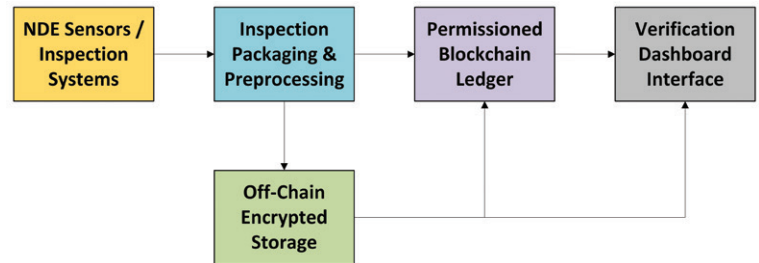
MSU Composite Vehicle Research Center (CVRC)

Design of a Secure Platform for NDE Data Management

The Composite Vehicle Research Center (CVRC) is a specialized research facility dedicated to the advancement of composite materials and structural technologies for defense and transportation applications. Focusing on the entire lifecycle of composite systems, from design and manufacturing to testing, the center aims to improve vehicle performance and safety through innovative engineering solutions.

Building on this mission, the CVRC is developing a secure, blockchain-enabled platform for the trusted storage, transmission, and verification of Nondestructive Evaluation (NDE) data. Modern NDE sensing systems generate critical datasets, such as pixel-based infrared (IR) thermography, distributed fiber-optic strain profiles, and ultrasonic robotic scanning, that require high levels of integrity and traceability for defense and critical infrastructure applications. Our project addresses these needs by designing a functional prototype that ensures data immutability, tamper resistance, and robust access control from the sensor level to the end-user.

The system architecture incorporates AES-based encryption and secure data packaging to protect sensitive information. A lightweight blockchain ledger (utilizing the Hyperledger Fabric framework) is integrated to store data hashes, timestamps, and access permissions, providing a verifiable audit trail for all datasets. To facilitate ease-of-use, we are developing a Graphical User Interface (GUI) dashboard that enables users to upload NDE datasets, track data provenance, and verify authenticity in real time. The platform is tested using representative datasets and simulated defense deployment scenarios to demonstrate a secure pipeline from ingestion to retrieval.



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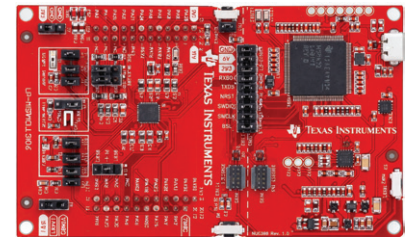
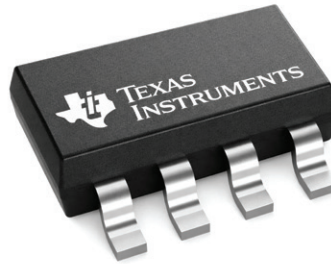
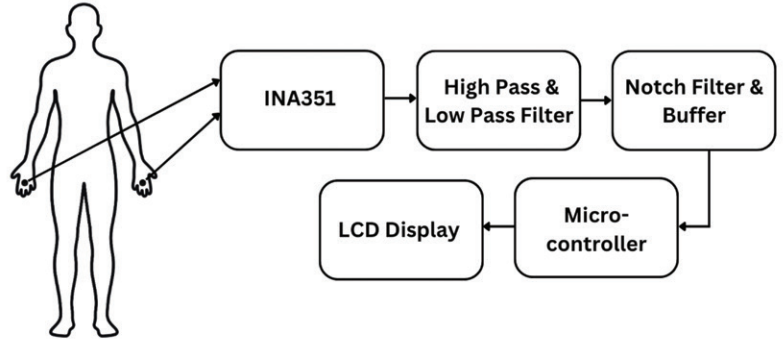
Texas Instruments ECG Signal Acquisition and Display System

Electrocardiogram (ECG) systems measure the electrical signals generated by the heart during each cardiac cycle. These signals, typically around 1 mV, are highly susceptible to noise and must be amplified and filtered before they can be digitized and displayed. This project focuses on the design and implementation of a standalone ECG signal acquisition and display system built on a custom printed circuit board (PCB). The goal is to create a compact system that acquires, processes, and displays ECG signals in real time.

The system consists of three main parts: an analog front end (AFE), a microcontroller, and a display interface. At the analog front-end level, the differential signal from the user's thumb electrodes first enters the INA351 instrumentation amplifier. The INA351 provides differential gain and strong common-mode noise rejection, which are critical for low-amplitude ECG signals. The amplified signal then passes through high-pass and low-pass filters that remove baseline drift and high-frequency interference. A notch filter further reduces powerline noise before the signal is sent for digitization.

The conditioned analog signal is input to the microcontroller's onboard Analog-to-Digital Converter (ADC), where it is sampled and converted into digital form. The microcontroller then processes the digitized waveform and transmits the data to the integrated LCD screen using SPI communication and control GPIO lines for real-time display.

The device operates as a standalone, battery-powered system using a 9V supply. The final design emphasizes stable performance and durability for transportation. The custom PCB implements the complete analog front end and interfaces with the microcontroller and display, resulting in a complete portable ECG solution.



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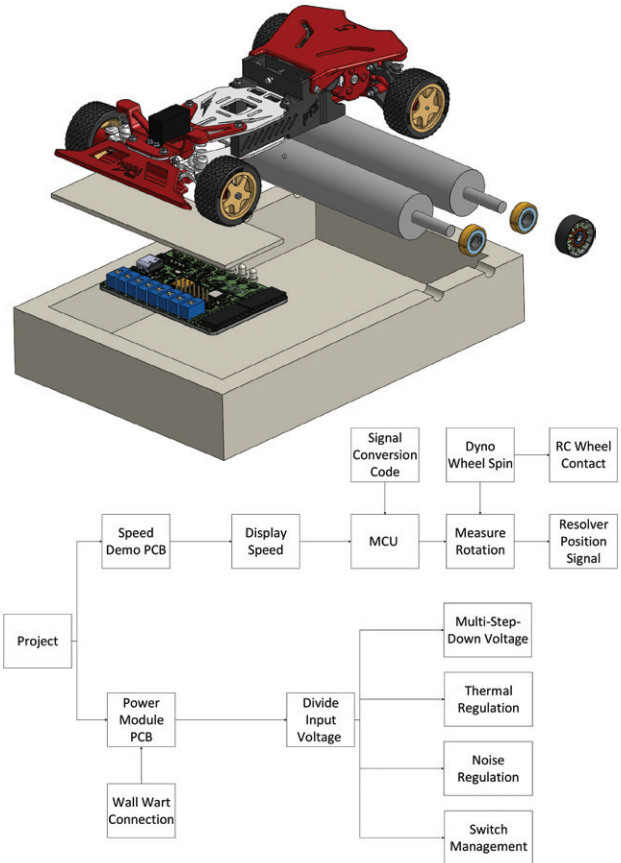
Texas Instruments

RC Car Speed Demo System with Power Module

Texas Instruments (TI) is a global semiconductor company that specializes in designing analog and embedded processing solutions used across various industrial and consumer markets. This project partners with TI to demonstrate resolver-based speed sensing using TI's ALM2402-Q1 resolver driver in a portable, demo-ready system.

Our team is developing an RC car speed demonstration platform that will in real time, convert the motion of the wheels into a readable speed output. The RC car will be mounted in an enclosure and drive "in place" on internal roller wheels that rotate beneath the RC car. Coupled to these rollers, a resolver converts mechanical rotation into sine/cosine electrical signals that can be used to represent real-time speed and rotational position. The ALM2402-Q1 interfaces with the resolver, and the conditioned signals are then converted to a displayed speed. To enable a fully portable system, we are also designing an accompanying power module that accepts a standard wall-wart input which will power the entire system as well as any external peripherals TI may use during their demos. The power module will generate multiple regulated supply rails with accessible connectors and independent on/off switches. Two custom PCBs will be designed and fabricated: one for the resolver driver interface and the other for the power module. An MCU will compute and display the speed data to an LCD display.

The objective of this project is to design and prototype a portable demonstration system that accurately measures RC car wheel speed using TI's resolver driver chip. By integrating the mechanical test enclosure, resolver interface electronics, and multi-rail portable power module, the system will provide a clean and repeatable platform for demonstrating resolver-based speed sensing using TI's components.



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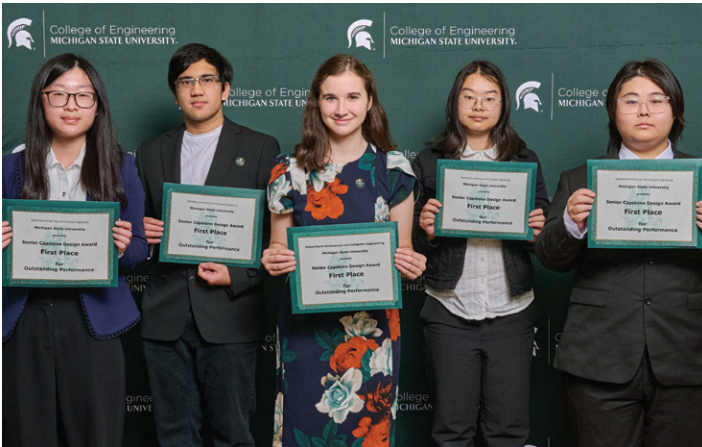
Esteban Garcia

Dallas, Texas

Project Facilitator

Dr. Shannon Nicley

Electrical and Computer Engineering Design Day Fall 2025 Awards



First Place Award

Team MSU Non-Destructive Evaluation Laboratory

“3D-Printed Flexible Sensors for Multi-Modal Sensing to Enable Digital Twins”

Left to right: Dingyun Long, Matthew Hein, Kathryn Tumavitch, Yufan Wu, Junwen Xiao



Second Place Award

Team Nic-Nix

“Personalized Nicotine Management System”

Left to right: Reese Willing, Nathan Tran, Gannon Blair, Fares Alhuwait, Nathan Gerrow



Third Place Award

Team Unluturk for Molecular Communication

“Molecular Communication Through Wind Tunnels”

Left to right: Jack Gattoni, Devonte Coppin, Harsh Manghnani, Michael Hichme



Fourth Place Award

Team Kent Consulting, Inc.

“A Smart Leveling Platform for Large Optics Telescopes”

Left to right: Salomon Beylouné, Almarelis Garcia, Gavin Murray, Kurk Edwards, Evram Attya



ME 412 Heat Transfer Laboratory

Yuping Wang
Academic Specialist
Department of Mechanical Engineering

Electronics Cooling – Review & Practice

Electronic devices, whether tiny microprocessors or large LED display panels, can be found in almost all areas of modern technology, and in each application, thermal management always presents a challenge. The heat generated during the device operation needs to be dissipated effectively to prevent overheating, and hence to maintain an optimal and stable performance and extend the lifespan of the system as well. For this project, students are expected to understand the importance and common methods used for electronics cooling. Each student team is to design, build, analyze, and test a heat transfer device that aims to enhance cooling from an electrically heated plate (simulating an electronic device). A box fan is available to provide airflow within a specified range. The objective of the design is to minimize the operating temperature of the plate when 20W of power is supplied. A second part of the project is for each team to choose and review a specific electronics cooling unit or conduct a general review of various cooling solutions for electronic systems. On the testing day, each team will have 15 minutes to set up, demonstrate/test, and disassemble their device. In addition, they will also prepare a PowerPoint slideshow for the audience to explain their design decisions, fabrication, operations and thermal analysis of their device.

Competition Schedule

Time	Station	Team Members
8:00	A	Wyland Hall, Colin Koot, James Patterson, Lily Reinke, Garrett Sauter
	B	Ebenezer Adjah, Peyton Ballard-McCrandall, Blake Burns, Andrew Hilbert, Brenden Jankowski
8:15	A	Benjamin Deininger, Reid Scaife, Natalie Stier, Bailey Surque, Javen Tumey-Patterson
	B	Mingjian Lai, Grace Owen, Lawrence Stanley, Adriana Theule, Yuming Wang
8:30	A	Grant Chesley, Jonathon Koehler, Noah Sosnowski, Kyler Spike, Aidan Weitekamp
	B	Joey Bastianelli, Jake Coury, Joseph Lamberg, Doug LeMasters, Sam Snyder
8:45	A	Aubert Kamdem, Andrew Koch, Caleb Montpas, Chris Nio, Emma Powell
	B	Matthew DeBona, Joseph Gall, Joseph Griffin, Sami Hasnaoui, Austin Wick
9:00	A	Hamza Ayaz, Alaina D'Allura, Kristina Dama, Olivia McCurdy, Chelsea Yang
	B	Daniel Hluz-Flores, Yuya Imamura, Elliott Miller, Emilio Ruma, Rivian Shoush
9:15	A	Sofia Aultman, Samantha Brown, Ryan James, Debra Lawlor, Kaitlyn Nguyen
	B	Mack Bartels, Riley Haener, Jacob Jackson, Brandon Nguyen, Luke Skonning
9:30	A	Sophia Draeger, Haley Kuplerski, Kaeden Palmitier, Alex Senclair, Anna Suranyi
	B	Shahd Alnasser, Vidur Dhanapune, James Handrich, Liam Keane, Justin Rukat
9:45	A	William Fiedler, Sean Kirby, Joshua Lyijynen, Eden Melamed, Stephen O'Rourke
	B	Ella Beck, Sidhaant Bhatt, Emerson Furhman, Kenyon Neal, Riley Newell
10:00	A	Seth Lindsey, Chanulya Perera, Kieran Russell, William Selais, Zachary Skilliter
	B	Alessandro Cabrera, Panashe Chiduma, Soham Inamdar, Rathin Jaikol, Savannah Nseir
10:15	A	Rigdon Freker, Thomas Gilbert, Raj Pataskar, Arjun Patel, Zachary Sawin
	B	Isabelle Christensen, Ana Konjevic, Connor Simpson, Wiley Smith, Emma Telepo
10:30	A	Jillian Carosella, Braden Grabaum, Emma Little, Luke Martin, Collin Norder
	B	Zuhaer Aranya, Kenneth Armor, Luke Bounds, Sandhya Jagannathan, Ryan Monaghan
10:45	A	Yahia Guenena, Reese Kent, Raul Murillo Martinez, Ryan Nehls, Lucas Wegrzyn
	B	Ethan Gehrke, Lucas Hicks, Dayton Long, Christopher Paige, Nathan Tessmer
11:00	A	Ethan Krahe, Dylan Lanthier, William Orloff, Joshua Spedoske, Adam Sypitkowski
	B	Rodney Barrow, Jett Edson, Wael Halabi, Luke McIntyre, Claire Osborne
11:15	A	Dylan Chaudhry, Aman Goenka, Nicholas Mansch, Aditya Sil, Braden Vertalka
	B	Tanner Auzins, Julian D'Souza, Ryan Fitzgerald, Lucas Kuzner, Qipei Zhong
11:30	A	Shane Bartlett, Ederick Plantegenest, Kurt Rademacher, Johnathan Runge, Nate Ulcak
	B	Aanshuman Agarwal, Dillon Ficke, Samuel Henn, Gabriel Lipps, Nikhil Narayana

ME 470 Mechanical Design & Manufacturing II



Nevzat Bircan Buğdaycı
Assistant Professor
Department of
Mechanical Engineering

Rope-Traversing Robot

The objective of this project is to design, build, and test a robot capable of traversing a suspended horizontal rope while transporting a payload. The robot will be powered by a standardized motor and must utilize mechanical transmission systems such as linkages, gears, friction drives, or similar mechanisms to achieve controlled motion along the rope. The system should demonstrate reliable movement, stable engagement with the rope, and efficient payload transport while maintaining a compact and lightweight design. Teams will fabricate their robots using materials and equipment available in the Manufacturing Teaching Laboratory (MTL). System performance will be evaluated based on four metrics: (1) payload successfully transported across the span, (2) mechanism weight, (3) traversal time, and (4) overall system size. The highest-performing team across all sections will receive the da Vinci Award.

Competition Schedule

Time	Team	Station	Team Members
8:00	S1T01	A	Erik Gonzalez-Zamora, Sean Kirby, Owen Webster, Godfrey Zheng
	S2T01	B	Brooke Adams, Shahd Alnasser, Tea Comai, Caden Koneval, Chad Stuecken
8:15	S1T02	A	Ava Carson, William Eby, Randy Seymour, Benjamin Simms
	S2T02	B	Anthony Davis, Saleem El Idrissi, Lucas Hicks, Henry Junghans, Michael Kahl
8:30	S1T03	A	Odrey Barreto Ramirez, Maggie Gaunt, Ava O'Neil, Pritesh Ravi
	S2T03	B	Hussein Alwraikat, Charlie LaBelle, Daniel Neill, Duc Nguyen, Devyn Thompson
8:45	S1T04	A	John Oginsky, Kimber Rhodes, Logan Volmering, Kenton Zatarga
	S2T04	B	Zahin Ahmed, Wael Halabi, Olivia McCurdy, Jackson Messer, Elliott Miller
9:00	S1T05	A	Joseph Brodzinski, Christopher Frontiero, Marin Leboucher, Myles Shoham
	S2T05	B	Benjamin Cannon, Evan Linsley, Fisher Poel, Grace Reeber, Luke Shehigian
9:15	S1T06	A	Devin Bennett, Gabe Meyerson, Skye Snyder, Sutton Wright
	S2T06	B	Nicholas Avery, Krish Gupta, Alec Johnson, Emma Telepo
9:30	S1T07	A	Xavier Cox, Aadi Kapoor, Jonathon Koehler, Lawrence Stanley
	S2T07	B	Jacob Casey, Douglas Cowan, Benjamin Drucker, Chase Fike, Javen Tumey-Patterson
9:45	S1T08	A	Zoe Atkins, Jake Crist, Beau Eckerle, Caleb Waller
	S2T08	B	Thomas Fluent, Zachary Johnson, Benjamin Kaake, Michael Tippy, Marco Vanoni
10:00	S1T09	A	Noah Battle, Taylor Meadows, Thomas Stackpoole, Alexander Stone
	S2T09	B	Adam Charboneau, Ryan Marvar, Steven Nguyen, Emilio Ruma, Alexander Wilbanks
10:15	S1T10	A	Connor Huang, Yuya Imamura, Carter Mayer, Nusayb Sarwar
	S2T10	B	Hayden Belanger, Vittorio DeGrazia, Jack Scott, Finn Weinstein, Nikhil Patel
10:30	S1T11	A	Dillon Ficke, Noah Haley, Dylan Murakami, Aiden Wishart
	S2T11	B	Liam Aitchison, Hannah Kleid, Kaitlyn Reif, Collin Rogers, Lukas Wegrzyn
10:45	S1T12	A	Rodney Barrow, Kristina Dama, Owen Pirog, Madison Wolters
	S2T12	B	Devin Grady, Ryan James, Christopher Kopiwoda, Adam Sypitkowski
11:00	S1T13	A	Griffin Kennedy, Ashwin Misra, Jason Slicker, Nate Ulcak
	S2T13	B	Shlok Chakraborty, Tyler Curtis, Gavin Lee, Jack Scott, Griffin Young
11:15	S1T14	A	Jonathan Hakim, Graham Parent, Rivan Shoush, Neil Tegui
	S2T14	B	Daniel Adragna, Lucas Sabadin Zampieri, Jacob Schreiner, Nicholas Todorov
11:30	S1T15	A	Nicholas Chrisekos, Michael Klimko, Wiley Smith, Adriana Theule

ME 478 Product Development



Dr. Tamara Reid Bush
Associate Dean for
Inclusive Excellence



Dr. Cory Wilson
Academic Specialist
School of Packaging

New Product Development

New products are vital to all firms, as their success can drive growth, enhance shareholder value, provide a significant competitive advantage, and propel the firm ahead of its competitors. Despite these potential benefits, innovation is inherently risky, and a substantial majority of new products face failure in the marketplace. Often, this failure can be traced back to an ineffective development process. Consequently, expertise in the new product development process as well as customer discovery is critical to the design and development process.

This course has the following objectives:

1. Identify and develop product concepts and definitions for an unmet market need.
2. Evaluate multiple designs that are mechanical in nature that address the market need.
3. Design, prototype and present a product that:
 - (i) incorporates biomechanical function,
 - (ii) is evaluated by multiple potential buyers and users, and
 - (iii) can be manufactured successfully and sold to a well-defined market.

Group	Members	Product Name and Description
A	Aanshuman Agarwal, Joey Furuya, Ethan Gehrke, Henry Junghans, Zea Labate, Ryan Nehls	Twist Assist: With you for every doorway.
B	Daniel Adragna, Joshua Bishel, Thomas Gilbert, Nicholas Todorov	Spartan Super Stretcher: Adjustable incline calf-stretching board with easy adjustability to help users prevent and recover from calf injuries.
C	Tea Comai, Emerson Fuhrman, Andrew Koch, Rivan Shoush, Manuel Vallejo	Kitty Sweep: We're more than just a litter box!.
D	Zachary Johnson, Ethan Krahe, Emma Littell, Riley Newell, Samuel Schroeder	Lock 'n' Roll: A cart designed to make ascending and descending stairs easier with heavy stuff.
E	Blake Burns, Kristina Dama, Andrew Marcaccio, Kaitlyn Nguyen, Owen Pirog	DeoDock: Designed for accessibility, DeoDock makes daily hygiene easier and safer for individuals facing mobility challenges.
F	Zachary Christiansen, Ella Fledderjohann, Jahnavi Movva, Stephen O'Rourke, Skye Snyder, Angelyn Wiedyk	Sparty Lift: Sparty Lift is a box lift solution for small spaces that gives a mechanical advantage to lift boxes from the floor to waist height, decreasing strain on the user's back and maintaining a minimal footprint for use in small spaces.
G	Andrew Alexander, Hamza Ayaz, Graham Parent, Nitsan Tal, Yuming Wang	Duo Lift: A shopping cart with two rotating baskets; designed for easy access to bottom basket for those with mobility issues.
H	Miles Benson, Lucas Kuzner, Douglas LeMasters, Arjun Patel, Arslan Umair	Apex Anchor: A pivoting, high strength roof anchoring system engineered to secure safety lines and keep roofing professionals safely locked in at every angle.
I	Sidhaant Vivek Bhatt, Gabe Meyerson, John Oginsky, Javen Tumey-Patterson, Griffin Young	EasiGlide: EasiGlide is a universal, leg-driven attachment that transforms manual wheelchairs into intuitive mobility aids, leveraging the body's most powerful muscles to enhance propulsion and prevent muscle degradation.



ME 497 Biomechanical Design

Dr. Tamara Reid Bush
Associate Dean for
Inclusion and Diversity



MKT 420 Biomechanical Design

Dr. Hang Nguyen
Associate Professor of Marketing
Business College

Biomechanical Design and New-Product Development

The Biomechanical Design and New-Product Development course (ME 497/MKT 420) provides students with a unique opportunity to develop and market a real, new product that incorporates biomechanical function. Students work in inter-disciplinary teams of engineers and marketers and experience the entire process of new-product development, from need identification, concept generation and testing, to product development, design analysis and launch. This course further strengthens students' knowledge and real-world exposure by working with Spartan Innovations. This year General Motors provided \$100 per team for prototyping costs.



Team	Team Members	Product Name and Description
01	Dario Fortuna, Jacob Halsey, Michael Kahl, Jackson Messer, Tyler Szuba	Easy-Tee: Mechanical device for golfers to help pick up their ball/place a tee in the ground without having to bend down which causes pain/injury.
02	Sofia Aultman, Alexandre Bourassa, Ava Carson, Nathan Durai, William Eby, Mia Gusumano	EZ Up: Helping seniors rise with confidence and stability. This is a sit-to-stand device that is marketed to seniors who struggle to rise from chairs.
03	Kathryn Czewski, Dylan Hammis, Emily Levin, Nikhil Patel, Zane Slanger-Grant, Owen Webster	Dolly Part'n: Enables a single person to safely lift and roll furniture to a new location with ease.
04	Ella Beck, Emma Munro, Peyton Parrish, Kaitlyn Reif, Lia Tomilo, Max Weiten	Pick Pal: I'll grab it so you don't have to.
05	Anthony Davis, Thomas Harvey, Nicholas Mansch, Eden Melamed, Raul Murillo Martinez	Hood Reacher: This is a device that will latch onto a car's hood latch. This mechanism will adjust position and hold your phone when you do work on your automobile, providing a convenient vantage point to watch videos while you work.
06	Lucas Hicks, Reese Kent, Carys Rawlins, Kimber Rhodes, Isabella Ruedisueli, Emilio Ruma	UpDog: What's UpDog? Not much – how about you? No – I was talking about this lift for pets with limited mobility.
07	Shahd Alnasser, Gabrielle DesRoberts, Madison Jurczyk, Juliette Macisco, Brandon Payne	Open Ease: Mechanical attachment on wheelchairs to allow users comfortability and ease while independently opening pull doors.
08	Zoe Atkins, Noah Battle, Jana Hassan, Keaton Klingelsmith, Alex Phillips-Breese, Alexander Stone	Can-Do Assisted Trash Can: A manual lift-assist system that transforms trash removal into a comfortable, more accessible experience that eliminates back strain.
09	Joshua France, Daniel Neill, Erica Peake, Vienna Thieu, Aidan Weitekamp	Upright: A retractable stand for crutches.

The Capstone Projects



Dr. Michael Lavagnino
Academic Specialist of Mechanical Engineering

Faculty Advisors: Seungik Baek, Lik Chuan Lee, Thomas Pence, Wei-Che Tai, Elisa Toulson, Guoming Zhu



Baek



Lee



Pence



Tai



Toulson



Zhu

Presentation Schedule – Engineering Building, Room 1202

Time	Team Sponsor	Project Title
8:00 a.m.	MSU Bikes Service Center	Bike Powered Prosthetics
8:30 a.m.	MSU Bikes Service Center	Above-Knee Prosthetic Bike Leg
9:00 a.m.	General Motors	Flex Body Modeling and Simulation Best Practices
9:30 a.m.	General Motors	Flex Body Modeling and Simulation Best Practices
10:00 a.m.	General Motors	Modeling Best Practices for Simpack’s SIMBEAM
10:30 a.m.	General Motors	Modeling Best Practices for Simpack’s SIMBEAM
11:00 a.m.	MSU Department of Mechanical Engineering	Constant Volume Combustion Chamber
11:30 a.m.	MSU Department of Mechanical Engineering	Data Acquisition and Schlieren Imaging System for a Constant Volume Vessel for Combustion Studies

ME 481 Mechanical Engineering Design Projects

ME 481 is a required course for mechanical engineering majors at MSU. The course provides students with a team-based capstone design experience in which they:

- Use the technical expertise, communication skills, and teaming methodologies they have learned throughout their mechanical engineering curriculum, together with their creativity, to solve real world problems
- Collaborate with practicing engineers to address problems sponsored by industry
- Develop new products or redesign existing products to reduce costs or enhance reliability and functionality
- Interact with large, medium, and small companies in the automotive, defense, aerospace, consumer products, and agricultural industries, and with US government agencies.

We gratefully acknowledge the participation support of this semester’s project sponsors: *Communit-e Splint, Dauch Corporation, Eaton Aerospace Corporation, Facility for Rare Isotope Beams, Fraunhofer USA, General Motors, Michigan AgrAbility, MSU Adaptive Sports & Recreation Club, MSU Baja Racing Team, MSU Bikes Service Center, MSU Department of Mechanical Engineering, MSU Experience Architecture, MSU Infrastructure & Planning, MSU Institutional Space Planning & Management, MSU Resource Center for Persons with Disabilities, North American Controls, Inc., Vertical Autonomy, and Wyatt’s Creative Works.*

MSU Bikes Service Center

Bike Powered Prosthetics

The MSU Bikes Service Center is a full-service, university-owned bike shop dedicated to promoting bicycling as a healthy and environmentally sustainable transportation alternative, helping students, visitors, and area residents enjoy riding on and off campus. At Michigan State University, approximately 1,000–1,500 bicycles are abandoned each year, many of which are collected and assessed by MSU Bikes. While bicycles are an abundant resource worldwide, many discarded bikes are scrapped for metal parts; however, these materials have the potential to be repurposed into functional lower-limb prosthetics, offering a more sustainable and impactful use. Currently, nearly 90% of individuals in developing countries who experience limb loss lack access to a prosthetic device that could significantly improve their mobility and quality of life. The MSU Bikes Service Center, led by Tim Potter, has partnered with Ben Hogan, a Certified Prosthetist Orthotist at Mary Free Bed Rehabilitation Hospital, to develop an innovative project focused on creating an affordable and functional prosthetic using materials sourced from abandoned bicycles. Considering the unique challenges faced in developing countries, Hogan sought a way to design prosthetics that could be easily and widely produced at a lower cost, creating a fully functional prototype constructed entirely from bicycle components and encouraging further exploration and refinement of the idea.

Our project was to assemble another prototype utilizing the original design of an above-the-knee prosthetic from a bike, modifying the design to emphasize functionality using accessible tools. Collaborating with a volunteer client enabled us to refine inconsistencies in the final design and evaluate the prosthetic's performance under practical, real-life conditions, with goals of functionality, durability, lightweight, and ease of adjustability.



Michigan State University

Team Members (left to right)

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Ella Beck
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Nicole Stensen
Grand Ledge, Michigan

MSU Bikes Service Center

Project Sponsors

Ben Hogan
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Tim Potter
East Lansing, Michigan

ME Faculty Advisor

Dr. Lik Chuan Lee

MSU Bikes Service Center Above-Knee Prosthetic Bike Leg

Benjamin Hogan is a Certified Prosthetist/Orthotist who has more than ten years of experience and specializes in lower extremity prosthetics. For the past nine years Ben has been working at Mary Free Bed Rehabilitation hospital, where he has participated in the Range of Motion project in Guatemala where he, and many others, provide life-changing prosthetics care for thousands of patients. For the past year, Ben has been working on a project titled Project Bike Leg. Tim Potter is an avid fan of cycling and is the Sustainable Transportation Manager at the MSU Bike Service Center. He has worked at the MSU Bike Service Center for 20 years as the manager of the Center. Tim partnered with Ben Hogan by donating bikes and parts for Project Bike Leg. Ben was one of the first student mechanics at the Center, and he has had a heart for bicycles ever since.

Nine out of ten amputees have no access to modern prosthetics that would otherwise help them live their lives like those around them, primarily due to accessibility issues in certain regions and the high cost of modern prosthetics in regions where they are available. However, with the abundance of bikes around the world, mainly abandoned ones destined to be scrapped, make them an excellent and readily available resource to construct an above-knee prosthetic. Additionally, the skills and technology necessary to construct a prosthetic such as this has been designed to be within the realm of possibility for many individuals, even those with no background in prosthetics. The students of this project built their own above-knee prosthetic, made entirely of common bike parts. This project is built upon a previous year's below-knee prosthetic from the same sponsors, utilizing prior information and guides from the sponsor. The final design provides an innovative and stable approach to creating an affordable and articulated above-knee prosthetic.



Michigan State University

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Ryan Nehls
Walled Lake, Michigan

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MSU Bikes Service Center

Project Sponsors

Ben Hogan
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East Lansing, Michigan

ME Faculty Advisor

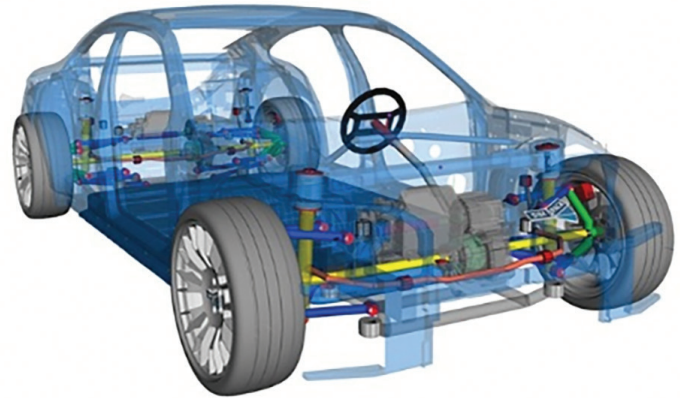
Dr. Lik Chuan Lee

General Motors

Flex Body Modeling and Simulation Best Practices

General Motors (GM) is a global powerhouse in automobile manufacturing, founded in 1908 in Flint, Michigan, with its headquarters in Detroit, Michigan. GM produces a wide range of vehicles, including but not limited to trucks and SUVs, through well-known brands such as GMC, Chevrolet, Buick, and Cadillac. In recent years, GM has dedicated itself to improving safety features, electric vehicle technology, autonomous driving, and sustainability in a pursuit to achieve zero crashes, zero emissions, and zero congestion. Additionally, GM is a leader in powering the American economy, directly employing over 97,000 people in the U.S. and investing billions of dollars into research and development. GM continuously seeks to improve operations to create a brighter, more efficient, and sustainable future in transportation.

Flexible bodies in multi-body dynamic (MBD) simulations increase accuracy; however, they often strain resources due to their complexity. To address this, our team conducted optimization studies for various suspension components, including the lower control arm, upper control arm, knuckle, shock yoke, and rear solid axle. We analyzed these flexible parts under various events (including ride, handling, and loads) to determine the optimal settings for each scenario. Using the results from our analyses, our team developed best practices for flex-body modeling and simulation to balance realism with computational efficiency. This resulted in guidelines that significantly reduce computation time and costs, while maintaining high fidelity in simulation results.



Michigan State University

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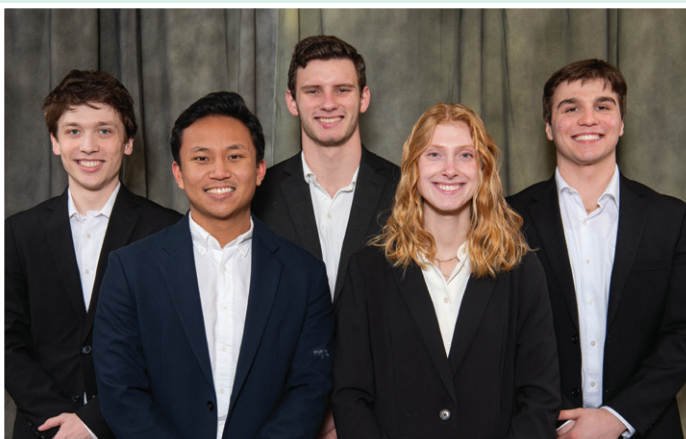
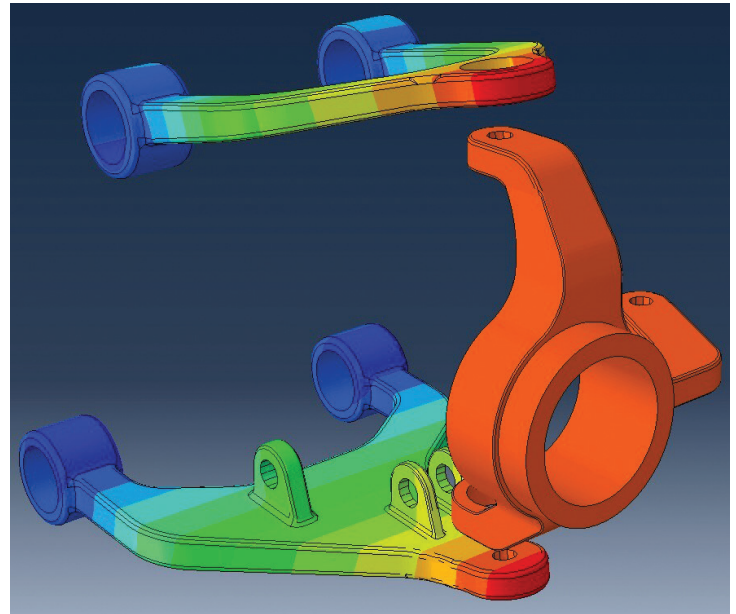
ME Faculty Advisor

Dr. Wei-Che Tai

General Motors Flex Body Modeling and Simulation Best Practices

Our project was completed in collaboration with an industry sponsor in the automotive sector that specializes in vehicle system modeling and simulation for product development. The sponsor provided access to commercial multi-body dynamics (MBD) software, training resources, and representative vehicle models used in real engineering workflows. Through this partnership, the team gained exposure to industry practices for balancing simulation fidelity with computational efficiency, as well as insight into how virtual validation supports faster product development cycles, reduced engineering costs, and improved vehicle performance in place of physical prototyping.

The project focused on improving efficiency in full-vehicle MBD simulations by optimizing the use of flexible body modeling. Incorporating flexible bodies increased simulation realism by capturing structural compliance; but it also significantly increased computational time and hardware demand, particularly in models containing more than 17 flexible components across the body, suspension and chassis systems. The team investigated strategies to balance accuracy and computational cost across three event categories (ride, handling, and durability load cases) by identifying optimized modeling settings for key component groups. The work was organized into targeted studies of suspension components (including control arms, damper yokes, multilink links, and wheel hubs). The resulting recommendations reduced simulation resource requirements while, maintaining acceptable accuracy, demonstrating pathways for faster analysis turnaround, and lowering computational cost in future vehicle development programs.



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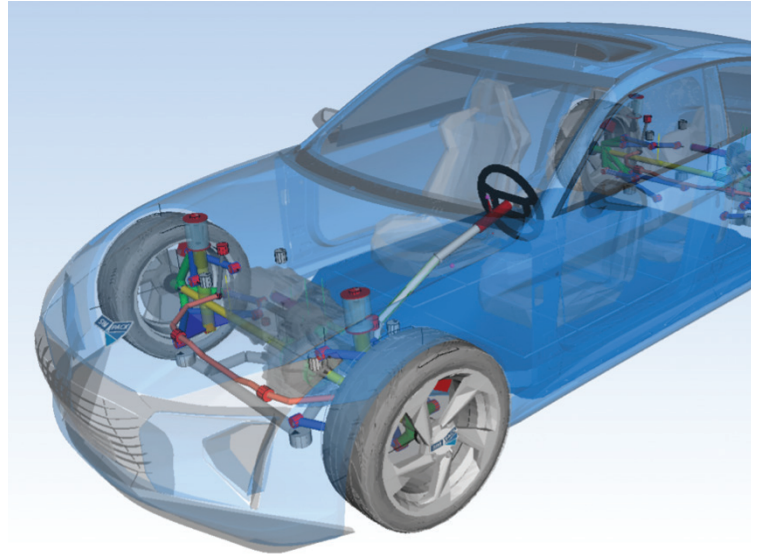
Dr. Guoming Zhu

General Motors

Modeling Best Practices for Simpack's SIMBEAM

General Motors is an automotive manufacturer that designs and produces vehicles used around the world. The company focuses on improving vehicle performance, safety, and comfort through thoughtful design and testing. Accurate computer-based simulations play an important role in this process by enabling engineers to study how vehicle components behave under real driving conditions without building physical prototypes. By testing parts virtually, General Motors can evaluate design changes early, identify potential issues, and compare concepts more efficiently. This approach reduces development time and cost while meeting performance and durability requirements.

This project focused on creating and evaluating multi-body dynamics models of three common vehicle suspension components: stabilizer bars, torsion bars, and leaf springs. These parts are critical to vehicle handling, durability, and ride comfort. Each component was modeled in SIMULIA Simpack using flexible body representations. Simbeam node and modal parameters were systematically varied, with emphasis on placement and count, to evaluate their influence on model response. The models were evaluated in full or partial vehicle handling, durability, and ride simulations. Real vehicle dimensions and operating loads were incorporated to ensure realistic simulations. The Simpack results were compared with results from Abaqus, a finite element analysis software. The main deliverable was a report providing clear and easy-to-follow guidelines for building reliable models in Simpack, serving as a structured reference to support confident and consistent use of the software.



Michigan State University

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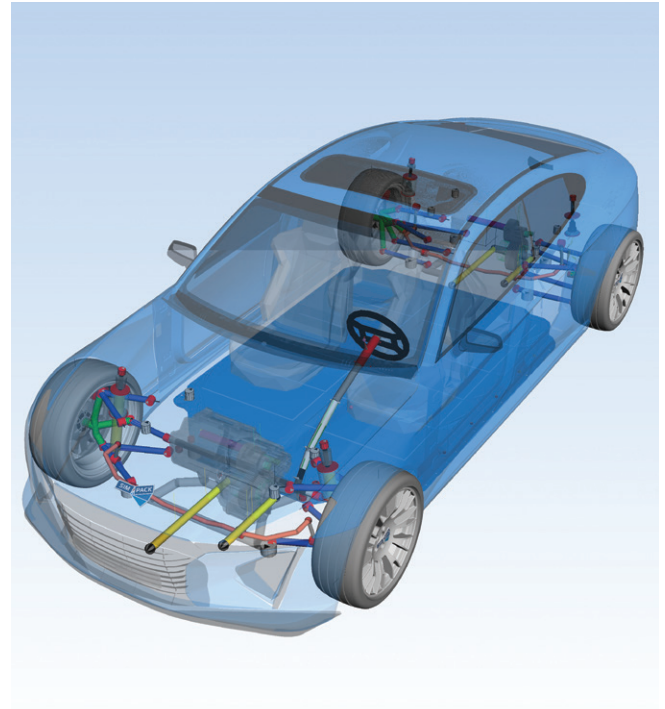
ME Faculty Advisor

Dr. Thomas Pence

General Motors Modeling Best Practices for Simpack's SIMBEAM

General Motors is a leading American automotive manufacturer responsible for the Chevrolet, Cadillac, Buick, and GMC car brands. Founded in 1908 and headquartered in Detroit, Michigan, GM operates on a global scale and is one of the world's largest automakers, with a strong focus on innovation, electrification, and advanced engineering practices. General Motors leverages advanced software simulations to help ensure the safety and reliability of components throughout their vehicles while minimizing costs and maximizing the speed of development.

In simulation and modeling, a more efficient model is desirable, as long as it maintains accuracy and cost. One way to achieve this is to maximize the efficiency of current tools instead of purchasing or developing more advanced software. Simpack is a very powerful tool with many capabilities and options. Many of these options are very complex, and the slightest change to the value can impact the fidelity of the model and the time it takes to solve the simulation. The key is finding a balance between accuracy, performance, and simulation time. This project studied the impact of the number of nodes (shape, accuracy), linear vs. non-linear modeling, and the number of modeled modes in simulating a Stabilizer Bar, Leaf Springs, and Torsion Bars. We tested three stabilizer bar configurations to observe the effects that more complex shapes had on the simulation times and accuracies. Improved model fidelity can lead to better representation of the real world in simulation. This can lead to better predictions and results earlier on in a vehicle development without the need for hardware. Optimized settings for each of these components can provide the necessary balance to ensure an ideal model fidelity for results, while also limiting the impact on solver time. This can save hundreds of thousands of dollars needed for new computation hardware or purchasing time on a computation cluster.



Michigan State University

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General Motors *Project Sponsors*

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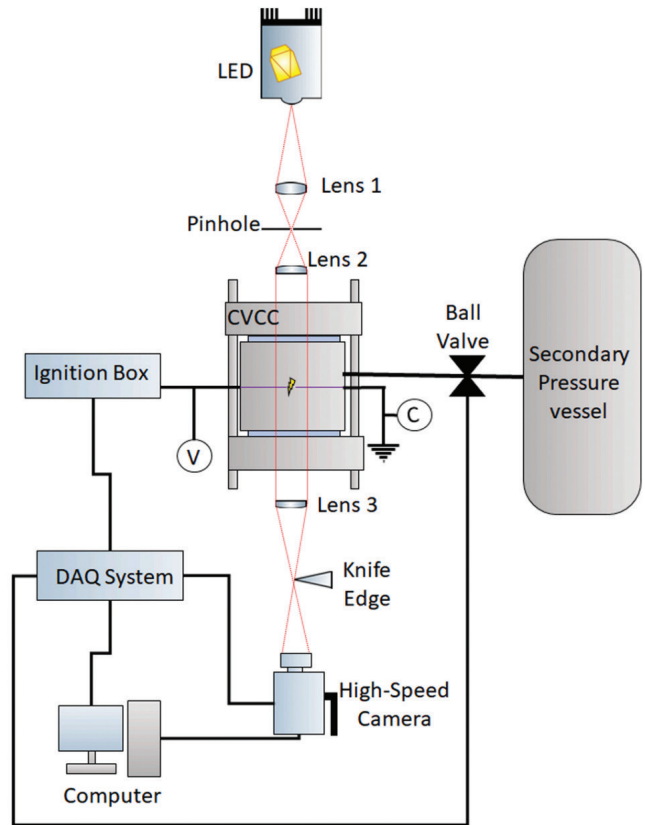
Dr. Seungik Baek

MSU Department of Mechanical Engineering

Constant Volume Combustion Chamber

The design of an optically accessible high-pressure constant volume vessel supports advanced combustion research at Michigan State University's Alternative Fuels and Combustion Laboratory. As the global energy sector works to reduce greenhouse gas emissions and transition toward renewable fuels, improving combustion efficiency and ignition performance is essential to meeting future emissions and fuel economy standards. Fundamental properties such as laminar flame speed and ignition behavior are critical for understanding combustion chemistry, validating chemical kinetic models, and enabling renewable fuels to be integrated into practical engine systems. Developing reliable experimental platforms to measure these properties is therefore central to advancing cleaner, more efficient combustion technologies.

This project focuses on redesigning and improving the laboratory's existing constant-volume vessel to enhance functionality, safety, and research flexibility. The new design must safely operate at high pressure and high temperature while providing improved optical access for ignition and spray visualization. Key upgrades include incorporating a dedicated access door to simplify cleaning soot and residue from the windows between tests, increasing window size relative to the combustion chamber to improve visibility of fuel injection and flame development, and adding an additional port for a pressure relief valve. A primary objective is also to make the system modular, enabling fuel injectors and spark configurations to be interchanged easily to support a range of experimental setups. Final deliverables include detailed CAD models, finite element analysis with a factor of safety calculations, and a comprehensive materials and cost assessment, resulting in a more robust, adaptable, and user-friendly combustion research platform.



Department of Mechanical Engineering
MICHIGAN STATE UNIVERSITY



Michigan State University

Team Members (left to right)

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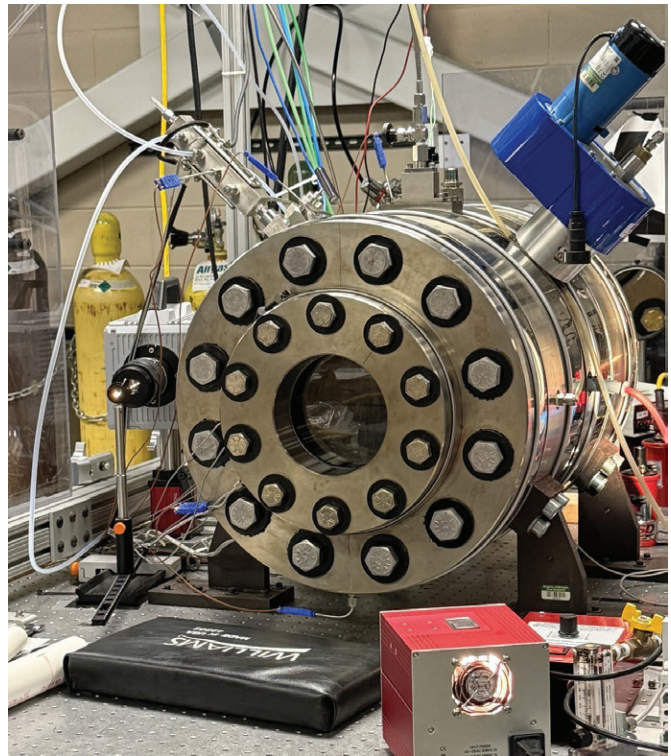
Dr. Elisa Toulson

MSU Department of Mechanical Engineering

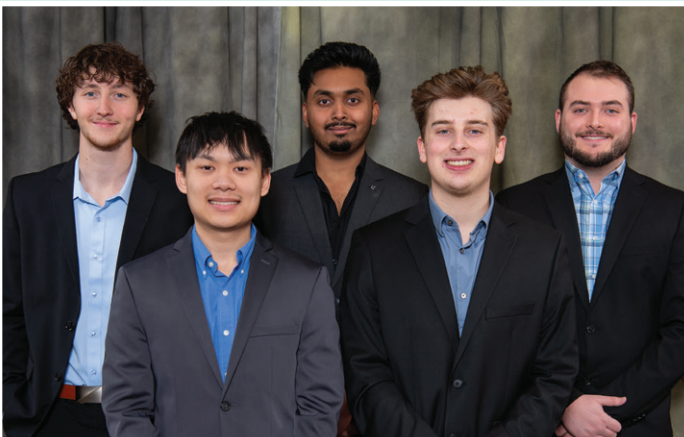
Data Acquisition and Schlieren Imaging System for a Constant Volume Vessel for Combustion Studies

The Alternative Fuels and Combustion Laboratory at Michigan State University supports combustion research using a high-pressure constant-volume vessel to measure and understand fundamental properties such as laminar flame speed. Experiments in the laboratory focus on fuel-air mixing and ignition development under high-temperature and high-pressure conditions relevant to engines and gas turbines. The results of this research are used to improve fuel efficiency, study alternative fuels, and enhance their use. The laboratory, supervised by Dr. Toulson, is looking for a new optically accessible constant-volume vessel that is capable of measuring flame speeds and imaging ignition and fuel injection at higher maximum pressures.

The objective of this project was to design a data acquisition system (DAQ) and Schlieren imaging system to bring additional capabilities and optimization to the new constant-volume combustion vessel. The DAQ system is designed to manage ignition timing, sensor measurements, imaging of combustion events, and gas composition in the combustion chamber. Because combustion happens in milliseconds, the imaging triggering system responds immediately at the start of combustion. The final design incorporates a wiring diagram with a National Instruments interface configured to control all DAQ subsystems. The Schlieren imaging system uses a single-pass Z-type configuration to reduce complexity and costs while ensuring clear combustion visualization. The final design is capable of spray pattern studies, alternative fuel testing, and dual fuel injector control. The components selected were modular and easily reconfigurable.



Department of Mechanical Engineering
MICHIGAN STATE UNIVERSITY



Michigan State University

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MSU Department of Mechanical Engineering

Project Sponsors

Jon Hilton
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Elisa Toulson
East Lansing, Michigan

ME Faculty Advisor

Dr. Elisa Toulson

The Capstone Projects



Dr. Michael Lavagnino
Academic Specialist of Mechanical Engineering

Faculty Advisors: Seungik Baek, Norbert Mueller, Siva Nadimpalli, Thomas Pence, Wei-Che Tai, Indrek Wichman, Neil Wright



Baek



Mueller



Nadimpalli



Pence



Tai



Wichman



Wright

Presentation Schedule – Engineering Building, Room 1220

Time	Team Sponsor	Project Title
8:00 a.m.	MSU Surplus Store and Recycling Center	Design of a Cover System for Vermicomposting
8:30 a.m.	Facility for Rare Isotope Beams (FRIB)	Gasket Polisher Arm and Grabber
9:00 a.m.	Wyatt's Creative Works, LLC	Modern and Innovative Home Storage Solutions
9:30 a.m.	Wyatt's Creative Works, LLC	Modern and Innovative Home Storage Solutions
10:00 a.m.	Wyatt's Creative Works, LLC	Intricate Jewelry Design
10:30 a.m.	Wyatt's Creative Works, LLC	Intricate Jewelry Design
11:00 a.m.	MSU Department of Mechanical Engineering	Fabrication of Bio-Inspired Metamaterial Mechanisms

Mechanical Engineering Design Program

Mechanical engineers make the world move and provide the energy for it to do so. One goal of the MSU Mechanical Engineering Program is to educate engineers who are prepared to lead, create, and innovate as their professional or graduate careers evolve. The Mechanical Engineering Design Program is the key element of the curriculum that supports this goal. There are five required design courses in the program which provide our students with eight hands-on team-based, ‘design, test and build’ projects, and numerous opportunities to practice and refine their written, oral, poster, and video presentation skills. The Design Program in Mechanical Engineering has attracted national recognition on many occasions and helps to distinguish the ME program as one of the best in the country.

The ME faculty who supervised ME 481 design teams this semester are: *Rebecca Anthony, Seungik Baek, Huazhen Fang, Yang Guo, Lik Chuan Lee, Zhaojian Li, Ricardo Mejia, Norbert Mueller, Siva Nadimpalli, Ahmed Naguib, Thomas Pence, Geoffrey Recktenwald, Mike Symons, Wei-Che Tai, Elisa Toulson, Indrek Wichman, Neil Wright, Junlin Yuan, Guoming Zhu.*

MSU Surplus Store and Recycling Center Design of a Cover System for Vermicomposting

The MSU Surplus Store and Recycling Center (SSRC) is a key part of managing waste from campus. The vision of the MSU Surplus Store and Recycling Center is to “lead the MSU community towards a culture of zero waste, where all our programming is funded through revenue from waste diversion.”¹ To fulfill the needs of MSU diversion efforts, the SSRC has different departments that focus on the highest and best uses of undesired items and collected waste to keep them out of the landfill. The SSRC collection team goes around campus picking up unwanted items, recyclables, organics, and trash from MSU buildings. Once the material makes it back to the building, staff members resell used items at lower prices through the Surplus Store and process recyclables through the Material Recovery Facility to be sent out to regional manufacturers. To recycle organics, the facility has implemented vermicomposting, a process where food scraps collected from campus are converted to vermicompost, a sustainable soil amendment.

The goal of this project was to design a system to thermally insulate the vermicompost wedges during the winter to create a stable environment for the worms. During the winter months, the wedge temperatures drop too low (40-50oF) to support efficient vermicomposting. Currently, the operations team members place a plastic sheet directly over the wedge. With this setup, the worms present in the compost can easily get stuck and freeze to the coverings when they surface in search of fresh air and food. To solve these problems, a system was developed to suspend a thermally insulated sheet over the mound. Inspiration was taken from previous attempts at solving this problem. By using engineering principles and problem-solving, we improved the current process to better insulate the wedge for productive vermicomposting year-round.



[1] “MSU Surplus Store and Recycling Center,” MSU Surplus Store, 02/12/2026. <https://msusurplusstore.com/>



Michigan State University

Team Members (left to right)

Ryan DePree
Grand Rapids, Michigan

Emerson Fuhrman
Sheridan, Wyoming

Sam Gamble
Grand Rapids, Michigan

Isabelle Christensen
Cowley, Wyoming

Aubert Kamdem
Holt, Michigan

MSU Surplus Store & Recycling Center

Project Sponsor

Julia Haidler
East Lansing, Michigan

ME Faculty Advisor

Dr. Neil Wright

Facility for Rare Isotope Beams Gasket Polisher Arm and Grabber

The Facility for Rare Isotope Beams (FRIB) at Michigan State University (MSU) is a world-class research and training center, hosting the most powerful rare-isotope accelerator. Researchers at the FRIB study the properties and fundamental interactions of rare isotopes and nuclear astrophysics and their impact on medicine, homeland security, and industry.

Within the High Power Targetry Group, iron gaskets are used to create a vacuum environment for the operation of a particle accelerator. It is critical to replace iron gaskets during every service period. To achieve a perfect vacuum, the surface of the gasket must be as smooth as possible; any scratches can cause air molecules to leak into the system. The current gasket manufacturing process requires significant manual labor. Each gasket is sanded using progressively finer sandpaper, ranging from 180 grit to 1200 grit, and the process takes over seven hours to complete. By utilizing a polishing machine, such as the Struers Rotopol-31, the sanding time can potentially be reduced by half. The Struers Rotopol-31 is a laboratory polishing machine equipped with a rotating disk that holds adhesive-backed sandpaper. The objective of this project was to design a mechanism with a grabber that securely holds the gasket while applying downward force onto the polishing surface. Since gaskets come in multiple sizes, the design incorporated an interchangeable grabber. The concept was designed and validated using 3D CAD and finite element analysis (FEA) software.



Michigan State University

Team Members (left to right)

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Joseph Tetteh
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Debra Lawlor
Oswego, Illinois

Facility for Rare Isotope Beams

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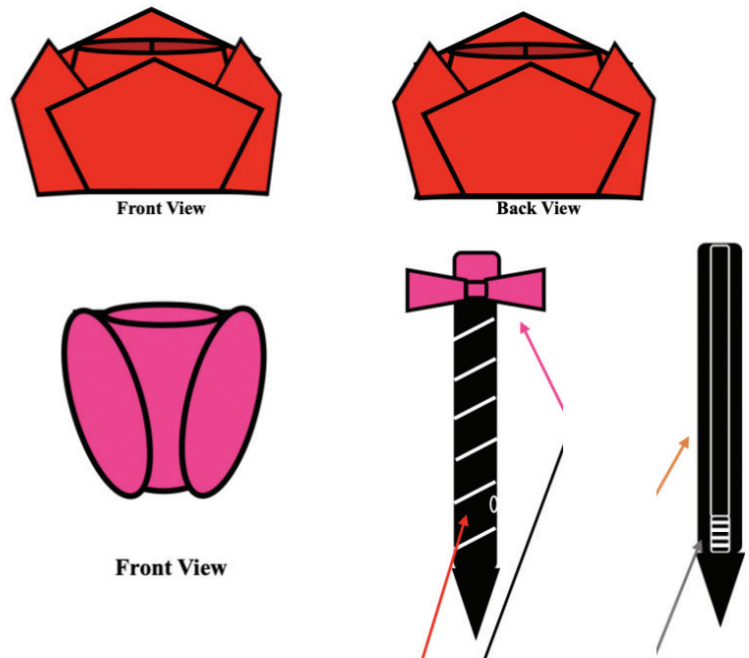
Dr. Siva Nadimpalli

Wyatt's Creative Works, LLC

Modern and Innovative Home Storage Solutions

Wyatt's Creative Works, LLC is an independent creative venture founded by Marquonda Wyatt, focused on innovation and the development of new design ideas. Guided by the brand statement, "the ultimate destination of creativity and innovation," the organization supports artistic and design-driven products ranging from published literary works to consumer product concepts. As a founder-led company, Wyatt's Creative Works emphasizes imagination, originality, and the translation of creative vision into tangible designs.

This project focused on the computer-aided design of a modern home storage product line based on provided concept sketches. Preliminary design sketches were converted into dimensioned engineering models across multiple product categories, including children's, pet, and personal care applications. The designs emphasized durability, reliable functionality, and material feasibility while maintaining the sponsor's aesthetic vision. Rendered animations and visualizations demonstrated product movement and functionality, resulting in a professional digital prototype package that supports future refinement and presentation.



Michigan State University

Team Members (left to right)

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William Selais
Commerce Township, Michigan

Emma Littell
Grand Rapids, Michigan

Riley Newell
Sterling Heights, Michigan

Christopher Paige
Milford, Michigan

Ethan Krahe
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Wyatt's Creative Works, LLC

Project Sponsor

Marquonda Wyatt
Grand Blanc, Michigan

ME Faculty Advisor

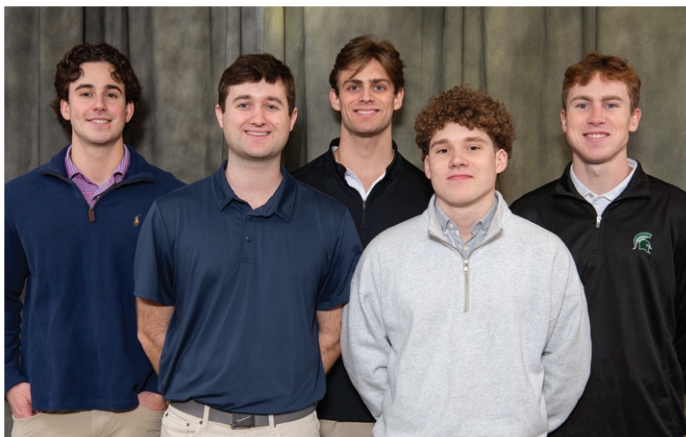
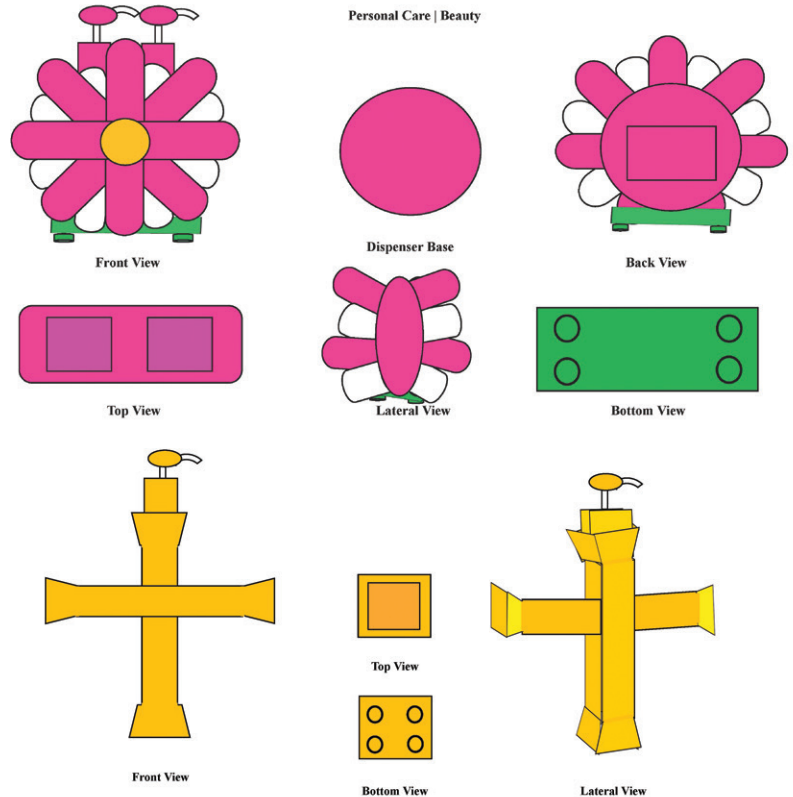
Dr. Indrek Wichman

Wyatt's Creative Works, LLC

Modern and Innovative Home Storage Solutions

Our industrial sponsor company, Wyatt's Creative Works, combines creativity and innovation to bring forth modern solutions in home storage, personal care, and reusable products. CEO, Marquonda Wyatt, focuses on developing modern, practical household products that blend functionality with contemporary aesthetics. The company centers its work around everyday home organization challenges and aims to improve convenience, accessibility, and usability through thoughtful design.

For this project, we were tasked with applying our design and technical skills to create improvements to home storage solution products. These categories included personal care, pet resources, and a children's recreational product. Our designs served to model ergonomic and visual improvements for the products of Wyatt's Creative Works. The primary objective was to improve upon the provided blueprints and translate them into detailed 3D CAD models. Each product was designed to combine functionality, aesthetic appeal, and practicality of use within any home environment. Our models reflected precise dimensions and realistic structural features. Much emphasis was placed on the structural integrity of each element of the products. On top of the engineering integrity of the project, we implemented thoughtful application of colors, materials, and textures to create an aesthetically pleasing home storage solution. Each facet of the project was a step toward a seamless integration into any home. Overall, the project represented an advanced display of CAD modeling, functional design visualization, and practical ergonomic product use.



Michigan State University
Team Members (left to right)
Grant Chesley
 Wayland, Michigan
Kyler Spike
 Lowell, Michigan
Nathan Grooters
 South Lyon, Michigan
Noah Sosnowski
 Macomb, Michigan
Aidan Weitekamp
 Southbury, Connecticut

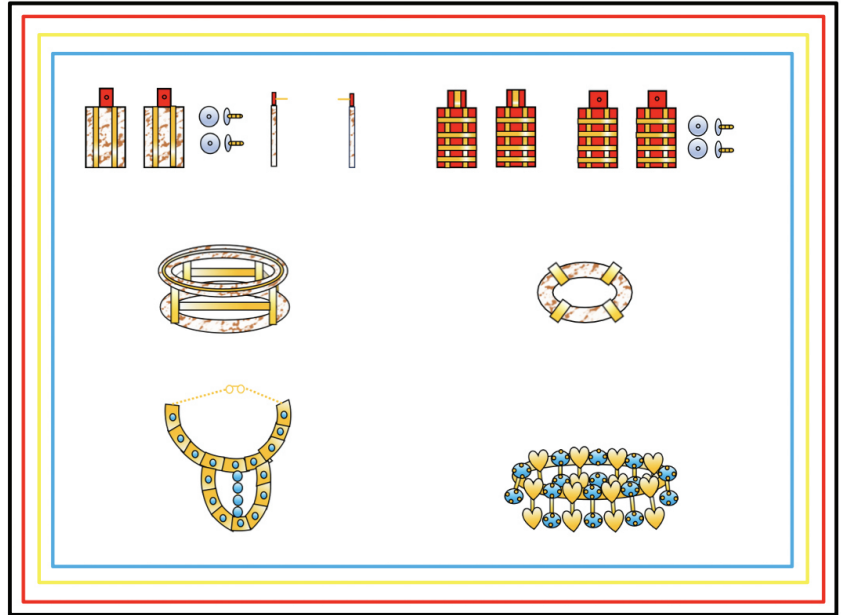
Wyatt's Creative Works, LLC
Project Sponsor
Marquonda Wyatt
 Grand Blanc, Michigan
ME Faculty Advisor
Dr. Seungik Baek

Wyatt's Creative Works, LLC

Intricate Jewelry Design

Wyatt's Creative Works is an innovation production company dedicated to showcasing the latest creative projects and inventive ideas. Founded in 2022 by CEO Marquonda Wyatt, an MBA graduate from the University of Michigan Flint, and a multidisciplinary creative professional. The company offers a variety of creative outlets and original works, currently serving as a place for storytelling, publishing, and innovative artistic expression through a multitude of ways.

For this project, the goal was to apply advanced 3D CAD using Siemens NX modeling and technical design skills to the development of an intricate jewelry collection. The project focused on designing a cohesive set of signature pieces including earrings, necklaces, bracelets, rings, toe rings, anklets, sunglasses, and traditional fashionable glasses encompassing both fine and fashion jewelry categories. In addition to the jewelry designs, the project also included the conceptual design and manufacturing considerations of a custom jewelry box. Emphasis was placed on attention to detail, precision, and thoughtful application of materials, colors, and textures to ensure high quality designs. Through this work, the project was supported by Wyatt's Creative Works' LLC mission by translating creative vision to market-ready designs while reinforcing professional design principles.



Michigan State University

Team Members (left to right)

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Linden, Michigan

Riley Haener
Clarkston, Michigan

Natalie Stier
Lake Orion, Michigan

Grace Owen
Holland, Michigan

Bailey Surque
Brooklyn, Michigan

Reid Scaife
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Wyatt's Creative Works, LLC

Project Sponsor

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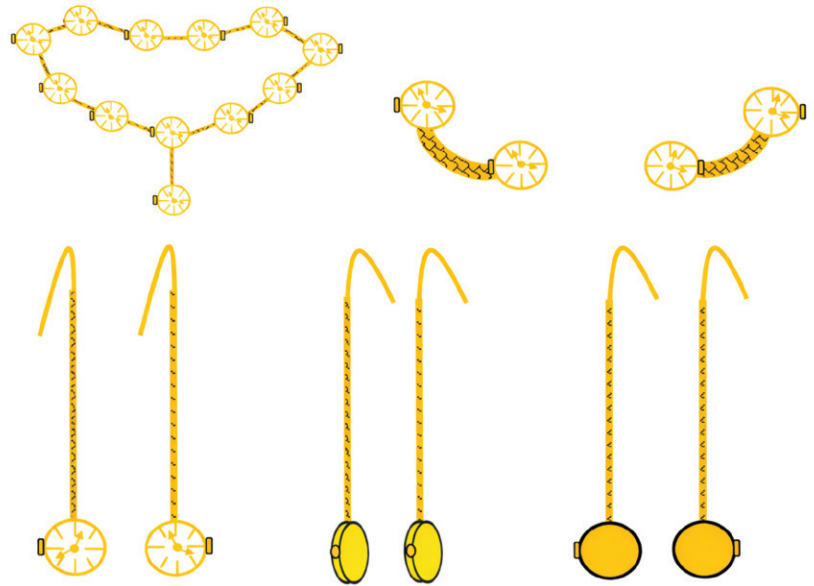
Dr. Norbert Mueller

Wyatt's Creative Works, LLC

Intricate Jewelry Design

Wyatt's Creative Works, LLC is a multifaceted creative company that specializes in publishing books, producing jewelry, and pursuing various other artistic endeavors. Founded on the principle that creativity should know no boundaries, the company operates across multiple artistic disciplines to bring diverse and imaginative products to life. The company focuses on blending traditional craftsmanship with innovative approaches to bring unique, creative products to market, serving customers who appreciate original, thoughtfully designed items. Wyatt's Creative Works has established itself as a trusted source for distinctive artisan goods that reflect both quality and creativity. Each product created by the company represents a commitment to originality and attention to detail, ensuring that customers receive pieces that are not only beautiful but also meaningful and enduring.

Our team's project was to design a jewelry box for display and storage, as well as 17 unique jewelry pieces, using computer-automated design software. Throughout the semester, we experimented with various digital design tools and developed a systematic workflow for creating unique patterns, bodies, and assemblies. Each piece was successfully produced, resulting in a comprehensive set of designs that met the sponsor's specifications. Each piece was designed to showcase both the capabilities of computerized design technology and Wyatt's Creative Works' aesthetic vision, resulting in a diverse portfolio of jewelry designs and a custom jewelry box made in the manufacturing teaching lab.



Michigan State University

Team Members (left to right)

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Grand Rapids, Michigan

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Wyland Hall
Farmington Hills, Michigan

Jacob "Coby" Porath
Newton, Massachusetts

Jiwon Lim
Seoul, Korea

Wyatt's Creative Works, LLC

Project Sponsor

Marquonda Wyatt
Grand Blanc, Michigan

ME Faculty Advisor

Dr. Wei-Che Tai

MSU Department of Mechanical Engineering

Fabrication of Bio-Inspired Metamaterial Mechanisms

Mechanical Engineering has always drawn inspiration from biological systems: airfoil designs that mimic bird wings and Velcro fasteners suggested by plant burr structure are examples of this. More recently, biological systems have inspired the development of mechanisms capable of sensing, actuating, and responding to external stimuli. While a variety of plants and animals have been studied for these purposes, many biological systems continue to present opportunities for new engineering design and development.

Our team was tasked with the design and fabrication of a bio-inspired mechanism that mimics a tick's fluid extraction and abdomen expansion processes. Ticks demonstrate a unique ability to undergo rapid and massive volumetric expansion while maintaining structural integrity. While certain detailed aspects of how all of this is accomplished in the living tick are still under ongoing biological investigation, enough is understood to suggest methods for mechanically replicating these expansion and storage mechanisms.

Our team developed a bio-inspired metamaterial mechanism that replicates the rapid extraction and expansion characteristics utilizing PLA 3D printing capabilities. Specifically, the design focused on using novel geometric structural behavior to achieve this rather than relying solely on material properties. The resulting prototype demonstrates the feasibility of mechanically replicating key aspects of biological expansion and fluid handling behavior and establishes a foundation for future refinement and continuous development.



Department of Mechanical Engineering
MICHIGAN STATE UNIVERSITY



Michigan State University

Team Members (left to right)

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Kaeden Palmitier

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MSU Department of Mechanical Engineering

Project Sponsors

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Thomas Pence

East Lansing, Michigan

ME Faculty Advisor

Dr. Thomas Pence

The Capstone Projects

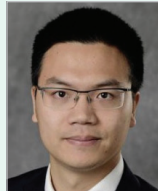


Dr. Michael Lavagnino
Academic Specialist of Mechanical Engineering

Faculty Advisors: Rebecca Anthony, Zhaojian Li, Ricardo Mejia, Guoming Zhu



Anthony



Li



Mejia



Zhu

Presentation Schedule – Engineering Building, Room 1225

Time	Team Sponsor	Project Title
8:00 a.m.	MSU Department of Mechanical Engineering	Automated Stem-Clipping for Robotic Apple Harvesting
8:30 a.m.	MSU Department of Mechanical Engineering	Design of an Automated Apple Stem-Clipping System
9:00 a.m.	MSU Department of Mechanical Engineering	Fruit Catching Module for Robotic Apple Harvesting
9:30 a.m.	MSU Department of Mechanical Engineering	Design of a Fruit Catching Device for Apple Harvesting
10:00 a.m.	Fraunhofer USA	Tracking Stage for Hyperspectral Imaging System
10:30 a.m.	Communit-e Splint	Mechanically Driven Orthopedic Splint
11:00 a.m.	Communit-e Splint	Mechanically Driven Orthopedic Splint

Mechanical Engineering Design Project Sponsorship

Interesting design projects that challenge the seniors in ME 481 and showcase the range of activities where mechanical engineers can work helps to make the Design Day experience special. The Design Program at MSU invites you to provide a challenging project for members of our senior class of mechanical engineers. As a sponsoring company, you introduce students to opportunities for ME students at your company; have the opportunity to create, build, and maintain relationships with students; benefit from the students' innovative design work; and bring the academic and working world together for them. Contact medesign@msu.edu to learn more about the opportunities to sponsor a design project.

MSU Department of Mechanical Engineering

Automated Stem-Clipping for Robotic Apple Harvesting

In a collaborative project, Red Cedar Distinguished Professor Dr. Zhaojian Li, of the MSU Department of Mechanical Engineering, worked with his research group and Renfu Lu of the USDA to develop a robotic apple harvesting system. Their development of this system focused on a simple and compact structure with 3-DOF “arms” and a deep-learning based camera developed for apple detection and localization. Their goal was to create an economically viable and improved robotic apple picking system, in lieu of existing development that is too expensive and complicated.

The apple picking robot recognizes apples on the trees, picks them and deposits them on cushioned ramps towards the collection system. When picked, some apples retain long stems or spurs. These stems can damage other apples in storage and transport. Our team was tasked with the goal of researching, designing, and building a module to solve this problem. Key design tasks consisted of large spur removal, fruit orientation identification and control, stem localization, and development of a compact, efficient and robust clipping mechanism. Our team worked closely with Dr. Li and graduate student Kyle Lammers through each stage of the design process. After researching orientation and clipping of the apples, our team decided to design an orientation system that is able to receive apples, visually determine the stem location, and use motorized wheels to manipulate the apple into position. When positioned, the apple would be ready for a z-axis clipping mechanism to lower and clip the stem using slight pressure on the apple. After this process is completed, the apple will be ready to be accepted into the remainder of the system and move on to be collected.



Department of Mechanical Engineering
MICHIGAN STATE UNIVERSITY



Michigan State University

Team Members (left to right)

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Joseph Griffin
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MSU Department of Mechanical Engineering

Project Sponsors

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Zhaojian Li
East Lansing, Michigan

ME Faculty Advisor

Dr. Zhaojian Li

MSU Department of Mechanical Engineering

Design of an Automated Apple Stem-Clipping System

An automated multi-arm system with the ability to harvest apples in an orchard environment was developed by Dr. Zhaojian Li and his research group at the Michigan State Department of Mechanical Engineering. The robotic system operated arms with four degrees of freedom led by a computer system. The computer system identified apples and extended the arm towards the subject. A vacuum system was employed through the arm to detach the fruit from the tree. The apples were transported via padded ramps and helical rails into a collection bin. The system gathered apples efficiently; but it risked leaving apples with branches, leaves, spurs, or long stems that would lead to damaged final goods.

Our team was tasked with developing an automated apple stem-clipping system that was incorporated into the pre-existing automated harvest fruit transportation process. The system involved three procedures: the removal of large branches and leaves, the orientation of the apple to expose the stem, and the clipping of the stem to a set desired length. Additionally, the mechanism needed to be efficient without damaging the fruit. The initial large branch and leaf removal used a set of two silicon, spiral rails driven by a motor and a set of gears. The silicon gripped the large offshoots of the stem and pulled it downward for removal. The apple orientation employed camera sensors that controlled a three-wheel disc mechanism driven by motors. The wheels were surrounded by foam material and rotated the fruit until the apple stem was in the necessary upward position. The stem-clipping system utilized raising the apple on a platform into a shear assembly which engaged like a spring to snip the stem. The outer side of the shears was built with a rounded edge to protect the apple. The entire automated apple stem-clipping system was compact, efficient, and suitable for continuous operation.



Department of Mechanical Engineering
MICHIGAN STATE UNIVERSITY



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Braden Grabaum
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Collin Norder
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MSU Department of Mechanical Engineering

Project Sponsor

Kyle Lammers
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ME Faculty Advisor

Dr. Zhaojian Li

MSU Department of Mechanical Engineering

Fruit Catching Module for Robotic Apple Harvesting

Dr. Zhaojian Li's research group has developed a multi-arm, robotic, apple-harvesting system that has been validated in commercial orchard environments, demonstrating high picking success rates and competitive cycle times. While the system efficiently detects, reaches, and detaches fruit, the workflow required each robotic arm to transport the picked apple to a designated dropping location, introducing additional travel distance and time that limited overall throughput.

For this project, the goal was to design and develop a module to reliably catch apples and transport them to a collection bin without requiring the robotic arms to spend time transporting each fruit to the drop point. The module had to consistently catch the harvested apples from various locations and heights without bruising or damage. Key constraints of this project included minimizing obstruction to the robot arm motion, preserving the field of view of cameras and perception sensors, and integrating with the current harvesting machinery. The project involved concept development, mechanical design, prototyping, and experimental evaluation to quantify improvements in harvesting efficiency and robustness.



Department of Mechanical Engineering
MICHIGAN STATE UNIVERSITY



Michigan State University

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Alessandro Cabrera
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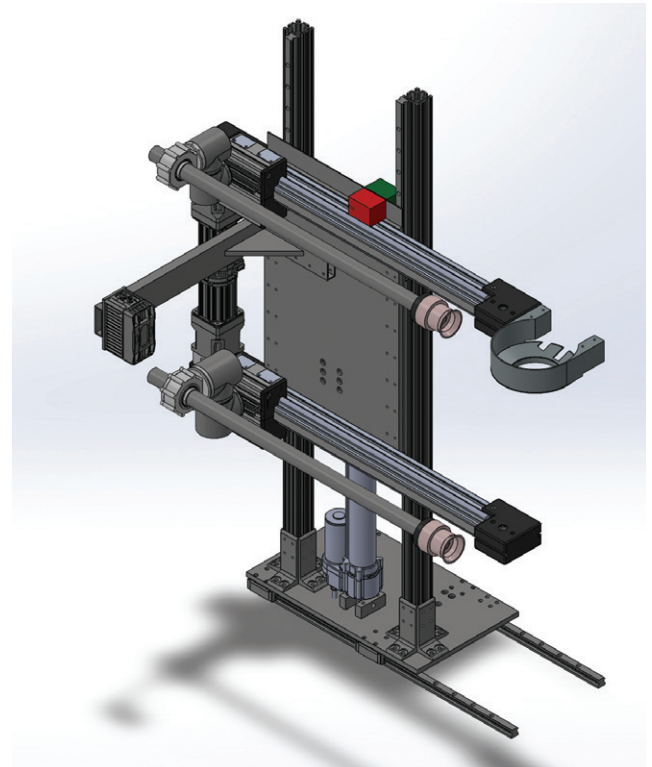
Dr. Zhaojian Li

MSU Department of Mechanical Engineering

Design of a Fruit Catching Device for Apple Harvesting

The Michigan State University Department of Mechanical Engineering sponsors a variety of projects that improve campus resources for Mechanical Engineering students. The department also sponsors projects of their own to be developed and potentially commercialized. These projects include undergrad students as well as PhD students by challenging and providing them the opportunity to grow their engineering skills in a collaborative environment.

The goal of this project was to work with an existing automated apple harvesting robotic system and improve and/or implement a new apple catching device on the existing automated apple harvester. The most important goal of our design was to limit the amount of time that the robotic arms would spend moving apples from the time they are picked, until they are dropped and the robot is able to transition to the next apple. By creating a moving catching arm, we were able to multitask and move the catching arm to meet the grabbing arm while it grabs an apple. By limiting the time wasted by the robotic arms moving to the drop zone, we are able to greatly increase the overall efficiency and, in turn, the total number of apples that this automated apple harvester can gather in a day. Even saving fractions of a second per apple harvested has a huge impact due to the sheer number of apples that the automated harvester can collect in a day. The robot can also work at nighttime, meaning any time saved per apple translates to an even larger performance increase. By focusing on the bottleneck portion of our existing apple harvesting device, we were able to maximize the efficiency of the robot at very minimal expense of cost and manufacturing needs. We implemented a more effective apple catching solution and we have made this apple harvesting device much more marketable and increased the potential success of this device in the commercial world.



Department of Mechanical Engineering
MICHIGAN STATE UNIVERSITY



Michigan State University

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MSU Department of Mechanical Engineering

Project Sponsor

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East Lansing, Michigan

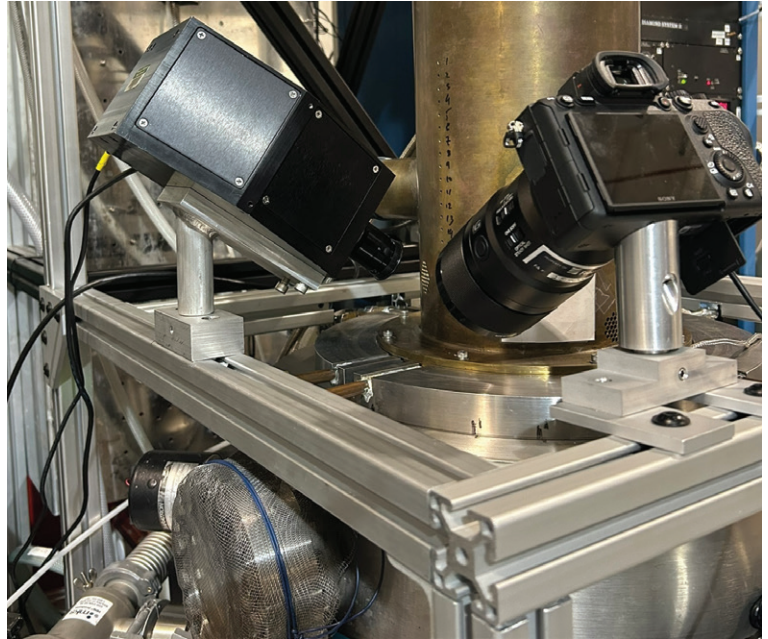
ME Faculty Advisor

Dr. Zhaojian Li

Fraunhofer USA Tracking Stage for Hyperspectral Imaging System

The MSU Department of Mechanical Engineering and Fraunhofer USA have developed a research partnership focused on diamond growth. By utilizing chemical vapor deposition (CVD) reactors, crystalline diamond structures can be grown on a substrate and monitored throughout the process. Because diamond growth requires significant time and energy, it is important to observe the growth progress and inspect the material to assess its quality. This monitoring is typically performed using a hyperspectral camera, which analyzes individual wavelengths of light to determine material composition and structural integrity.

To obtain comprehensive data, the camera must physically move around the reactor's viewport so that a three-dimensional data cube can be generated for all specimens in the process. Currently, this motion is performed manually, resulting in inconsistencies in data collection, increased difficulty in analysis, and slower imaging times. This project addresses these limitations by developing CAD models and a prototype of a moving camera stage capable of automated motion with extremely fine and consistent increments. This design is to interface with the existing hardware surrounding the reactor. The automation is to be user configurable with inputs ranging from individual steps to a complete sweeping motion. The system incorporates a circumferential motion component that enables the camera to orbit the viewport within defined limits while also enabling vertical and angular adjustments to properly align the camera's optical axis with the viewport.



Michigan State University

Team Members (left to right)

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Aman Goenka
Kolkata, India

Tanner Auzins
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Dylan Chaudhry
Bloomfield Hills, Michigan

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Fraunhofer USA *Project Sponsor*

Tanvi Nikhar
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ME Faculty Advisors

Dr. Rebecca Anthony

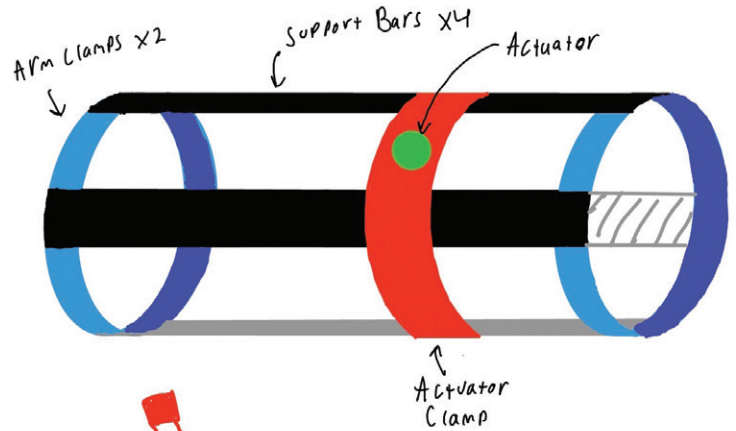
**PhD Candidate Cameron
Papson**

Communit-e Splint

Mechanically Driven Orthopedic Splint

Communit-e Splint provides a new and innovative solution to a process that has not been modified in decades. Dr. Michael Ayad, D.O., is an orthopedic surgeon at McLaren Health in Mount Clemens, Michigan. Dr. Ayad founded Communit-e Splint after experiencing firsthand the challenges of delivering orthopedic care under high-pressure and intense environments. Fracture care still depends on manual technique, individual experience, and physician availability, especially when limited resources make efficient and consistent care essential. Communit-e Splint was built on the belief that better tools can create more equitable care, and that efficiency, precision, and compassion should not depend on geography and circumstance.

Traditional fracture reduction and splinting relies on manual force applied by clinicians, followed by plaster or fiberglass immobilization. This process is highly operator-dependent, time-consuming, painful for patients, and frequently requires sedation. It is associated with high rates of malreduction, reapplication, and downstream surgical intervention. This project centers on designing a mechanically driven orthopedic splint to make fracture reduction more controlled, repeatable, and safer than traditional hands-on methods. A control system provides guidance, limits, or automated actuation commands to regulate dial rotation and prevent excessive force, unsafe displacement, or over-correction. Upon achieving desired alignment, the system mechanically locks the applied forces, maintaining reduction and immobilization without continuous user input. Overall, this project aims to show how thoughtful mechanical design supported by intelligent feedback control can reduce variability, improve consistency, and modernize an antiquated process while remaining intuitive, scalable, and safe for patients.



Michigan State University

Team Members (left to right)

James Patterson
Winston-Salem, North Carolina

Macy Spevacek
Macomb, Michigan

Colin Koot
Mason, Michigan

Lily Reinke
Grand Rapids, Michigan

Garrett Sauter
San Diego, California

Communit-e Splint Project Sponsor

Michael Ayad
West Bloomfield, Michigan

ME Faculty Advisor

Dr. Guoming Zhu

Communit-e Splint

Mechanically Driven Orthopedic Splint

Communit-e Splint is a leading-edge medical manufacturer focused on innovating and modernizing the current procedure in orthopedic splints for all fractures, ranging from arms and legs to minute specifics such as disc and radial fractures. The company is led by Dr. Michael Ayad, with goals of improved reliability, consistency, and patient safety. With current procedures, the outcome relies heavily on professional experience and manual application. Communit-e Splint aims to eliminate these variables by building upon mechanically controlled systems as opposed to hands-on work. They have been committed to developing the medical space through the combined efforts, research, and designing of multiple different engineering disciplines.

The focus of this project is the mechanically driven orthopedic splint, a device using a multitude of mechanical components. The physical framework of the product is based on an arm cast fitted with collars to uninjured parts of the arm. Between two collars there is an array of tracks with adjustable actuators that can slide up and down the tracks. The actuators can then be locked in place and lowered to fine resolution in order to apply enough pressure in specific locations based on readings from embedded sensors throughout the system. These sensors will read the applied force, pressure distributions, displacements along the axis, and any vibrations that would impede stability. These readings are read and processed by an AI data management system that will output adjustments needed by the actuators, which will guide professionals towards a streamlined process. The deliverables of our project include the entirety of the detailed CAD work for this mechanical splint, as well as a functional prototype capable of manual actuator adjustment and locking mechanism. A developed AI guidance assistant will provide the baseline for data analysis.



Michigan State University

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Lansing, Michigan

Jake Messman
Manchester, Michigan

Liam Rich
Islip, New York

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La Grange, Illinois

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Michael Ayad
West Bloomfield, Michigan

ME Faculty Advisor

Dr. Ricardo Mejia

The Capstone Projects

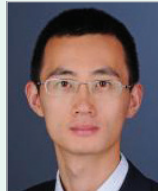


Dr. Michael Lavagnino
Academic Specialist of Mechanical Engineering

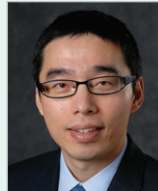
Faculty Advisors: Rebecca Anthony, Huazhen Fang, Yang Guo, Mike Symons, Indrek Wichman, Neil Wright



Anthony



Fang



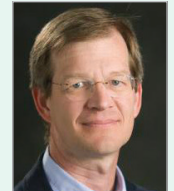
Guo



Symons



Wichman



Wright

Presentation Schedule – Engineering Building, Room 1300

Time	Team Sponsor	Project Title
8:00 a.m.	MSU Department of Mechanical Engineering	Dynamometer Initial Structural Design
8:30 a.m.	MSU Baja Racing Team	Custom CVT for Baja SAE Vehicle
9:00 a.m.	MSU Formula Racing Team	Load Cell and Vehicle Data Collection
9:30 a.m.	North American Controls, Inc.	Design Considerations for 3D Printed Manifolds
10:00 a.m.	North American Controls, Inc.	Design Considerations for 3D Printed Manifolds
10:30 a.m.	Eaton Aerospace Corporation	High Temperature Burst
11:00 a.m.	Eaton Aerospace Corporation	High Temperature Fuel Testing

Mechanical Engineering Design Program Awards

The Mechanical Engineering Design Program makes two project awards on Design Day. The most significant award is the Thomas Alva Edison Design Award—a medal—given to each member of the ME 481 Capstone design team that produces the most outstanding technical design project. This award considers the team’s performance over the duration of the project, their presentations, the project solution, and prototype quality.

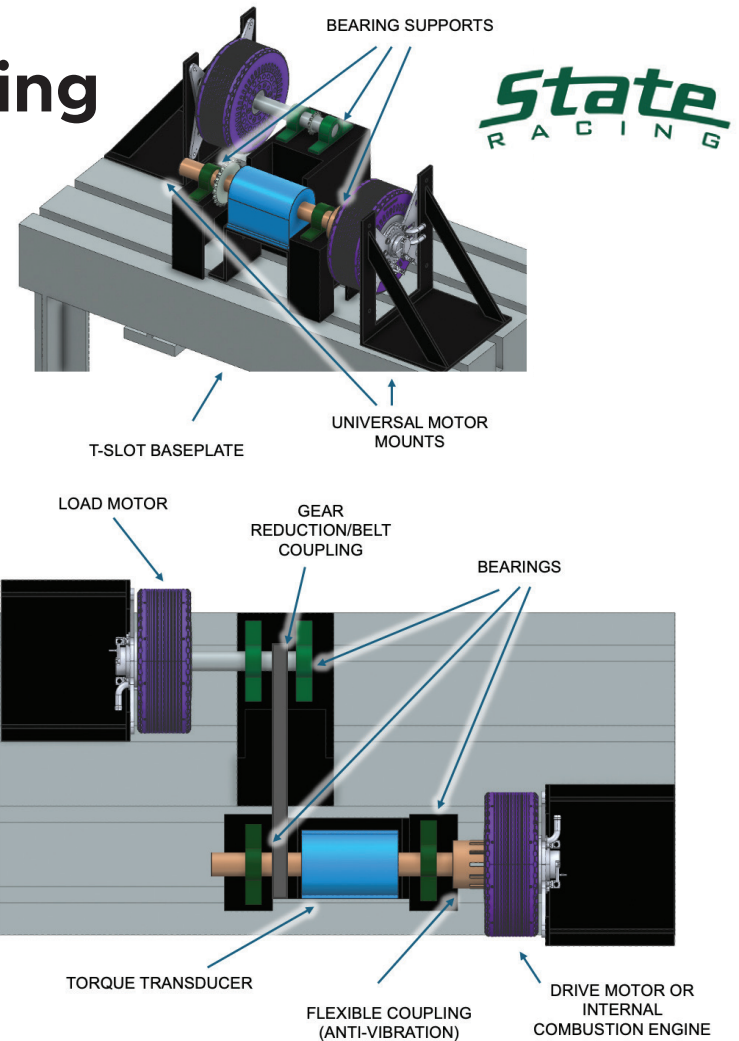
A second ME 481 Capstone award is given to the team that gives the best technical project presentation. The importance of communication of scientific and engineering ideas cannot be understated, and it is for this reason that we make the ME 481 Project Presentation Award. Award winners typically will have built an impressive prototype which forms the basis for a very clear and effective presentation of the project background and its solution, often incorporating live or video demonstrations of its functionality.

The ME Design Program also presents the Leonardo da Vinci Machine Design Award to the winners of its ME 470 Machine Design competition. The specific design problem and criteria for this competition change from semester to semester.

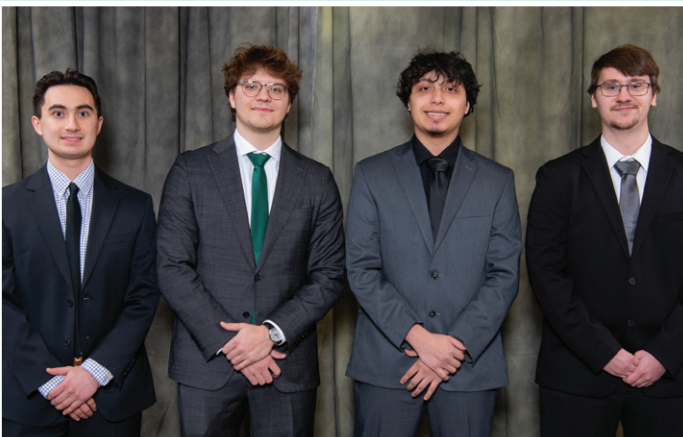
MSU Department of Mechanical Engineering Dynamometer Initial Structural Design

The College of Engineering at Michigan State University fosters a culture of innovation rooted in the principles of design and mechanics, offering students various opportunities to strengthen their creative problem-solving skills. In that spirit, the college supports four student-led racing teams: Formula SAE, Baja SAE, Solar Racing, and Spartan Velocity, as they design, build, and compete with unique high-performance vehicles. The drivetrains developed by these teams represent critical systems that require careful testing and refinement to remain competitive.

Our team is the first to collaborate on a multi-semester project, spanning multiple engineering disciplines, with the goal of producing a single, multi-functional dynamometer that will be utilized by all four teams to test the performance of their respective drivetrains. From engine tuning to drive cycle simulation, a dynamometer will provide a significant competitive advantage that will help our MSU racing teams succeed. Our responsibility in the first stages was to compile data from the various teams to create a set of design parameters for choosing necessary mechanical and electrical components, design adjustable mounts for motors and a torque transducer, and select appropriate coupling and alignments features to balance accessibility with system stability and safety. Due to the extended nature of the project, our team was required to effectively document our process and suggestions for how future teams can carry out the project to final completion.



Department of Mechanical Engineering
MICHIGAN STATE UNIVERSITY



Michigan State University

Team Members (left to right)

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Charles Wejroch
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Yahia Guenena (not pictured)
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MSU Department of Mechanical Engineering

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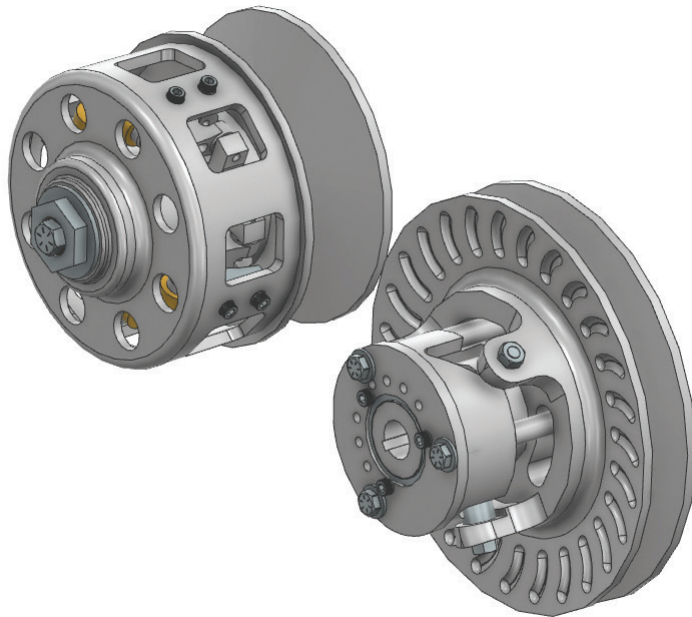
Michael Symons

MSU Baja Racing Team

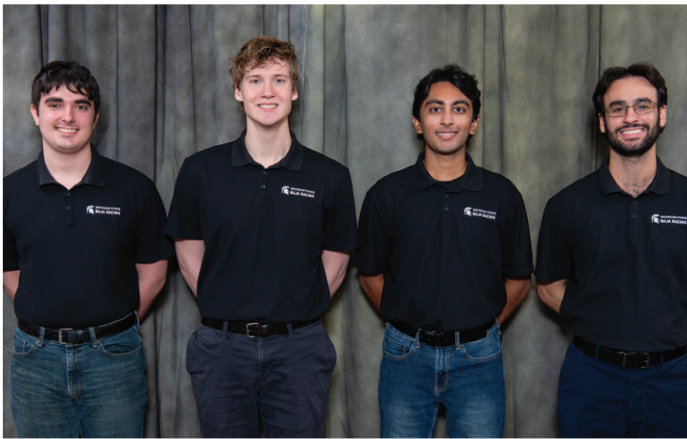
Custom CVT for Baja SAE Vehicle

MSU Baja begins its season with design work, addressing issues from previous competitions and developing innovative solutions. Utilizing software such as Siemens NX, Ansys Workbench, Fusion 360, and Altair Motionview, the team completes a new vehicle design. Once complete, manufacturing kicks off with the team constructing a new vehicle from scratch annually. The process begins by bending and notching chassis tubes in-house, then assembling and welding those tubes together according to the chassis model. Meanwhile, other subsystems machine components on mills and lathes, with more intricate parts precision machined on a CNC Mill. Once built, vehicle testing starts and the team ensures the vehicle meets vehicle performance and reliability targets. The season then culminates in competitions usually beginning by the close of the spring semester.

The Baja team uses a belt-driven centrifugal CVT transmission to transmit power from the engine to a reduction box. Currently, the team is using a Gaged GX9 CVT, an off-the-shelf solution from Gaged Engineering, commonly used by Baja teams. As the team's skills have grown, it has started to outgrow the GX9 and is seeking performance beyond what the Gaged can offer. Other teams with performance on par with the MSU Baja team are currently running custom CVTs. In order to remain competitive, the MSU Baja team will need to begin to develop their own CVT to gain more transmission variability. This is the first step before eventually heightening the gearbox ratio, enabling more torque while maintaining the current top speed with a future gearbox redesign.



**MICHIGAN STATE
BAJA RACING**



**Michigan State
University**

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**MSU Baja
Racing Team**
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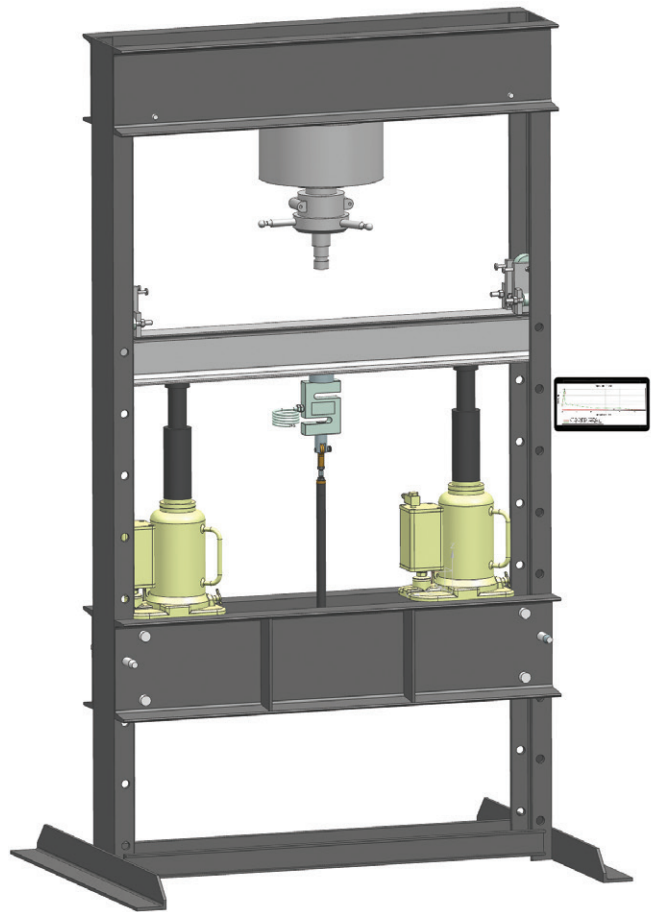
ME Faculty Advisor
Dr. Huazhen Fang

MSU Formula Racing Team

Load Cell and Vehicle Data Collection

Each year, the MSU Formula Racing Team designs and builds a race vehicle for the Formula SAE competition. Given that high strength and light weight are critical, the team produces a carbon fiber monocoque; and this year the team is implementing carbon fiber struts in their suspension. According to FSAE rules, composite structural components must be validated, generally including 3-point bend, perimeter shear, T-peel, and tensile pullout tests. These tests are typically carried out externally with assistance from the MSU Composite Vehicle Research Center and other partners. However, with in-house test equipment, testing timelines can be accelerated, reducing delays between tests and enabling more experimentation in the design and fabrication of composite parts.

A stress testing jig was created to adapt a standard shop press to measure failure modes of various samples. These samples can be tested in compression or tension, with failure modes being measured by the integrated load cell and linear scale. These data are then recorded and displayed live to the user using a single-board computer and screen and can also be exported to a flash drive for external post processing. The functionality offered by this system is comparable to expensive commercial universal testing machines but at a significantly lower cost. This enables student engineering teams to prototype and validate designs in-house rapidly, improving iteration speed and design safety. By enabling accurate characterization of material strength and failure modes, the device supports safer mechanical design in automotive and structural applications and promotes more efficient, cost-effective engineering development.



State
RACING



Michigan State University

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MSU Formula Racing Team

Project Sponsor

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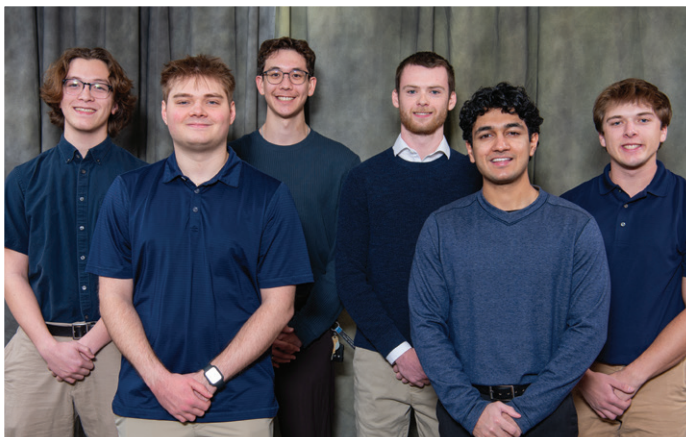
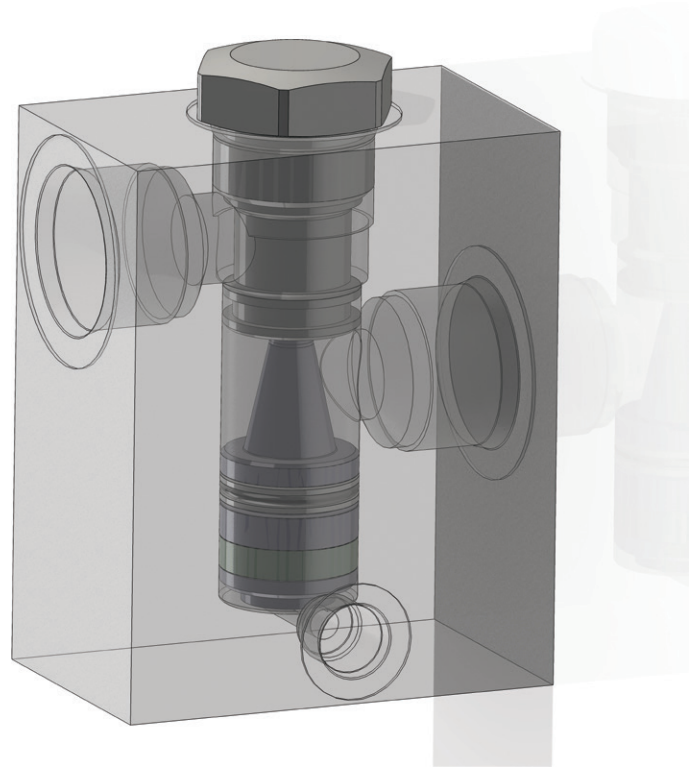
ME Faculty Advisor

Michael Symons

North American Controls, Inc. Design Considerations for 3D Printed Manifolds

North American Controls, Inc. (NAC) designs and manufactures custom fluid power systems for defense industry applications. The company specializes in integrating pumps, motors, valves, filters, and actuators through manifolds with complex flow paths and numerous machined features. These manifolds are critical components of fluid power systems and must meet strict performance requirements. Due to their complex designs, prototype manifolds are an essential part of the development process for design verification. However, machining aluminum manifolds is time-consuming and expensive, which can limit design iterations and increase development time.

Our team investigated the feasibility of using consumer-grade 3D printers to develop functional prototypes for verifying functionality and to expedite the design process. A candidate manifold was provided with common features for analysis. Key challenges included housing rupture, ensuring water tightness, printing threaded features, and surface finishes for sealing. Various parameters were considered: material, layer height, wall thickness, printing orientation, infill density, infill pattern, and surface finish. Experimental testing addressed the key challenges by pressurizing the prototype manifolds using a pump to simulate operating conditions. The results provided valuable insight for producing reliable prototype manifolds and determined which parameters were most important when integrating additive manufacturing into the design process.



Michigan State University

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North American Controls, Inc.

Project Sponsor

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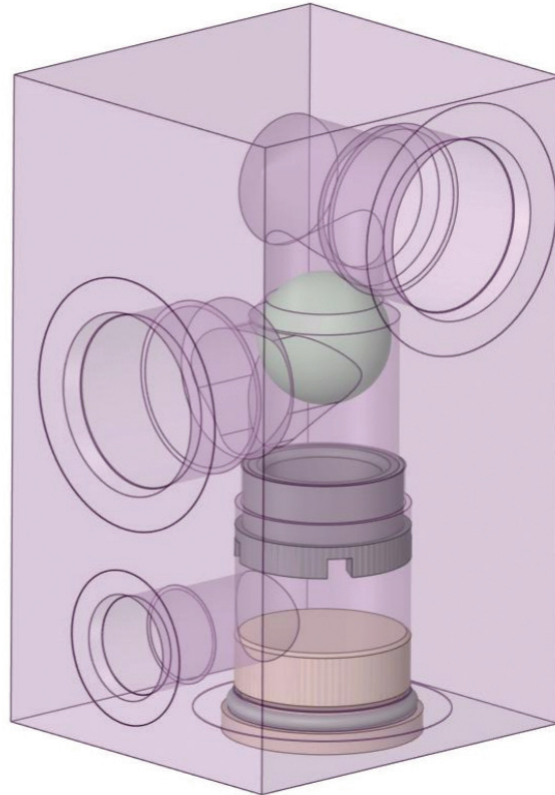
ME Faculty Advisor

Dr. Rebecca Anthony

North American Controls, Inc. Design Considerations for 3D Printed Manifolds

North American Controls, Inc. (NAC) designs and manufactures high-performance fluid control systems for defense applications. Their products integrate with pumps, motors, filters, and actuators by controlling fluid flow and pressure in precision-machined aluminum manifolds fitted with various valves and logic elements. Due to the complexity of these systems, NAC relies on extensive design verification to ensure safety, reliability, and performance prior to production.

This project evaluates the feasibility of using consumer-grade FDM 3D printing to produce functional fluid manifold prototypes for early-stage design validation. The goal is not to replace production aluminum manifolds but to quantify and improve the pressure-holding capability of 3D-printed prototypes used during development testing. Key failure modes (including inter-layer leakage, housing rupture, threaded feature failure, and sealing surface deficiencies) are investigated through controlled pressure testing. The study examines how printing parameters such as layer height, wall thickness, print orientation, and infill characteristics influence performance, ultimately developing practical guidelines to reduce prototype lead time and cost while maintaining functional reliability.



Michigan State University

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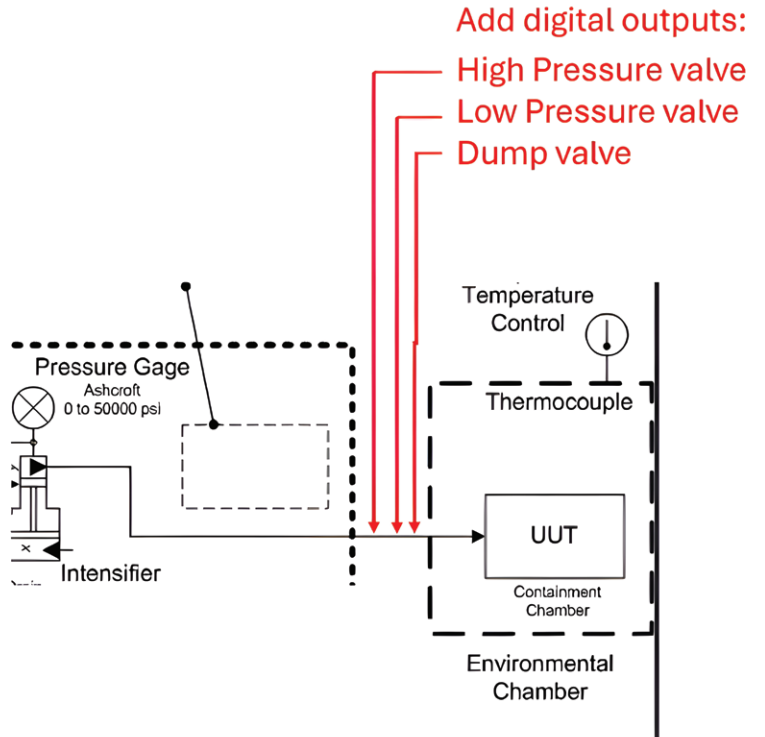
ME Faculty Advisor

Dr. Yang Guo

Eaton Aerospace Corporation High Temperature Burst

Eaton's Aerospace Test Facility in Jackson, Michigan supports qualification and development testing for commercial and military aircraft components, helping verify that hardware performs safely and reliably in demanding service conditions. The facility evaluates Eaton products such as Kevlar, wire-braided, and fire-resistant hoses; couplings and fittings, check valves and swivels, and fuel ducts used in fuel, hydraulic, cooling, and pneumatic systems. Core capabilities include environmental conditioning from approximately -67°F to 500°F, vibration testing using shaker tables, lifecycle pressure- impulse testing, and fire testing, providing the controlled, repeatable validation needed to meet aerospace requirements.

For this project, our team designed a high-temperature, high-pressure burst test system to expand the facility's existing burst testing capability and close a key gap in combined temperature- pressure testing. Leveraging the available 500°F oven and common aerospace test fluids (including MIL-PRF-83282 and Skydrol), the concept integrates high-pressure plumbing, instrumentation, and controls rated up to 50,000 psi to enable safe, controlled pressurization and regulated venting. The design emphasizes operator safety and test repeatability through defined pressure ramp/hold profiles, appropriate component selection and ratings, and clear operating steps. Final deliverables included system schematics (P&ID-style), a safety-focused bill of materials, a 3D layout model for fit and routing, and a draft operating procedure that supports both rapid burst testing and sustained hold conditions for extended- duration testing.



Powering Business Worldwide



Michigan State University

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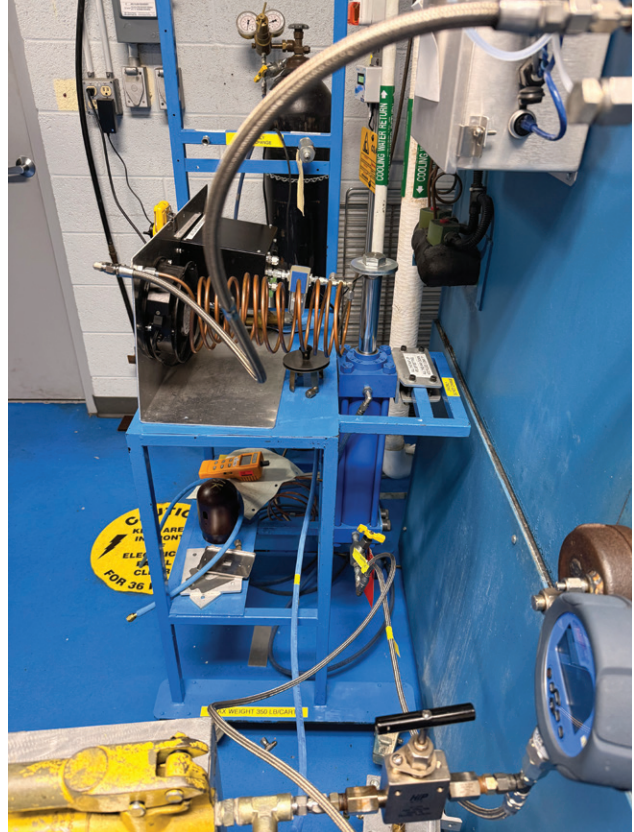
ME Faculty Advisor

Dr. Indrek Wichman

Eaton Aerospace Corporation High Temperature Fuel Testing

Eaton Aerospace Corporation is the aerospace division of Eaton Corporation plc, a global power management company. It is a global Tier 1 supplier in the aerospace and defense industry. Eaton Aerospace specializes in defense, engineering and manufacturing of advanced systems for commercial, military, and space applications. The company produces fuel systems, hydraulics, motion and flight control technologies, engine components, oxygen systems, and electrical power management solutions that enhance aircraft safety, reliability, and performance. Supporting both original equipment manufacturers and aftermarket customers worldwide, Eaton operates across a broad international market and plays a crucial role in major aircraft programs. Beyond delivering high-quality components, the company is committed to advancing intelligent power management, sustainable engineering and innovative manufacturing technologies. Eaton continually invests in cutting-edge solutions and skilled talent to help shape a safer and better future for global aviation.

For this project, the goal was to develop a mobile cart that can be wheeled up to any setup. This cart needed to have built-in attachments within and outside the chamber for monitoring, safety and regulation. The key deliverables were a schematic of the design, a bill of materials, 3D model of the system, safety logic, and a procedure on how to operate the system. To guarantee success for this project, we took inspiration from the already existing setup used by Eaton Aerospace. The final design provides an innovative approach to the problem and improves reliability, efficiency and safety along with optimizing performance of the system. Eaton's primary priority is the safety of the employees; thus, it is of utmost importance that the solution provided by us maintains those safety standards.



Powering Business Worldwide



Michigan State University

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Dr. Michael Lavagnino
Academic Specialist of Mechanical Engineering

Faculty Advisors: Ricardo Mejia, Ahmed Naguib,
 Geoffrey Recktenwald, Wei-Che Tai, Indrek Wichman,
 Junlin Yuan, Guoming Zhu



Mejia



Naguib



Recktenwald



Tai



Wichman



Yuan



Zhu

Presentation Schedule – Engineering Building, Room 2243

Time	Team Sponsor	Project Title
8:00 a.m.	MSU IPF, ISPM, RCPD, XA	Accessible Signage
8:30 a.m.	MSU Adaptive Sports & Recreation Club	Mechanical Braking System for Mobility Scooter
9:00 a.m.	Vertical Autonomy	VA-15 Fuselage Redesign
9:30 a.m.	Vertical Autonomy	Unmanned Aerial Vehicle Parachute Design
10:00 a.m.	MSU Department of Mechanical Engineering	Eddy Current Damper for ME452L Laboratory
10:30 a.m.	Michigan AgrAbility	Wheelchair Mounted Grain Feeder
11:00 a.m.	Dauch Corporation	SmartBar® – Reduction in System Lash

Supporting ME Design Projects

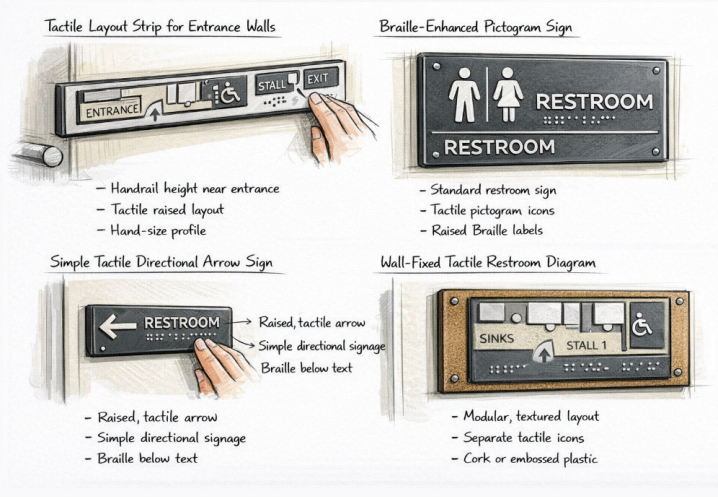
Each semester, ME 481 has a wide range of design projects for the students to select from. Many of these are from industrial sponsors. But many of these engineering projects come from groups not typically associated with engineering, such as, the Theatre Department, social service, or humanitarian groups, and MSU student groups or clubs (ie., MSU Adaptive Sports & Recreation Club and the Sailing Club). Some of you reading this may have done your capstone project on an experience of this type.

These projects need funding and will benefit from your support through a contribution or endowment. Your gift enables the ME Design Program to continue to complete projects that help these worthwhile causes. Contact ME Design at medesign@egr.msu.edu to learn more.

MSU IPF, ISPM, RCPD, XA Accessible Signage

The MSU Infrastructure Planning and Facilities (IPF) plans, builds, and maintains MSU's campus to support education, research, and the university's mission. Some of the primary responsibilities of IPF include building maintenance, landscape and grounds services, power and water, and transportation systems. This department plays a key role in ensuring that campus facilities operate efficiently and reliably. The MSU Resource Center for Persons with Disabilities (RCPD) works to create opportunities for individuals who experience disabilities across campus. RCPD promotes inclusivity by supporting access to MSU programs, traditions, and resources for the benefit of all. Together, these departments contribute to maintaining a smoothly operating university that is accessible and welcoming to the entire MSU community. MSU Institutional Space Planning and Management (ISPM) serves as the university's central planning body, providing oversight for how space is used with academic priorities. In projects such as accessible signage and wayfinding improvements, ISPM ensures that design standards, campus consistency, and long-term planning considerations are integrated into implementation decisions.

This project investigates accessible signage for rooms across MSU buildings, primarily restrooms for those with visual impairments. The signage meets ADA requirements along with universal design standards like raised text, braille integrations, high contrast visuals, standardized placement, and incorporating tactile maps. Prior to designing the prototype, interviews were done with different departments and future users to research and fully understand the needs of the users and what is possible to manufacture. The prototype of the signage was durable, tactile, inclusive, and tested with users. The process was fully documented for future reference and use.



 Institutional Space Planning and Management
MICHIGAN STATE UNIVERSITY


**INFRASTRUCTURE PLANNING
AND FACILITIES**


MICHIGAN STATE
UNIVERSITY
RCPD
Resource Center for
Persons with Disabilities

 Experience Architecture
MICHIGAN STATE UNIVERSITY



Michigan State University
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MSU IPF, ISPM, RCPD, XA
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East Lansing, Michigan

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Dr. Wei-Che Tai

MSU Adaptive Sports & Recreation Club Mechanical Braking System for Mobility Scooter

MSU Adaptive Sports & Recreation Club is an inclusive program at Michigan State University that promotes health, wellness, and teamwork through sports for individuals with physical disabilities. Founded in 2014 by Piotr Pasik after recognizing a lack of adaptive activity opportunities on campus, the club provides athletes a community and access to sports such as boccia ball, wheelchair hockey, wheelchair rugby, hand-cycling, table tennis, and wheelchair tennis. Through sport and participation, the program supports physical health while working to reduce common stereotypes surrounding disability.

This project continued the development of a three-wheel mobility scooter used for reliable daily transportation around campus. Sponsor feedback highlighted that the scooter relied primarily on regenerative braking and lacked a dedicated mechanical braking system, which limited safe stopping performance, especially on snow and ice. The project delivered a rear-wheel mechanical braking system with a push-brake control that was designed and integrated into the existing scooter. Our team also selected and installed a new battery system with compatible charging to ensure ample power for a full day of travel, regardless of the weather. The final outcome improved safety, usability, and rider confidence for indoor and outdoor campus operation year-round.



Michigan State University

Adaptive Sports & Recreation Club

Est. 2014



Michigan State University

Team Members (left to right)

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Anna Suranyi
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Chanulya Perera
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Hailey Kuplerski
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MSU Adaptive Sports & Recreation Club

Project Sponsor

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ME Faculty Advisor

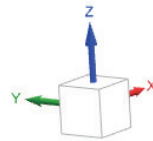
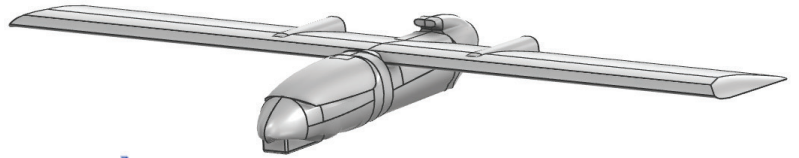
Dr. Guoming Zhu

Vertical Autonomy

VA-15 Fuselage Redesign

Vertical Autonomy is a technology company that designs, builds, and operates advanced unmanned aerial systems, particularly vertical take-off and landing (VTOL) aircraft equipped with autonomous capabilities for mission-critical applications. It develops rugged platforms optimized for endurance, payload capacity, and flexible launch/recovery; and it integrates intelligent autonomy systems for navigation, sensor coordination, and dynamic mission execution. Beyond aircraft design and manufacturing, Vertical Autonomy provides full lifecycle support including engineering, field operations, and training, with a focus on delivering actionable intelligence to help customers make better decisions in defense, public safety, and scientific missions.

Our project was to redesign the VA-15 fuselage so it could be additively manufactured while maintaining a low weight with strong aerodynamic capabilities. The updated model needed to meet NDAA compliance and fit all type 1 drone specifications, which include but are not limited to print size, weight and several other key factors. Our goal was to create a lightweight, structurally sound fuselage that houses all required components. That includes the wiring, the battery, the motor, and autopilot, while still being modular to house different payloads. Throughout the project we modeled the previous design of the fuselage to test its limitations in terms of aerodynamics, manufacturability, and integration. From there, we redesigned the structure using the Design for Additive Manufacturing (DFAM) principles, consolidated parts and optimized the internal structure for a strength-to-weight ratio. We validated the design through FEA and CFD work, along with manufacturing feasibility as well as a cost evaluation.



Michigan State University

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Brighton, Michigan

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Vertical Autonomy *Project Sponsors*

Sean Hilbert
Hillsdale, Michigan

Stephen Ziegenfuss
Hillsdale, Michigan

ME Faculty Advisor **Dr. Junlin Yuan**

Vertical Autonomy

Unmanned Aerial Vehicle Parachute Design

Vertical Autonomy is a Michigan-based aerospace company that designs and manufactures cutting-edge unmanned aerial vehicles (UAVs) across multiple vehicle classes with operations in defense, public safety, and science. The aircrafts use a special wing borne Vertical Take Off and Landing (VTOL) system with tactical vertical launch and recovery capability paired with forward flight maneuvers. As the company progresses toward FAA certification for Beyond Visual Line of Sight (BVLoS) operations, reliable, efficient, and accurate safety systems are necessary to ensure safe recovery in the case of vehicular failure.

This project involved designing a compact, lightweight and efficient parachute recovery system for UAV weights ranging from approximately 55 to 160 pounds and operational airspeeds up to 100 knots (100 mph). The parachute system is limited to loads less than six Gs of force during deployment and landing. In order to cater to better aerodynamics and overall performance efficiency, the system weighed under 1.5kg or less, fit within a tight enclosure on the aircraft itself, and enabled repacking and redeployment. The mechanism can either be deployed manually from a ground station or automatically under a set of specified conditions.



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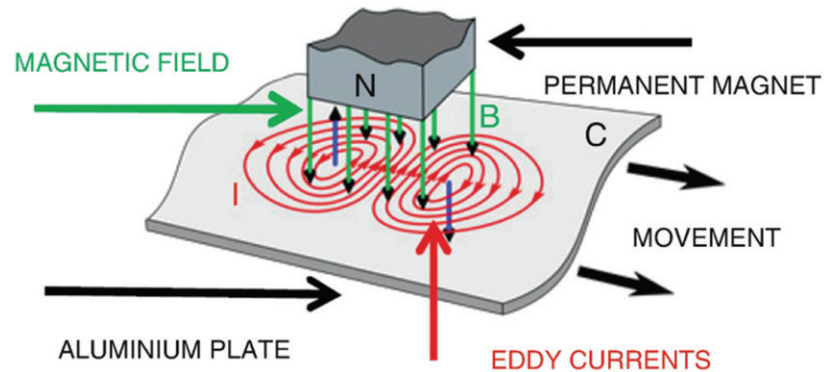
ME Faculty Advisor Dr. Ahmed Naguib

MSU Department of Mechanical Engineering

Eddy Current Damper for ME452L Laboratory

The Michigan State University Department of Mechanical Engineering serves as one of the primary academic units within the College of Engineering, offering undergraduate and graduate programs in mechanical engineering. The department oversees several laboratory courses designed to reinforce theoretical coursework through hands-on application, including the ME452L Controls and Vibrations laboratory. Through continual evaluation and improvement of its instructional facilities and equipment, the department seeks to ensure that laboratory experiences align with course learning objectives and provide students with accurate and meaningful demonstrations of core engineering principles.

The objective of this project was to design and fabricate five adjustable damping systems to replace the existing pneumatic dampers used in ME452L. The team first characterized the performance and limitations of the current damping systems, then developed a magnetic-based, eddy current damping system that was intended to more closely approximate linear viscous behavior with the intention of improving educational effectiveness. The final design was required to integrate with the existing laboratory equipment, provide a controllable range of damping, and be robust for repeated student use.



Department of Mechanical Engineering
MICHIGAN STATE UNIVERSITY



Michigan State University

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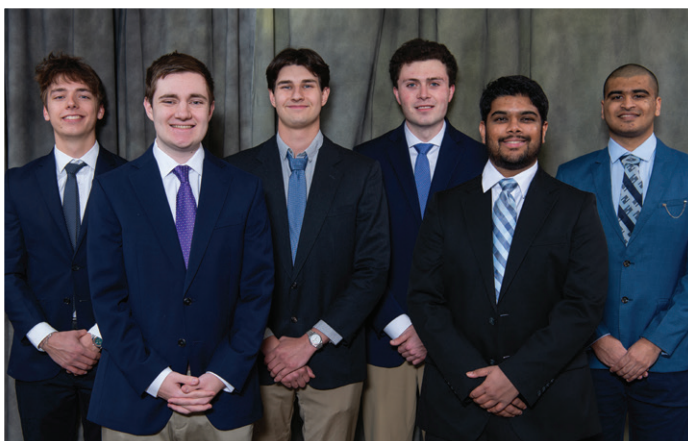
ME Faculty Advisor

Dr. Geoffrey Recktenwald

Michigan AgrAbility Wheelchair Mounted Grain Feeder

Michigan AgrAbility is a program dedicated to assisting individuals in the agricultural industry who are living with injury, illness, or disability so they can continue working safely and productively. Funded by the United States Department of Agriculture through Michigan State University Extension and Easterseals MORC, the organization partnered with a dairy farm family in Ionia County, Michigan, to support their son, Landen. Landen sustained a brain injury in early childhood that resulted in cognitive and physical disabilities. As he approached adulthood, his family sought assistance in identifying meaningful, safe farm tasks that would enable him to remain actively involved in daily operations. Feeding grain to calves housed in individual pens was identified as an appropriate and valuable responsibility that aligned with his interests and abilities.

Our team designed and implemented a grain dispensing system that enabled Landen to independently feed calves using his power wheelchair. A rechargeable 12-volt Moultrie deer feeder was selected and mounted to his wheelchair using a custom-designed attachment system developed through CAD modeling and FEA analysis to ensure safety and reliability. A large, accessible push-button control was integrated to enable Landen to consistently dispense one pound of grain into each calf's bucket without lifting or scooping. A prototype was built, tested on-site at the farm, and refined based on performance and user feedback. The final system provided a detachable, safe, and user-friendly solution that enabled Landen to complete a daily chore independently while maintaining the operational needs of the farm.



Michigan State University

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Michigan AgrAbility

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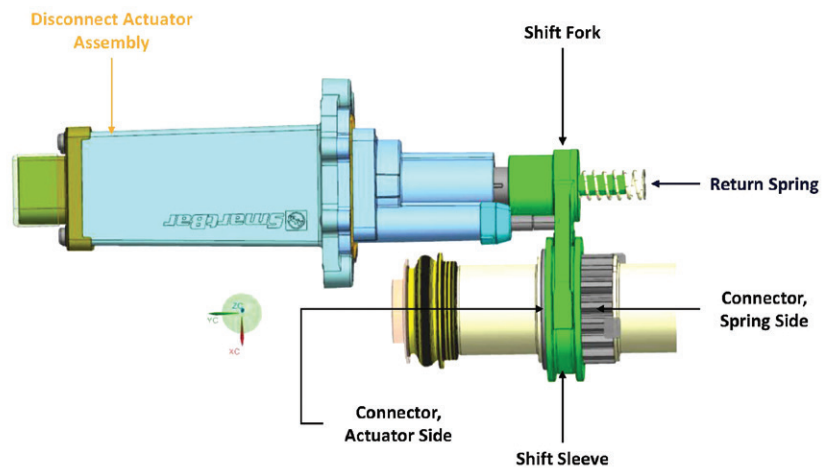
ME Faculty Advisor

Dr. Ricardo Mejia

Dauch Corporation SmartBar[®] - Reduction in System Lash

The Dauch Corporation (formerly known as American Axle & Manufacturing) was founded in 1994 by Richard E. Dauch. Headquartered in Detroit Michigan, it is a Tier I supplier for OEMs (original equipment manufacturer) that provides a multitude of driveline components for both internal combustion and hybrid/electric vehicles. The Dauch Corp. continues to pull ahead of the competition by engineering proven technologies such as their Quantum[®] line of axles and the well-established SmartBar[®]. While its products' performance speak for themselves, Dauch never settles until its extensive, all-weather testing meets its high standards. Introduced in 1999, SmartBar[®] provided OEMs a seamless, proven mechanism to drastically improve a vehicle's off-road capabilities. The product has since been installed on new vehicles as part off-road focused trim packages.

SmartBar[®] is an electronic disconnecting sway bar (also referred to as a stabilizer bar). The capability of disconnecting the sway bar from the vehicle's driver's seat enables a seamless transition from on-road conditions to off-road. A gear-sleeve system on the SmartBar[®] was to be redesigned or improved to reduce the total system lash below a given value of 0.5 degrees. The initial system lash is measured to be between 0.9 and 1.1 degrees with the current design. The actuator attached to the SmartBar[®] was to be assumed not to change. Dauch sought a 3D model design, written report, and preliminary prototype for the improved connection system.



DAUCHTM



Michigan State University

Team Members (left to right)

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Design Day Awards Fall 2025

ME 481 Edison Award for Best Capstone Design Project

The Edison Undergraduate Design Award is given to the ME 481 Design Team that is judged to have produced the best technical design project.

Team Michigan AgrAbility:
Assistive Device for Limited Arm Function

Left to right: Damon McConnell, Miles Hayes, Brody Stack, Finn Jarvis, Brandon Davies



ME 481 Best Capstone Project Presentation Award

The ME 481 Project Presentation Award for the best presentation of a design project.

Team Arthrex, Inc.:
Precision Oscillating Tip Saw System

Left to right: Joshua Wasmund, Ella Kruschka, Adam Laubach, Hunter Hendricks



ME 470 da Vinci Award (Best Mechanical Design)

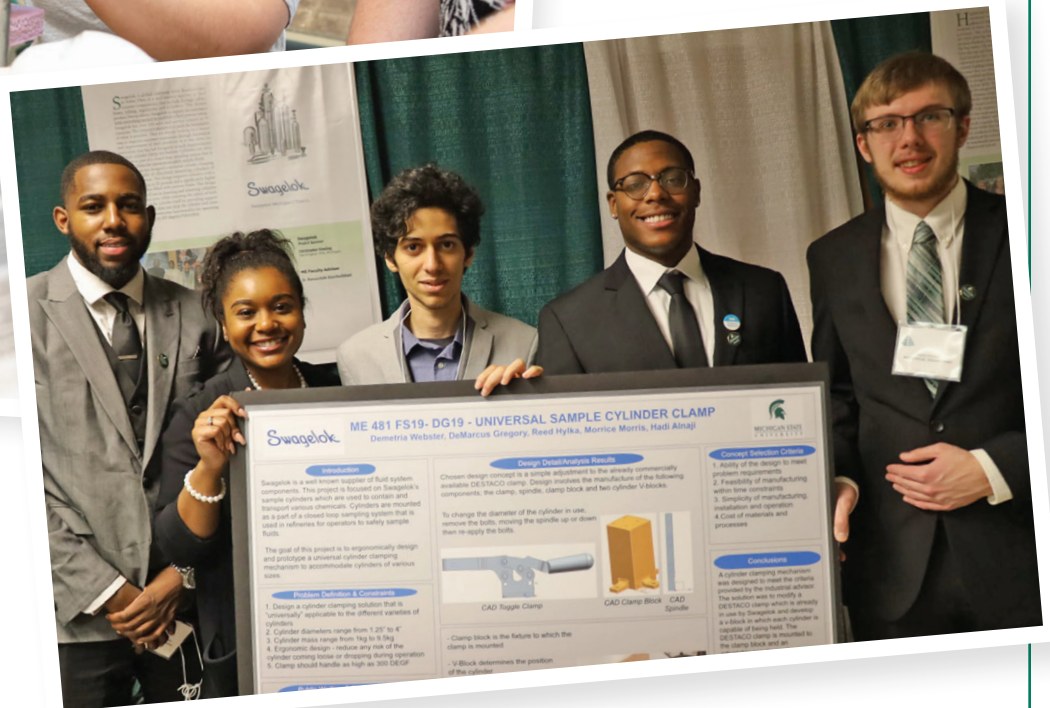
The Leonardo da Vinci Award was presented to the team with the best machine design.

Left to right: Alexander Smith, Ethan Gehrke, Zea Labate, Raul Murillo Martinez, Ryan Nehls



MICHIGAN STATE UNIVERSITY
 COLLEGE OF ENGINEERING FALL 2026
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**Look for
 Fall Design
 Day projects
 coming in
 December
 2026!**



Swagelok ME 481 FS19-DG19 - UNIVERSAL SAMPLE CYLINDER CLAMP
 Domènec Webster, DaMarcus Gregory, Reed Hyika, Morrice Morris, Hadi Alnajaj

Introduction
 Swagelok is a well known supplier of fluid system components. The project is focused on Swagelok's sample cylinders which are used to contain and transport various chemicals. Cylinders are mounted on a part of a closed loop sampling system that is used to refill/recharge for operators to safely sample fluids.

Problem Definition & Constraints

1. Design a cylinder clamping solution that is "universal" applicable to the different varieties of cylinders.
2. Cylinder diameters range from 1.25" to 4"
3. Cylinder mass range from 1kg to 5 kg
4. Ergonomic design - reduce any risk of the cylinder coming loose or dropping during operation
5. Clamp should handle as high as 300 DEGP

Design Detail/Analysis Results
 Chosen design concept is a simple alignment to the already commercially available ODS/STACO clamping. Design involves the manufacture of the following components, the clamp, spindle, clamp block and two cylinder V-blocks.

To change the diameter of the cylinder in use, remove the bolts, moving the spindle up or down, then re-apply the bolts.

Concept Selection Criteria

1. Ability of the design to meet problem requirements
2. Feasibility of manufacturing within time constraints
3. Simplicity of manufacturing installation and operation
4. Cost of materials and processes

Conclusions
 A cylinder clamping mechanism was designed to meet the criteria provided by the instructor. This solution was to modify a DE/STACO clamp which is already in use by Swagelok and mounting it in a block in which each cylinder is capable of being held. The DE/STACO clamp is mounted to the clamp block and as...

Clamp block is the feature to which the clamp is mounted

V-Block determines the position of the cylinder

Images: CAD Suggest Clamp, CAD Clamp Block, CAD Spindle



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- Use advanced public cloud technologies that are in high demand
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- Experience data science practices with data wrangling, analytics with potential Artificial Intelligence/Machine Learning application opportunities



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