

MICROGRAVITY MACHINE

Virtual Design Review 4



TEAM 511



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Pedro Siman

Recovery Engineer



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Tietsworth

Controls Engineer



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Test & Systems Engineer



Collin Gainer

Aero Design Engineer

Pedro Siman

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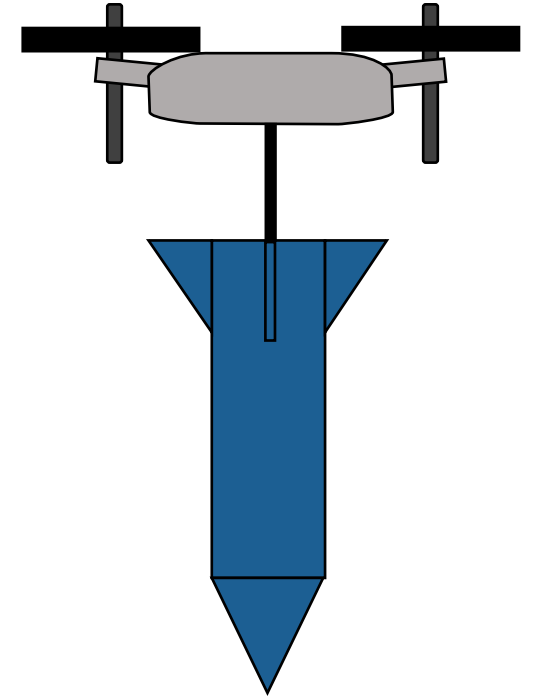
Mike Conroy

**Florida Space
Group
Consortium**

Pedro Siman

Project Objective

The objective of the project is to design a reproducible system that can be dropped, achieve microgravity during its descent, and be safely recovered for reuse.

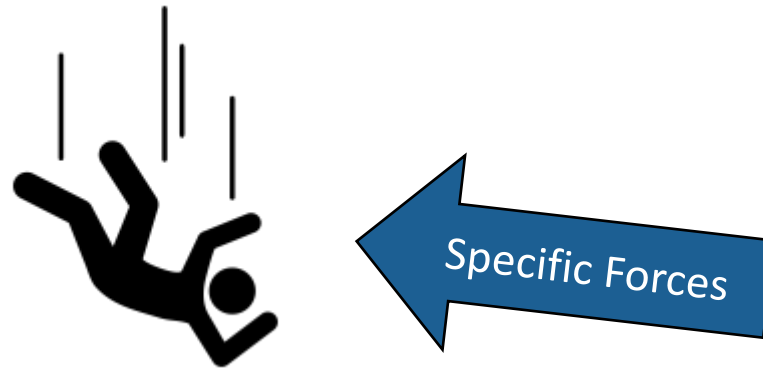


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What is Microgravity?

$$\vec{F}_{Specific} = \frac{\sum \vec{F}_{nongravitational}}{m} \approx 0 \frac{m}{s^2}$$

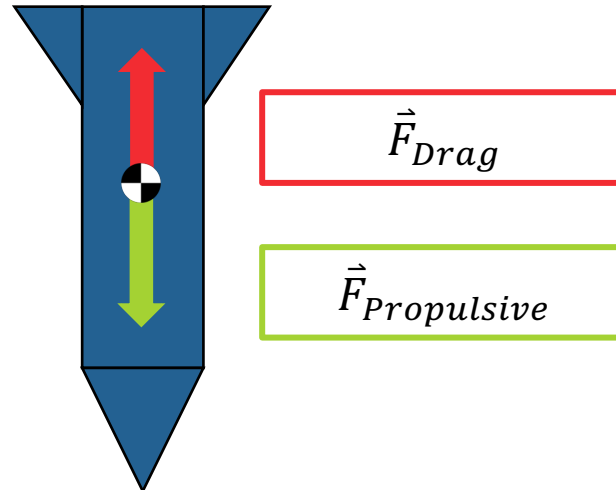
What does an accelerometer measure?



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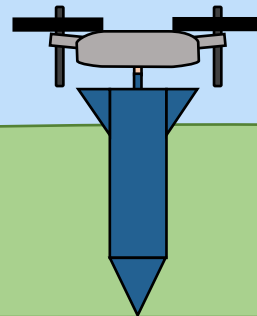
Achieving Freefall

$$\vec{F}_{Specific} = \vec{F}_{Propulsive} - \vec{F}_{Drag} \approx 0 \frac{m}{s^2}$$



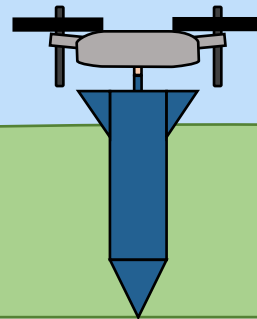
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Competition Day



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Competition Day



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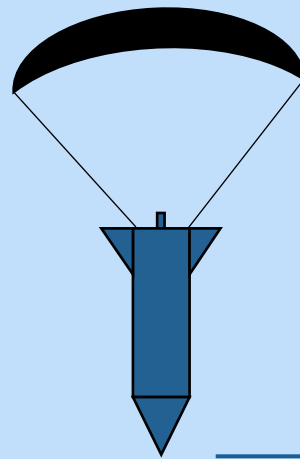
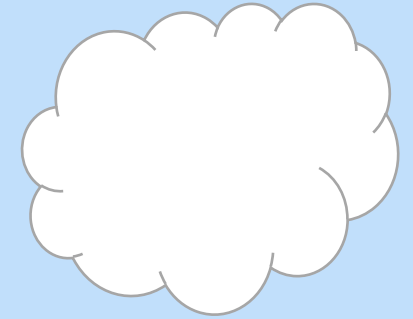
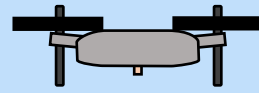


Competition Day



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Competition Day



~650 ft (200m)

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Summary

Assumptions

Tested in standard earth atmosphere

Vehicle's path is clear of obstacles

Drag negligible for initial 0.5 seconds of free fall

Weather conditions aren't of concern

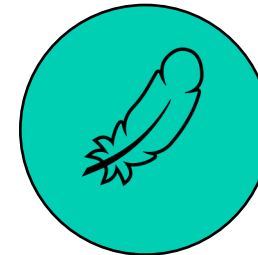
Key Goals



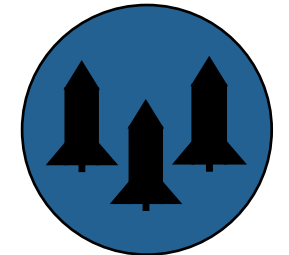
Microgravity



Recoverable



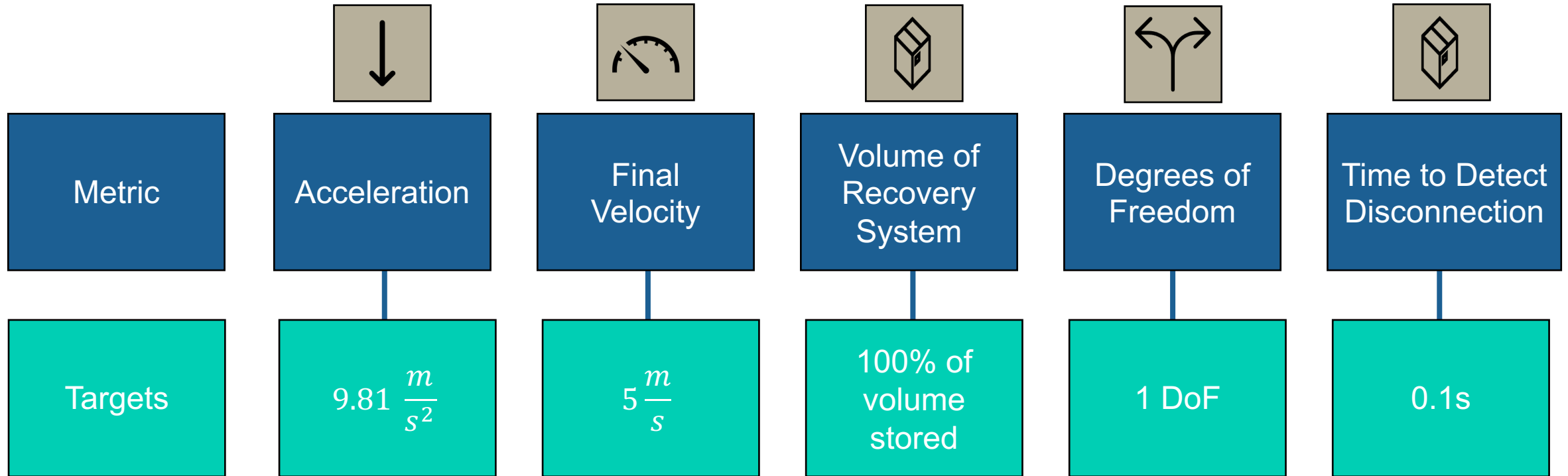
Meet Weight Requirements



Reproduceable

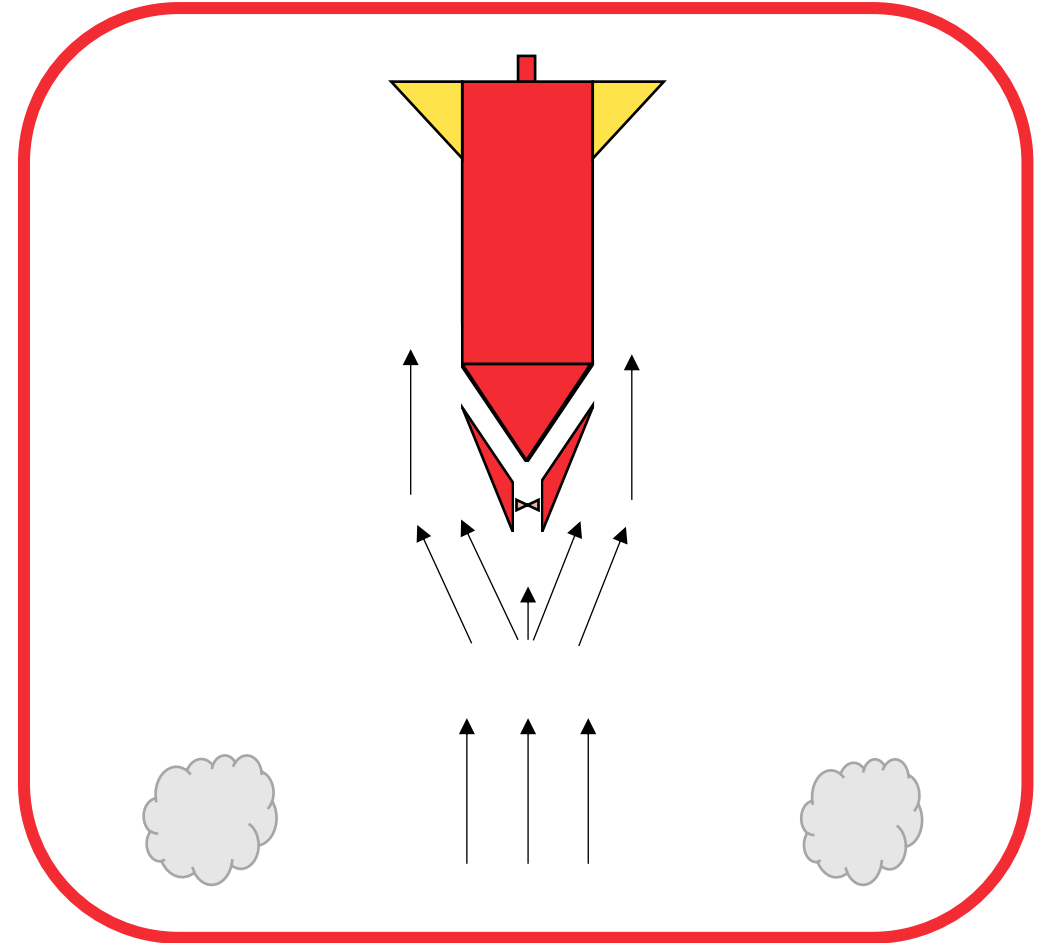
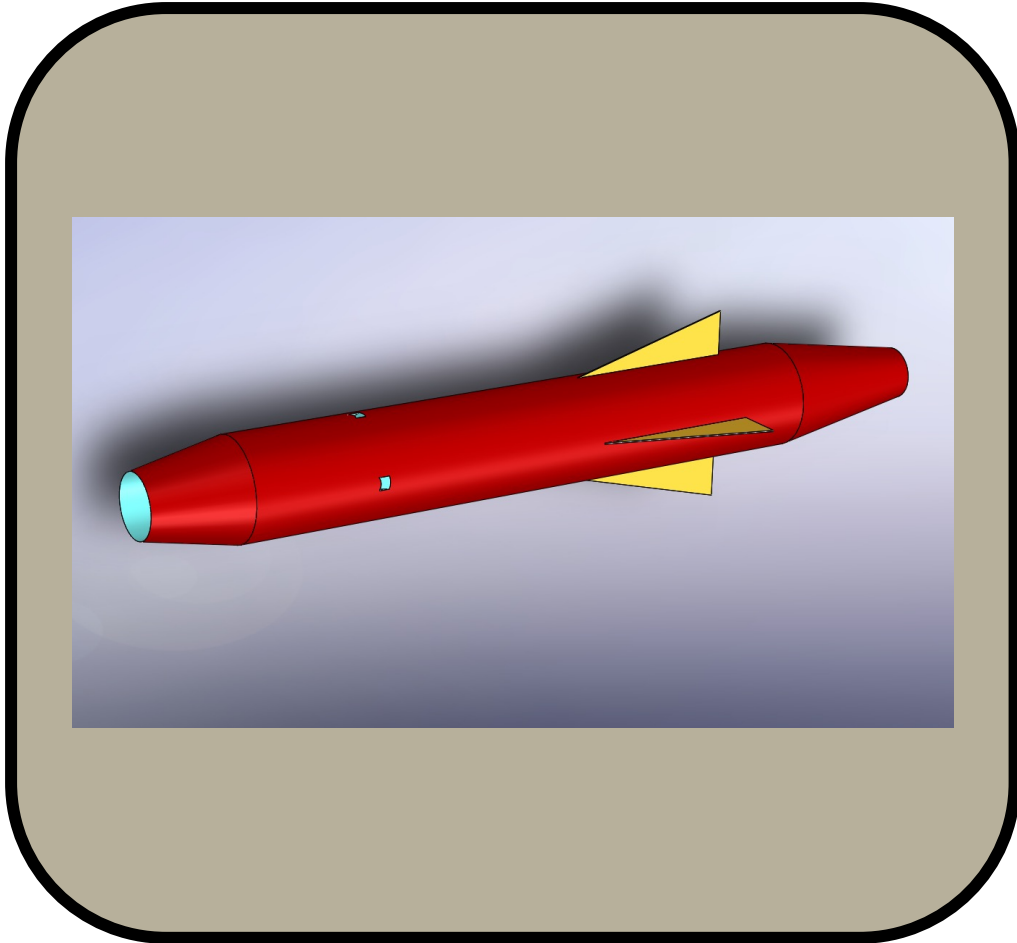
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Targets and Metrics



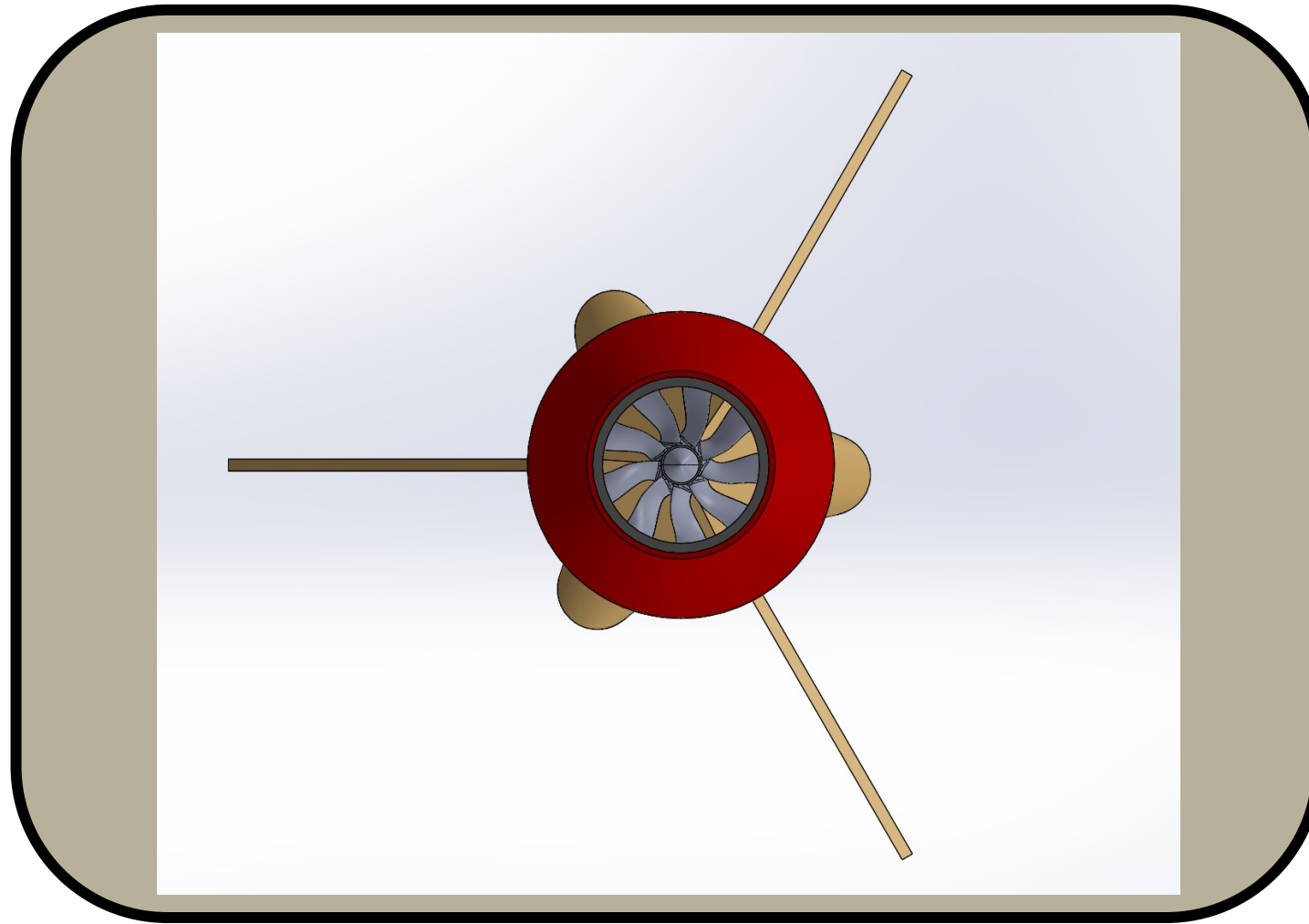
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Selected Design: Ducted Fan



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Front View: Updated CAD



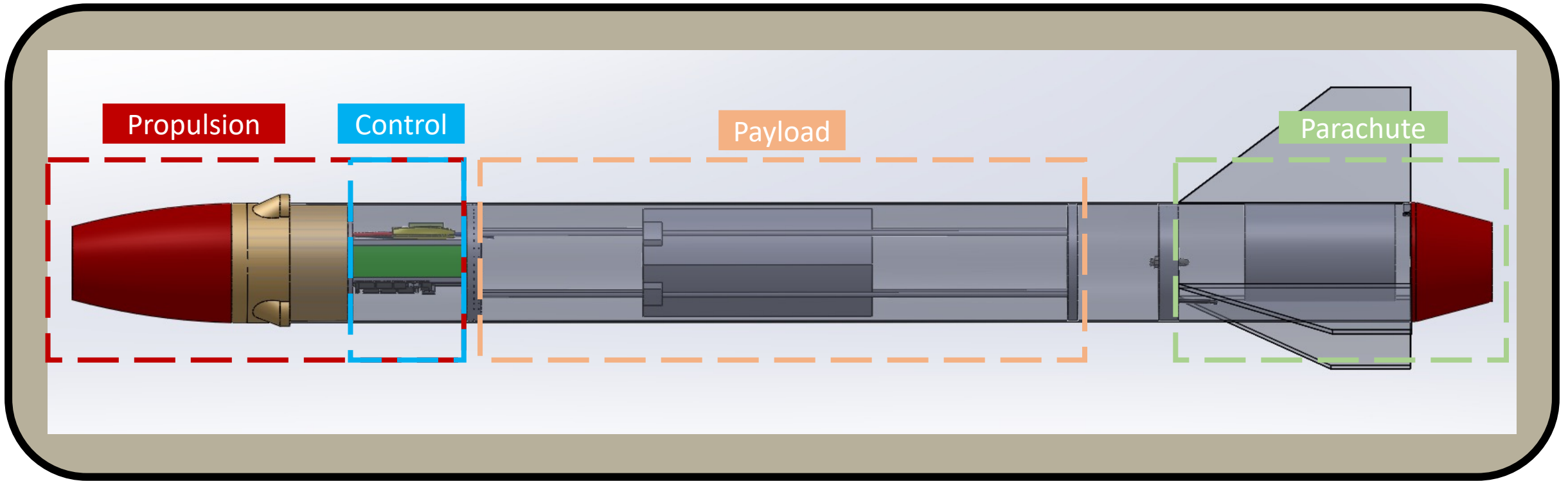
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Side View: Updated CAD



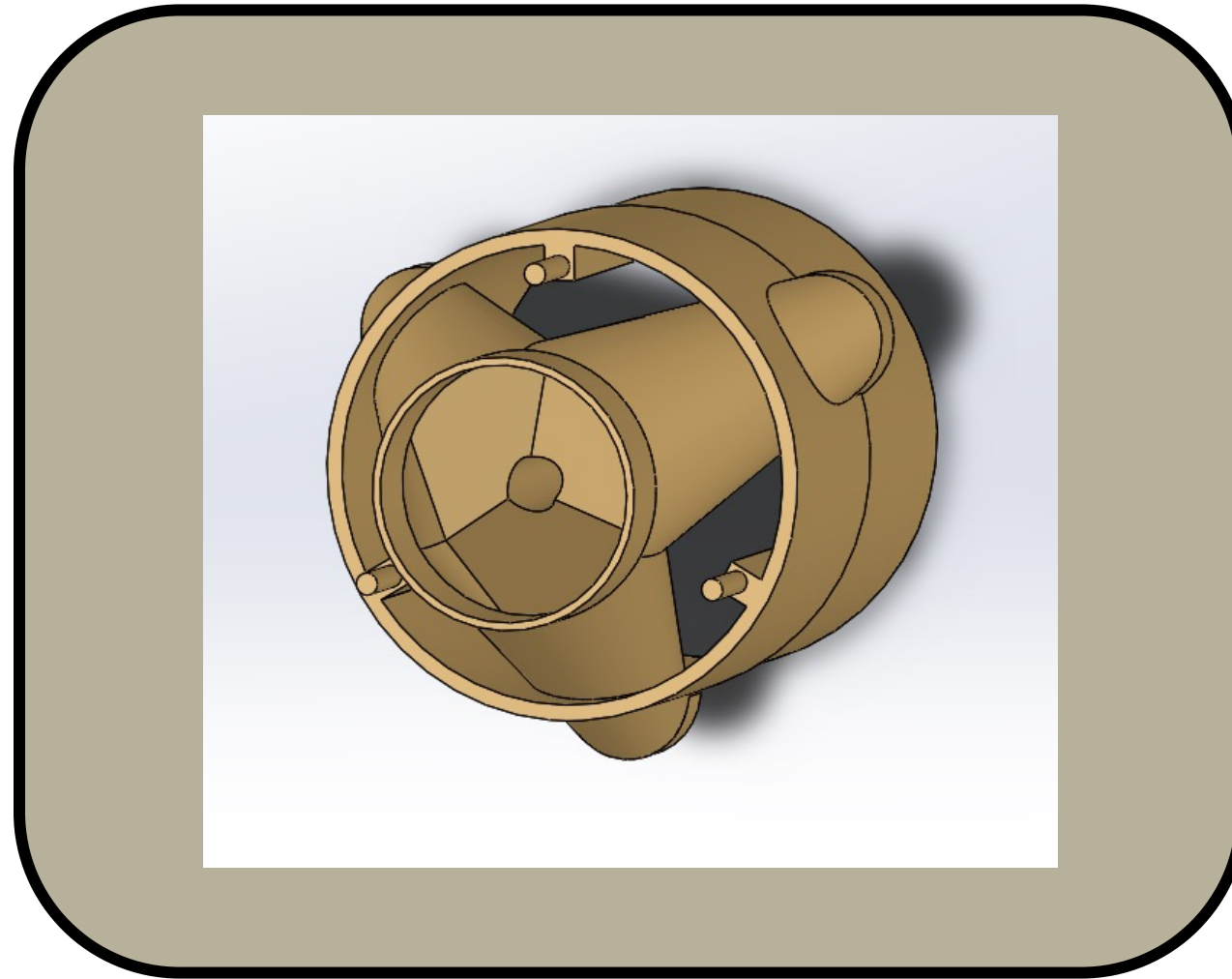
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Side View: Updated CAD



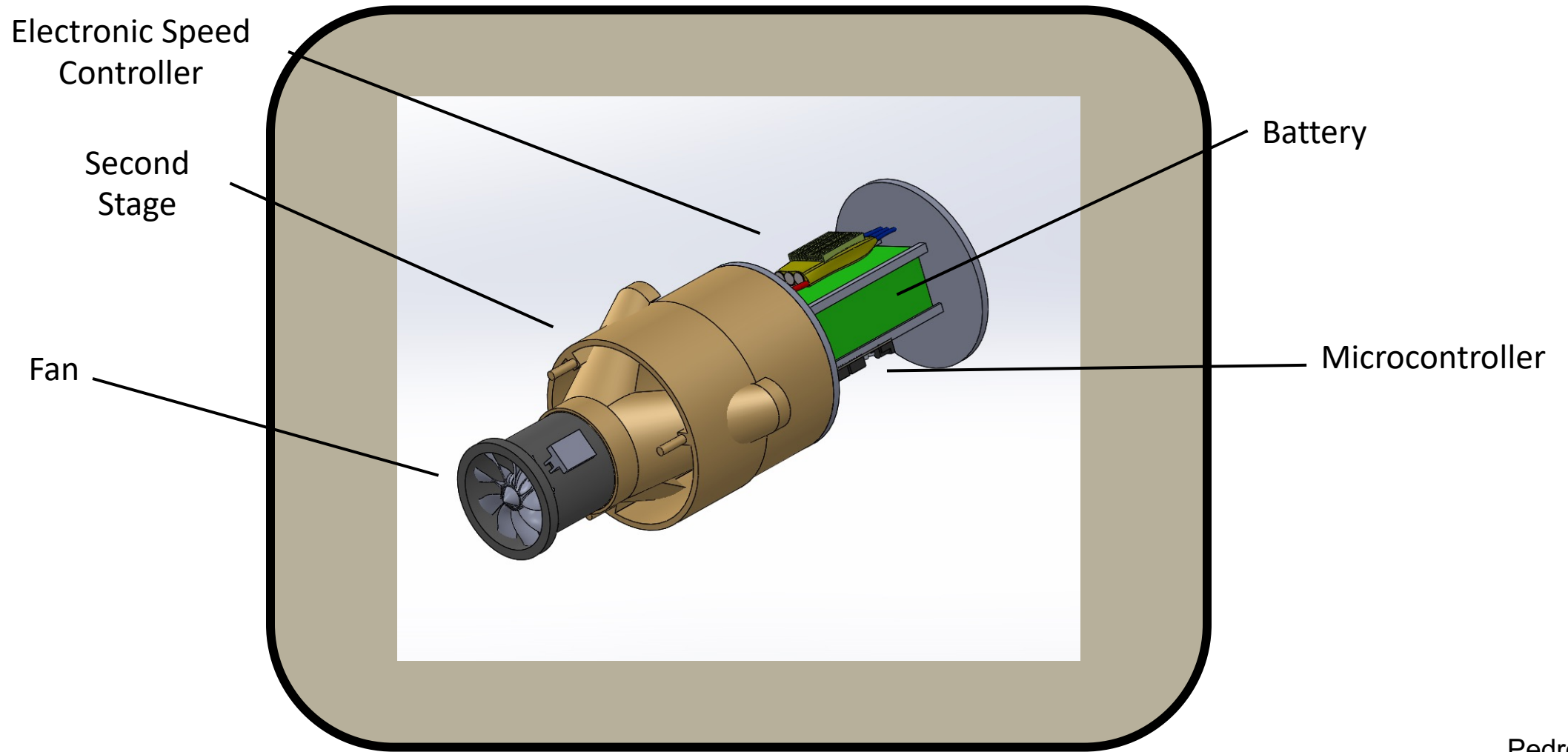
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Fan Intake: Updated CAD



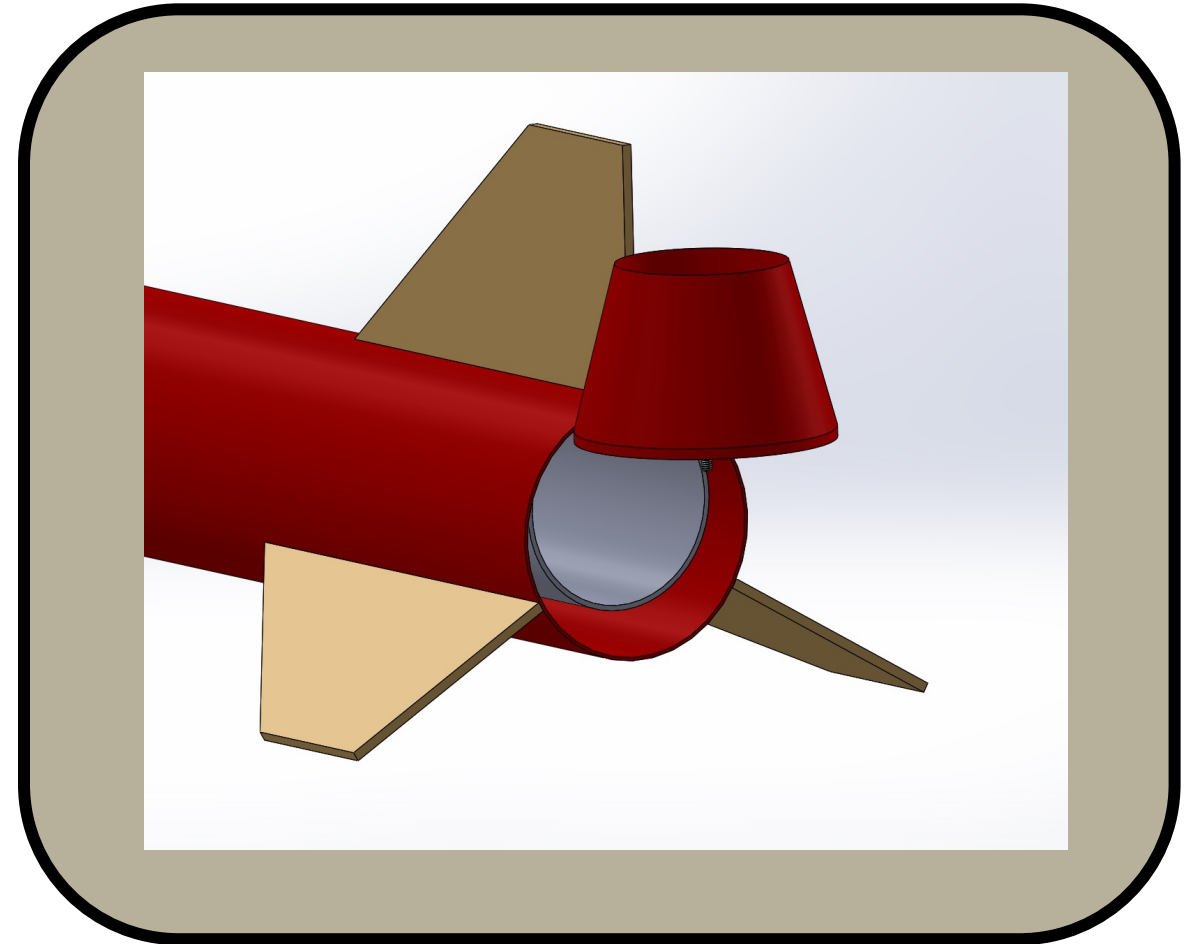
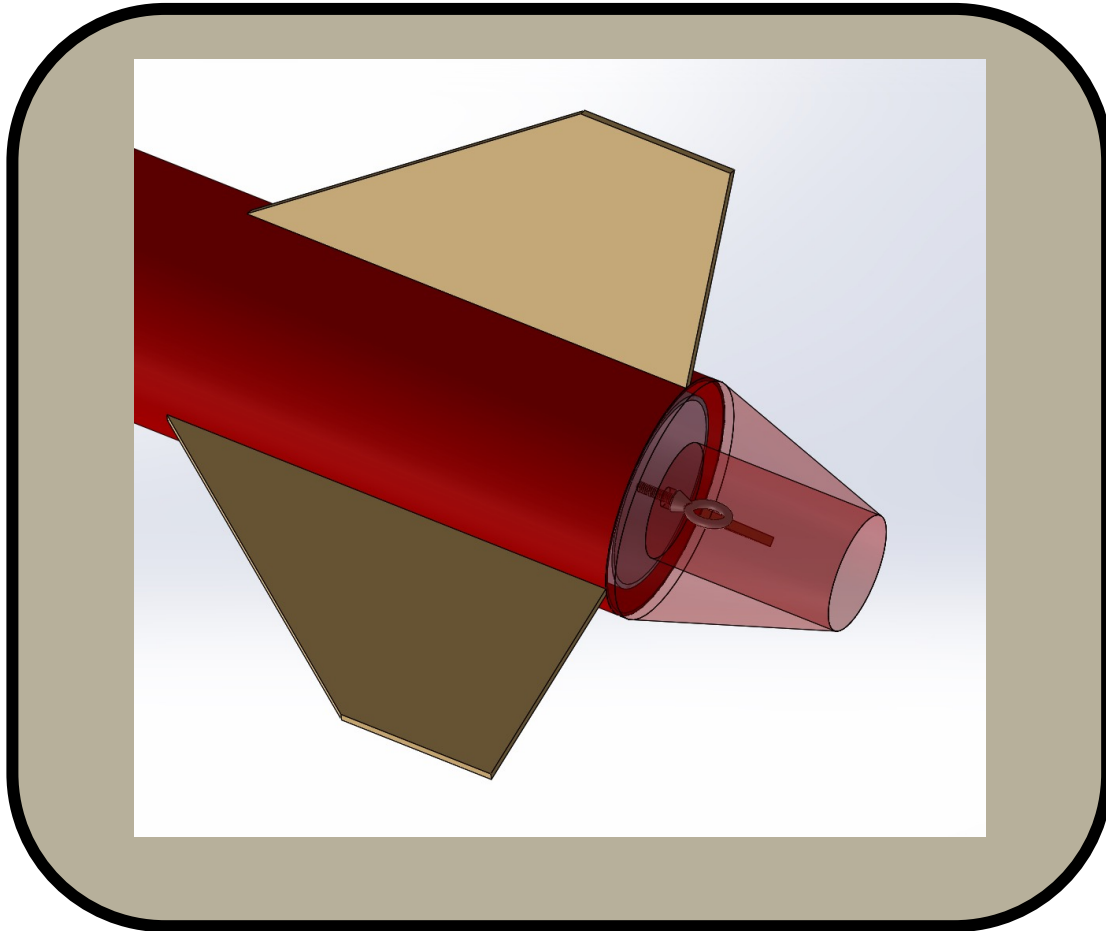
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Propulsion System



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Parachute Storage



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Uncontrolled Simulation

1st portion: Vehicle falls under gravity with drag acting on it.

2nd portion: Vehicle slows after parachute is released

$V \approx 4 \text{ m/s}$ 0.5 s after the parachute is opened

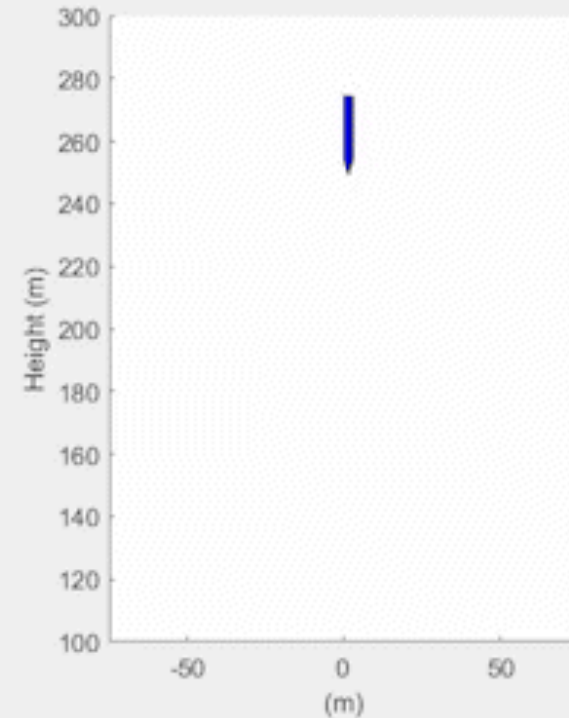
Samuel Duval

Uncontrolled Simulation

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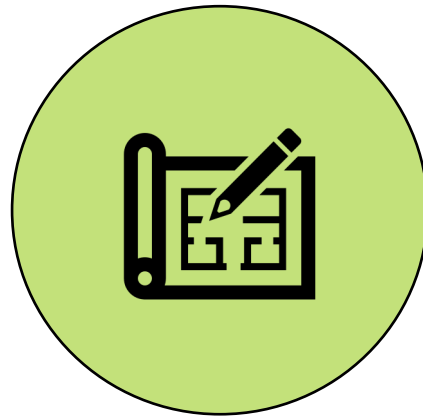


Samuel Duval

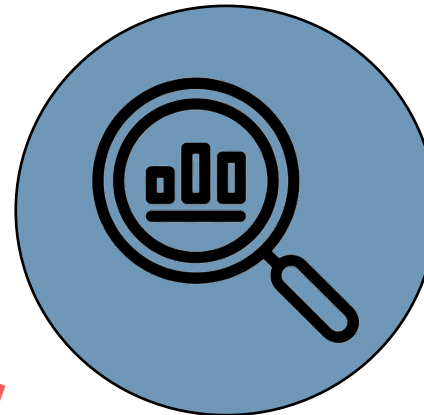
Recent Work



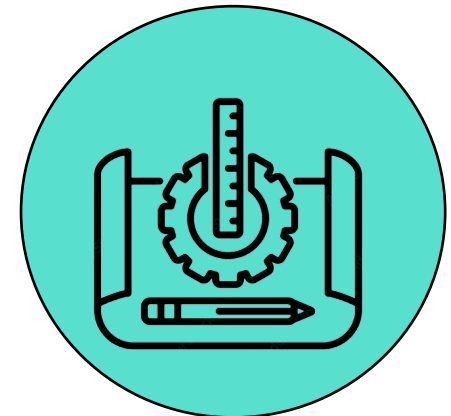
Selected & Ordered
Parts



Updated
CAD

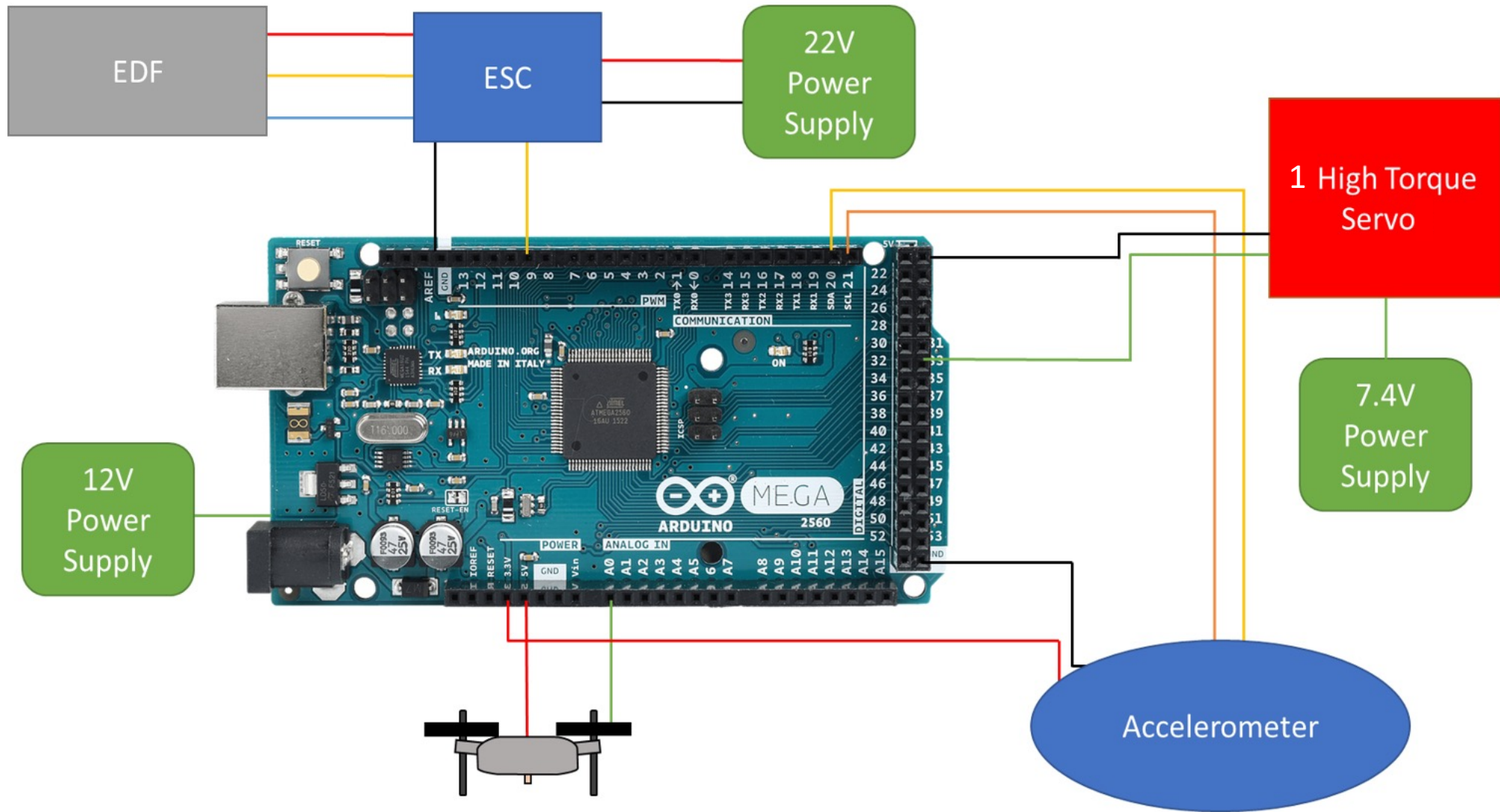


CFD
Analysis



Prototyping

Sam Duval



Sam Duval

Selected Parts



80mm Ducted Fan
Motor 3400g Thrust



5,000 mAh 22.2v Lipo
Battery



Waterproof Digital Servo
w/ 20kg Torque



Brushless Motor ESC –
100 Amps

Sam Duval

Selected Parts



96" Parachute



Epoxy



OVERTURE PLA
Filament 1.75mm

Sam Duval

Selected Parts



Graphite Powder Lubricant



1/4", 2 ft metal rods



BlackTube Body

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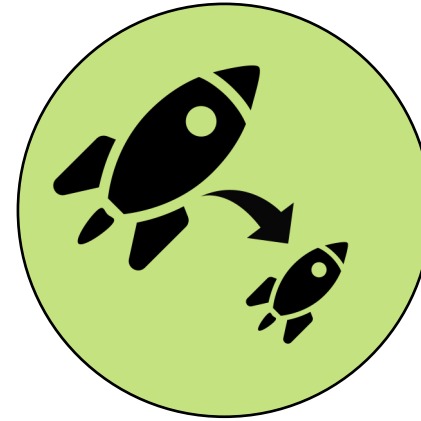
Future Work



SUBSYSTEM TESTING



ASSEMBLY



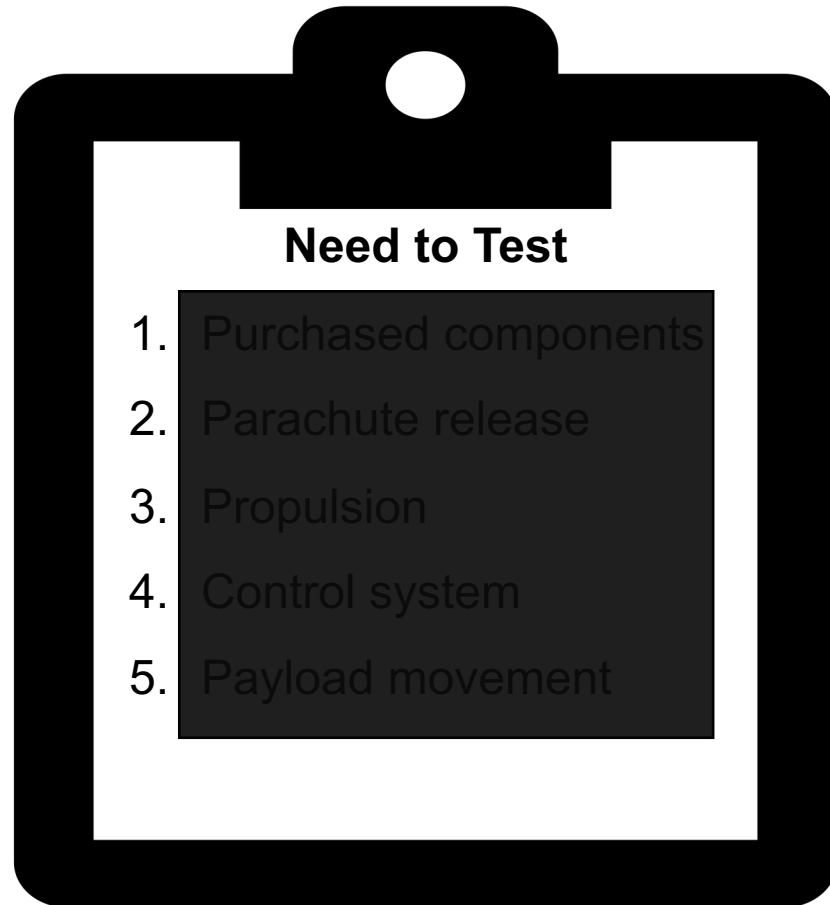
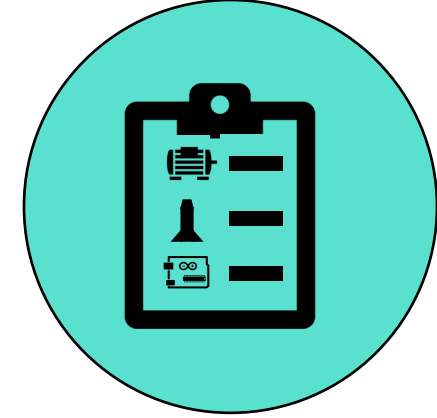
SUBSCALE TESTING



COMPETITION

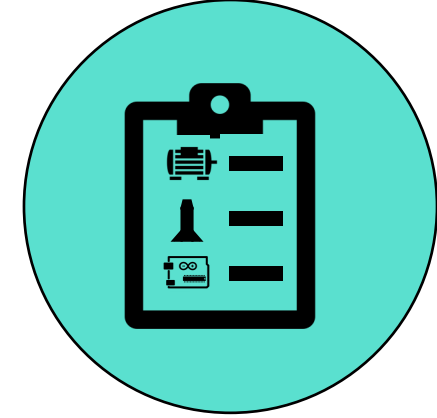
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Testing Plans



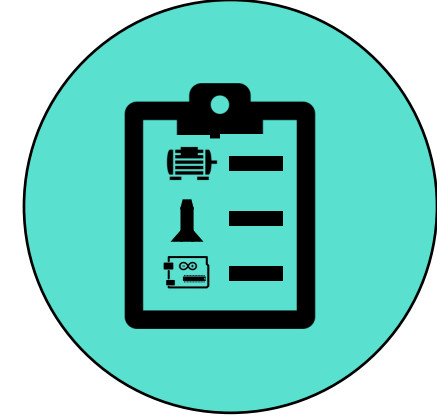
Sam Duval

Testing Plans



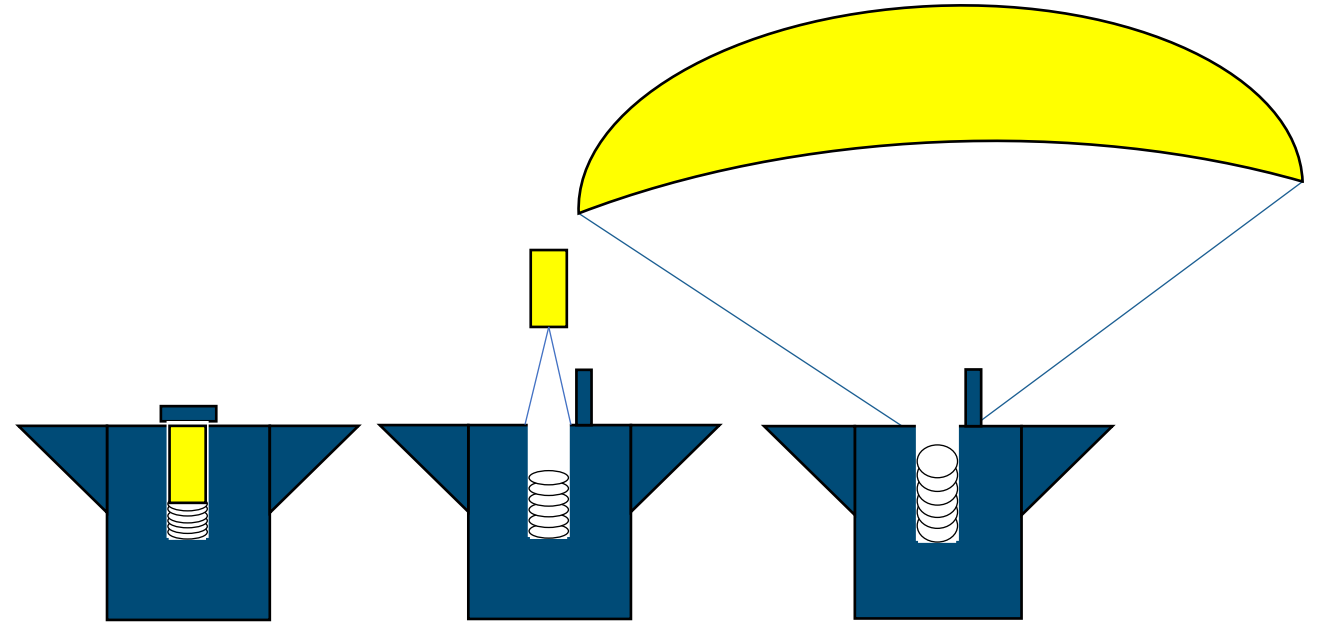
Sam Duval

Testing Plans



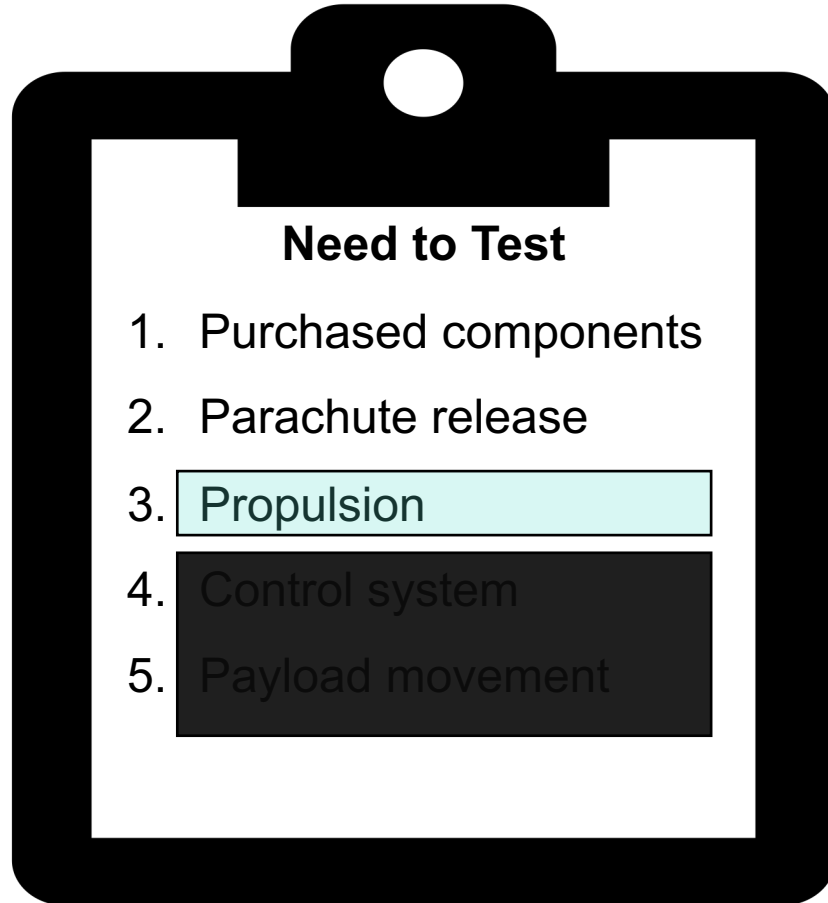
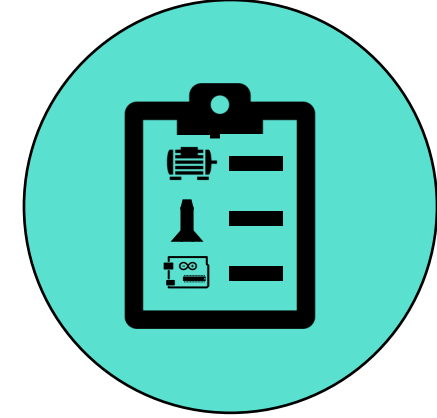
Need to Test

1. Purchased components
2. Parachute release
3. Propulsion
4. Control system
5. Payload movement

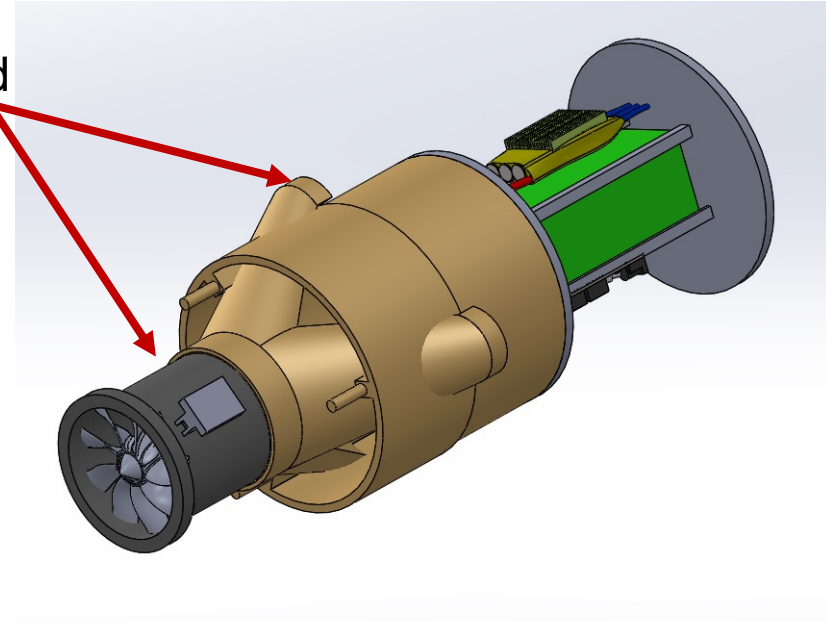


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Testing Plans

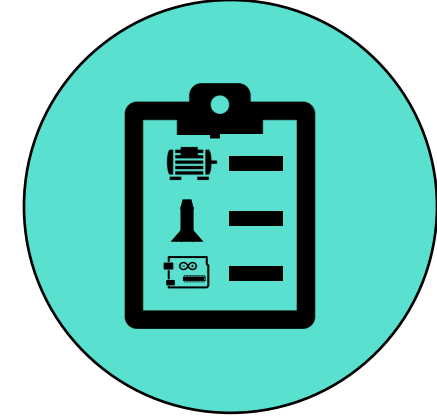


Thrust
Provided

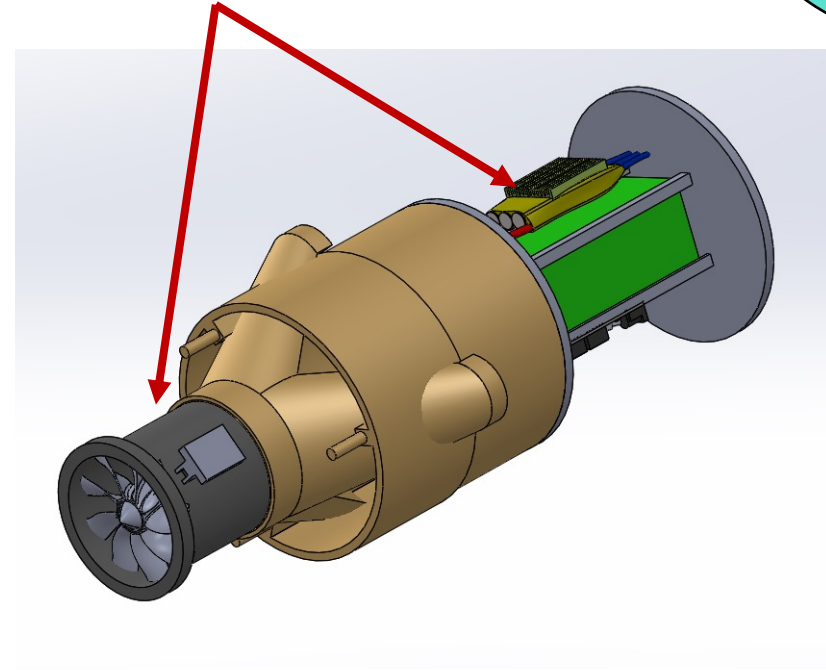


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Testing Plans

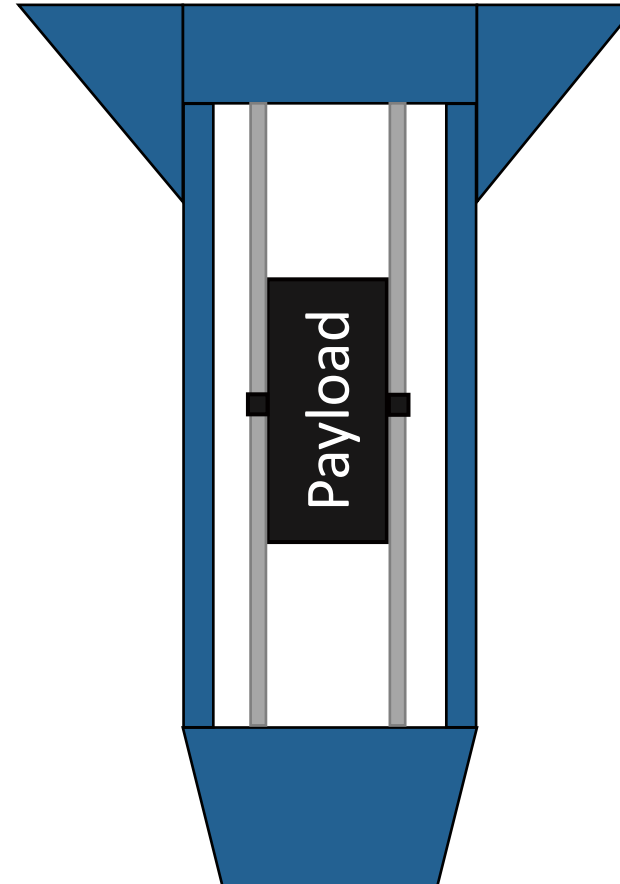
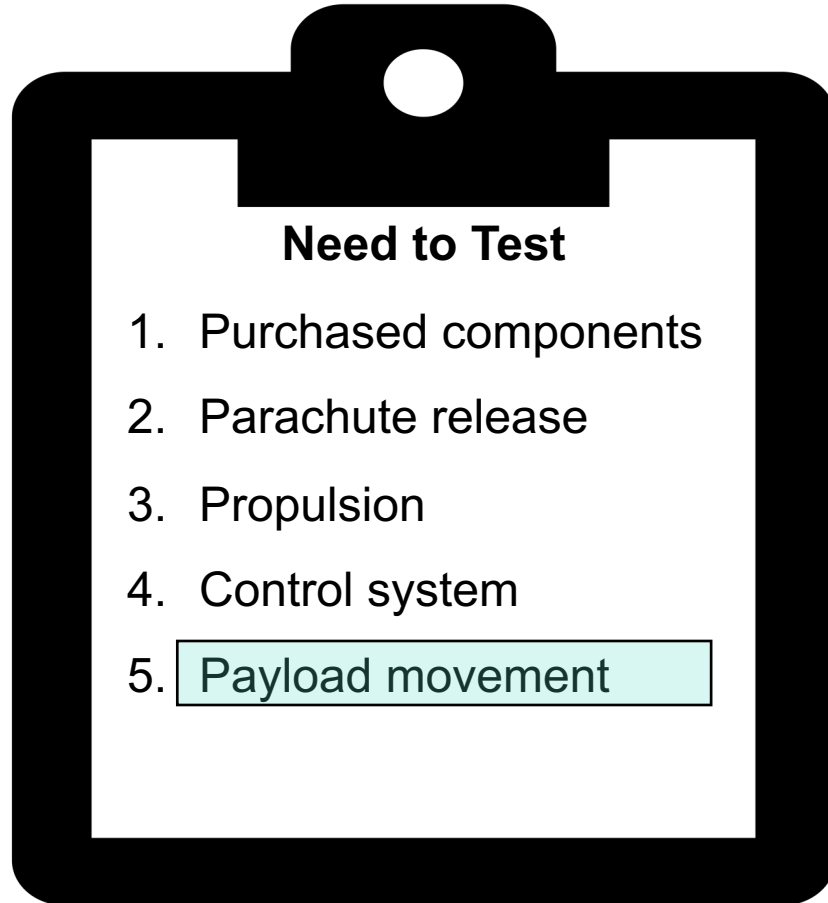
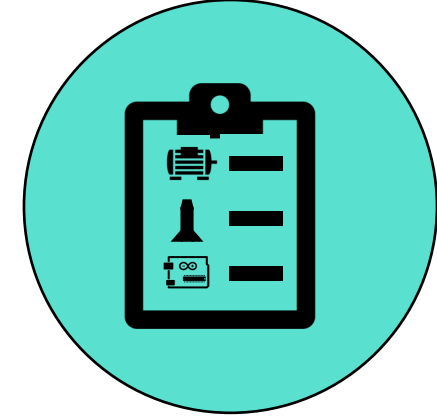


Thrust control from
Inputted drag values



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Testing Plans



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Arduino Demo

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References

Images:

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https://www.esa.int/ESA_Multimedia/Images/2007/11/Zero-G_Airbus_A300_for_parabolic_flights

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<https://www.hitec.uni-hannover.de/en/large-scale-equipment/einstein-elevator/>

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Further Readings:

<https://www.gozerog.com/>

https://www.nasa.gov/mission_pages/sounding-rockets/missions/index.html

<https://www.zarm.uni-bremen.de/en/drop-tower/general-information.html>

<https://www.hitec.uni-hannover.de/en/large-scale-equipment/einstein-elevator>

https://www.youtube.com/watch?v=4aCMDQsx740&ab_channel=TomScott

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