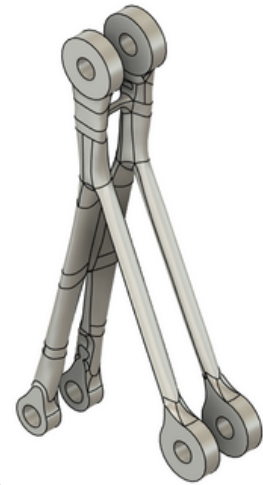
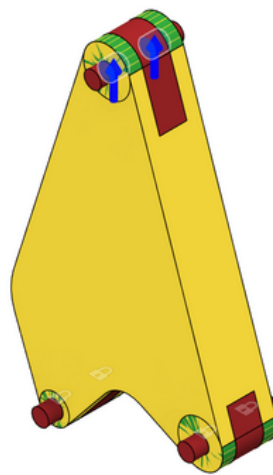
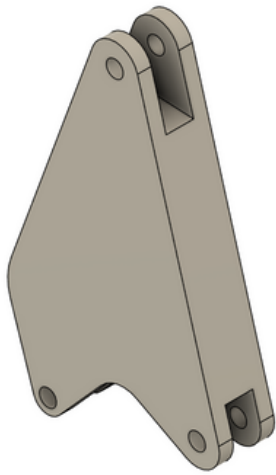


## ENGINE BRACKET TOPOLOGY OPTIMIZATION FOR LASER POWDER BED FUSION



### What?

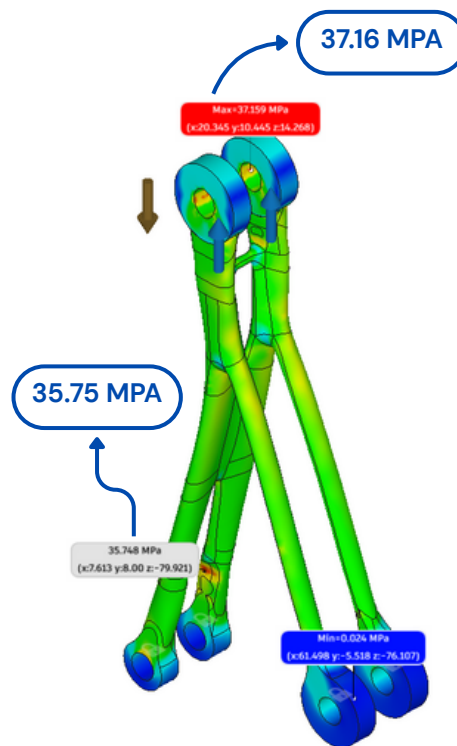
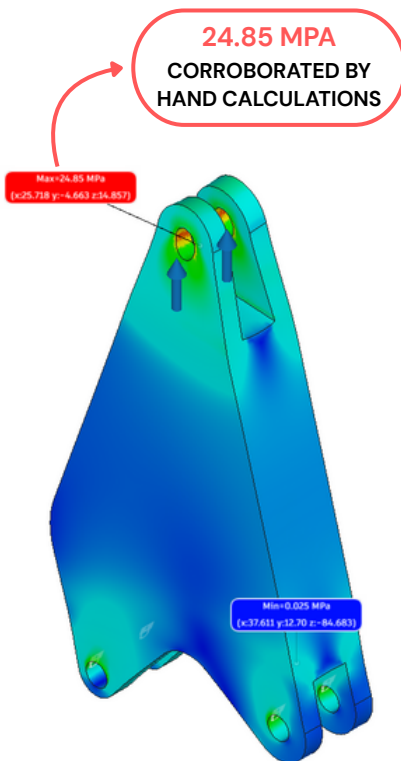
- Optimized an **AlSi10Mg** engine bracket for a defense system for **LPBF** manufacturing
- Aimed to minimize mass while ensuring safety under a **1600 N** tensile load

### 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 peak stress of **~209 MPa** remained safely below the **460 MPa** limit



1

PRESERVE AND  
OBSTACLE  
GEOMETRIES

2

SETUP LOADS AND  
CONSTRAINTS

3

OBJECTIVES AND  
MANUFACTURING

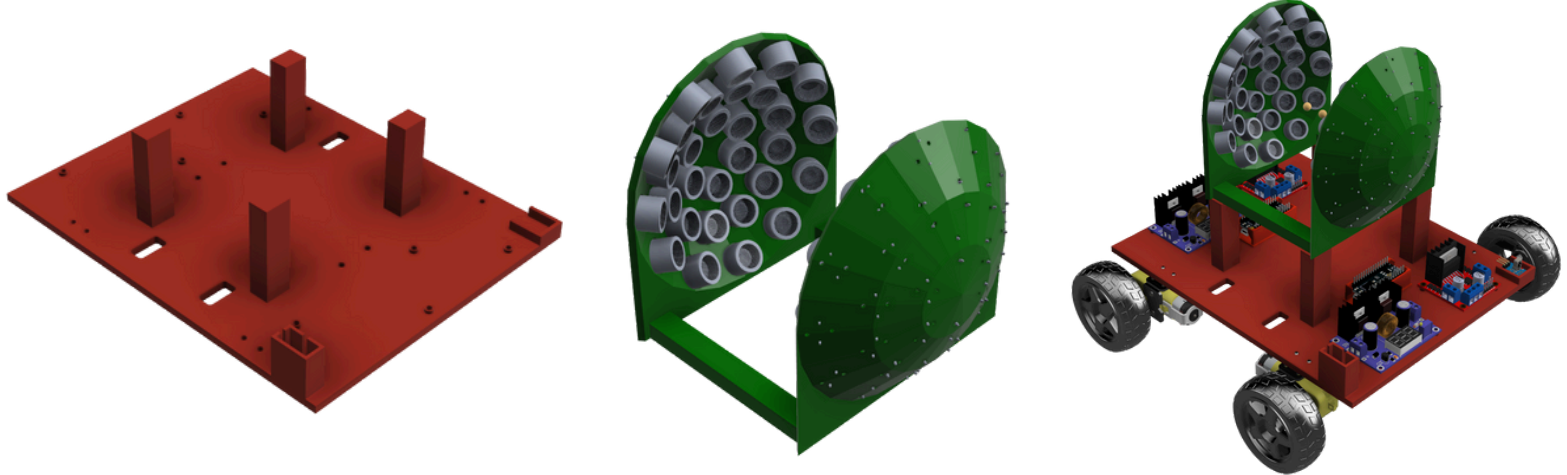
4

MATERIAL  
SELECTION

5

EXPLORE  
GENERATIVE  
DESIGN

## TRANSPORTATION VIA ULTRASONIC LEVITATION SYSTEM



### What?

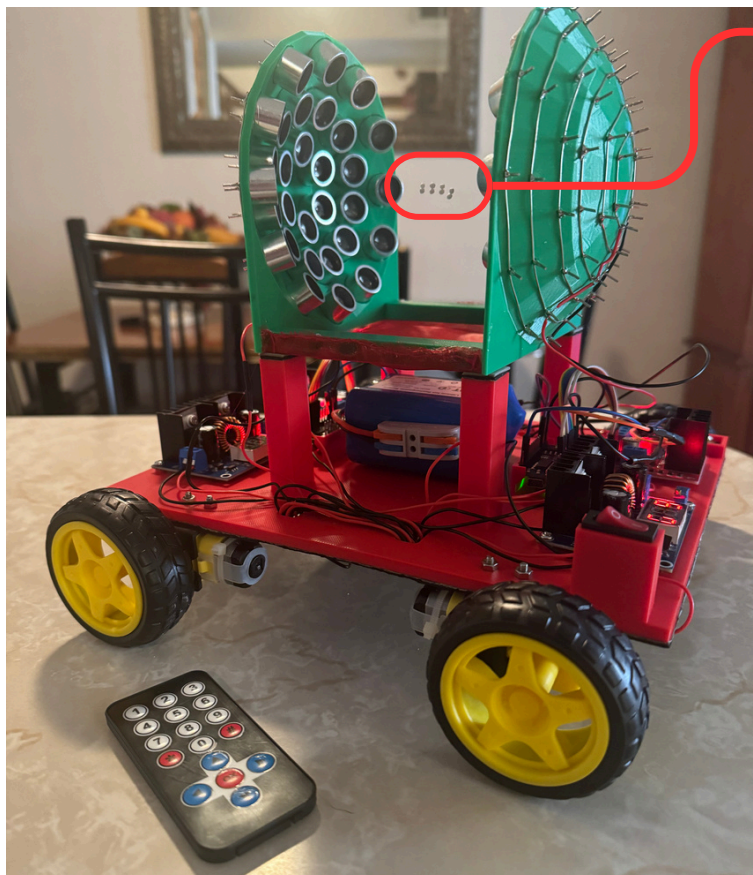
- Created a transport system using **ultrasonic levitation**
- Focused on demonstrating non-contact transportation by synchronizing **60 opposed ultrasonic transducers**

### How?

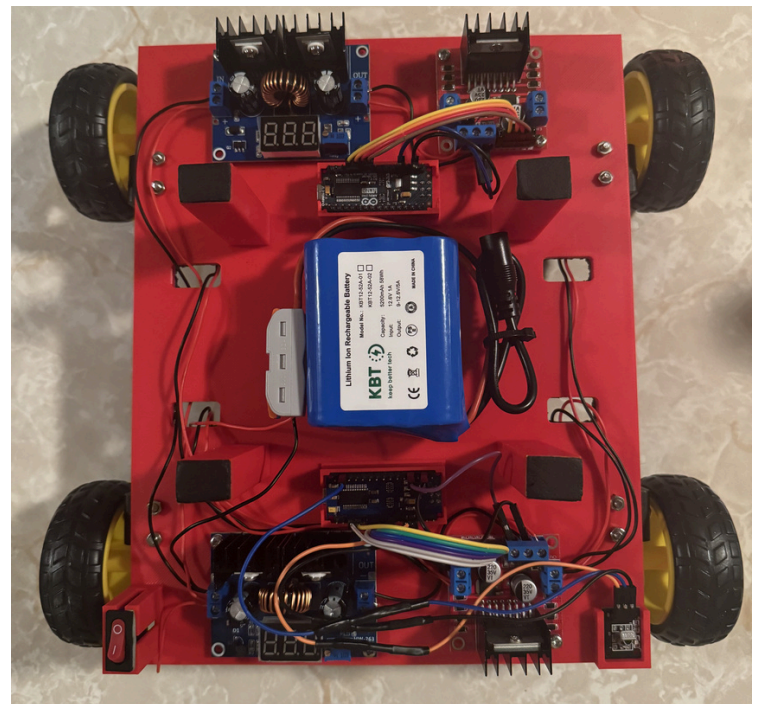
- Configured **Arduino Timer 1 interrupts** to synthesize **40 kHz** acoustic standing waves, eliminating main-loop blocking to ensure levitation stability
- Used Autodesk Fusion to design a custom **3D printed** base for stability and transportation of the system

### Results

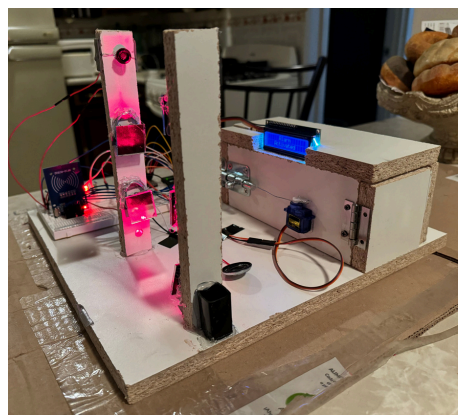
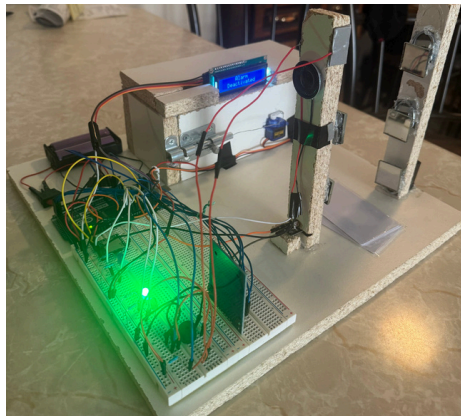
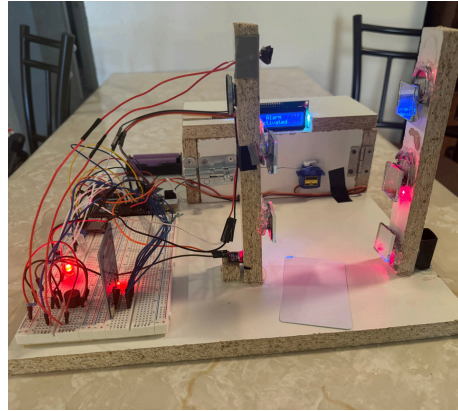
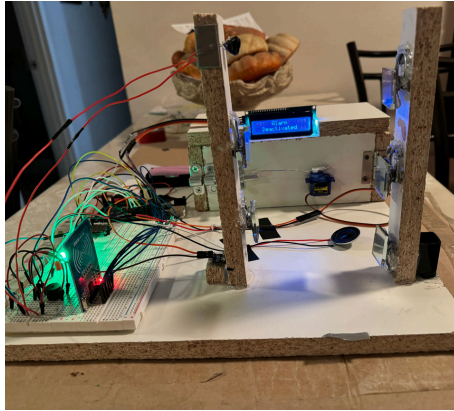
- Achieved stable acoustic levitation of low-density payloads (**<5 mg**), validating precise non-contact transportation capabilities
- Enabled precise remote control for object movement
- Demonstrated effective non-contact transport capabilities



Ultrasonic Levitation



## LASER SECURITY ALARM SYSTEM



### What?

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

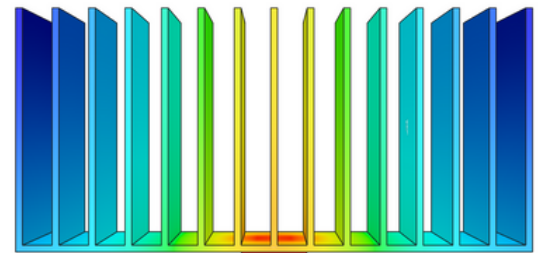
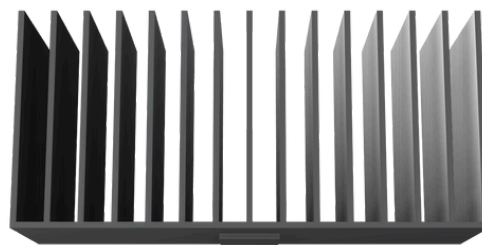
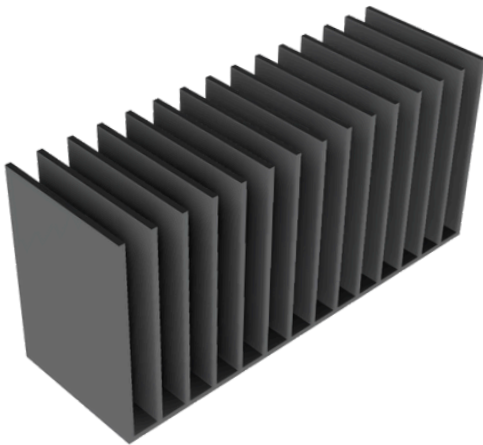
### How?

- 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



SIMULATED CPU

### 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**