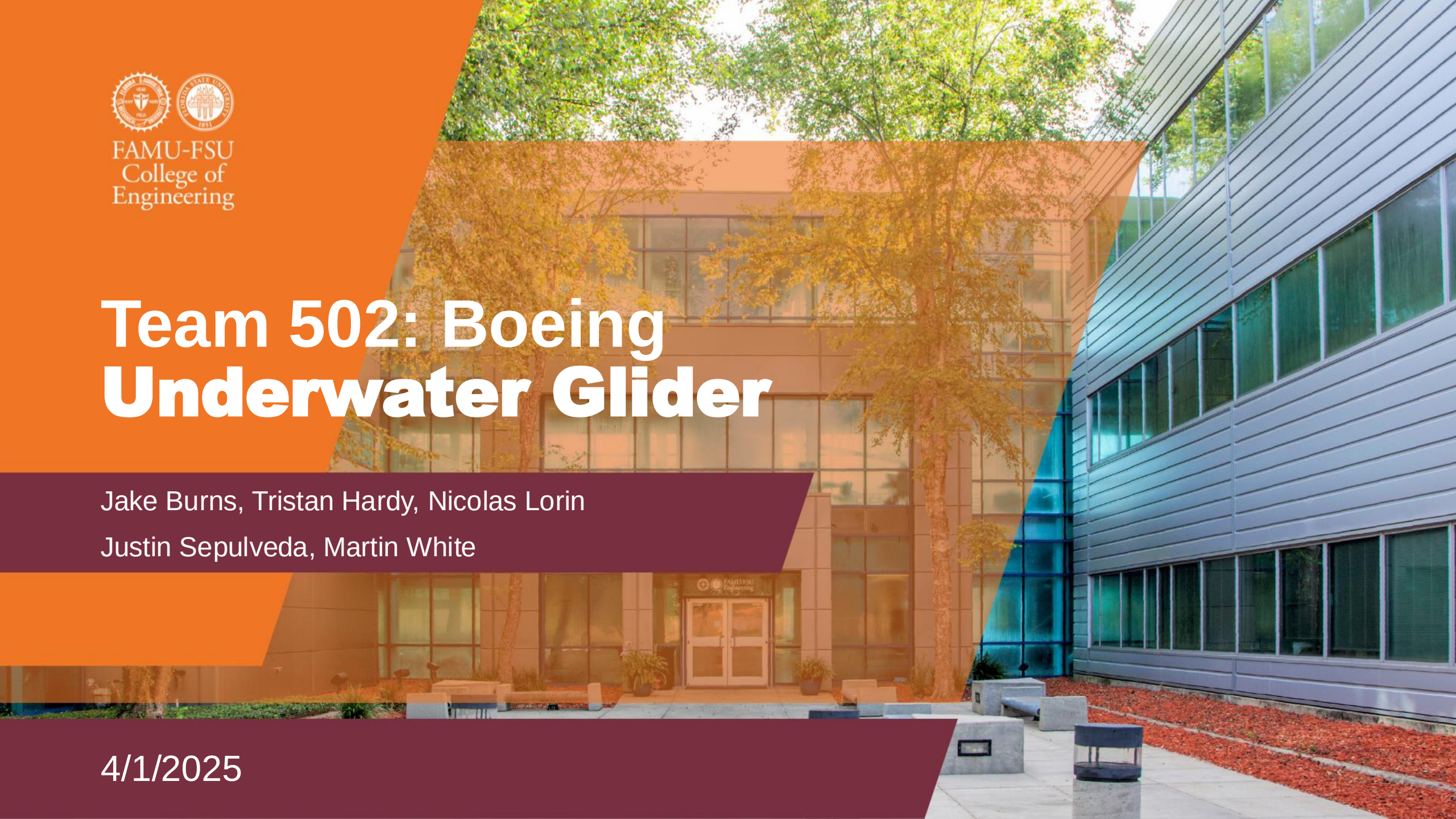

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Team 502: Boeing Underwater Glider

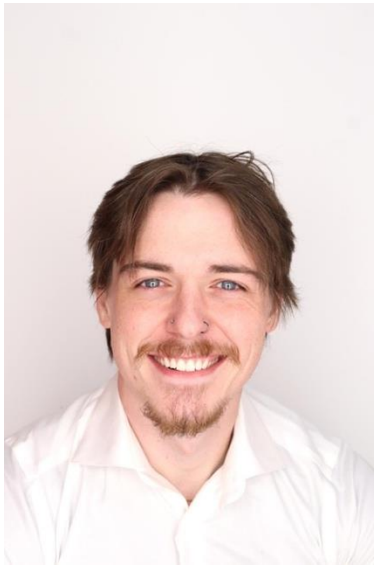
Jake Burns, Tristan Hardy, Nicolas Lorin

Justin Sepulveda, Martin White

4/1/2025

Team Introductions

Jake Burns
Simulations Engineer



Tristan Hardy
Modeling Engineer

Nicolas Lorin
Controls Engineer

Justin Sepulveda
Systems Engineer

Martin White
Materials Engineer

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Sponsor and Advisor

Project Sponsor
Shawn Butler

Project Sponsor
JaQuan Young

Academic Advisor
Shayne McConomy

Faculty Advisor
Kourosh Shoele

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Objective

The objective of this project is to simulate and construct an underwater glider.

Justin Sepulveda

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Sepulveda

What is an underwater glider?

- Autonomous underwater vehicle
- Often buoyancy driven
- Upgraded mission duration and energy efficiency

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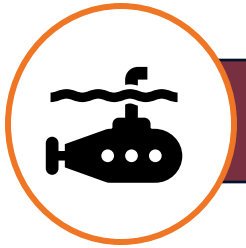
Key Goals

Energy efficiency

Data collection



Motion

Durability

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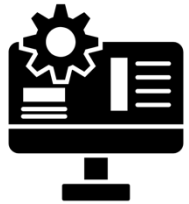
Customer Needs

Motion

- Operates at depths up to 10 feet.

Sensing Capabilities

- Collects data about environment
- Processes data to adjust



Simulation

- Optimal path simulations
- Performance while operating

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Functional Decomposition

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Motion

Control Lift	40-70 [lift-drag ratio]
Control Pitch	Angle of Attack ≤ 10°
Control Yaw	Sideslip Angle ≤ 10°
Control Roll	Bank Angle ≤ 10°

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Operation

Store Power	30 [Wh]
Store Data	1 [GB]

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Hull

Endure Fatigue Stress	10 [cycles]
Withstand Pressure	6 [psi]

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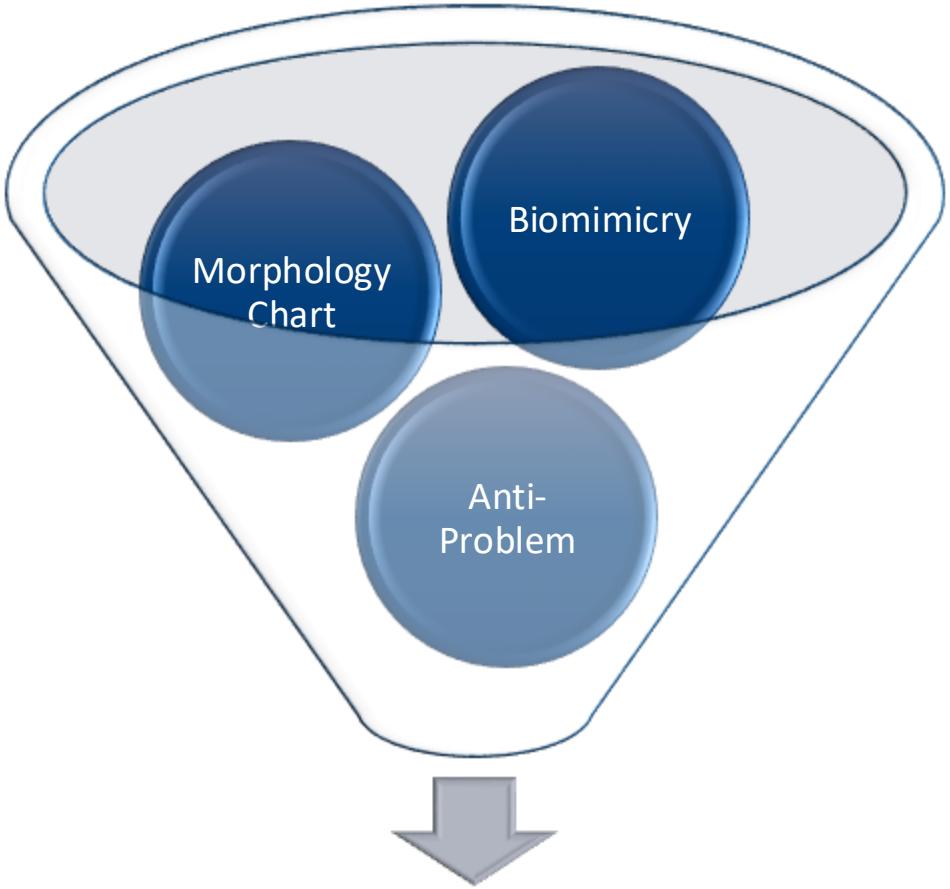
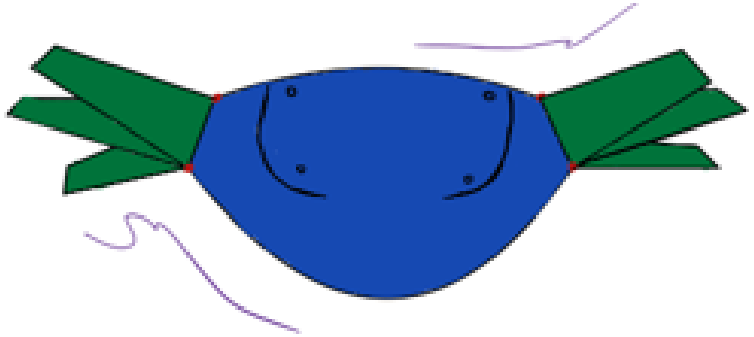
Ideation Methodology



Concept Generation

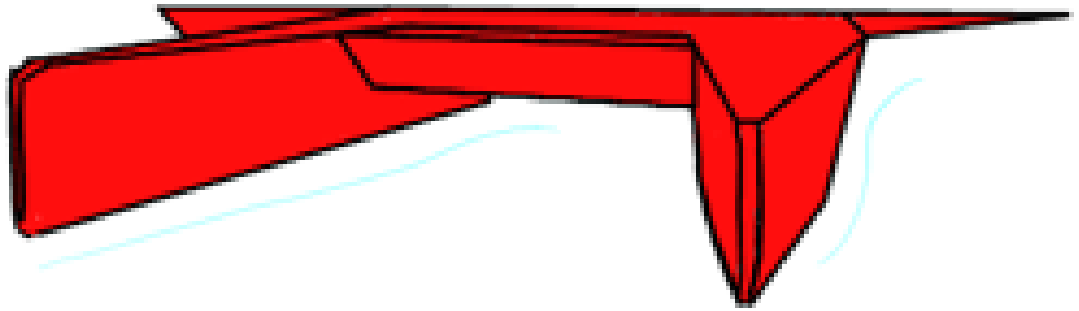
High Fidelity Concepts

Piston Excavated Buoyancy

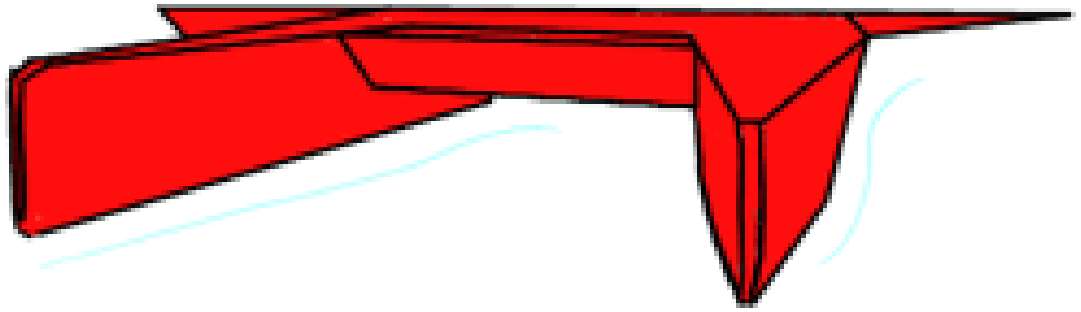


Adjustable Wing Glider

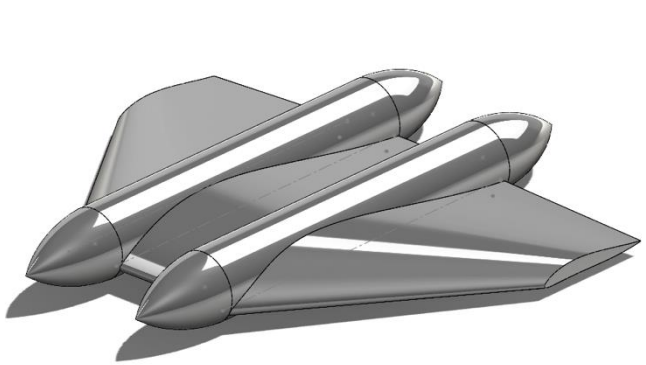
Dual Hull Glider

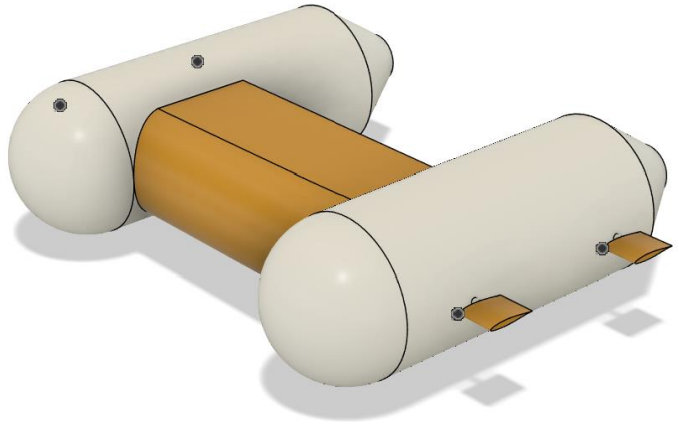


Selected Concept and Iterations

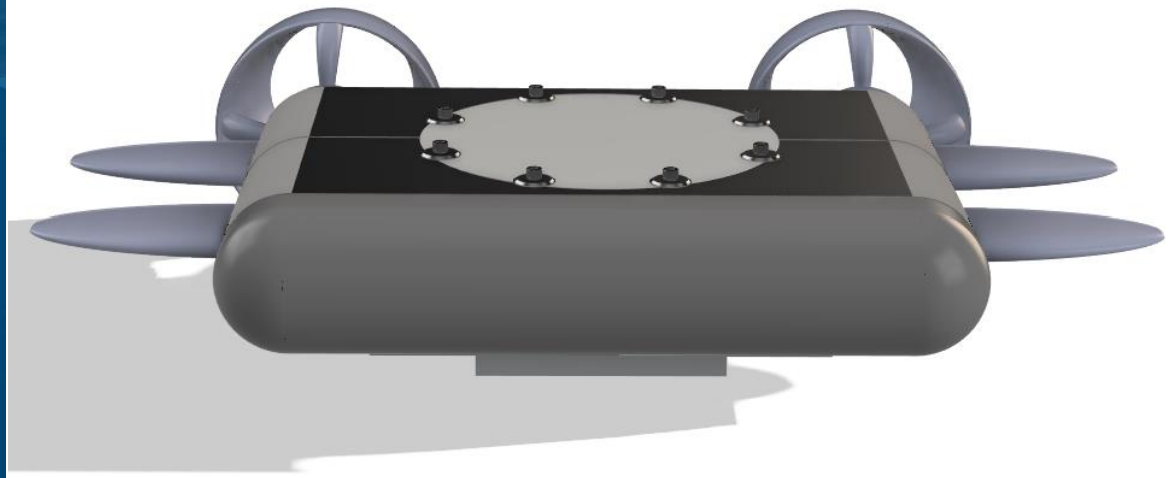


Dual Hull Glider

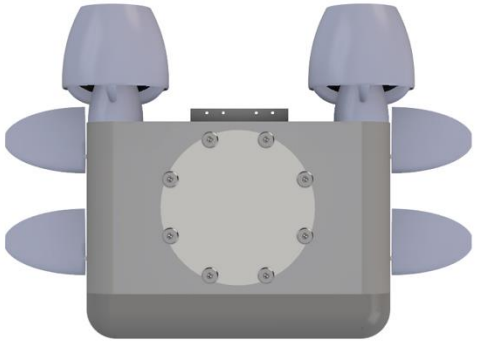


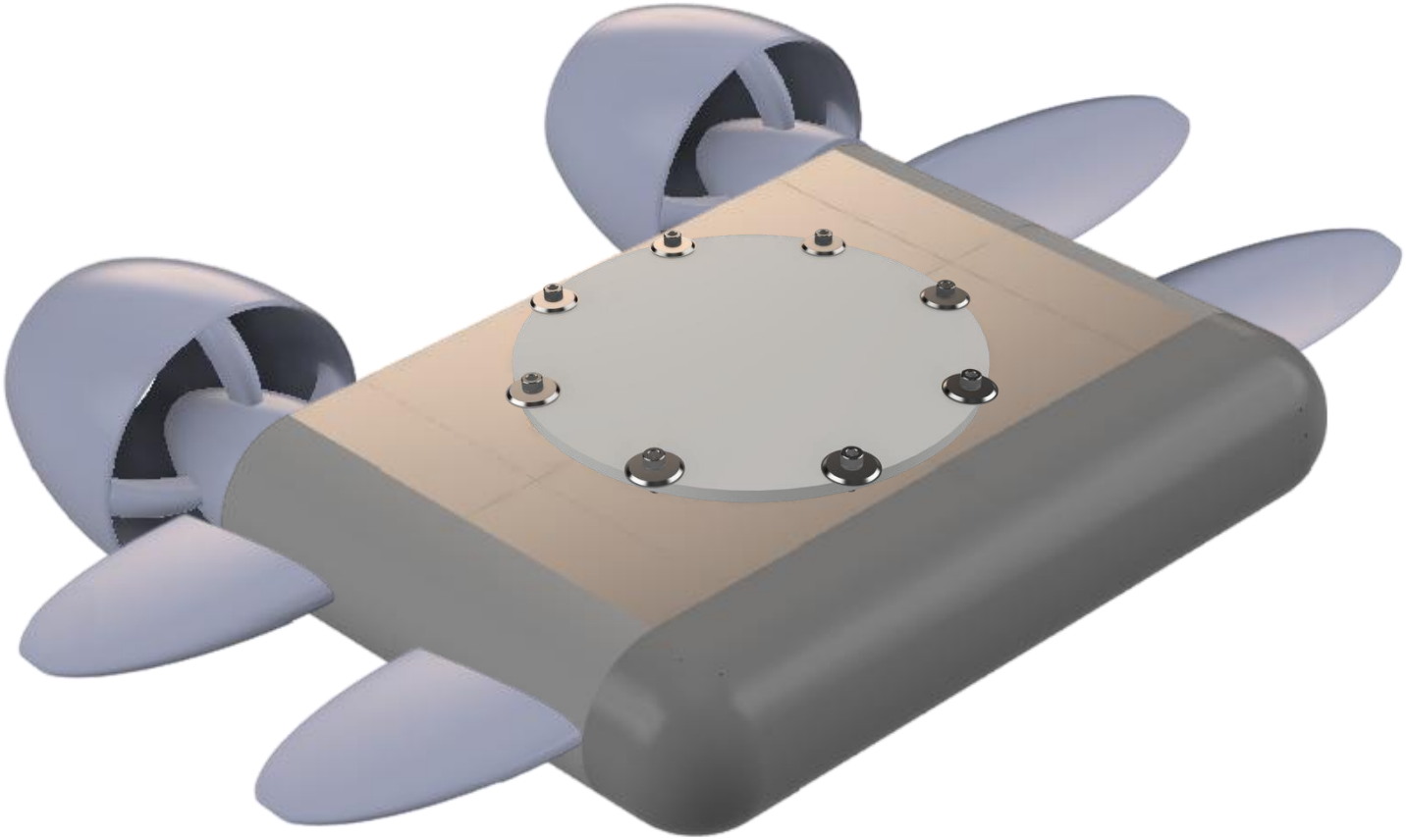


Final Concept Selection

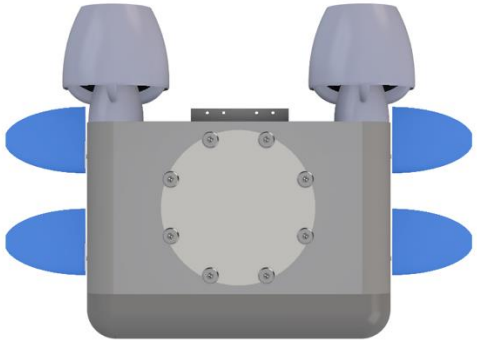


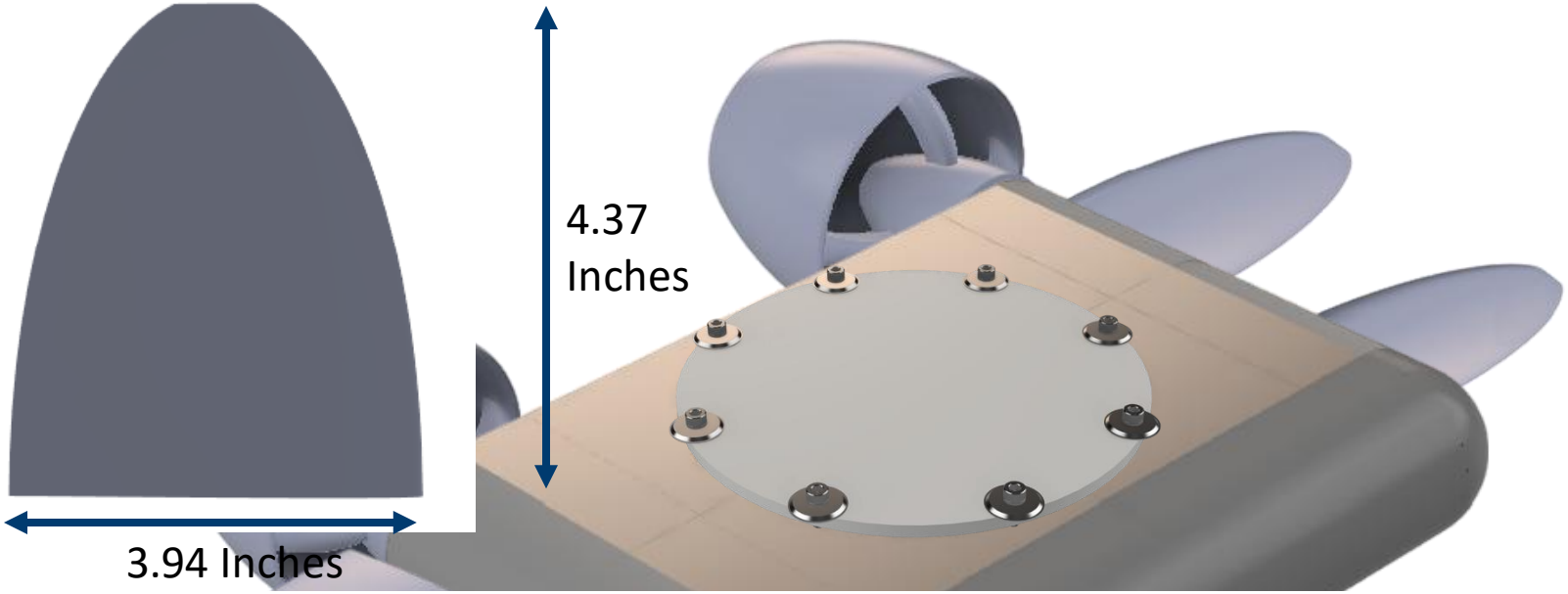
Main Features

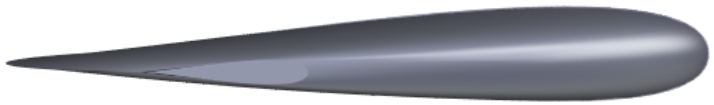


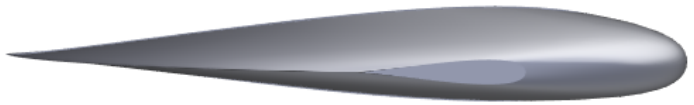


Main Features

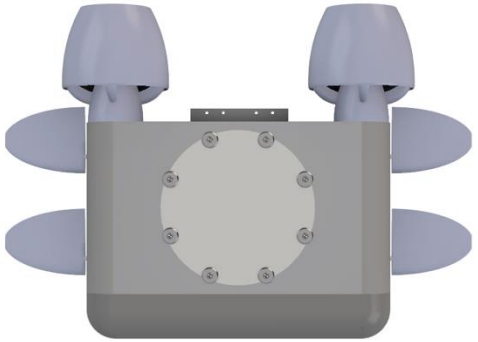


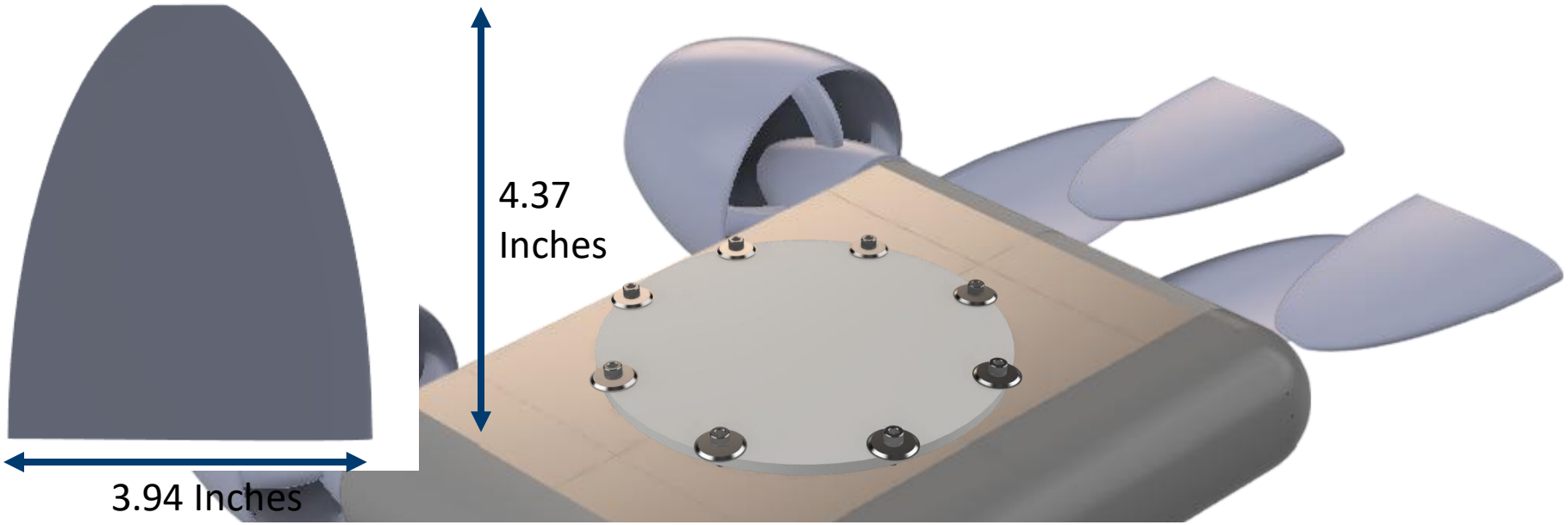


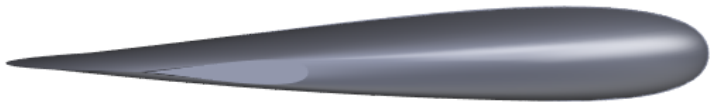


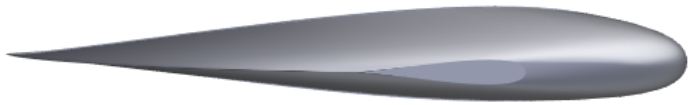


Main Features

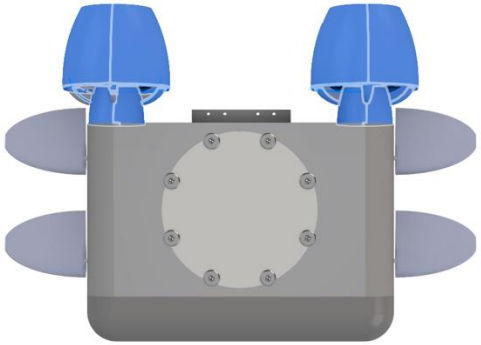


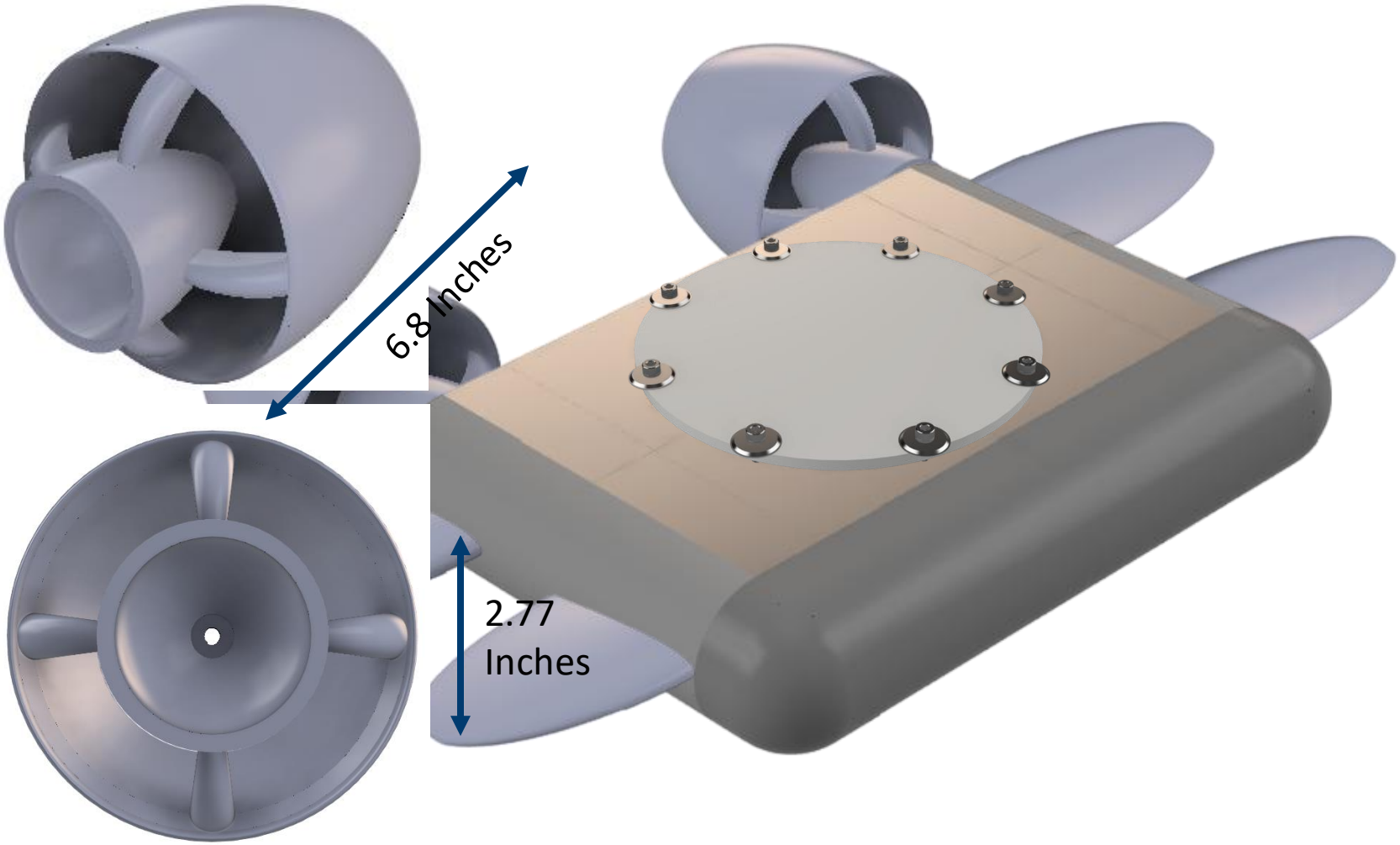






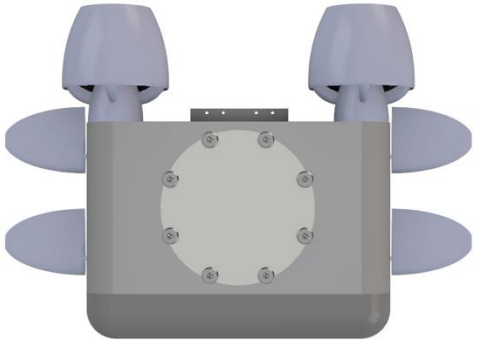
Main Features

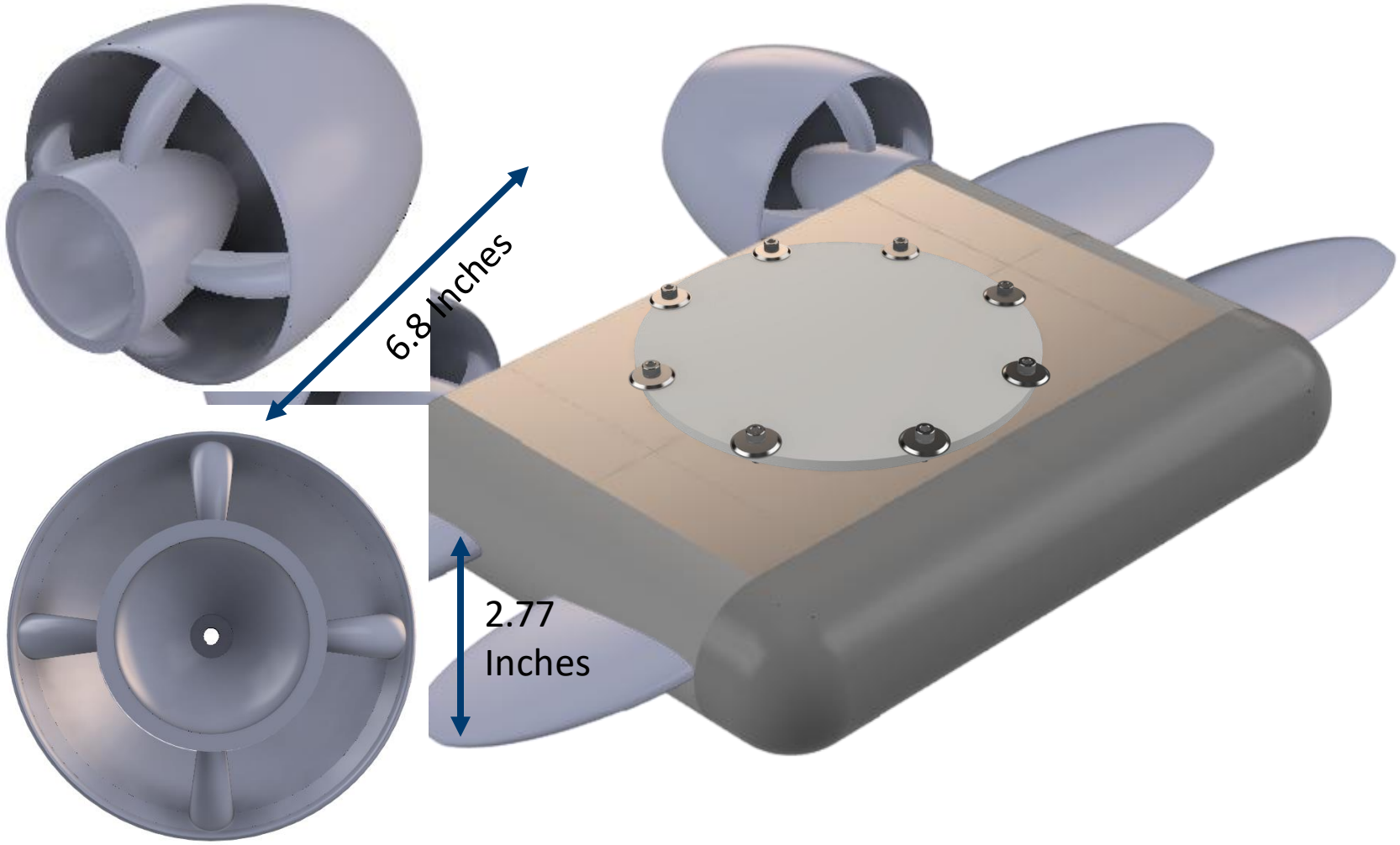




Tristan Hardy

Main Features





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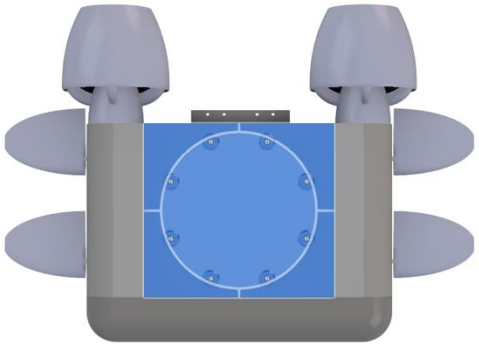
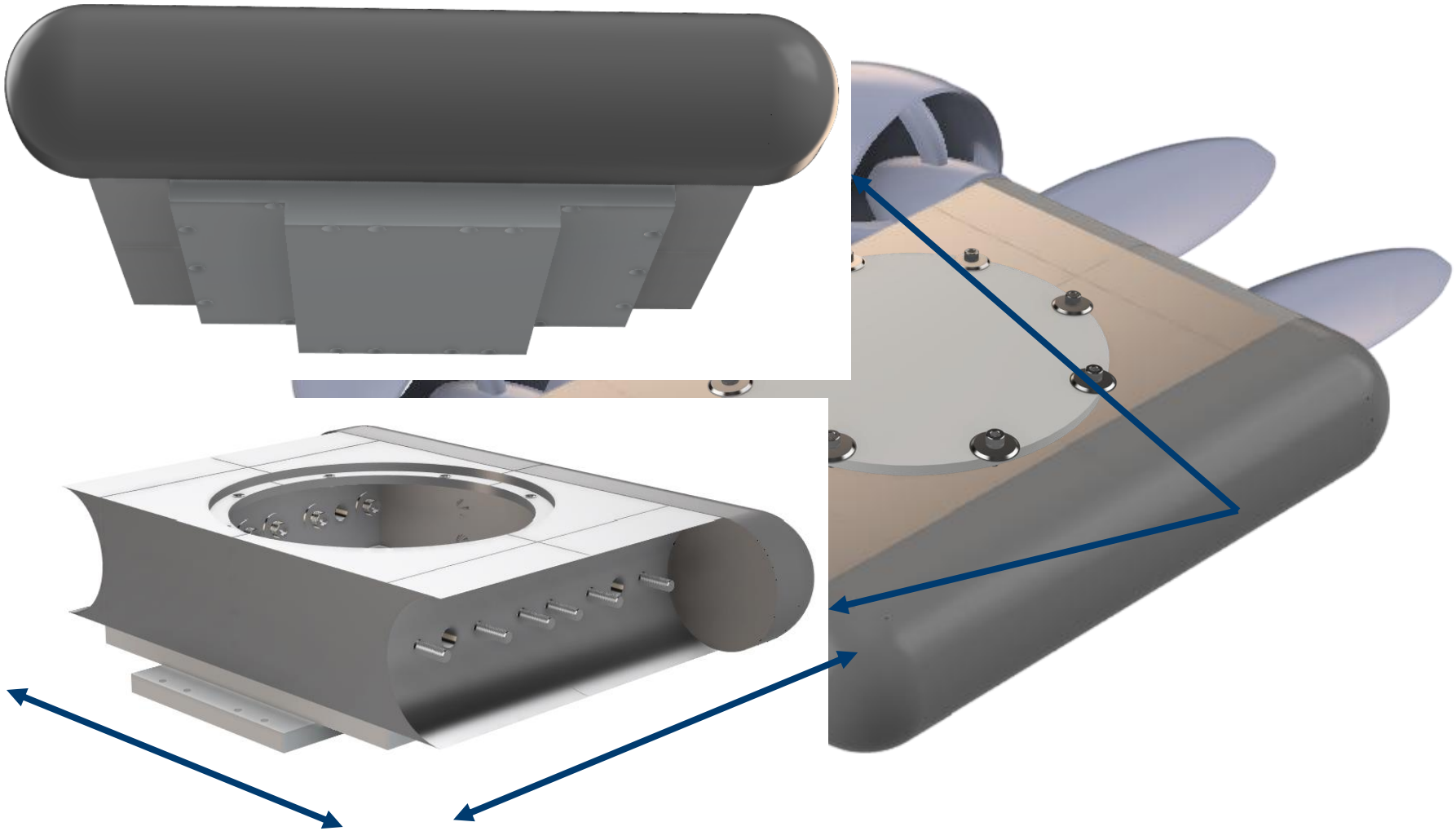
Main Features

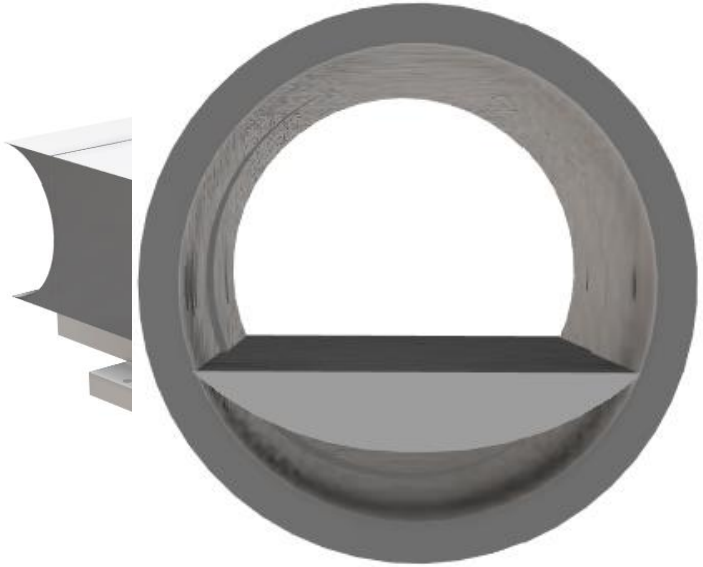




11 X 10 Inches

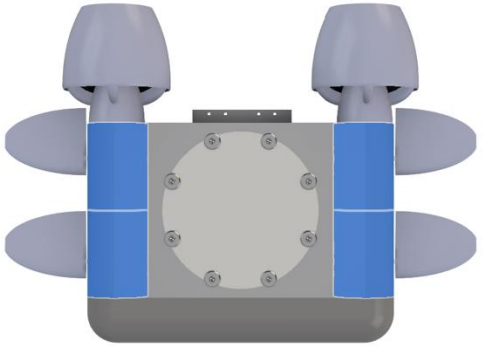
Main Features

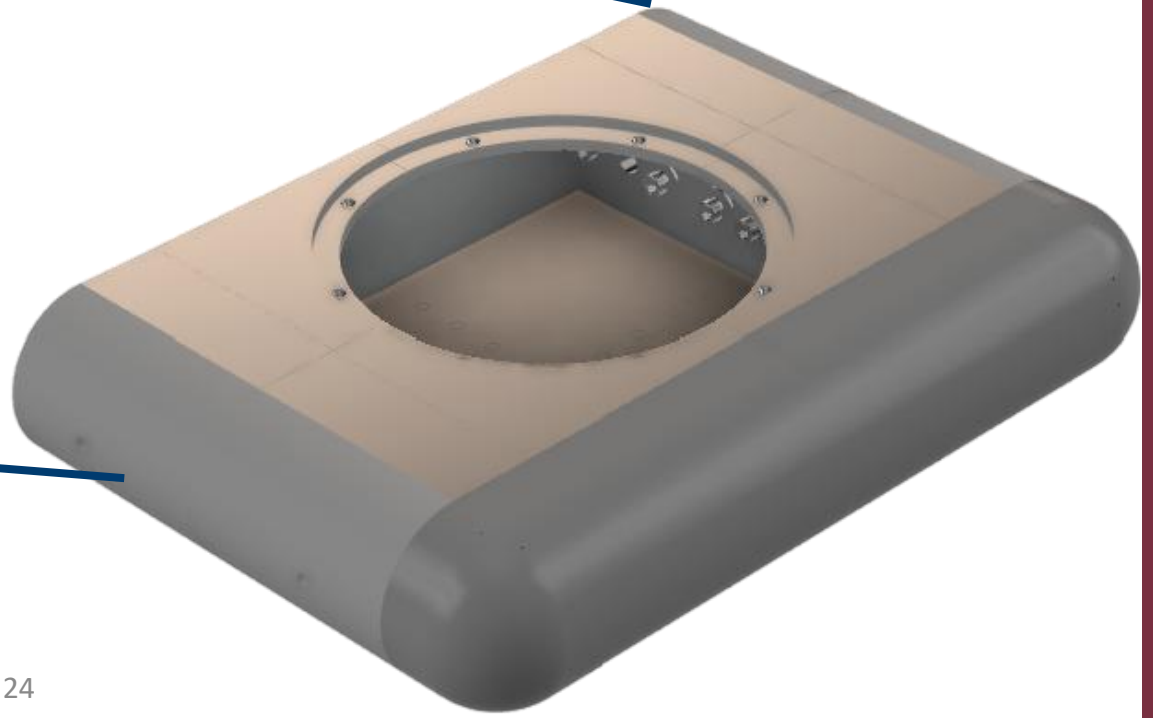
10 Inches



3.5 Inches

3 Inches





Why CFD?

Surface Pressure

- Identify high drag regions
- High drag corresponds to low efficiency

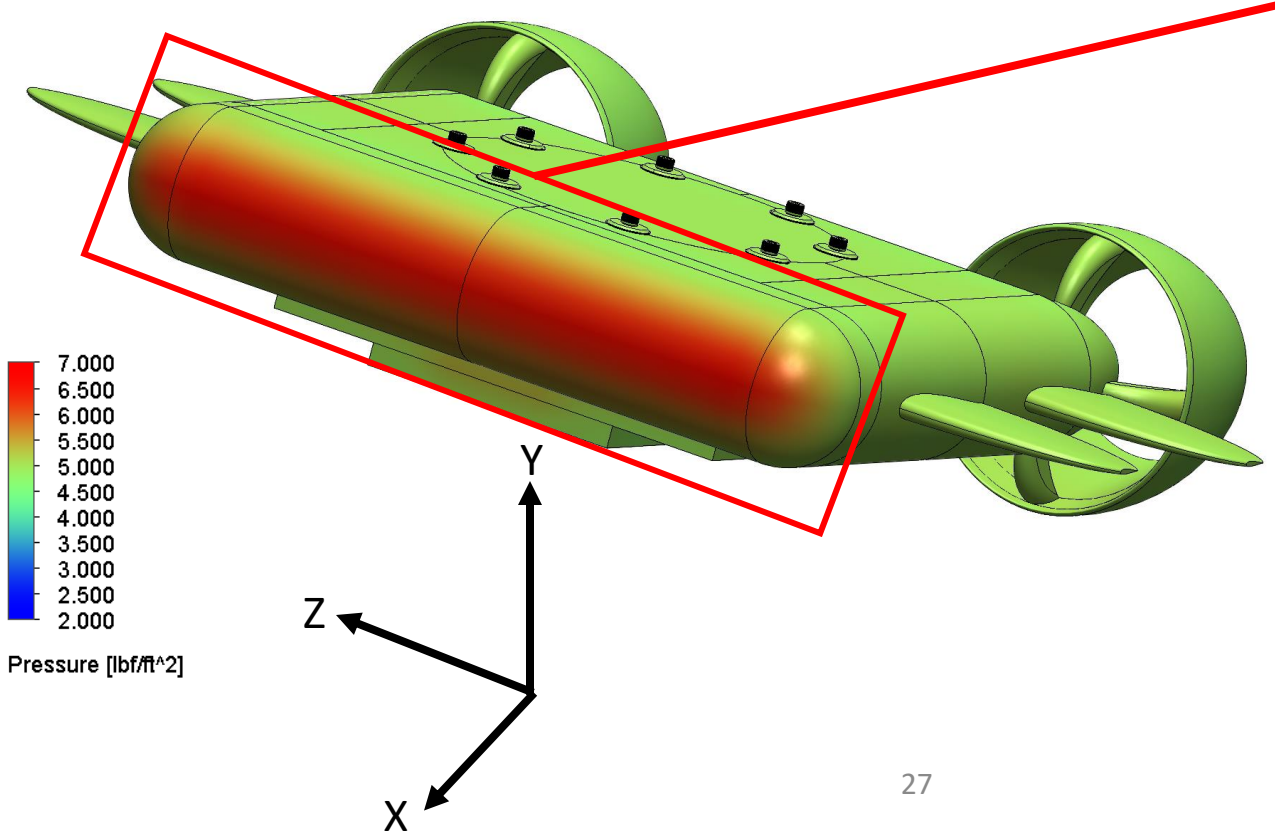
Velocity Visuals

- Streamlines can show flow direction
- Further inform regions of high/low drag

Design Decisions

- Insight into fluid motion over glider
- Tune controller values
- Verify sensor readings

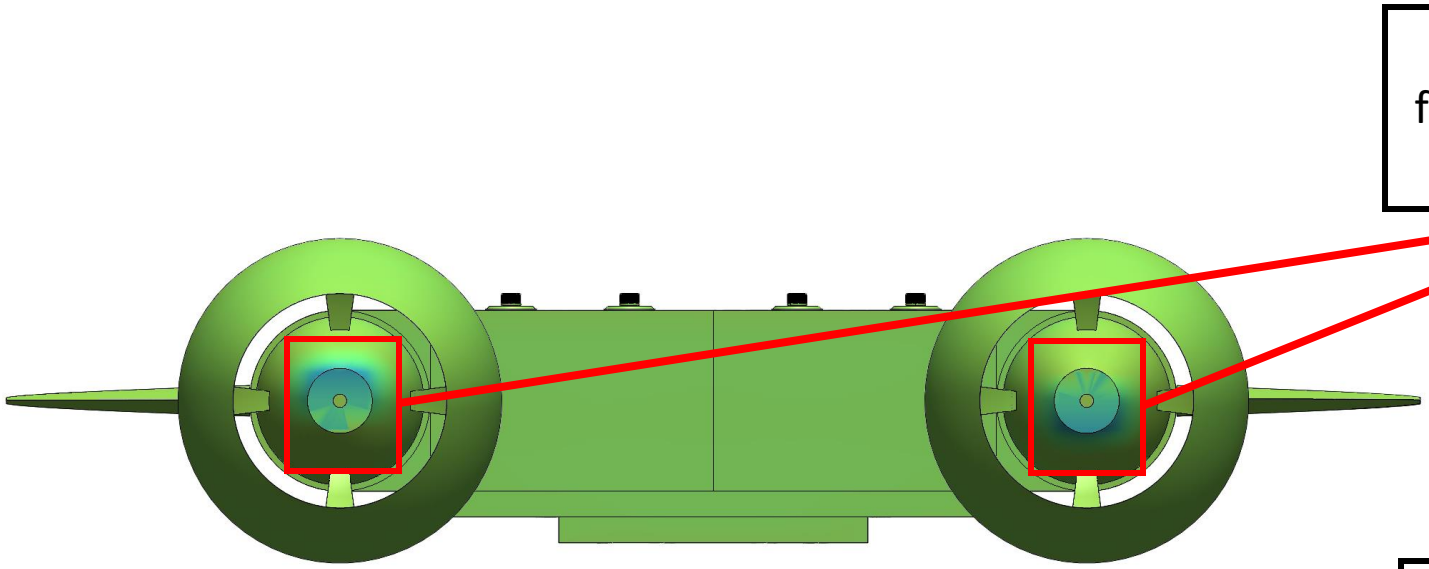
Surface Pressure



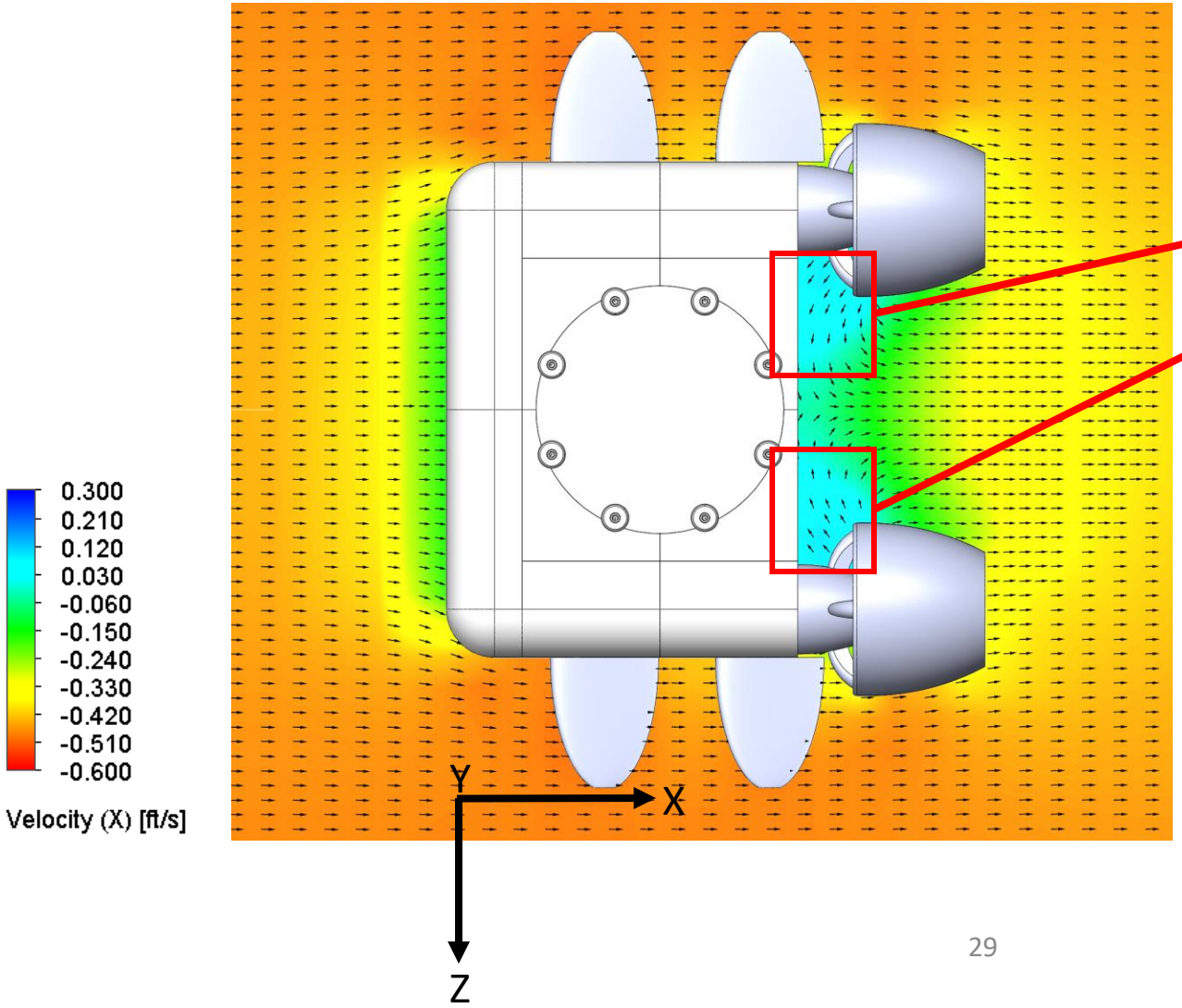
Current configuration has high drag on the nose cone

Nose cone could be swept out further in the x-direction

Surface Pressure



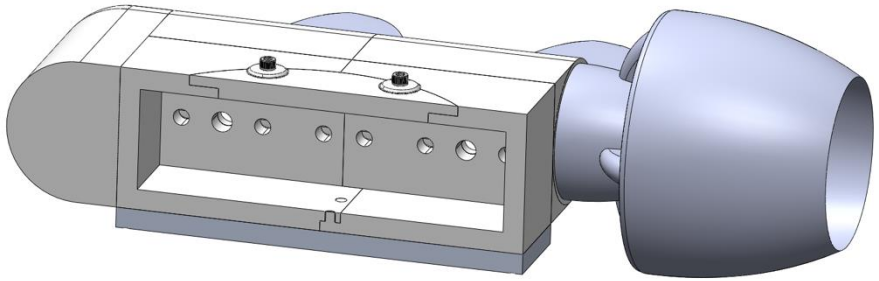
Velocity Contour

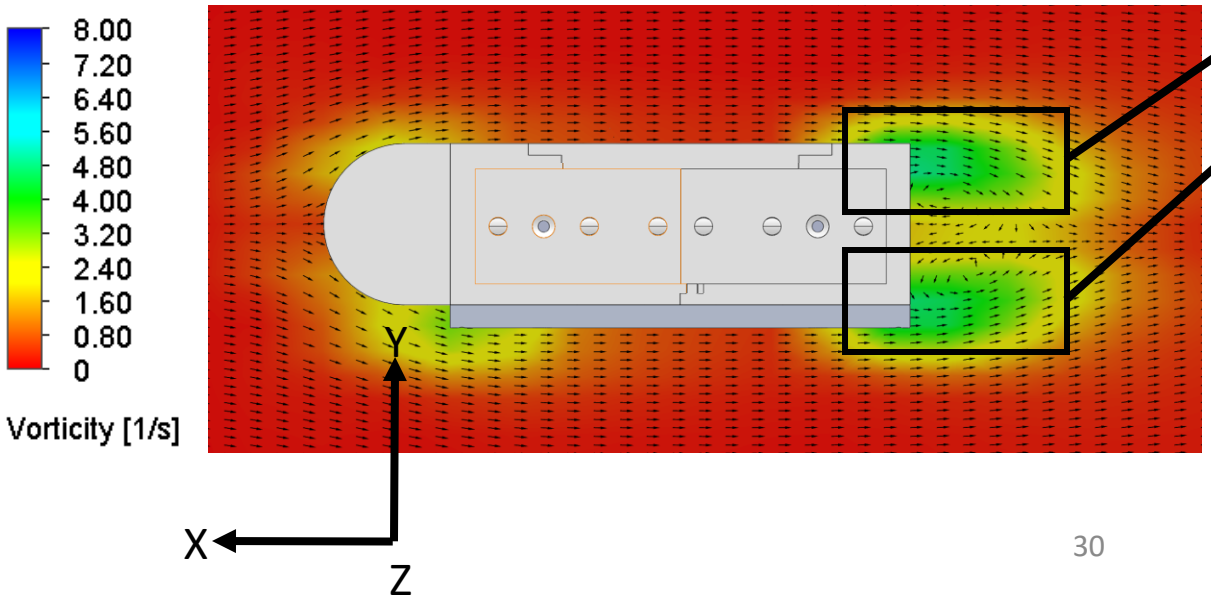


Fluid slows down by about 1 ft/s

Sharp back step increases drag on the body

Vorticity Contour

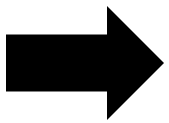


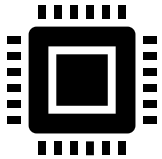


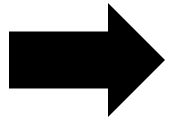
Large recirculation regions

Support the backward step's influence on high drag

Control Protocol





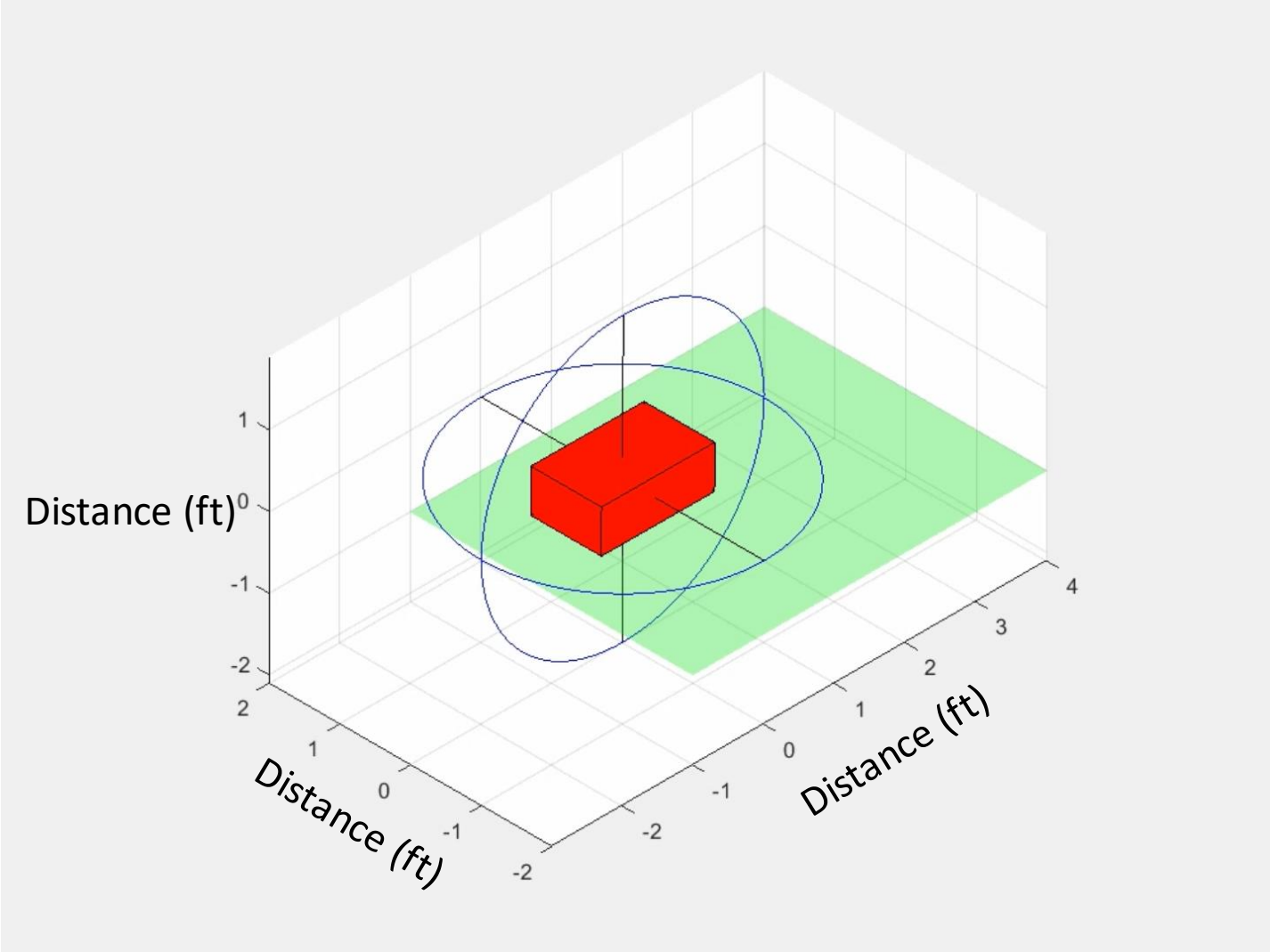


Sense Environment
- Pressure
- Roll
- Pitch
- Yaw

Choose Controller
- Velocity
- Roll
- Pitch
- Yaw

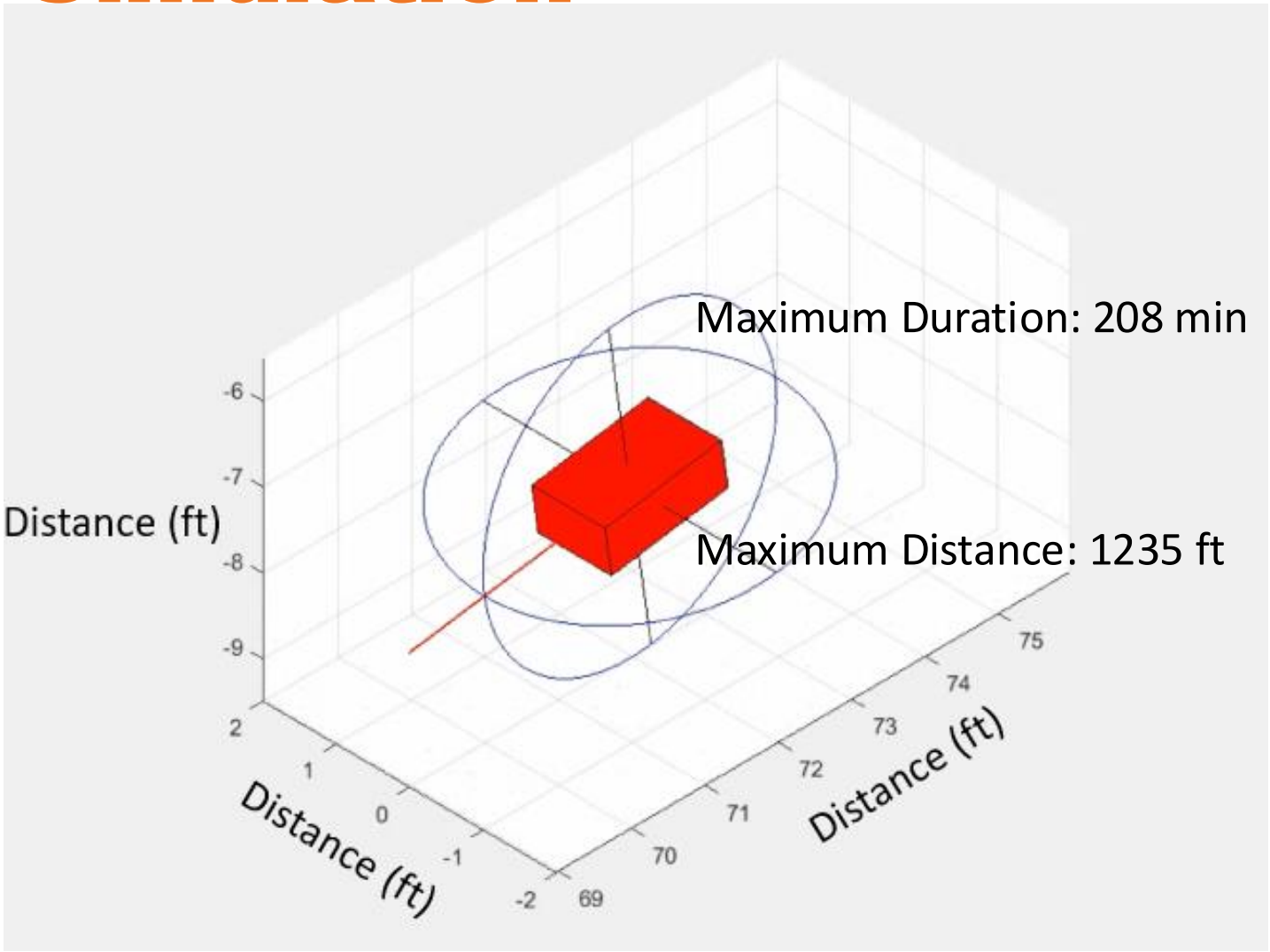
Apply Correction
- Velocity
- Roll
- Pitch
- Yaw

Ideal Simulation



Video Speed: 6x

Ideal Simulation

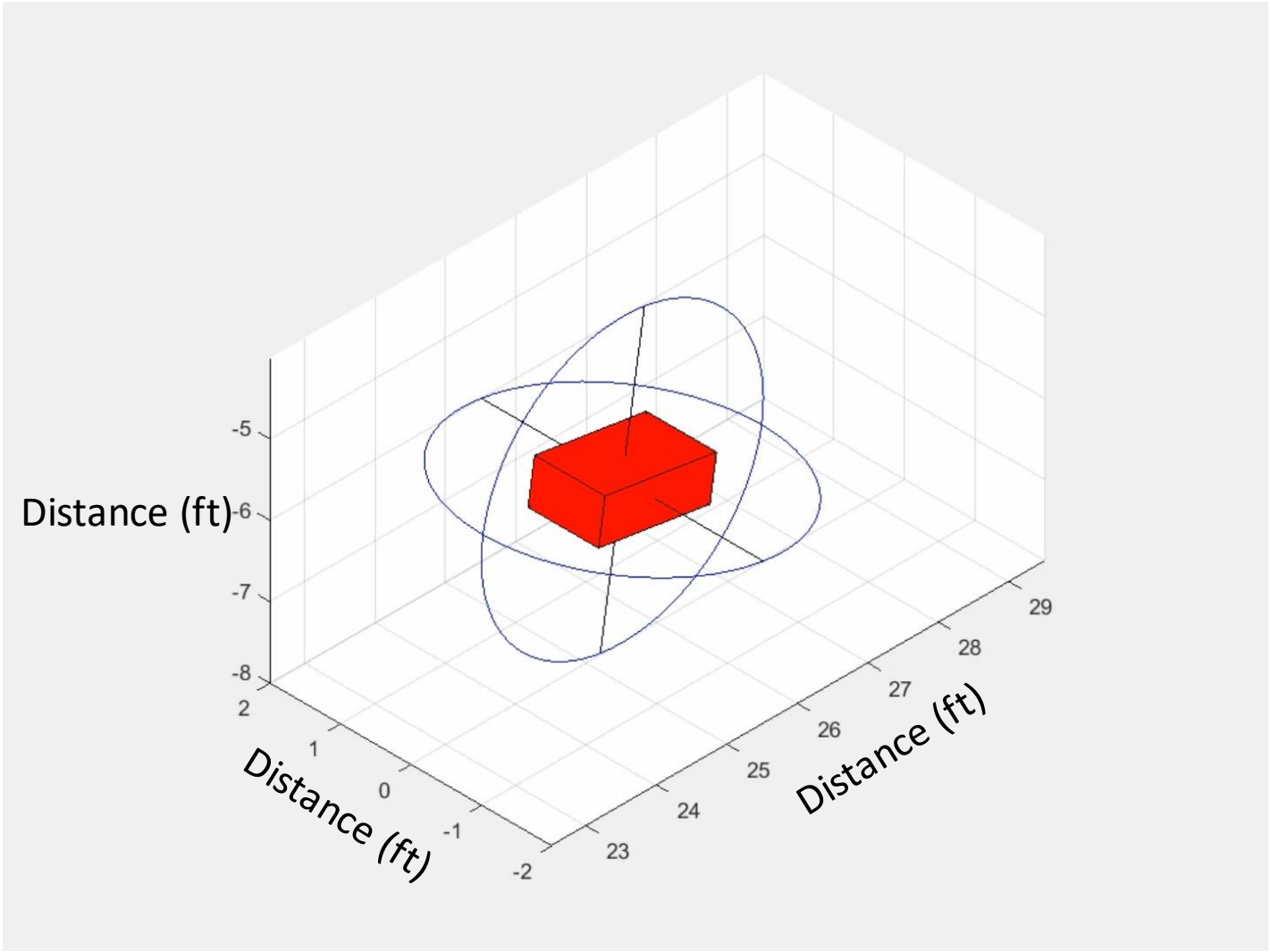


Video Speed: 6x

Maximum Duration: 208 min

Maximum Distance: 1235 ft

Disturbance Simulation



Video Speed: 2.6x

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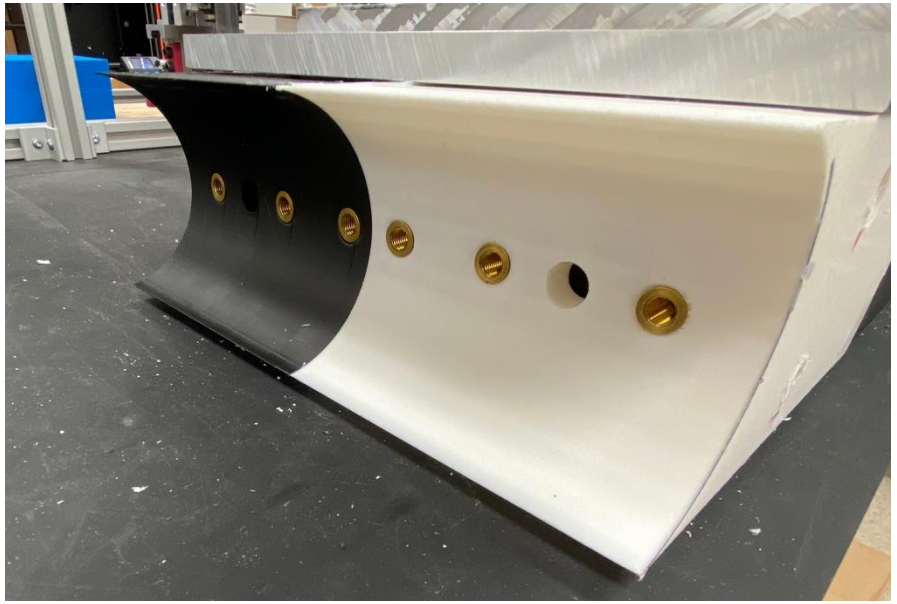
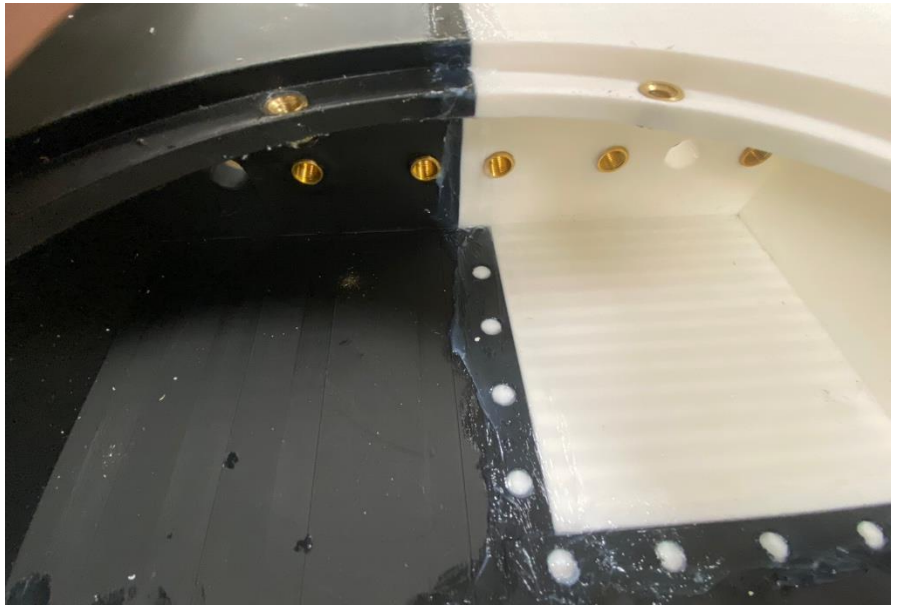
Manufacturing - Inserts



5/16 in. heat inserts used to connect the hulls to the center box



¼ in. heat inserts used to connect the lid to the center box

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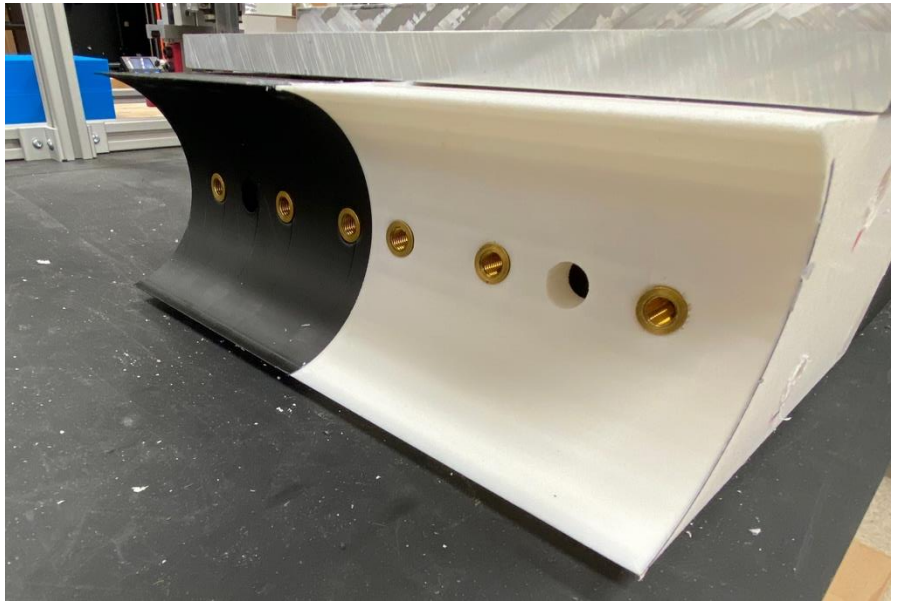
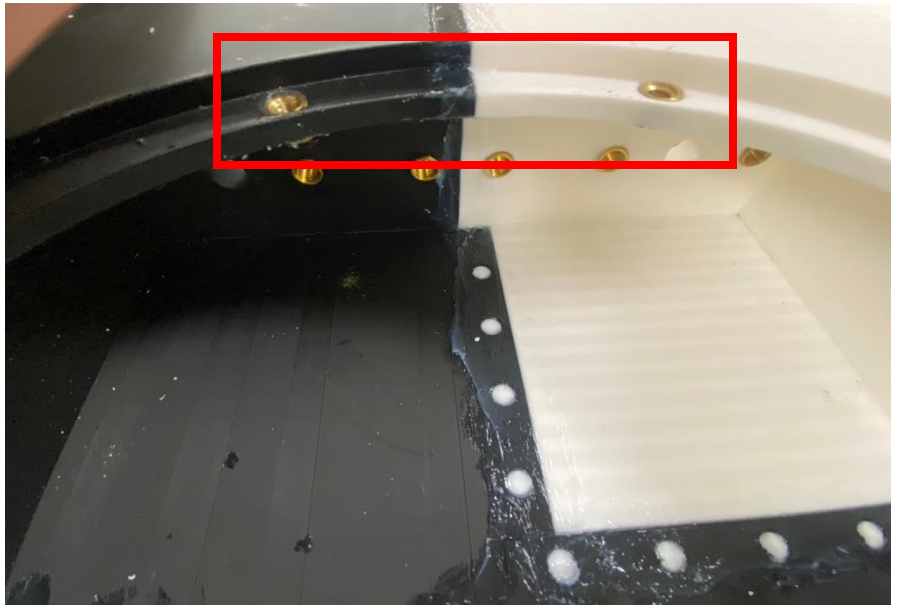
Manufacturing - Inserts



5/16 in. heat inserts used to connect the hulls to the center box



¼ in. heat inserts used to connect the lid to the center box

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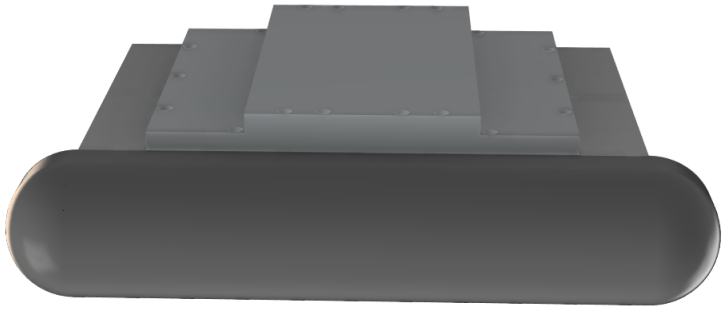
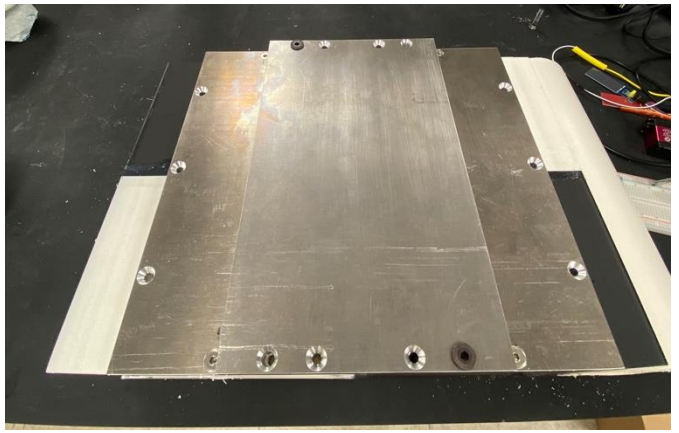
Manufacturing – Metal Plates





Metal plates installed on underside increase weight of glider by *9 lbs*

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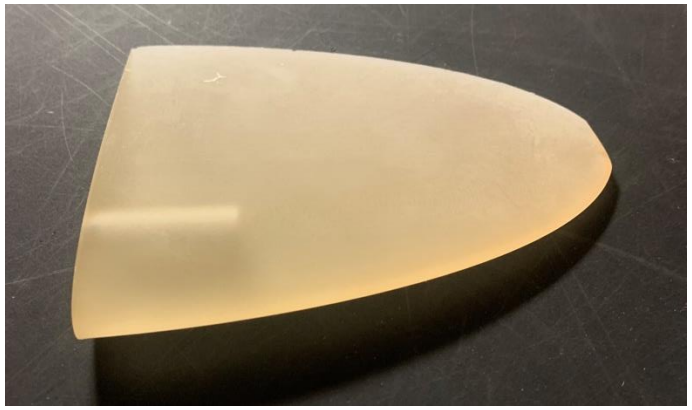
Manufacturing – SLA Printed Parts



New resin printed parts have very smooth surfaces and improved sturdiness

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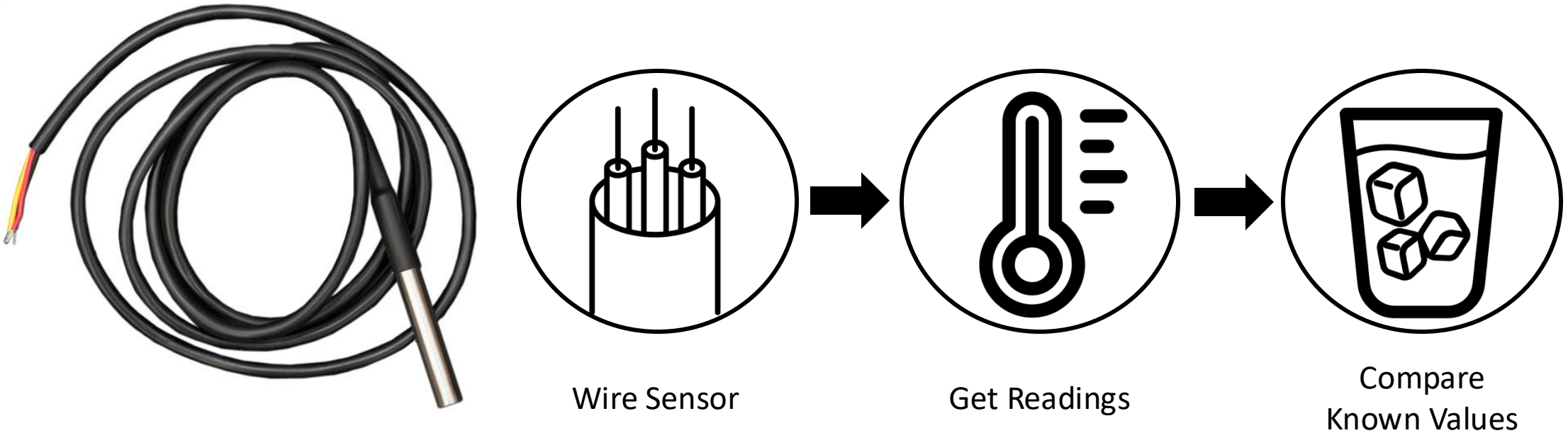
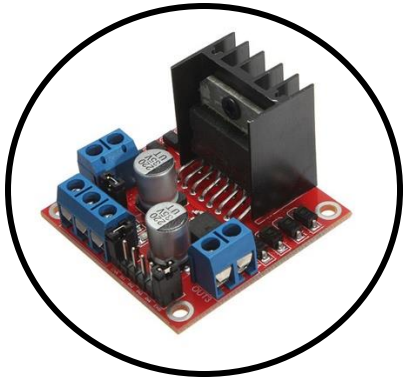
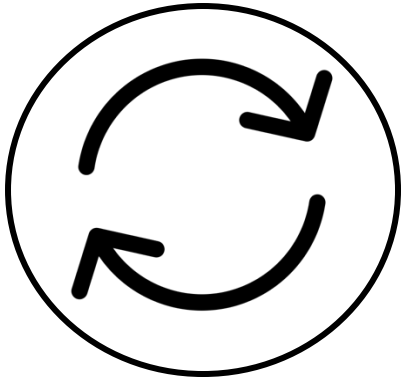
Temperature Sensor



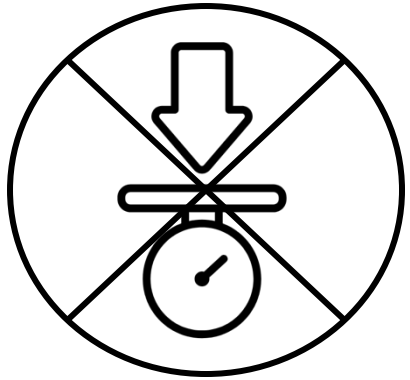
DC Motors



Wire Driver

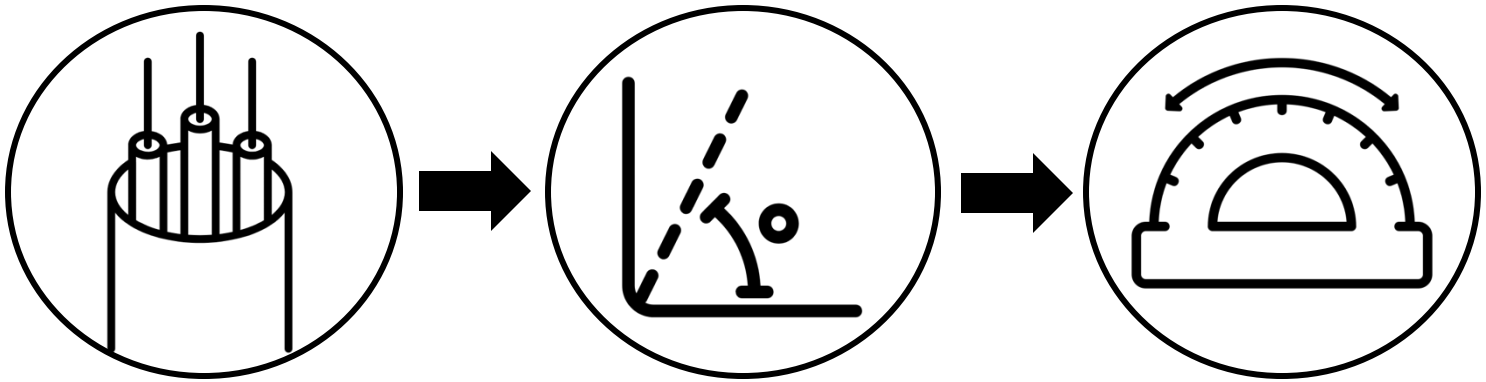


Test Motors



No Load Torque

Servo Motor



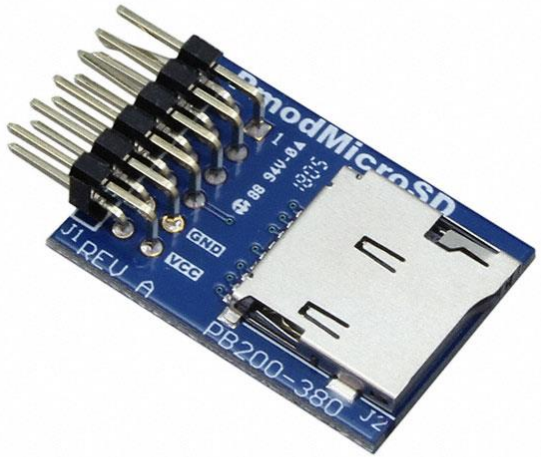
Wire Motors

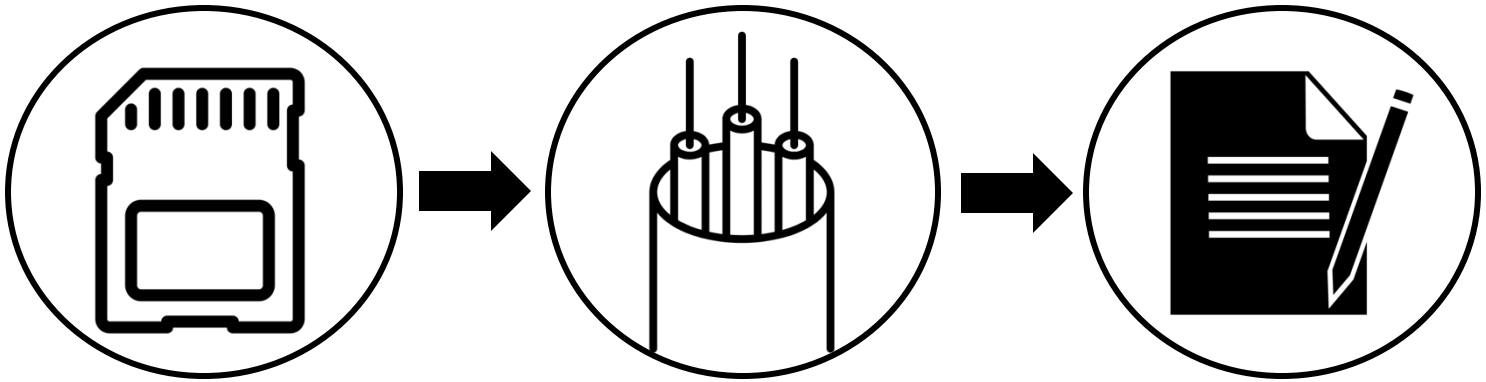
Code Angles

Compare Values

SD Card

+



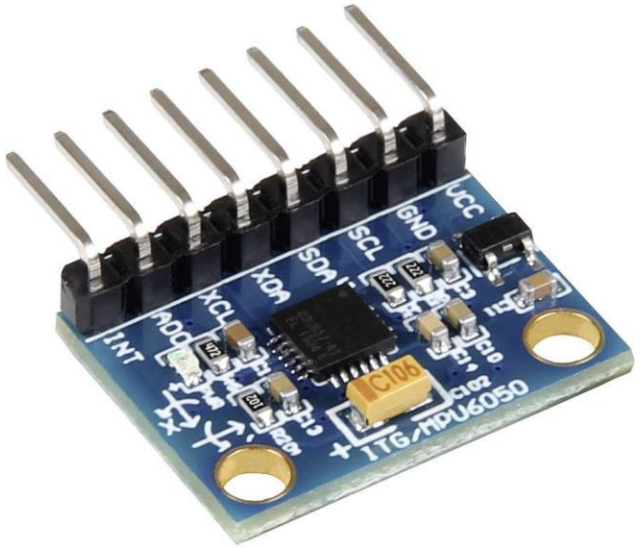


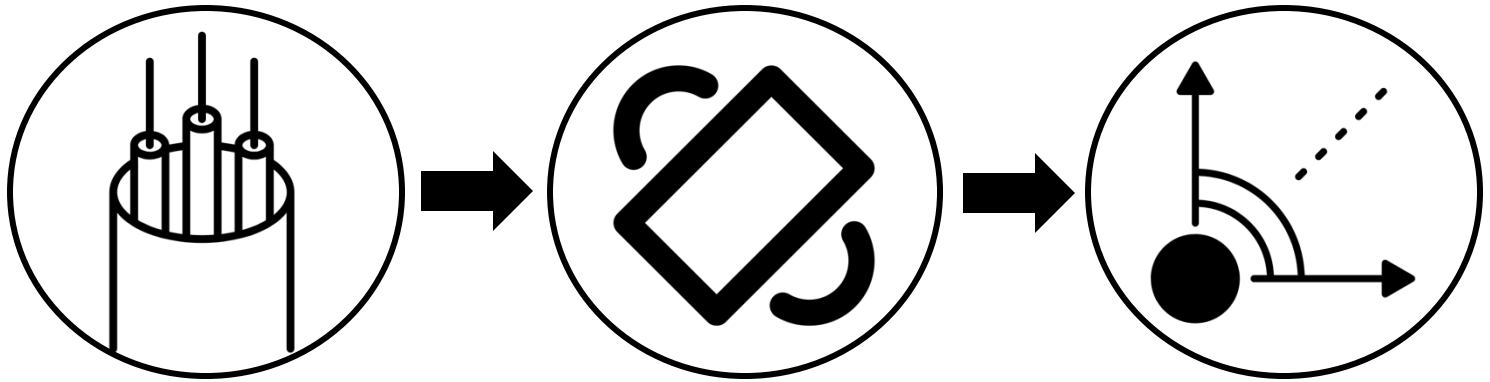
Format SD Card

Wire Module

Read and Write Data

Accelerometer



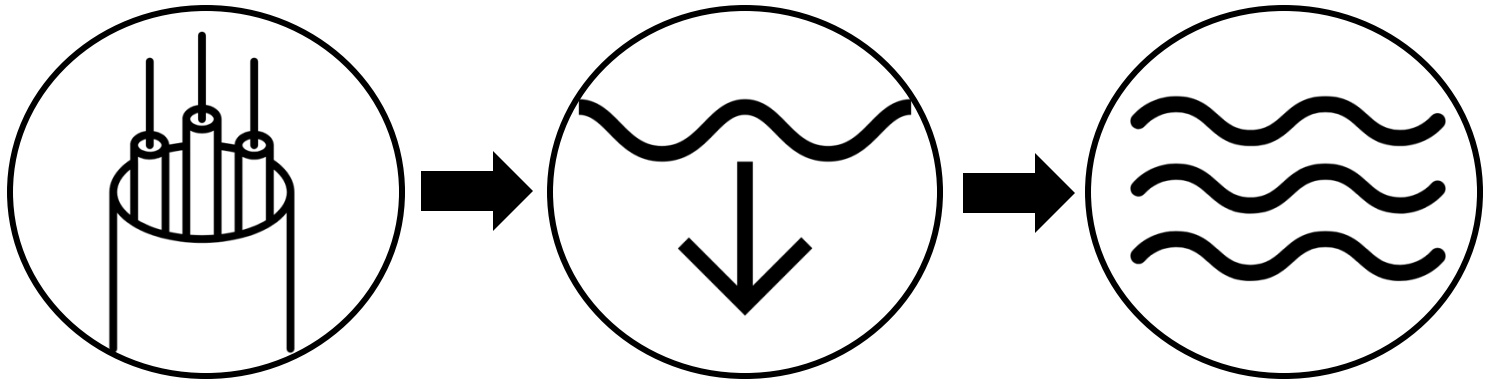


Wire Sensor

Tilt Sensor

Compare
Known Values

Pressure Transducer



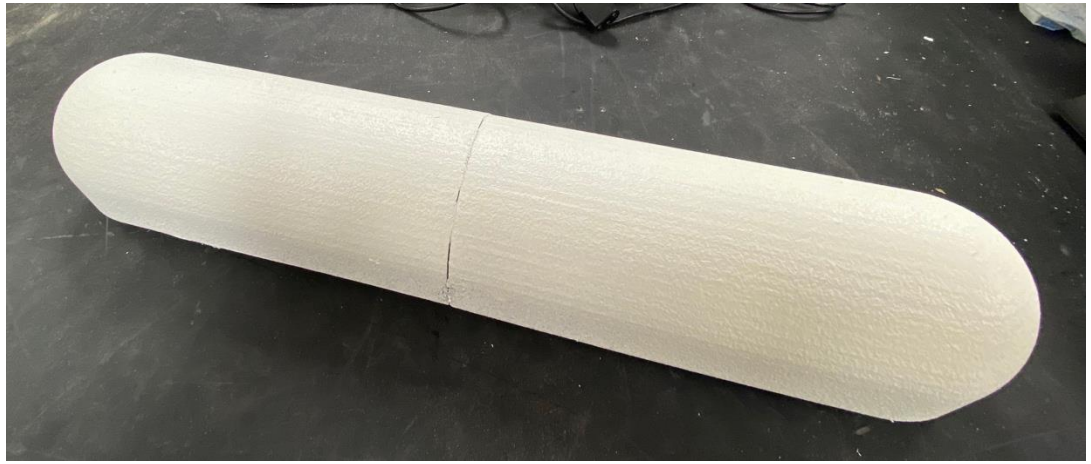
Wire Sensor

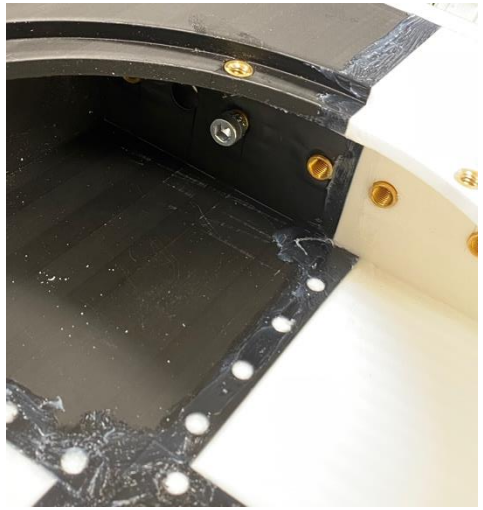
Check Static Reading

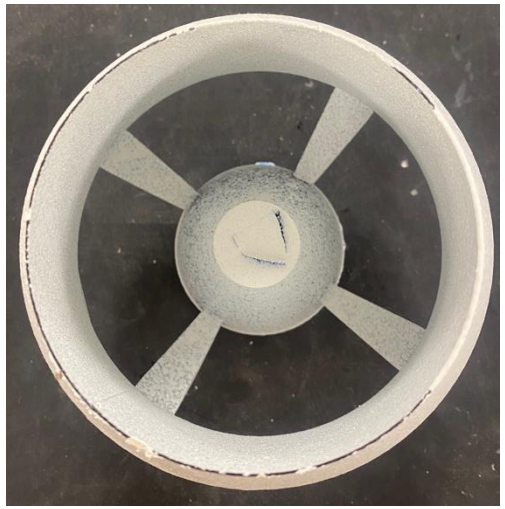
Check Stagnation Reading

Sealing

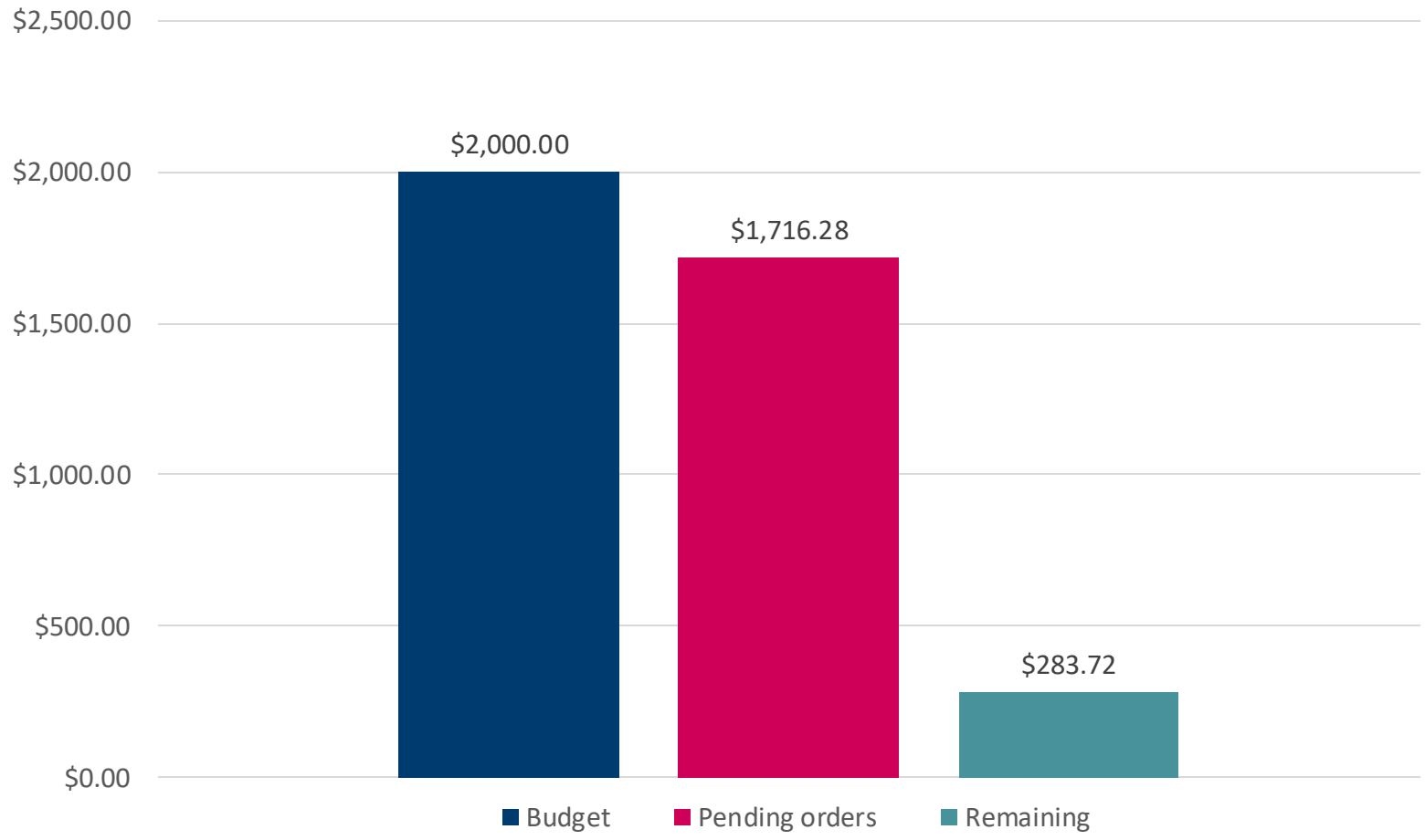
- Caulk and sealing coat combination
- Additional coats to be placed over final assembly







Budget



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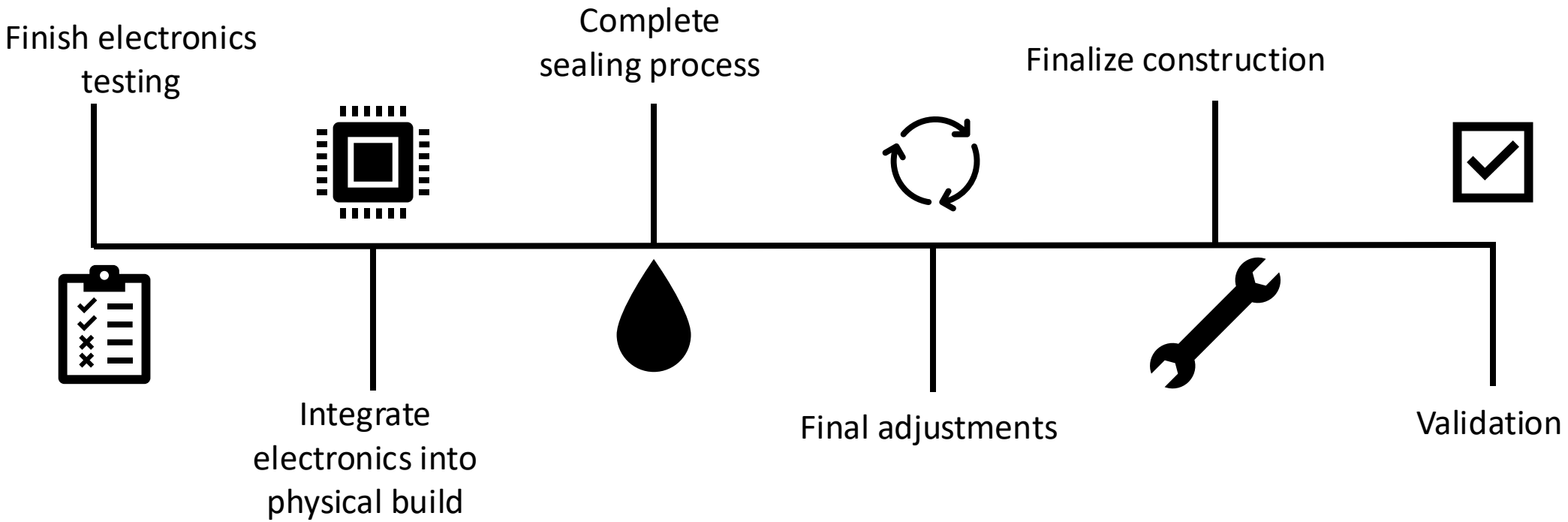
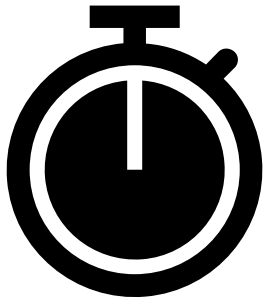
Future Work

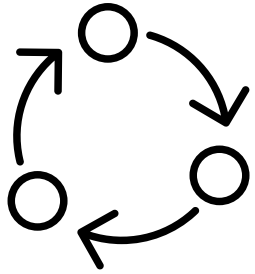

Finish electronics testing
Integrate electronics into physical build
Complete sealing process
Final adjustments
Finalize construction
Validation

Lessons Learned

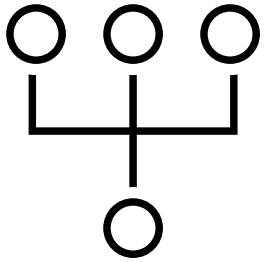


Time management

Identifying priorities early



More iterations



Overall integration

Connect on LinkedIn

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