ALFONSO RUIZ

MECHANICAL ENGINEERING AT THE UNIVERSITY OF TEXAS AT EL PASO

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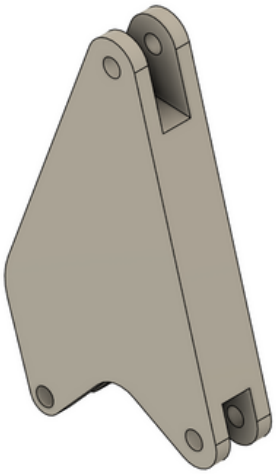
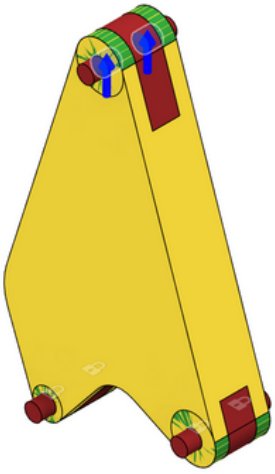
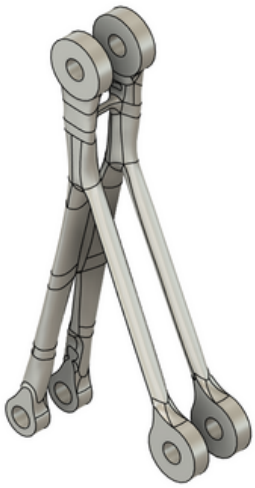
ENGINE BRACKET TOPOLOGY OPTIMIZATION FOR LASER POWDER BED FUSION







What?

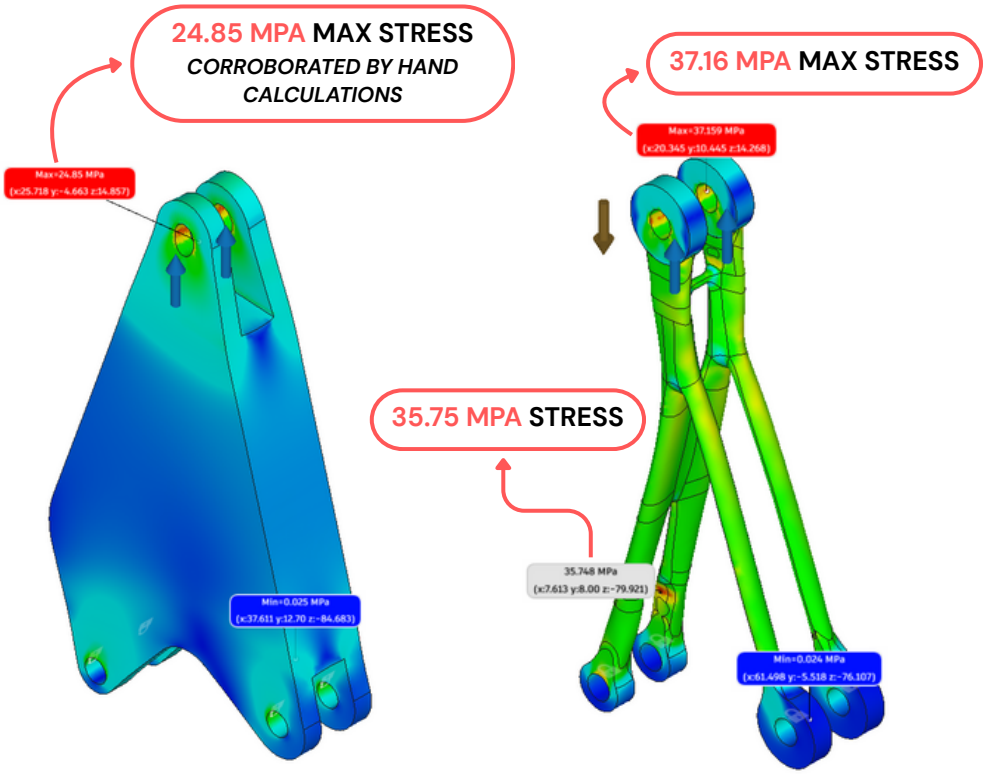
- Optimized an **AlSi10Mg** engine bracket for **LPBF** additive manufacturing
- Aimed to minimize mass while ensuring safety under a **1600 N** tensile load

How?

- Used Autodesk Fusion **Generative Design** to create an optimized structure
- Validated **FEA** results using hand calculations and physical tensile testing

Results

- Achieved **86%** mass reduction (223 g to 31 g) with a predicted **safety factor of 6.5**
- Withstood **9018 N** without failure, confirming a **safety factor greater than 5.6**
- Calculations confirmed the maximum stress (**209 MPa**) remained safely below the **460 MPa** limit



1. PRESERVE AND OBSTACLE GEOMETRIES
2. SETUP LOADS AND CONSTRAINTS
3. OBJECTIVES AND MANUFACTURING
4. MATERIAL SELECTION
5. EXPLORE GENERATIVE DESIGN

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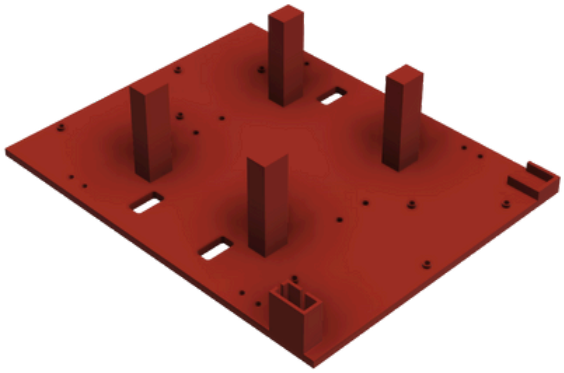
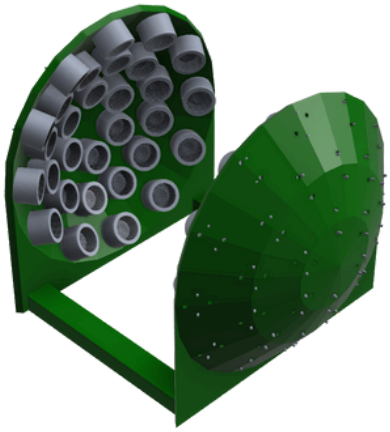
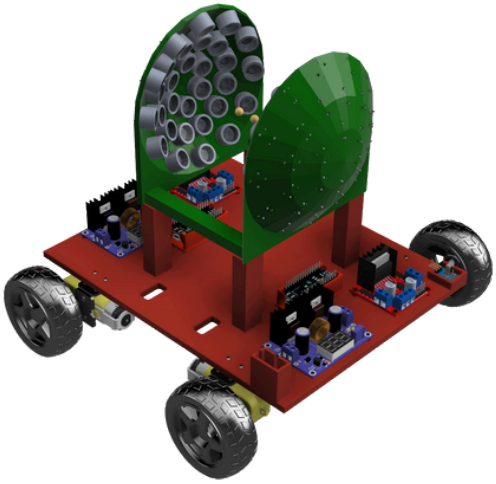
TRANSPORTATION VIA ULTRASONIC LEVITATION SYSTEM







What?

- Created a transport system using **ultrasonic levitation**
- Focused on demonstrating non-contact transportation by synchronizing **60 opposed ultrasonic transducers**

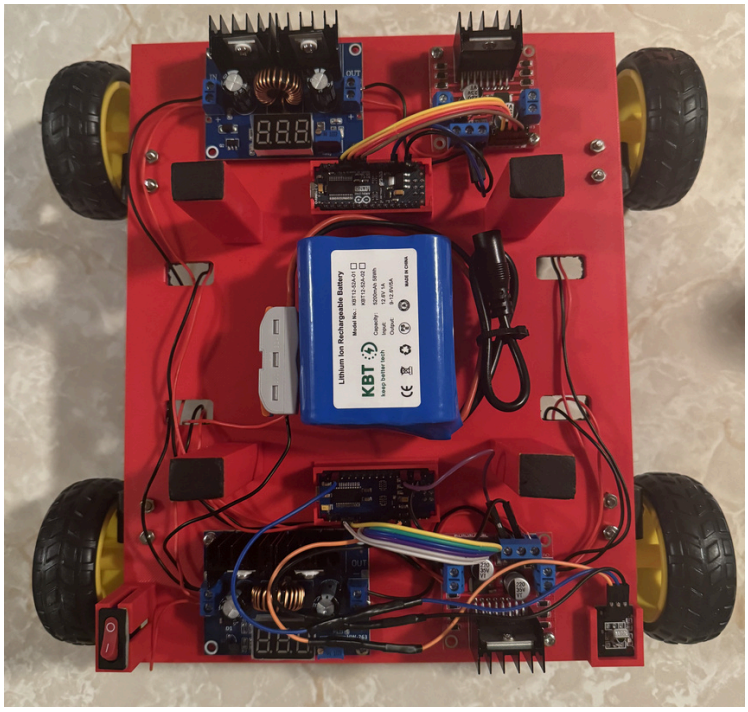
How?

- Implemented **Arduino Timer 1 interrupts** to generate **40 kHz** acoustic standing waves, eliminating main-loop blocking to ensure levitation stability
- Used Autodesk Fusion to design a custom **3D printed** base for stability and transportation of the system

Results

- Achieved stable acoustic levitation of low-density payloads **(<5 mg)**, validating precise non-contact transportation capabilities
- Enabled precise remote control for object movement
- Demonstrated effective non-contact transport capabilities

Ultrasonic Levitation



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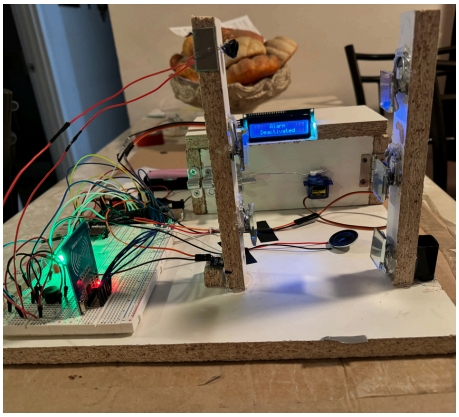
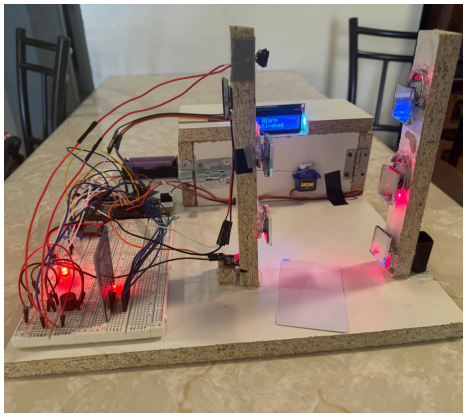
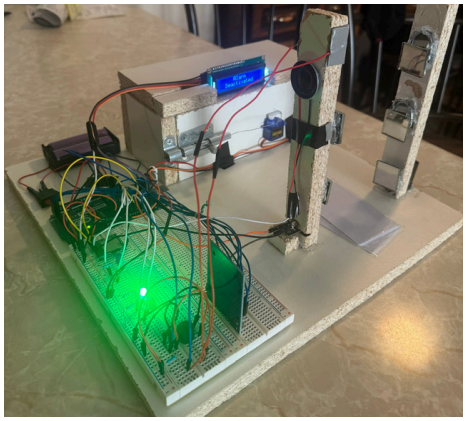
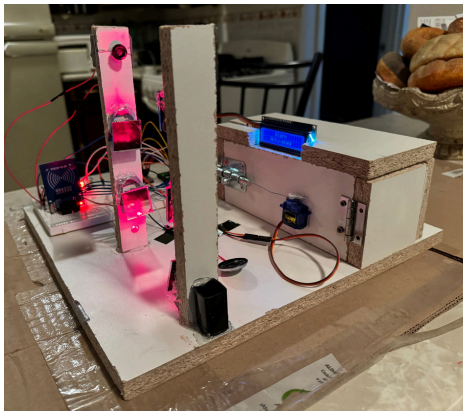
LASER SECURITY ALARM SYSTEM









What?

- Designed an automated **Laser Security Alarm System** to monitor and secure restricted access zones

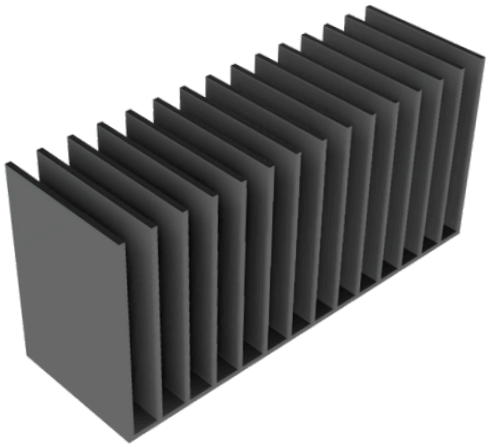
How?

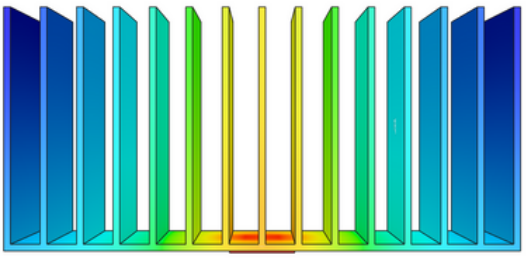
- Developed a continuous detection grid by aligning mirrors and photoresistors to trigger audiovisual alarms immediately upon beam interruption
- Integrated **RFID authentication and I2C protocol** to manage secure key-card access and real-time LCD status reporting

Results

- Validated system reliability by achieving **instant detection** of physical breaches while enabling seamless bypass for authorized users

HEAT SINK DESIGN





What?

- Designed a heat sink in Autodesk Fusion to dissipate heat from a simulated CPU surface, targeting a **22±2°C** temperature reduction

How?

- Conducted thermal **FEA** to simulate natural convection and applied **analytical heat transfer formulas** to optimize fin geometry

Results

- Validated design performance by reducing surface temperature from **85°C to 64.3°C**, achieving a **20.7°C reduction**