KEIVAN FARHAN

Engineering Portfolio

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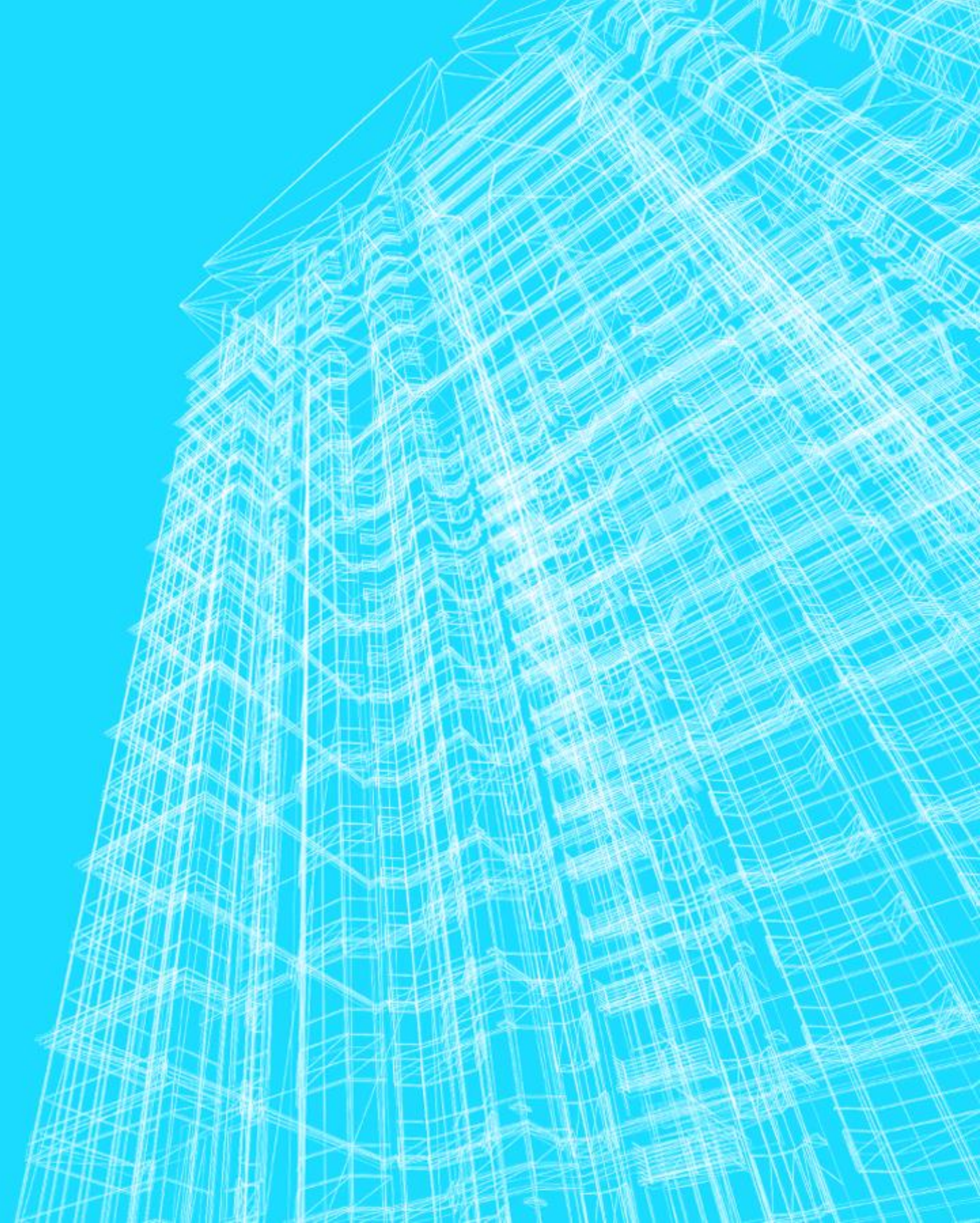


PROJECT (2018): GT CAPSTONE DESIGN

Ruggedized Outdoor Eco (Energy Storage System)

EnerJackets

sonnen

Designed By: Keivan Farhan, Alex Gray, Rafael Garcia, Kenta Yasuda, Maddy Kanne & Kate Moss

Problem Background

- The sonnenBatterie is a smart energy storage system (ESS) that saves users money by harvesting energy from the solar PV system or the grid when energy is cheapest and uses the stored energy to power the home when energy rates are more expensive
- The power detection system senses power outages and automatically switches the home to battery power

Problem Statement

Redesign the Sonnen energy storage system enclosure to be weather resistant and maintain safe temperatures for batteries, inverter, and the interior of the enclosure

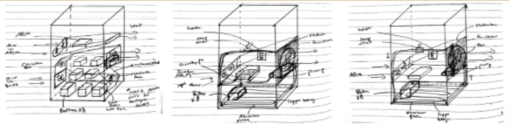
Specification Requirements

Operating Ambient Temperature	0 - 45°C
Maximum Allowable Temperature of Inverter	100°C
Noise	< 50 dB from 6 ft away
Weather	IP54 or NEMA 3R enclosure rating
Forces	200 lbs force against unit at farthest point from fasteners
Dimensions	84" x 25.6" x 15.25"
Usable Energy Capacity	4 kWh - 16 kWh

IP(Ingress Protection)54: Levels of sealing effectiveness of electrical enclosures, protected from limited dust ingress and water spray

NEMA3R: enclosure constructed for outdoor use to protect from hazards (dirt, water, ice)

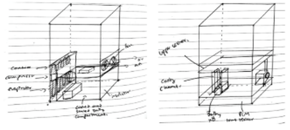
Concept Sketches



Fully Air Cooled System

Fully Fluid Cooled System

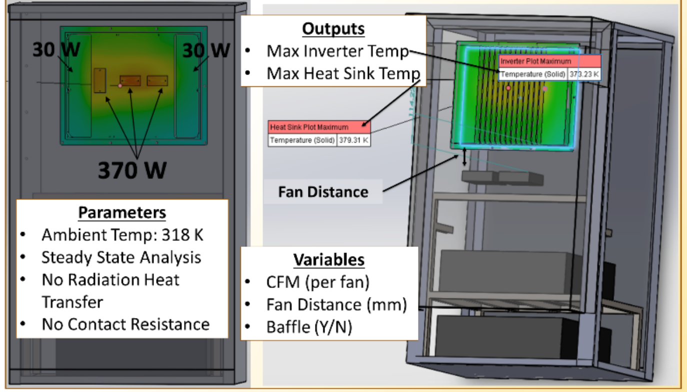
Combination Air and Fluid Cooled System



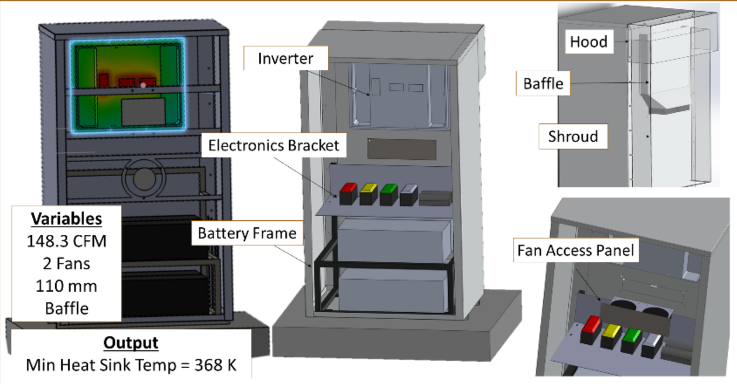
Condenser and Evaporator System

Phase Change Material Cooled System

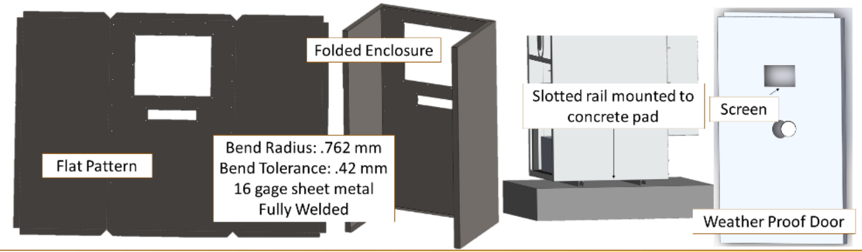
SOLIDWORKS Flow Simulation



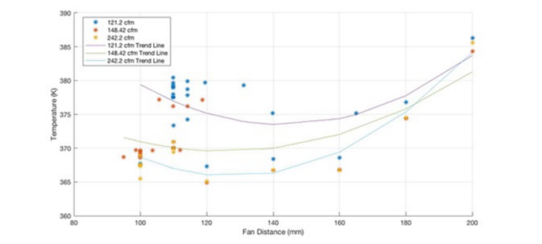
Final Design



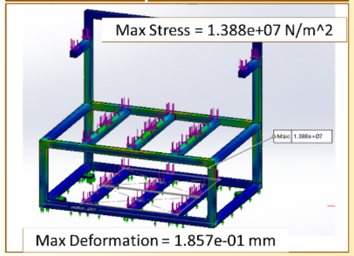
Sheet Metal Enclosure



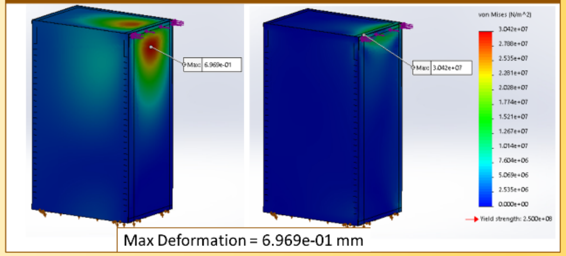
CFM – Distance Relationship



Battery Frame FEA



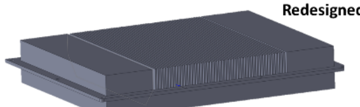
Enclosure FEA



Future Considerations

- Evaluate sound levels
- Evaluate the effect of moisture in the air
- Evaluate the effect of ambient pressure
- Consider the cost and power consumption of various fan types

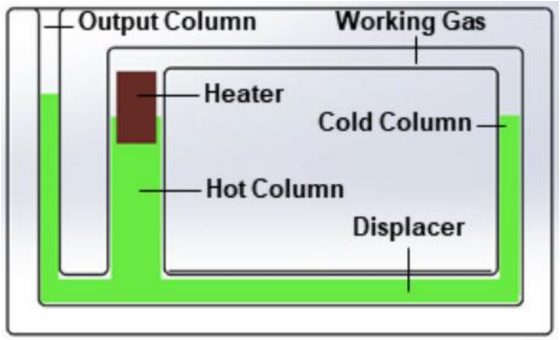
Redesigned Heat Sink



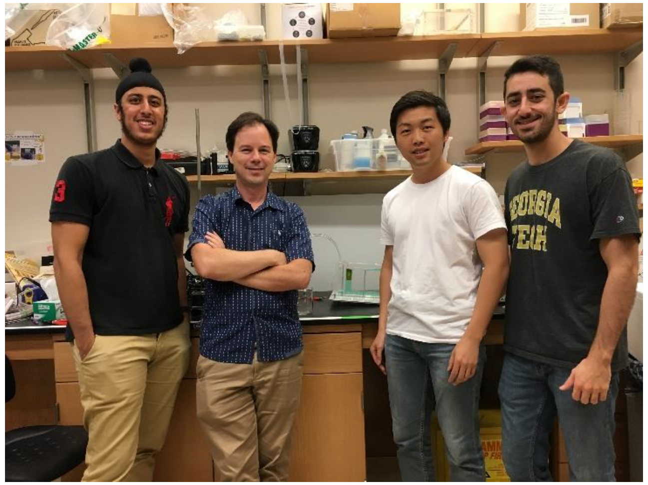
Increased surface area

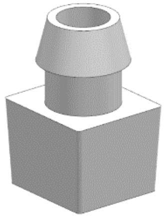
RESEARCH (2018): FLEXIBLE LIQUID-PISTON STIRLING ENGINE OPTIMIZATION

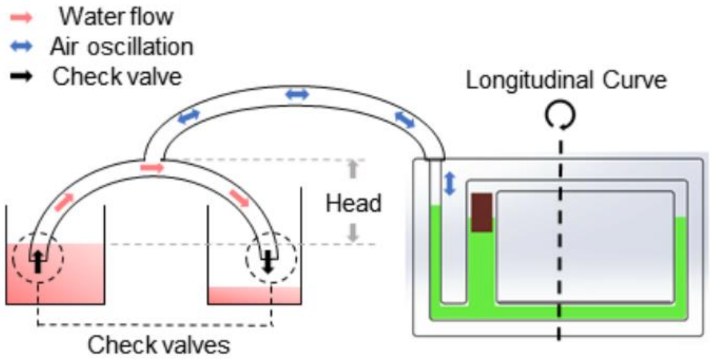
- → Tested and developed a bendable engine made from PDMS polymer that can convert waste heat to liquid pumping
- → Designed acrylic engine mold and 3D printed joining tube plugs to improve engine's pumping capabilities
- → Co-authoring academic research paper to analyze the effect of bending forces and input heating power on engine performance



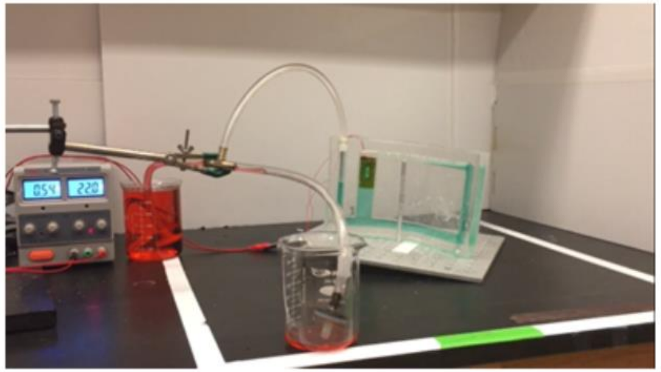
Engine schematic


Team photo with Dr. Sulchek


3D-printed tube plug

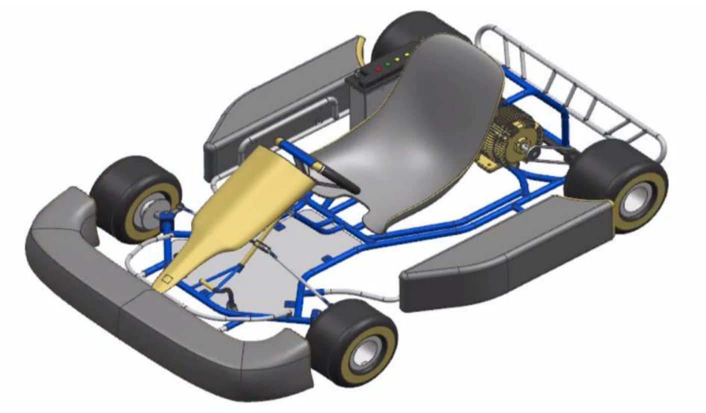


Pumping schematic

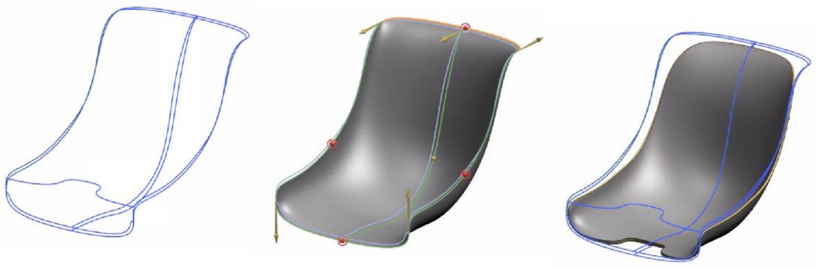

Physical pumping apparatus

PROJECT (2018): ELECTRIC GO-KART MODELING AND ANALYSIS

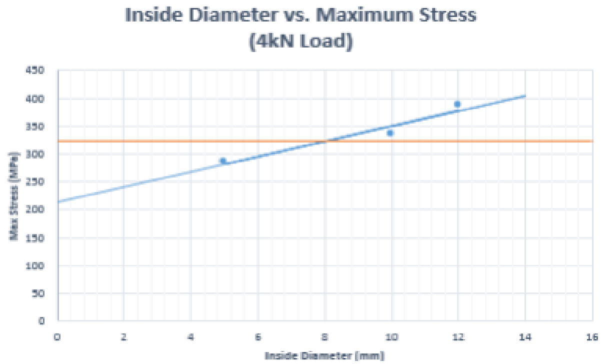
- Goal: Design a new product with multiple complex parts using various surface and solid 3D modeling techniques. Then, test and validate the design with structural Finite Element Analysis (FEA) simulations
- 37 unique parts, 59 total (excluding hardware)
- By simulating impact collisions on NX Nastran, the hollow fenders that were made of aluminum were too weak and thin.
- A low-density foam was incorporated into the fenders to provide more impact toughness and minimize added weight



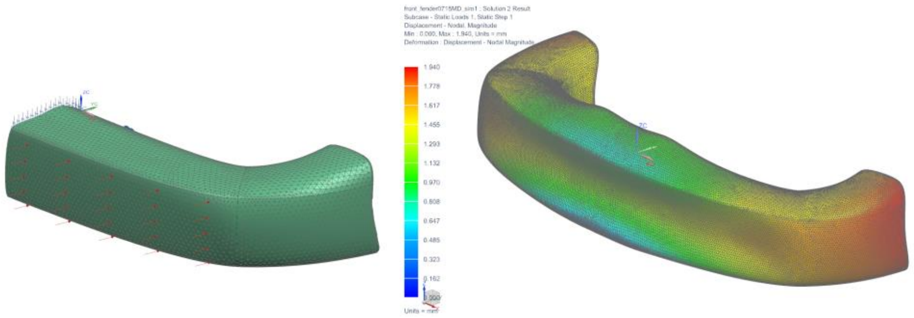
Final go-kart assembly



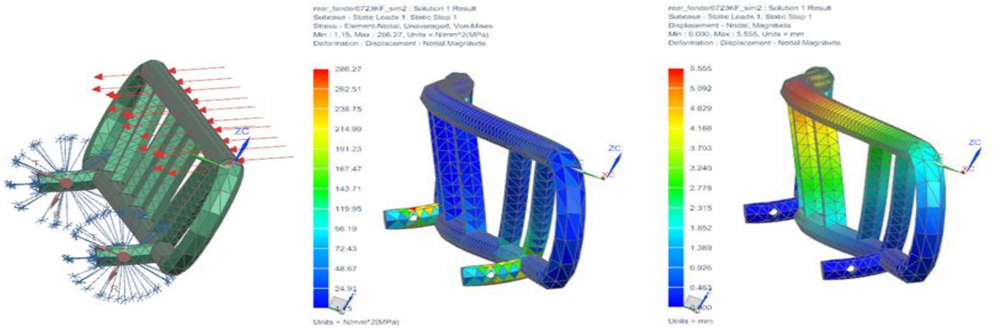
Bezier splines used to create the driver seat



Stress-pipe diameter relationship



Deformation results for front bender



Stress and deformation results for rear fender

INTERNSHIP (2017): MECHANICAL PART DESIGN FOR CMWS TEST SYSTEM UPGRADE

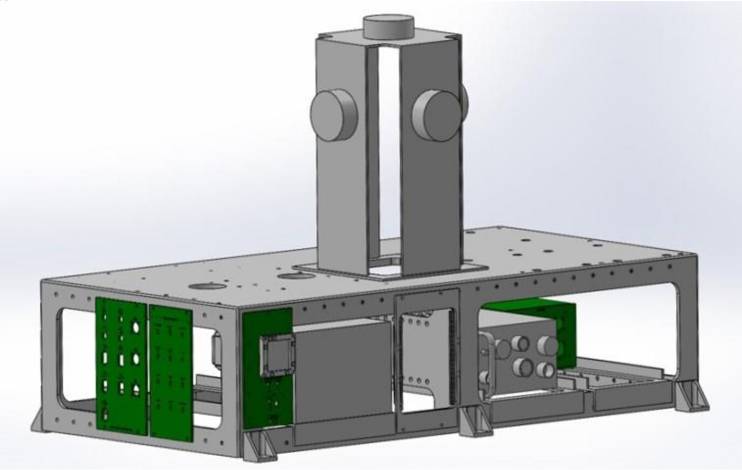
→ Led mechanical design of signal conversion box and 3 interfacing panels to support next-gen upgrade to control unit for Common Missile Warning System (CMWS) test units

CMWS Hot Mockup Unit (HMU) test system

Common Missile Warning System

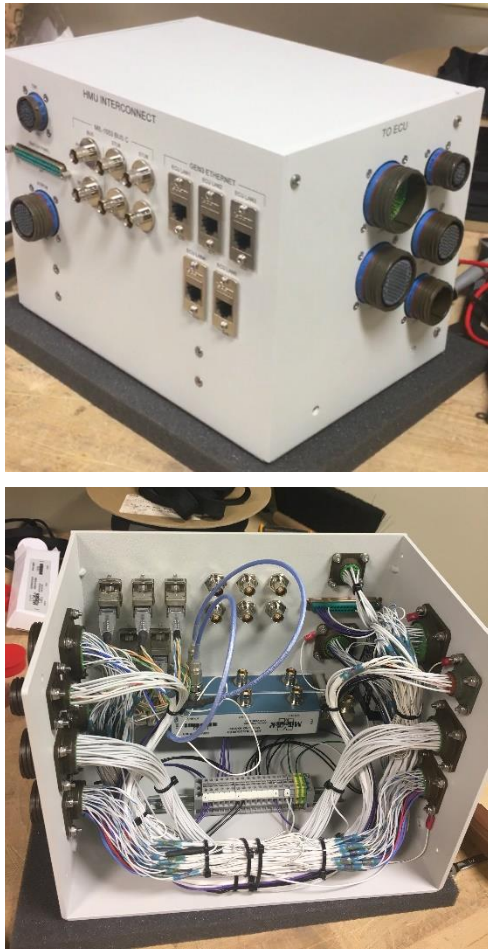
AH-64E Apache helicopter equipped with CMWS

INTERNSHIP (2017): MECHANICAL PART DESIGN FOR CMWS TEST SYSTEM UPGRADE

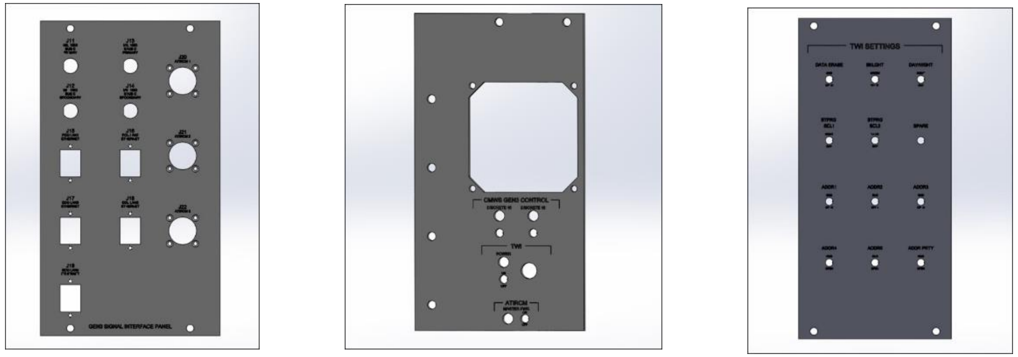


Test system modeled with new components shown in green

Preliminary conversion box model



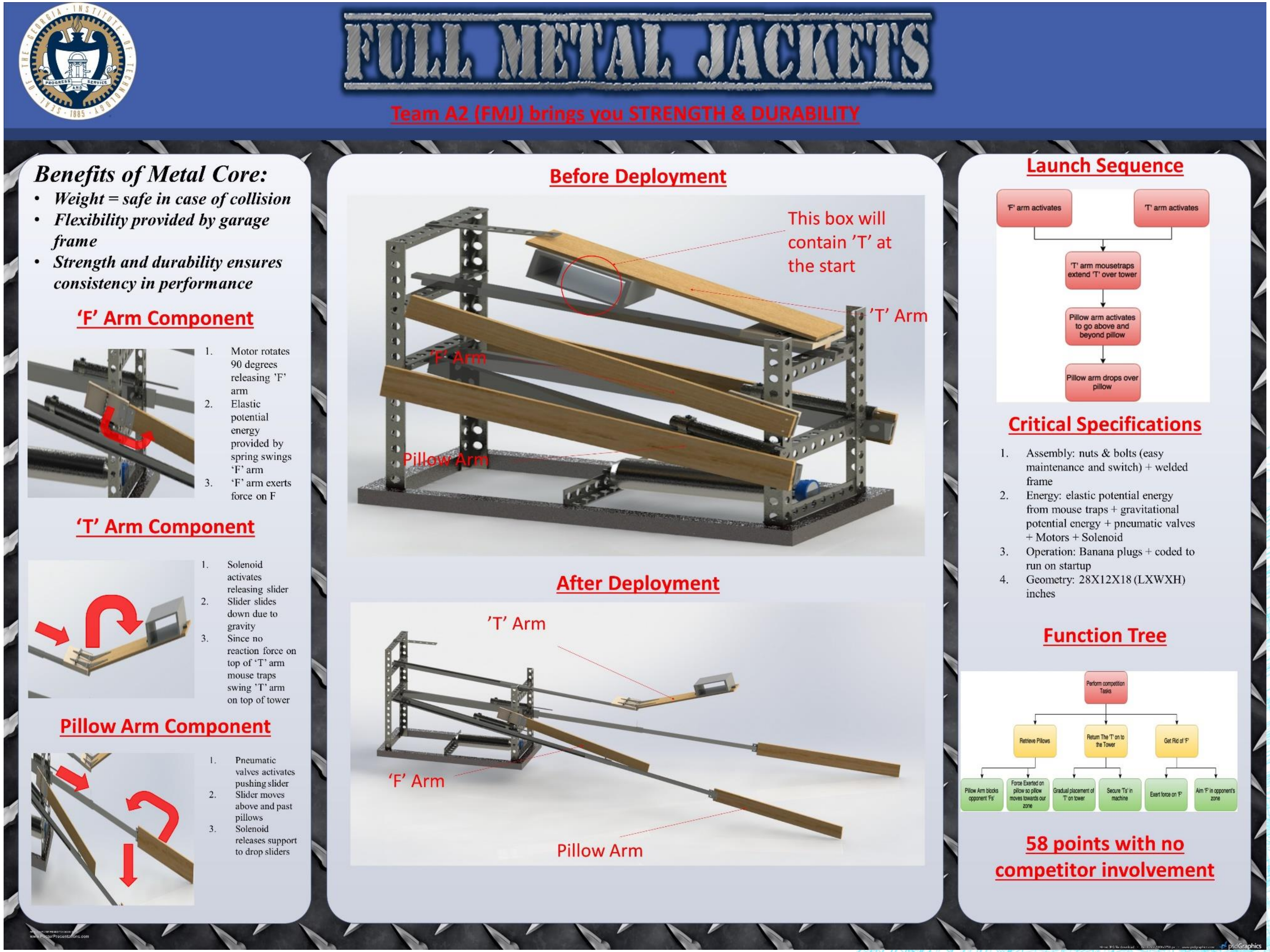
Fully fabricated conversion box



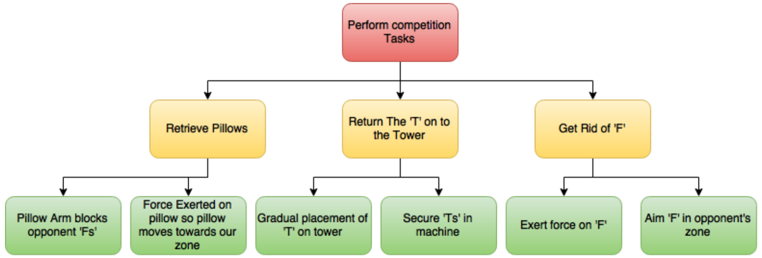
Models of new panel hardware

PROJECT (2016):
GT ME2110 DESIGN COMPETITION

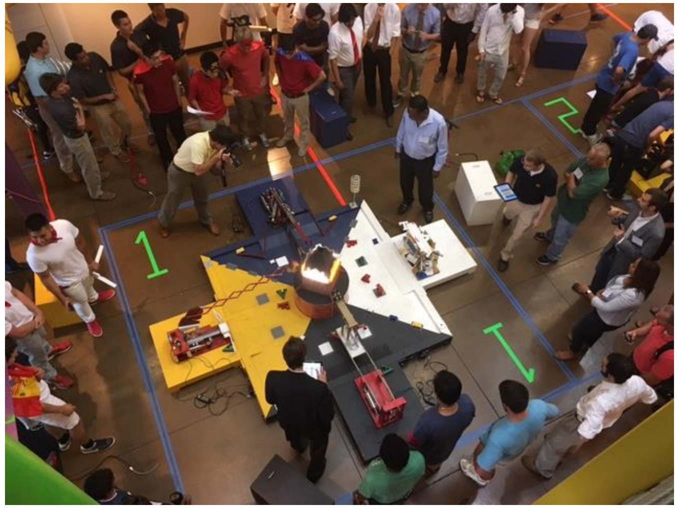
→ Goal: Design a machine to compete against others in performing prescribed tasks, namely removing block letter ‘F’, returning block ‘T’, and retrieving miniature pillows



PROJECT (2016):
GT ME2110 DESIGN COMPETITION



Machine function tree



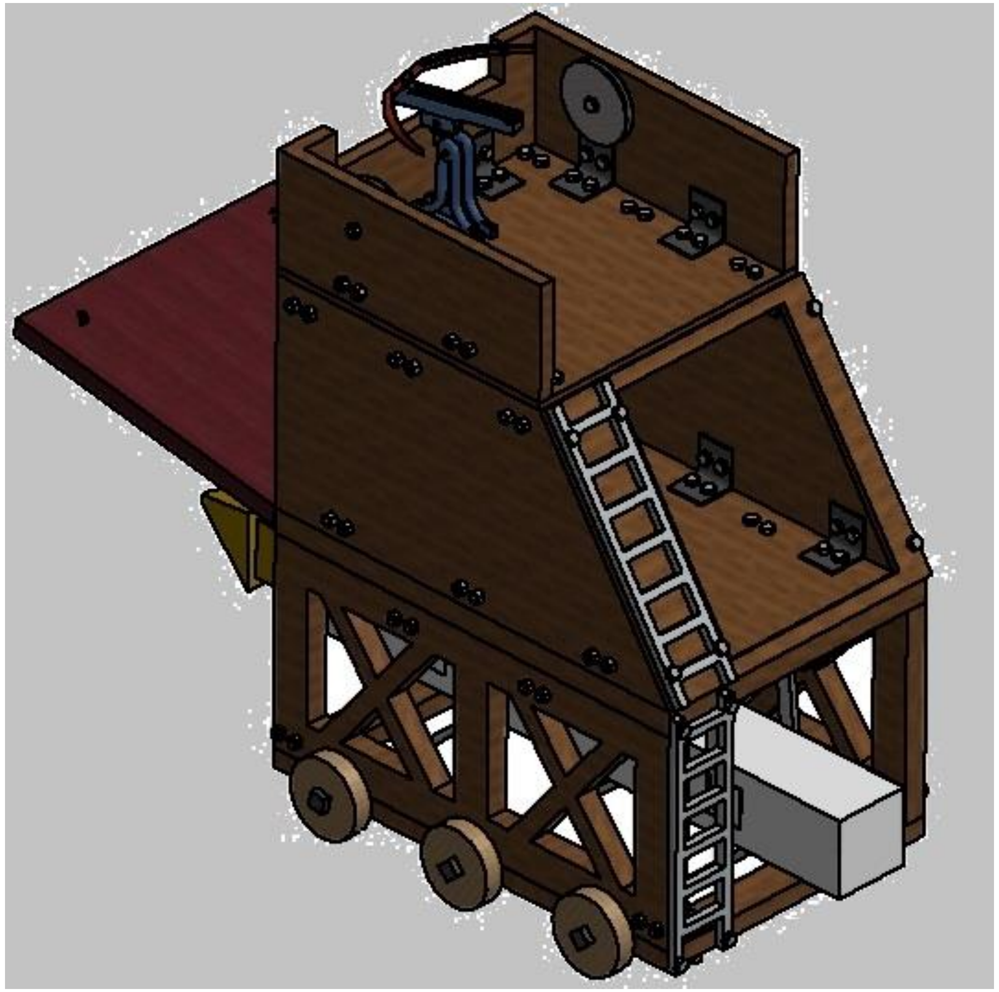
Shot of arena on competition day

Competition-ready machine (top left) and various team photos from throughout the project

PROJECT (2015): ME1770 3D MODELING PROJECT

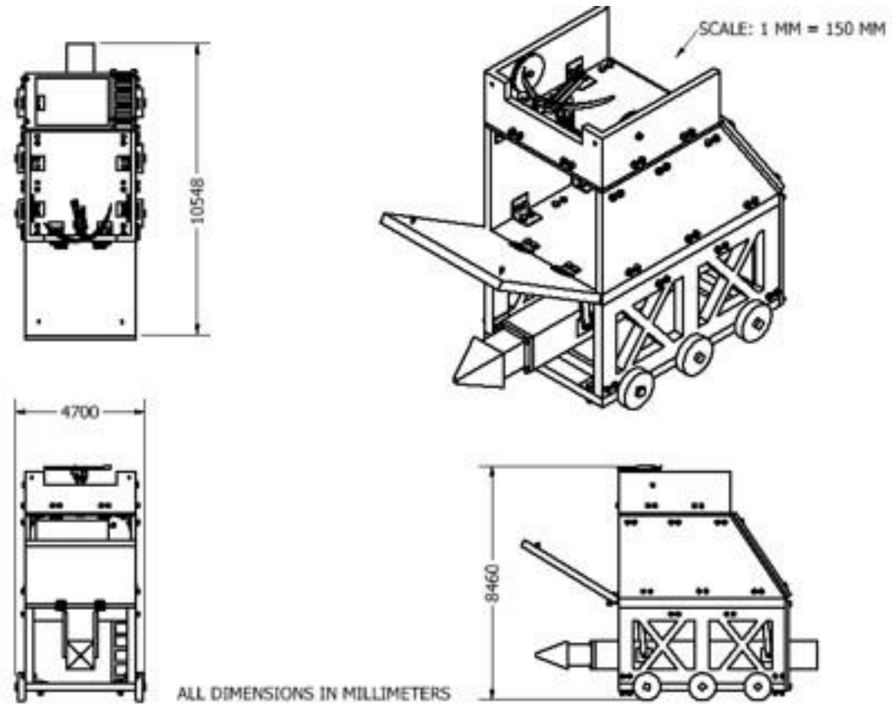
→ Goal: Design and model a machine (Siege Machine) with many components and structural parts using Autodesk Inventor

→ Approach
- Something captivating mechanical engineers
- Large-scale mobile machine
- Simple, yet unique design
- Historical concept with modern interpretation

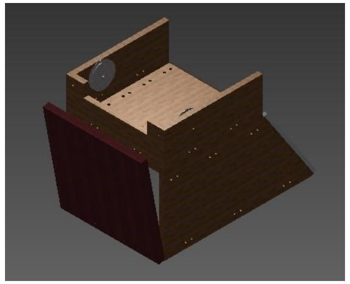


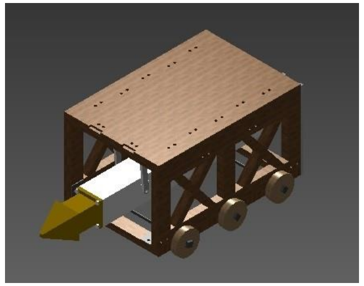
Fully assembled Siege Machine

PROJECT (2015): ME1770 3D MODELING DESIGN PROJECT



Schematic showing overall dimensions





Each subassembly shown, from left to right: crossbow, drawbridge roof, and battering ram base

Rendering of the Siege Machine in battle

WOODWORKING PROJECTS

FIJI Island Week roof structure

Stained dining table

Workbench fence and roofing

Bunked bed frame