AUDIO · LEADERSHIP

Snow Speakers and Live DJs for Michigan Tech's Winter Carnival

January – February 2026

Project Scope

Organize the month-long snow speaker build for Michigan Tech's Audio Engineering Society to host live DJs.

Project Considerations

- Icing speakers directly into carved snow without damaging them
- Integrating Red Bull's event jeep into the snow statue
- Building and wiring the statue in Houghton's winter weather
- Minimize expenses to suit a limited club budget

Assembled Project

- 24' x 8' snow speaker statue
- 32 subwoofers, 10 PA's, 4 midwoofers, 2 horns, up to 20kW
- Red Bull event jeep with DJ deck and space heater

Project Summary

As AES chapter president, I led the build for a six-DJ performance at Michigan Tech's Winter Carnival 2026. The snow speaker statue is built using temporary plywood forms to mix snow and water in place for the structure. Once the shape is created, a volume is carved out and a plywood baffle is iced in for speaker mounting. Wires are run from a central amplifier rack to each set of woofers. This year Red Bull partnered with our club to supply their event jeep, which is configured with a DJ deck and platform out the sunroof. A space heater keeps the DJs warm all night long. During this event we were proud to hand out 2,500 free cans of Red Bull to students and families enjoying the festivities. The statue delivered loud, quality sound and continues to be a cornerstone of the Michigan Tech Winter Carnival experience.


RedBull


RedBull


RedBull

AES 2026 DJ LINE-UP

WINTER CARNIVAL ALL-NIGHTER

In front of the M&M

TASCO —— 4:15-5:00 PM
EDM AND HOUSE

DJ MYTHO —— 5:15-6:00 PM
ENERGETIC AND HARDCORE

STATTAX —— 6:15-7:00 PM
HEAVY BASS AND RHYTHM

STELSKI —— 7:15-8:00 PM
GREAT BEATS

DJ DOUBLE-E — 8:15-9:00 PM
2000'S DANCE

CONWAY —— 9:15-9:00 PM
A CURATED EXPERIENCE

J MAN —— 10:15-11:00 PM
EDM AND GIRLYPOP

NORTHERN LIGHTS DRONE SHOW
11:15-11:30PM

AUDIO AES

AUDIO · FABRICATION

Large Rotary Style Subwoofer for Infrasonic Audio

Fall 2024 – Spring 2025

Project Scope

Design and build a large rotary subwoofer that generates high-energy infrasonic audio for resonance trials and practical theater effects.

Project Considerations

- Thorough safety and FMEA analysis
- Minimal vibrations
- Power compatibility
- Rigid fan blades
- Constant fan velocity

Design Solution

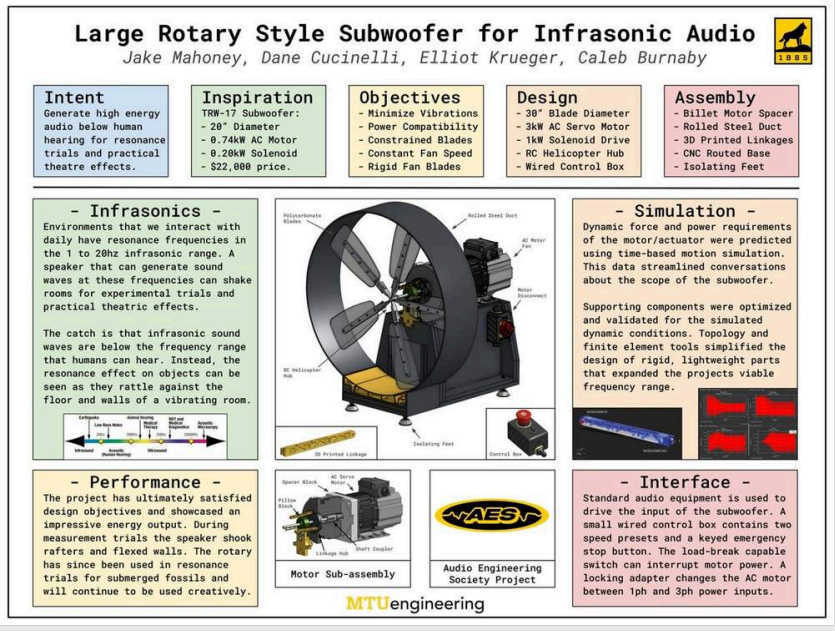
- 30-inch blade diameter
- 3 kW AC servo motor
- 1 kW solenoid drive
- RC helicopter hub
- Wired control box

Assembled Project

- Billet motor spacer
- Rolled steel duct
- 3D-printed linkages
- Isolating feet

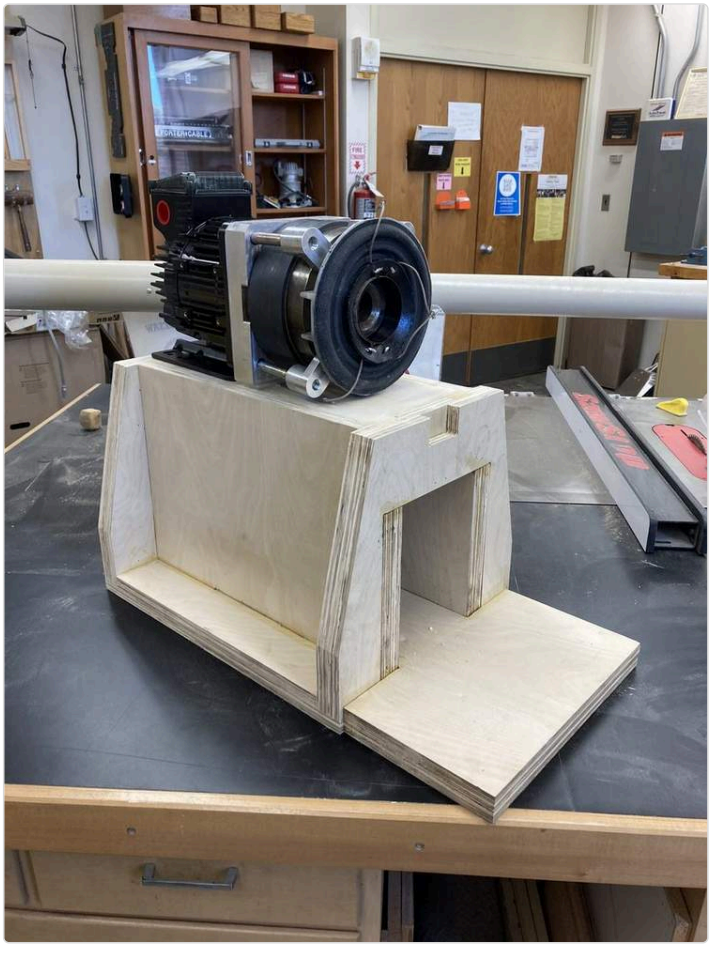
Project Summary

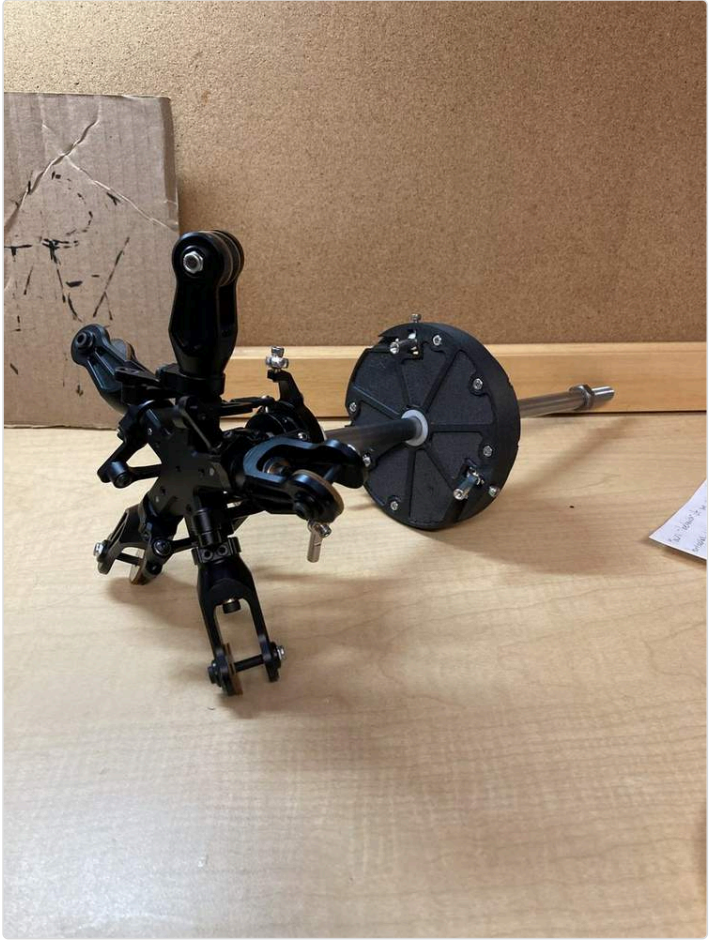
The Large Rotary Subwoofer was a passion project I completed through the Audio Engineering Society at Michigan Tech. A rotary subwoofer is a unique type of speaker that plays infrasonic frequencies at high energy levels. This technology had caught my eye on YouTube around the time that I started college, and when I found the Audio Engineering Society I decided we had to build one. With club backing I fundraised a $2,500 budget that let my team bring the project to life. The subwoofer uses an RC helicopter pitch collective to decouple motor velocity and blade pitch. The 30" blades paired with a 3kW AC servo motor and 1kW subwoofer solenoid mean that the rotary can deliver wall-flexing power to its environment. During trials it reproduced tactile effects that simulated a minor earthquake. The project was showcased at Michigan Tech's annual Design Expo, where it competed against senior design projects with a showcase video and poster presentation. In Spring 2025 a Michigan Tech Archaeology class reached out to use it for fossil resonance trials, vibrating fossils underwater with infrasonic frequencies and picking up resonances with a water microphone. With more time and budget I'd love to continue improving the frequency response by designing lower-inertia blades made from carbon fiber laminates.



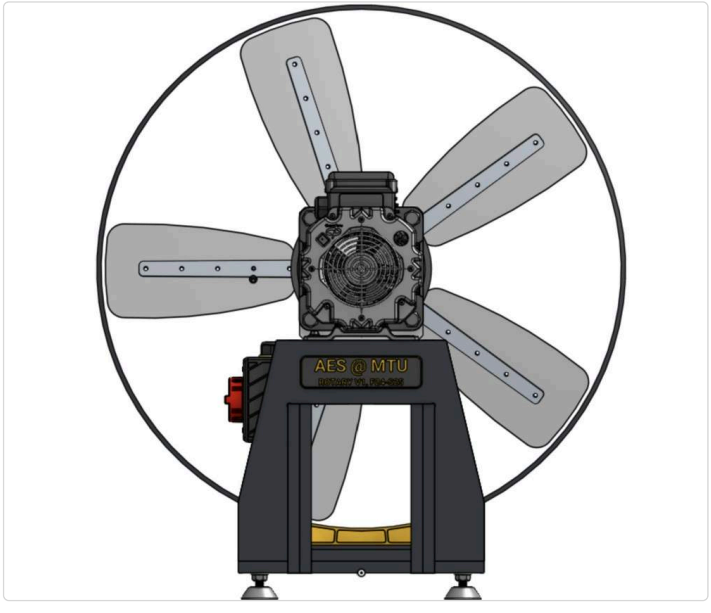
Open the Design Expo poster (PDF)

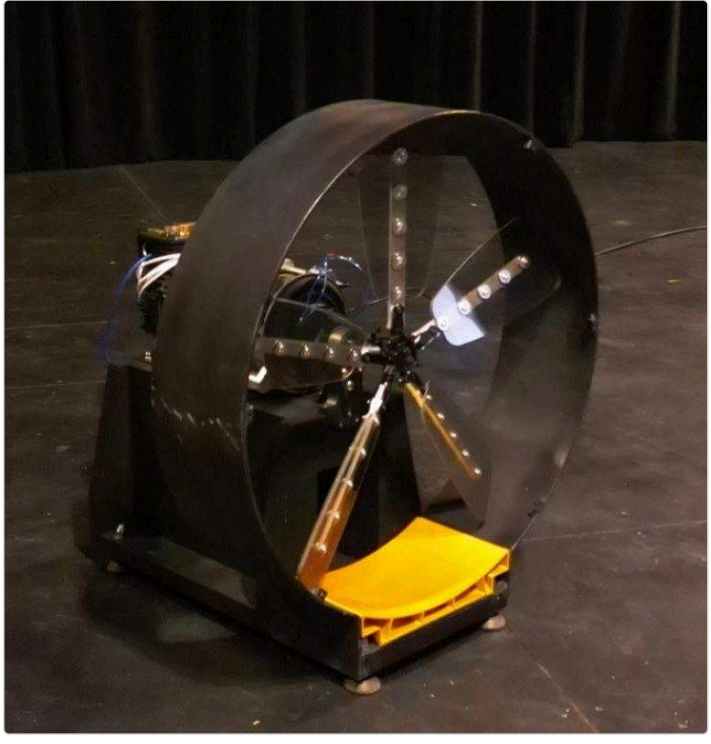

LAGUNA
LAGUNA
IQ
PRO

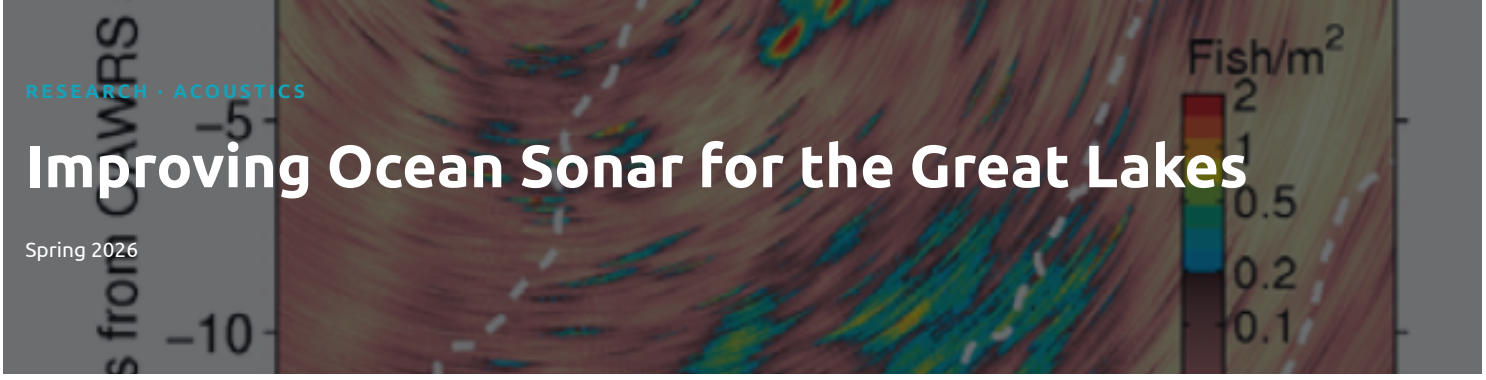





A
ES


AES @ MTU





RESEARCH · ACOUSTICS

Improving Ocean Sonar for the Great Lakes

Spring 2026

Project Scope

Build a compact, directional sonar package that improves Ocean Acoustic Waveguide Remote Sensing (OAWRS) for shallow, ice-covered Great Lakes waters.

Project Considerations

- Side lobes reverberate in a narrow waveguide and decrease the signal to noise ratio (SNR)
- Existing vertical source arrays are too deep for shallow lake waters
- Ship-towed arrays are less effective and less economical in ice-covered lakes

Design Solution

- Parametric ultrasonic arrays for low-frequency, directional sound from a small transducer
- Compact source-receiver package sized for an autonomous vessel
- Hardware collects the data for my mentors, Dr. Gan and Dr. Evans, to signal process and acoustically model

Project State

- Initial research conducted Spring 2026, hardware development starting Fall 2026
- Validation planned in MTU's wave tank before open-water testing
- Funded by the Great Lakes Fisheries Commission (GLFC)
- USGS has expressed interest in the method for ice-covered lake environments, and ONR support is in pursuit for naval under-ice sensing

Project Summary

This is a GLFC-funded research project I'm doing as an Undergraduate Research Fellow through Michigan Tech's COE-REU program. Ocean Acoustic Waveguide Remote Sensing maps fish concentration using a submerged source array, the waveguide formed by the surface and lakebed, and a receiver array. The original method was built for the deep ocean which

enabled aspects of its design like extremely large source and receiver arrays. In the shallow water and ice covered Great Lakes the current method is not very effective or viable. I'm building a compact source-receiver package around parametric ultrasonic arrays to adapt and improve the method to this new challenging underwater environment.

Parametric Ultrasonic Arrays for Ocean Acoustic Waveguide Remote Sensing (OAWRS) in the Great Lakes and Other Challenging Environments

By: Jake Mahoney. Mentor: Dr. Evan Lucas (CS)

Background

Ocean Acoustic Waveguide Remote Sensing (OAWRS) is an acoustic remote sensing method with the potential to simultaneously and instantaneously monitor fish concentration across large areas of aquatic bodies. OAWRS operates by sending out linear frequency modulated (LFM) signals from a submerged acoustic source while the water surface and seabed act as an acoustic waveguide for sonic propagation. Acoustic signals reflect off schools of fish and are collected by a receiver array, which are processed to determine fish location and concentration as seen in Figure 1. Researchers show that fish species can be differentiated based on their frequency-dependent "signature" at different LFM center frequencies [2].

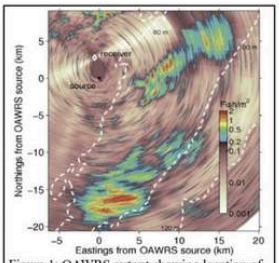


Figure 1: OAWRS output showing location of fish density [1]. The white dashed lines represent bathymetry contours.

Challenges with Current OAWRS Configuration and Size

1. Side Lobes in a Narrow Acoustic Waveguide: Side lobes are an unwanted noise pattern caused by acoustic energy radiating at angles away from the main direction of propagation. In shallower bathymetry the acoustic waveguide is narrowed which increases the reverberation of side lobes [3]. This reverberating energy arrives at the receiver alongside the signal of interest which decreases the signal to noise ratio (SNR). To counter this effect in shallower bathymetry, a higher directivity source could be used to minimize these unwanted echos. Dr. Gan within MTU's MAE department has identified a technology, parametric ultrasonic arrays (PUAs), that could be used to create low frequency sound waves with very high directivity [4]. This more compact method could eliminate the large wavelength transducers currently used in OAWRS.

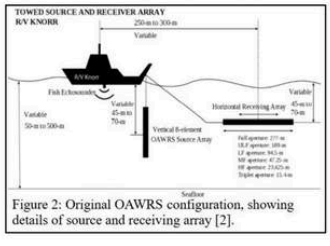


Figure 2: Original OAWRS configuration, showing details of source and receiving array [2].

2. Draft Depth: The current vertical source array, seen in Figure 2, has a large draft that challenges its implementation in non-oceanic conditions. A horizontal or more compact source array could be more suitable for use in shallow bathymetry conditions. It could also enable implementation with smaller vessels, including autonomous ones.

3. Surface Ice: The current ship-towed pair of arrays is not suited for continual testing in the presence of surface ice. While the current OAWRS method has been demonstrated in ice-free

Open the full proposal (PDF)

TESTING · NVH

Modal Test and Analysis of Michigan Tech's Formula SAE Chassis

Spring 2026

Project Scope

Characterize Formula SAE chassis dynamics across the frequency range excited by rotating components.

Experimental Setup

- Free-free boundary condition: car suspended on low-stiffness bungies and a highpass filter to remove translational modes

Design Solution

- Roving-hammer modal test with 43 tri-axial accelerometers, steel hammer tip for maximum excitation energy
- 256 Hz bandwidth, 512 spectral lines for 1 Hz resolution, 5 averages per point
- Tube chassis simplified to nodes at welded joints, modeled in Inspire and Hypermesh
- Strike points at the roll cage top and front bumper corners, with drive-point checks for validation

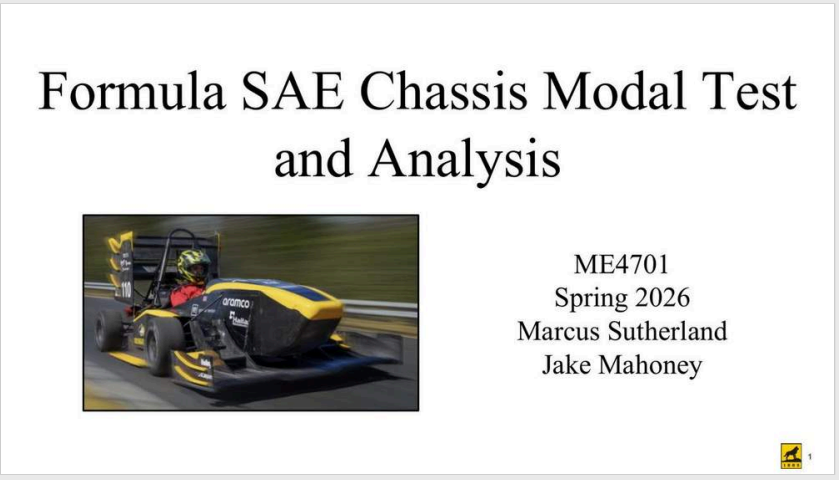
Results Processing

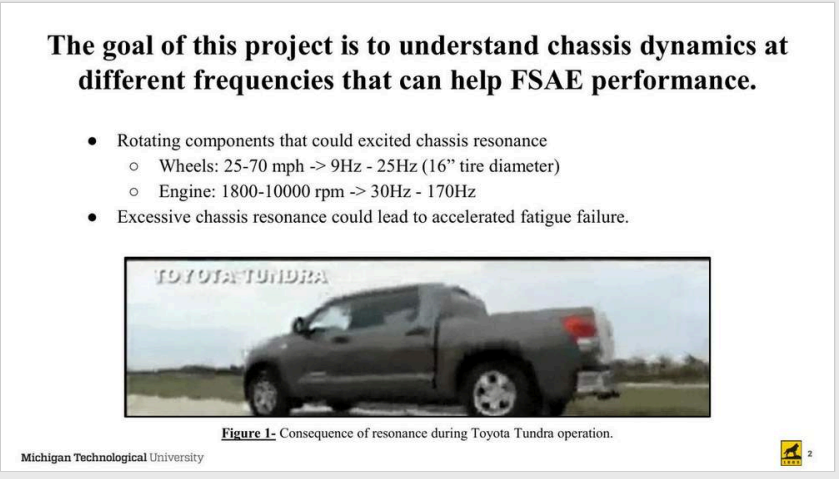
- Full chassis instrumented and struck at all 43 nodes; higher-amplitude strikes cut low-frequency noise while holding high-frequency response
- Data curve-fit incrementally through the bandwidth in PolyMax Plus
- 12 mode shapes identified, from 40.7 Hz up to 188.5 Hz
- Reciprocity checks, modal synthesis, and MAC matrix comparison used to validate the results

Project Summary

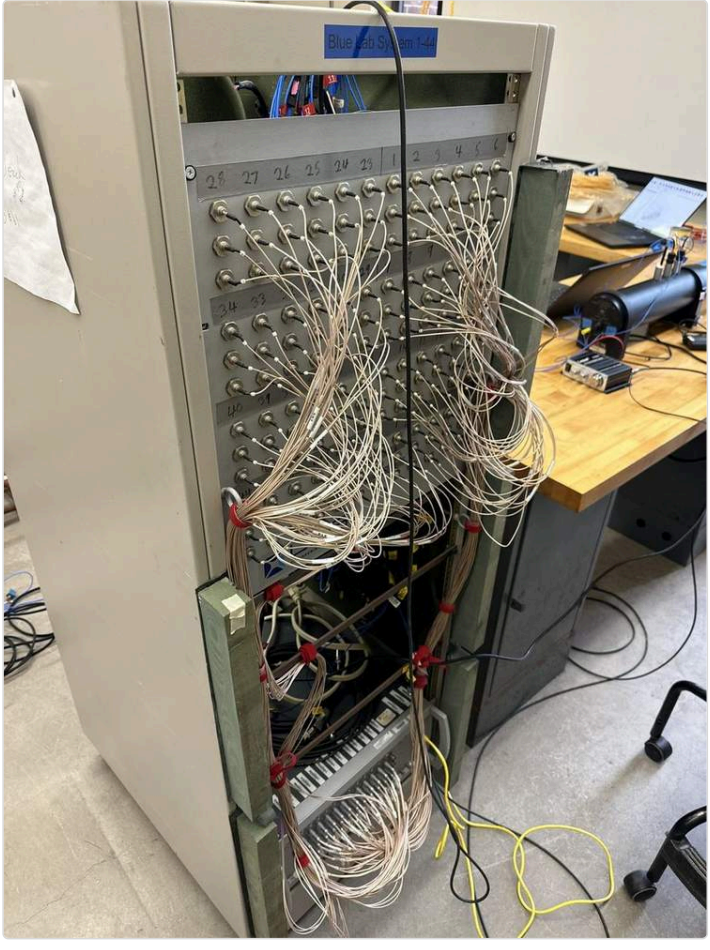
This was an ME4701 project I completed in Spring 2026. The goal of the project was to identify potential chassis resonances that could be excited by rotating components like the wheels and engine. First the chassis was modeled in Hyperworks to easily import the node locations into TestLab. The chassis was instrumented with 43 tri-axial accelerometers wired to a SCADAS III. Preliminary strikes showed noise at low frequencies, so we switched to firmer hammer hits, which cut that noise while still exciting the higher modes cleanly. We curve-fit the response data through the bandwidth in stages and identified

12 distinct mode shapes between 40.7 Hz and 188.5 Hz. Reciprocity testing came back strong in the Y and Z directions, with only slight variance in X. The MAC matrix confirmed the mode shapes were independent. This process highlighted the importance of organizing experimental data, especially with so many channels and strike points.





Open the full presentation (PowerPoint)


Blue Lab System 1-44


Blue System 1-44
1-12
13-22
23-34
35-44