Design Build Launch

Mechanical and Aerospace Engineering • Advisors: Dr. Liu, Dr. Canino

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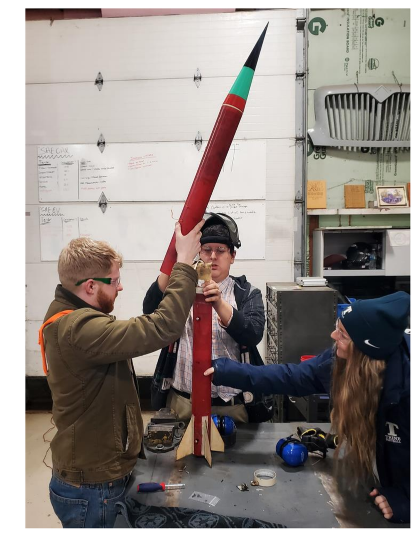
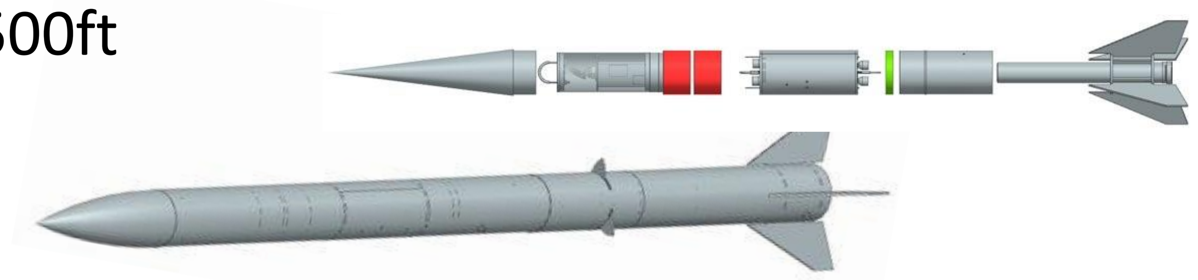
Abstract

Trine's Design Build Launch senior design team had the challenge of building a high-power rocket that would be able to reach a pre-determined apogee and deploy a payload that will autonomously receive RF signals to perform a series of tasks upon landing.

Customer Needs and Requirements

- Rocket must utilize a high-power solid rocket motor
- Rocket must be recoverable and able to relaunch
- Payload must land, receive commands, and take pictures of surroundings
- Rocket body must use limited metal
- Rocket must reach a target apogee of 4,500ft

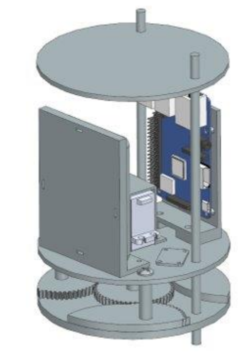




Concept Selection

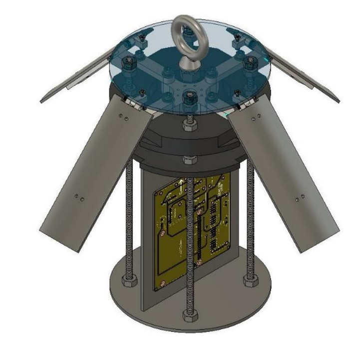
Aerobraking Methods

Plate Method



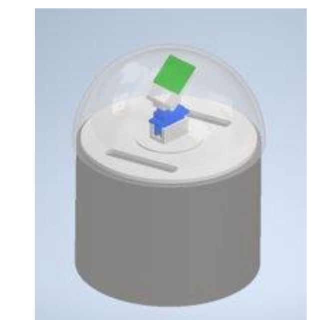
Disc shaped flaps that rotate out from the body of the rocket, increasing drag.

Flap Method

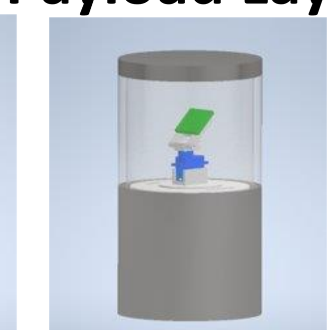


Rectangular flaps that rise from the body of the rocket, increasing drag.

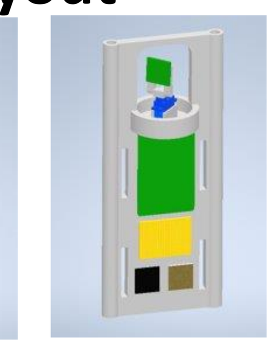
Payload Layout



Clear Nose Cone



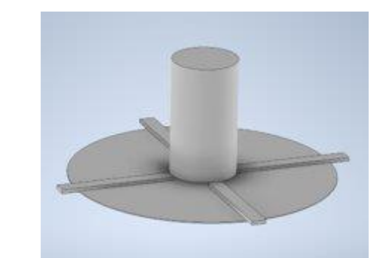
Canister



Sled

Payload Landing Methods

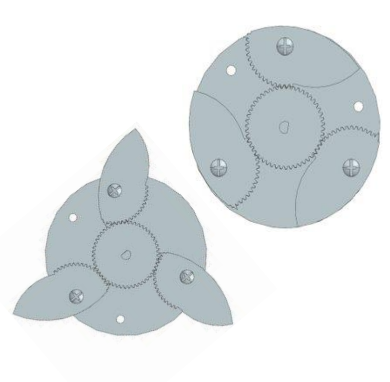
Spring Legs

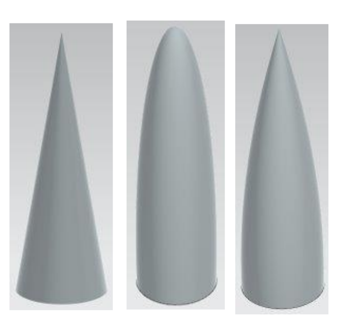


Net Base

Design Solution

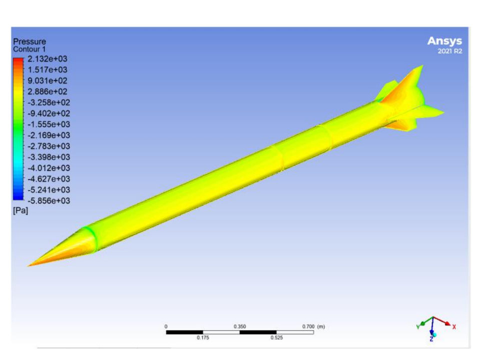
An aerobraking system was implemented to increase the drag as the rocket increases in altitude. This system uses a Raspberry Pi running a MATLAB script to deploy multiple flaps from the side of the rocket body, increasing the drag.





Multiple nose cone designs were utilized to alter the drag characteristics if the rocket. Different nose cones will be used for different weather conditions.

CFD simulations were conducted to predict the drag characteristics of the rocket at different speeds and attack angles.



Manufacturing

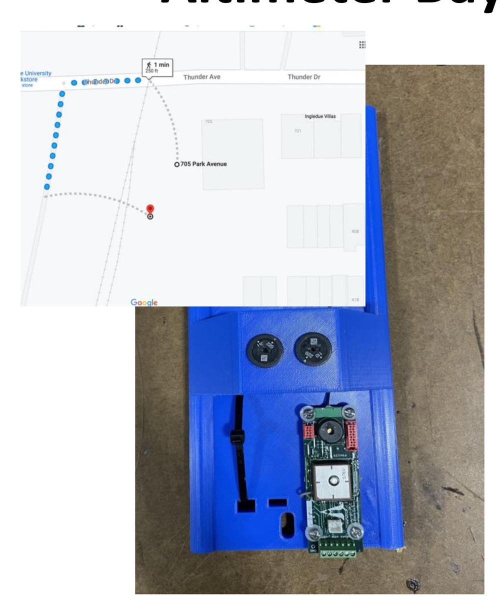
Rocket Body

Fiberglass body tubes for high strength

Nose Cones

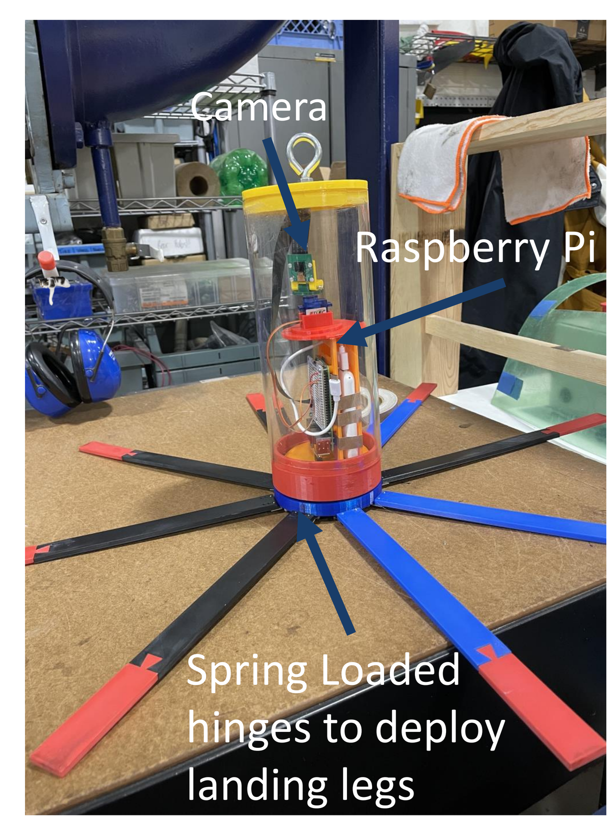
3D-printed modular nose cone for rapid changes

Altimeter Bay



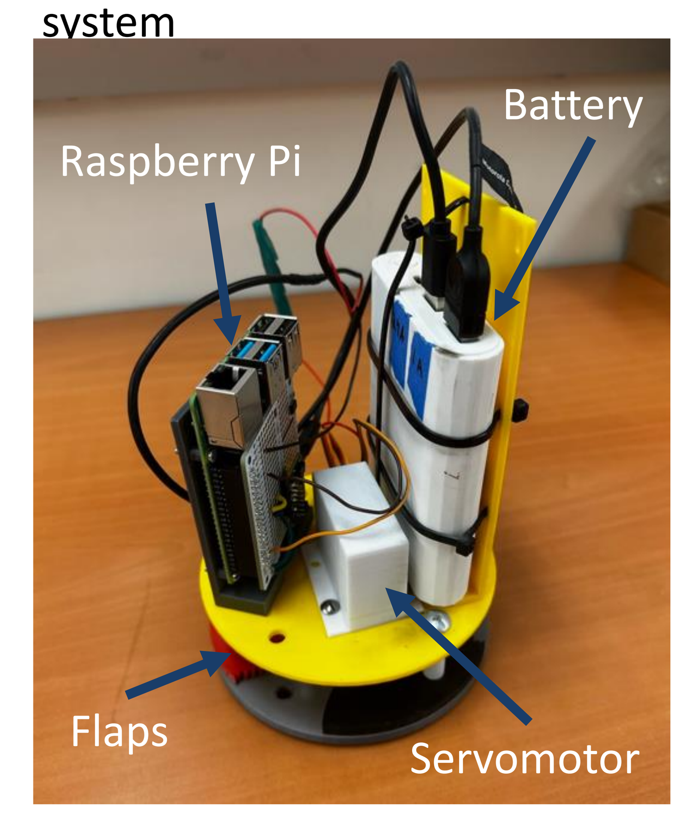
Altimeters and GPS for tracking flight data and deploying parachutes mounted on 3D printed sled

Payload



Aerobraking

3D printed bulkheads, gears, and flaps for light weight system

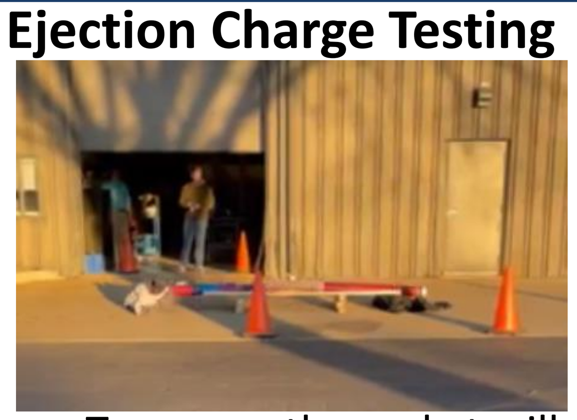


Fins

1/8th inch plywood wrapped in carbon fiber reinforced fins to avoid breaking during flight or while landing.

Testing and Validation

Ejection Charge Testing



To ensure the rocket will separate and deploy the parachute

Wind Tunnel Testing

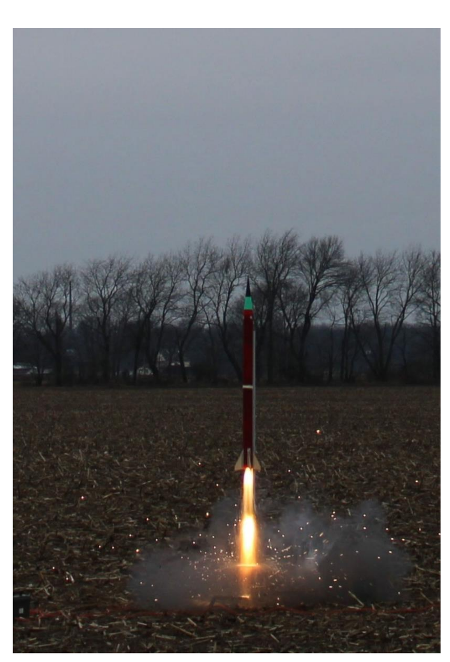
Validating CFD model for drag coefficient

Vacuum Chamber testing

Simulating flight for barometric altimeters by changing the pressure

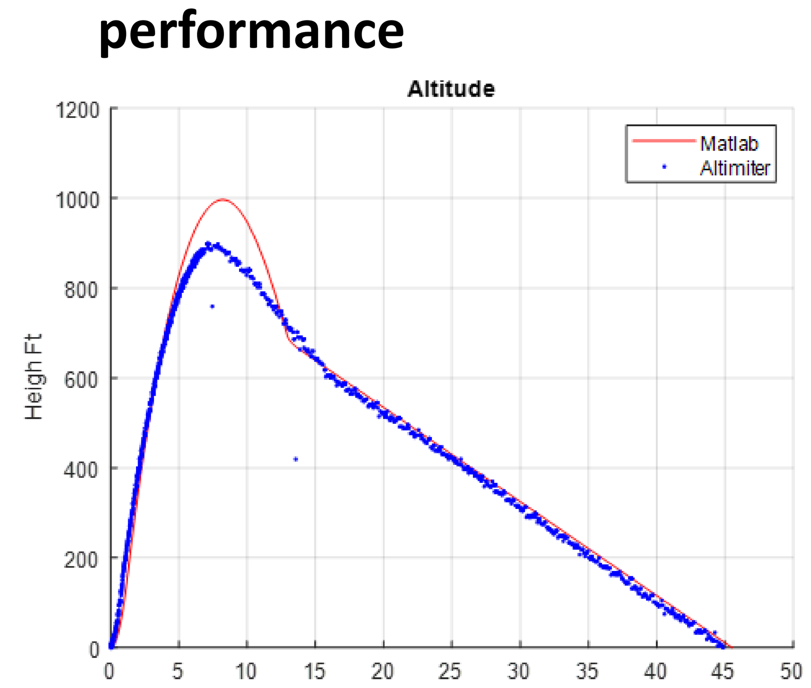
Payload Drop Testing

Subscale Launch



Smaller rocket launched: 60% of full-scale design

MATLAB Model to predict performance



Four Full Scale Launches

Testing multiple nose cones, payload deployment methods, and the aerobraking system

Acknowledgments

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