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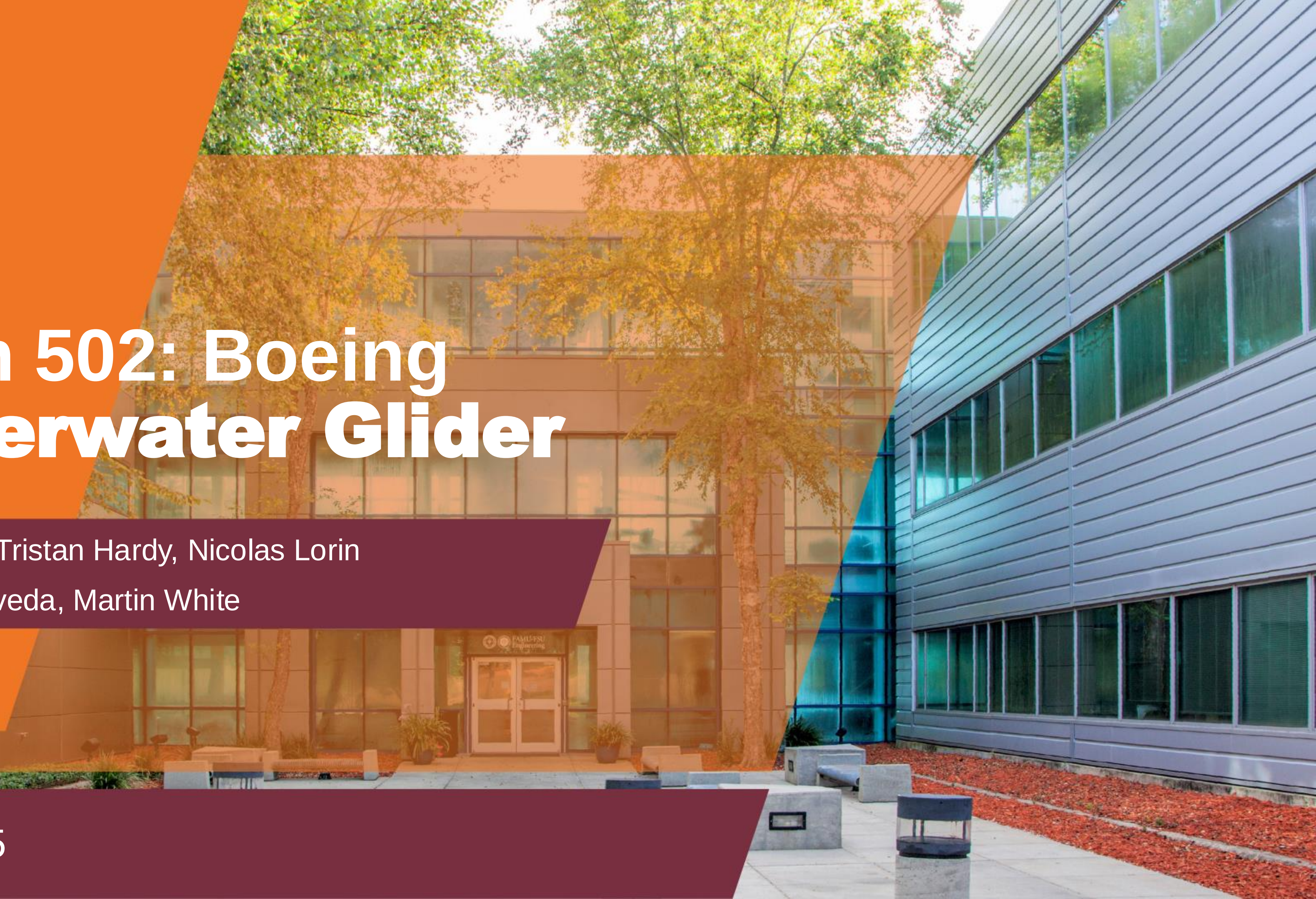
Team 502: Boeing **Underwater Glider**

Jake Burns, Tristan Hardy, Nicolas Lorin

Justin Sepulveda, Martin White

2/18/2025



Team Introductions

Jake Burns
Simulations Engineer

Tristan Hardy
Modeling Engineer
Presenting

Nicolas Lorin
Controls Engineer

Justin Sepulveda
Systems Engineer
Presenting

Martin White
Materials Engineer
Presenting

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Engineering

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.

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Key Goals

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- Energy efficiency
- Data collection
- Motion
- Durability

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Sepulveda

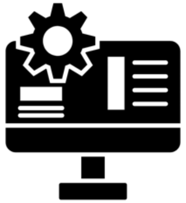
Customer Needs

Motion

- Operates at depths up to 10 feet.

Sensing Capabilities

- Collects data about environment
- Processes data to make adjustments



Simulation

- Optimal path simulations
- Performance while operating

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Functional Decomposition

- Motion
- Operation
- Hull

Motion

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

Operation

Store Power	150 [J/m]
Store Data	1 [GB]

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Hull

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Endure Fatigue Stress	10 [cycles]
Withstand Pressure	45 [kPa]

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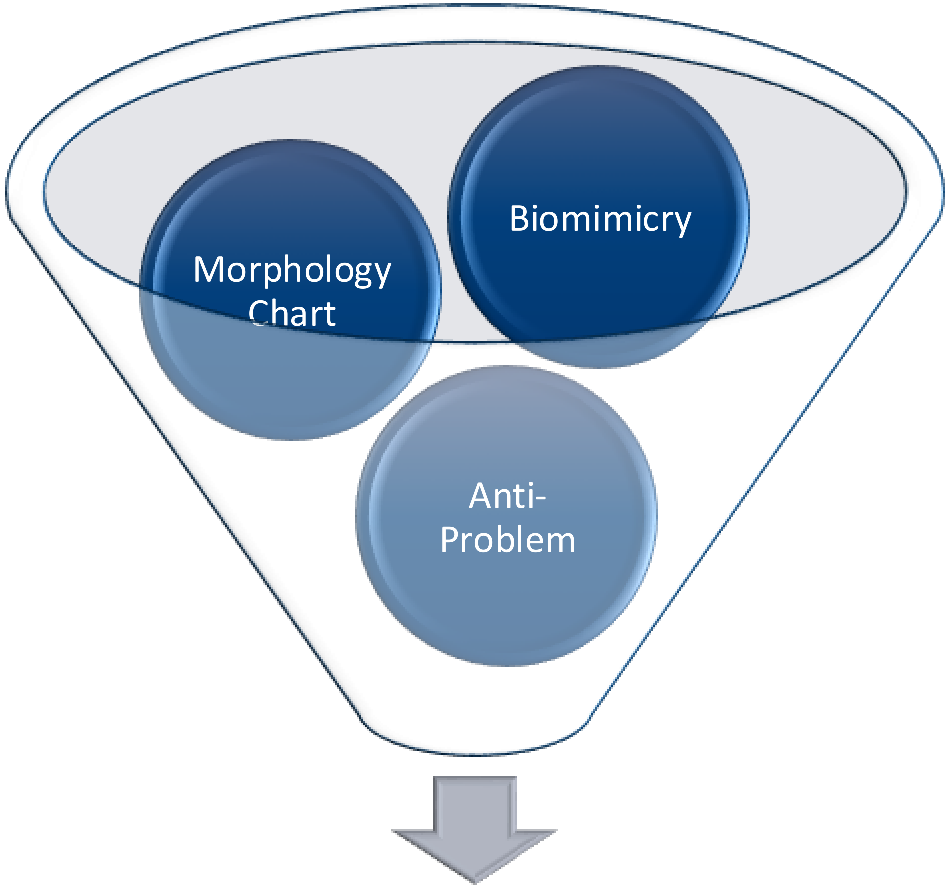
Tristan Hardy

Ideation Methodology



Concept Generation

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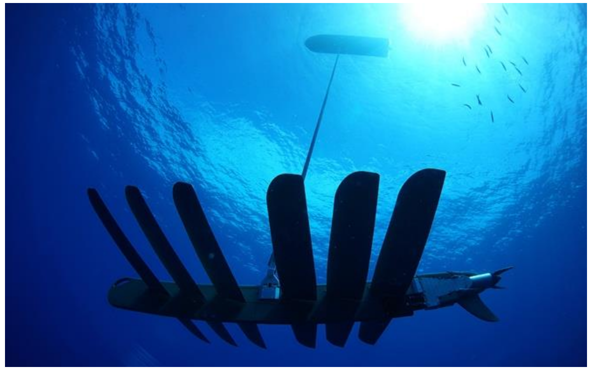
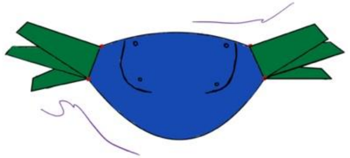
Potential Concepts

Datum

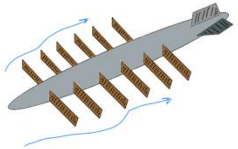


Boeing Wave Glider

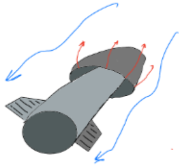
Propeller Glider



Adjustable Wing Glider

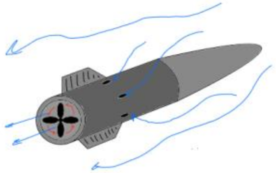


Energy Harvesting Glider

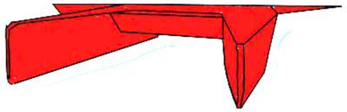


Jellyfish Glider

Piston Glider



DC Motor Glider

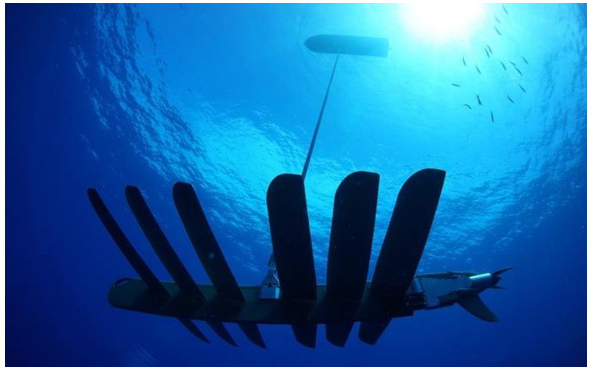


Dual Hull Glider

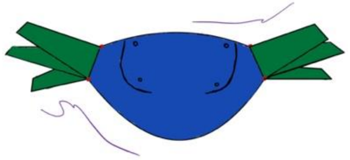
Tristan Hardy

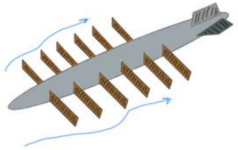
Potential Concepts

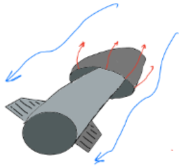
Datum


Boeing Wave Glider

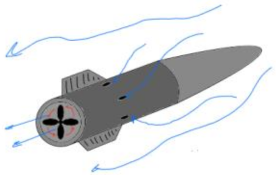

Propeller Glider

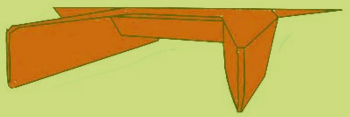

Adjustable Wing Glider


Energy Harvesting Glider


Jellyfish Glider


Piston Glider


DC Motor Glider


Dual Hull Glider

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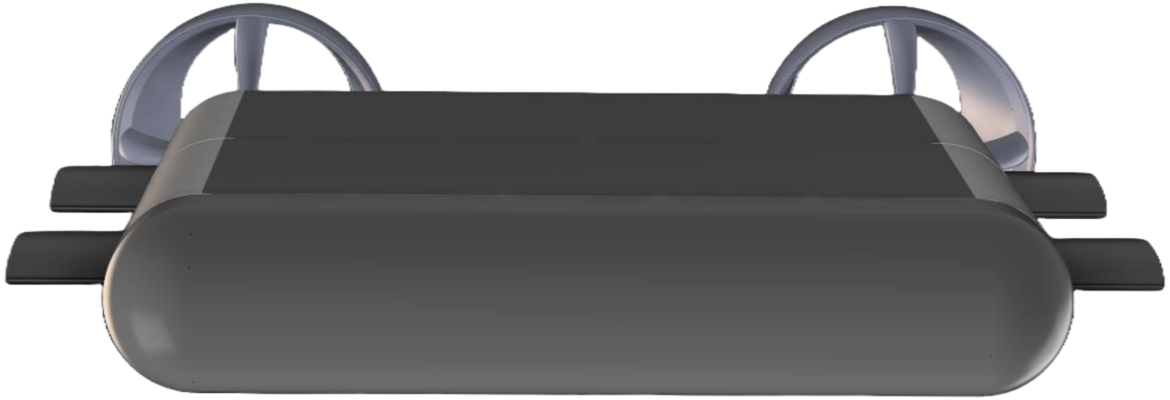
Final Concept Selection



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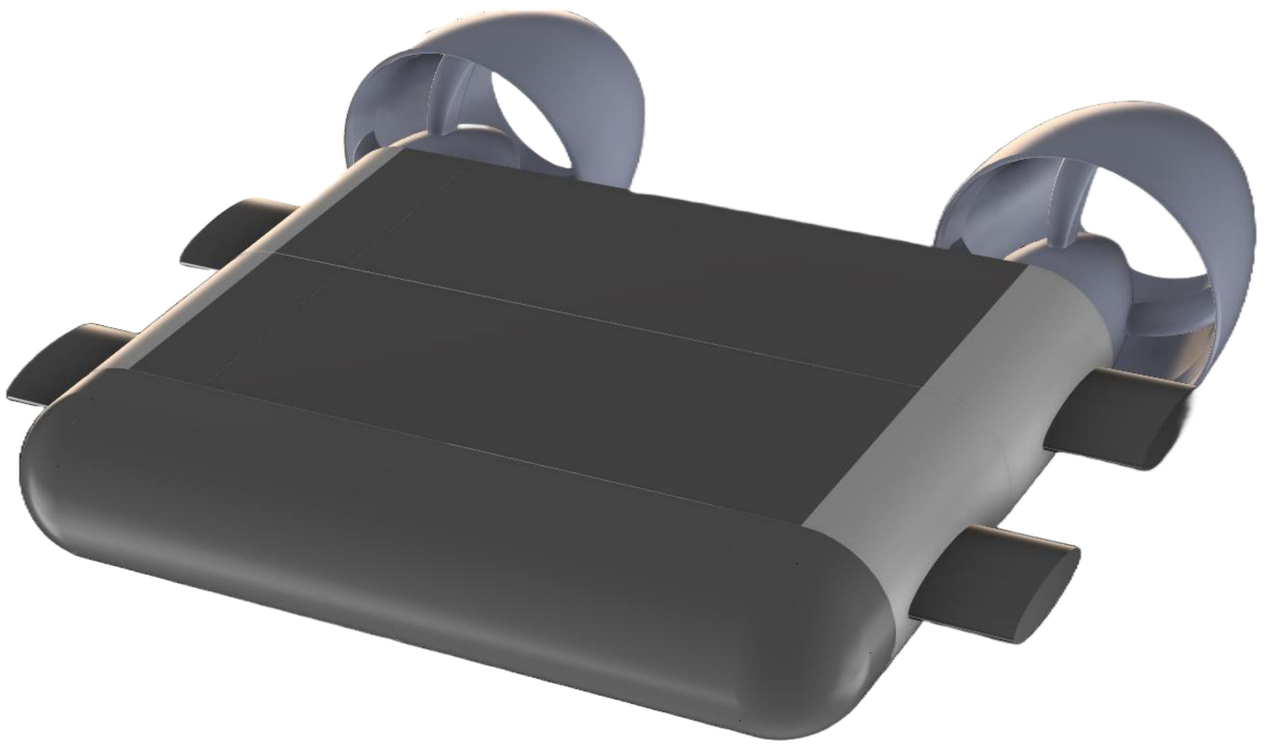
Main Features

Digital Model

- Dive planes
- Entirely buoyancy driven

Physical Model

- Propellors
- Dive planes
- **Not** buoyancy driven
- Emulates motion of digital model



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Flow Separation Studies

What is flow separation

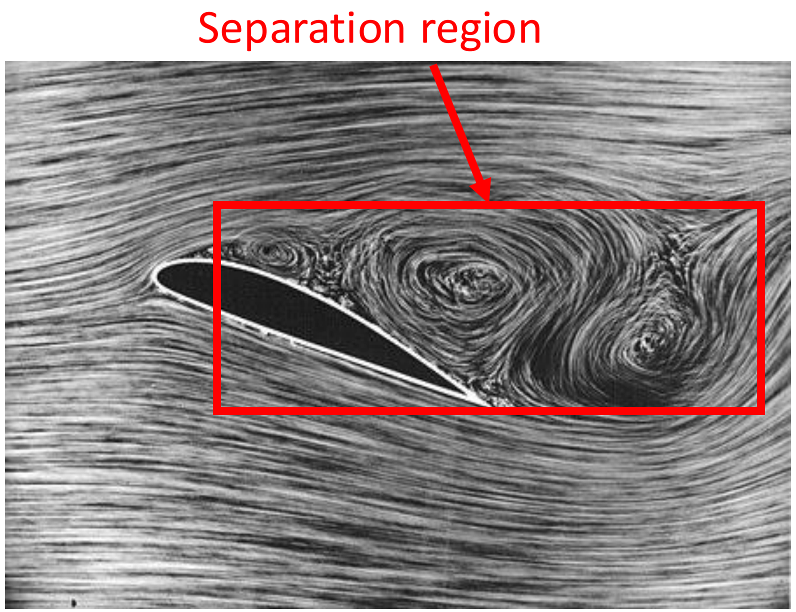
- Occurs when the fluid detaches from the body
- Results in a “separation region”

Why is flow separation bad

- Increased drag
- Vortices which can create vibrations on the body causing unwanted fatigue
- Cavitation bubbles in water
- All decreases efficiency

How can flow separation be used

- SolidWorks Flow Simulation toolbox was used to find surface pressure
- Force values can be resolved, which give can be used for the control law



Flow on an asymmetric airfoil

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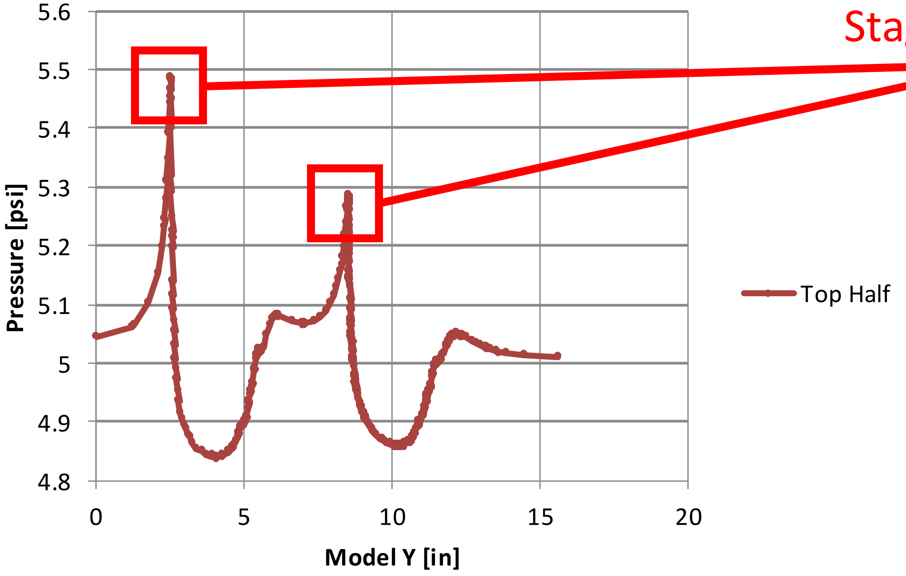
First Double Airfoil Case

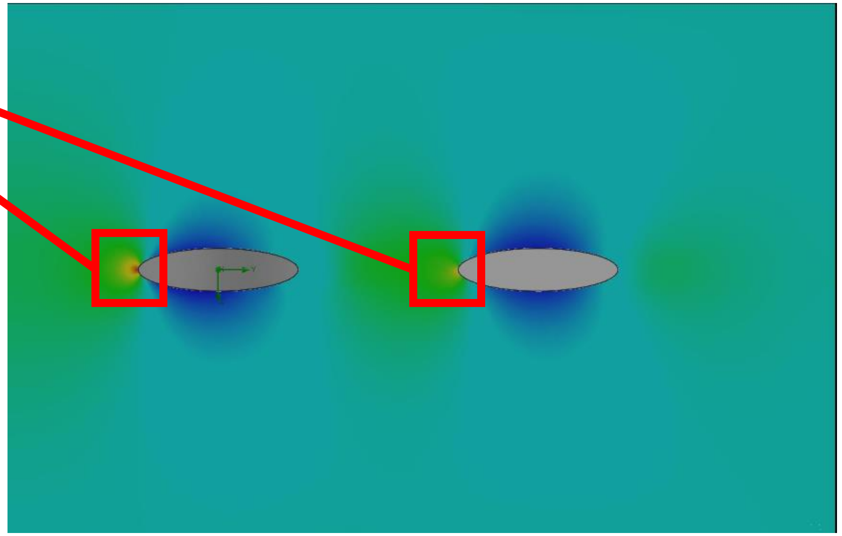
- V = 80 in/s
- P = 5 psi

Baseline Orientation Pressure Distribution



Stagnation Point

Baseline Orientation Pressure Contour



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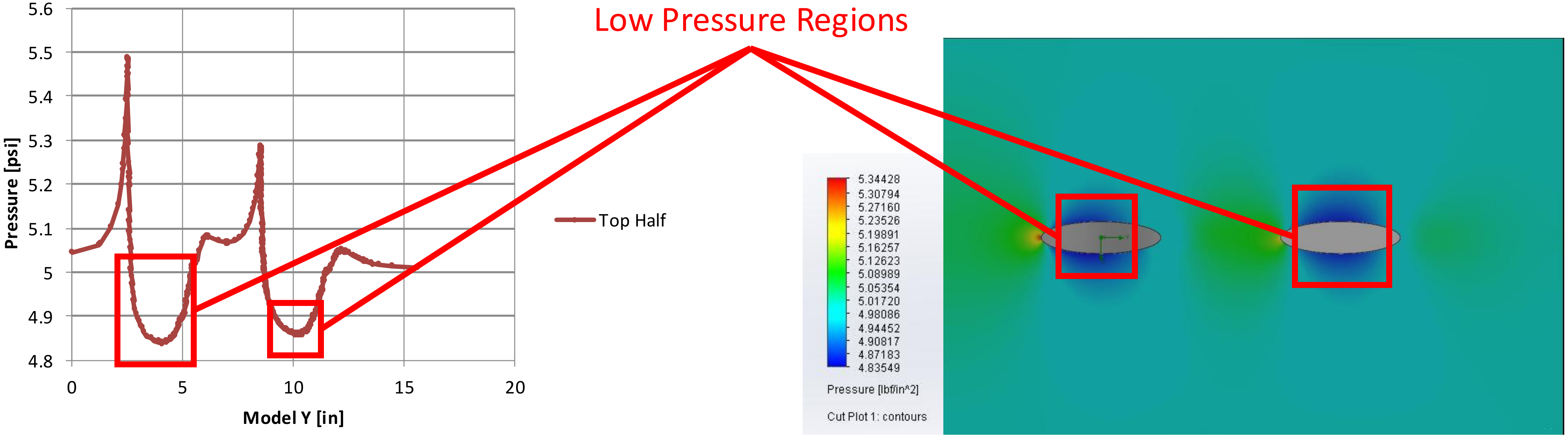
Baseline Orientation Pressure Distribution

Baseline Orientation Pressure Contour



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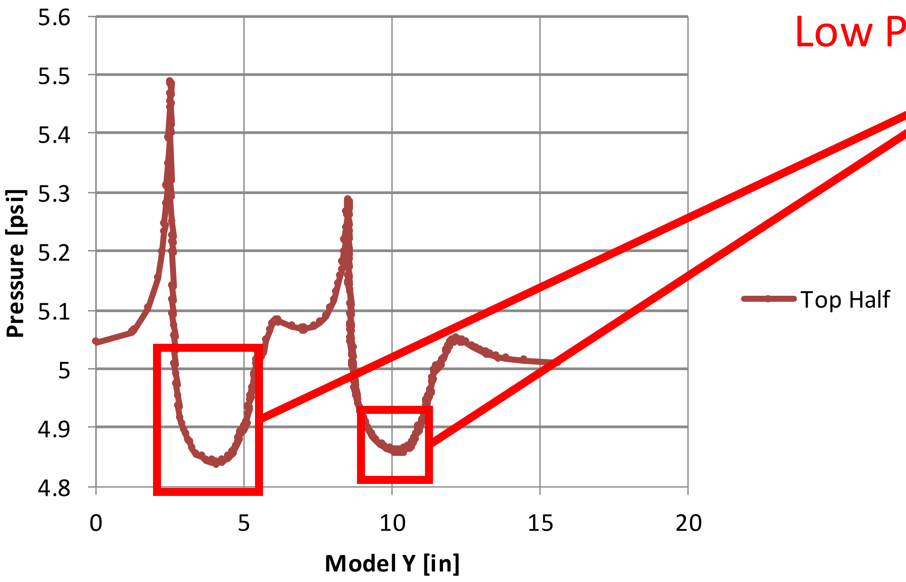
Double Airfoil At Angle of Attack

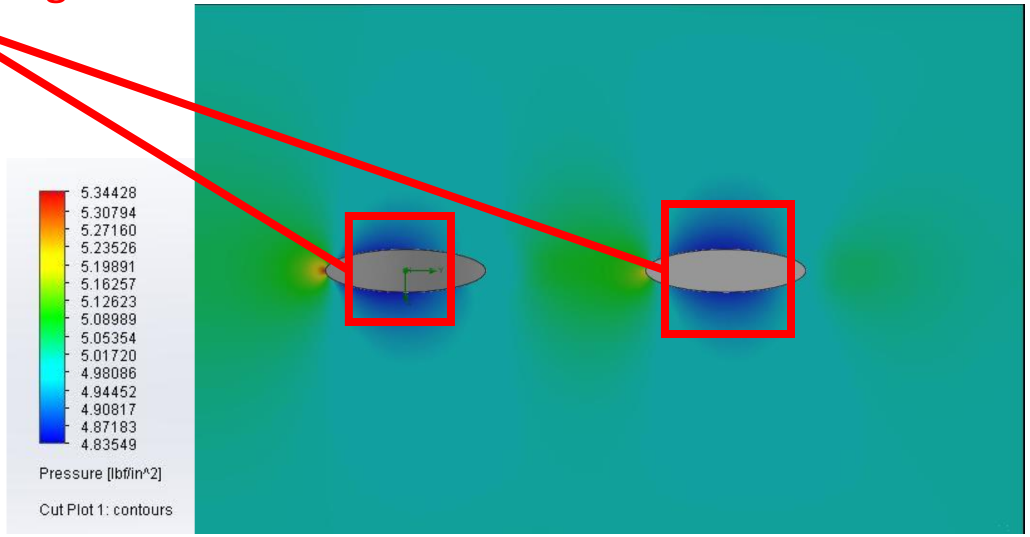
- V = 80 in/s
- P = 5 psi
- Back airfoil pitched -10 degrees

Baseline Orientation Pressure Distribution



Low Pressure Regions

Baseline Orientation Pressure Contour



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Double Airfoil At Angle of Attack

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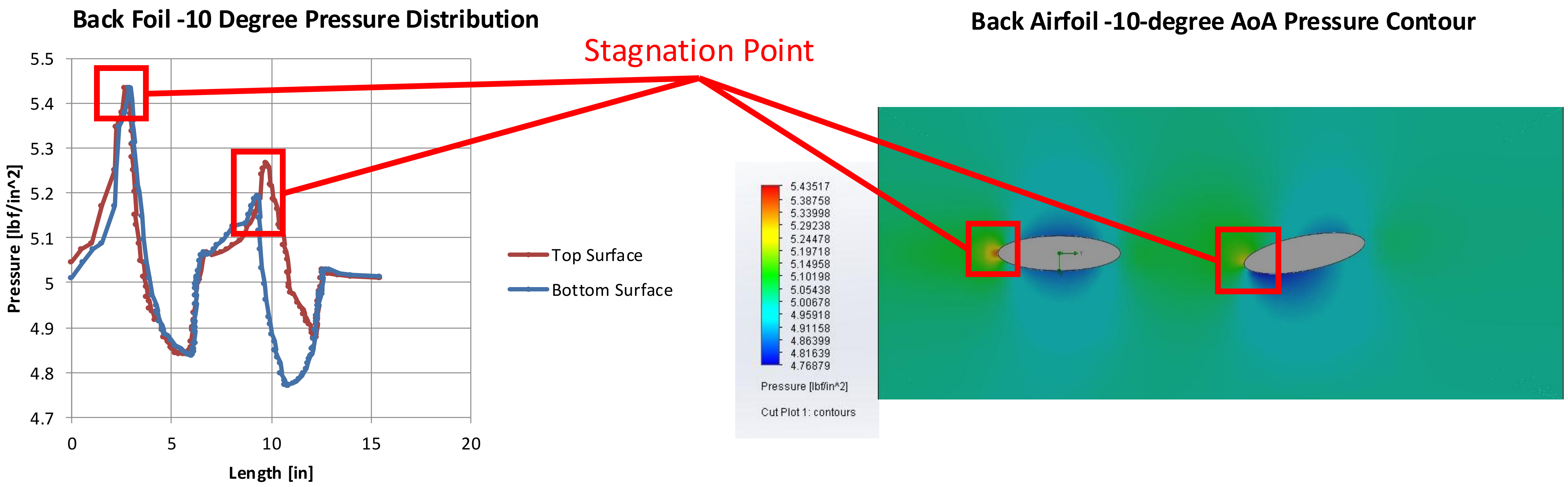

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Double Airfoil At Angle of Attack

- V = 80 in/s
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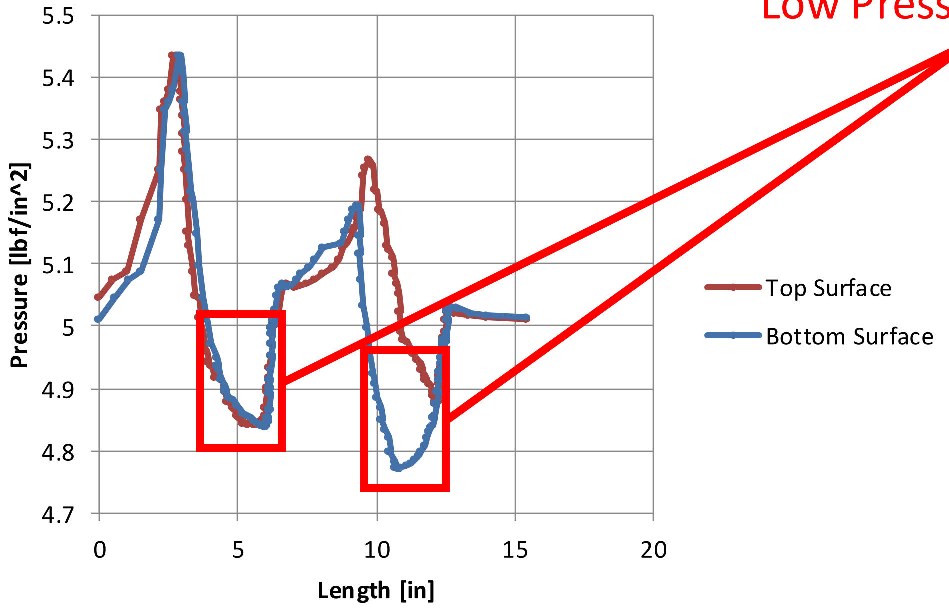
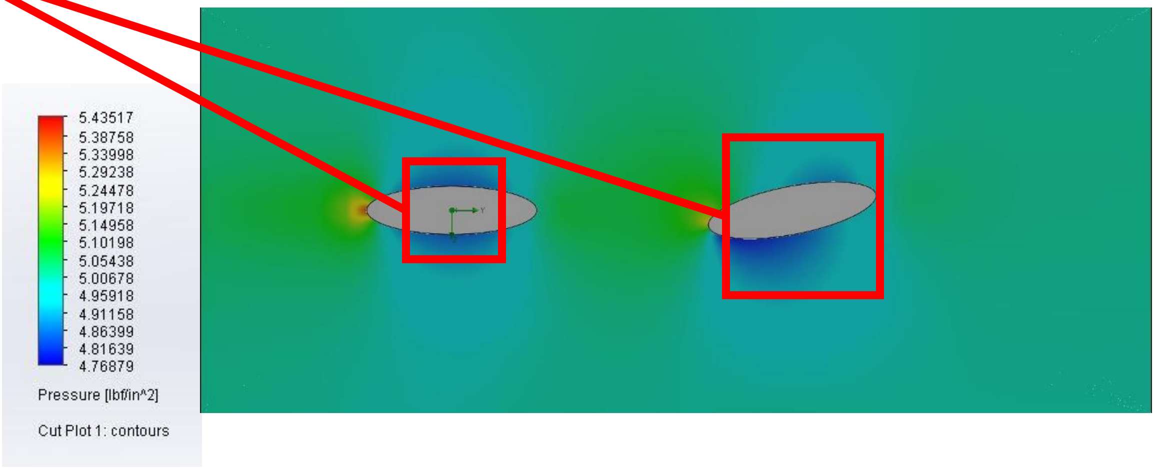
- Back airfoil pitched -10 degrees

Back Foil -10 Degree Pressure Distribution



Low Pressure Regions

Back Airfoil -10-degree AoA Pressure Contour



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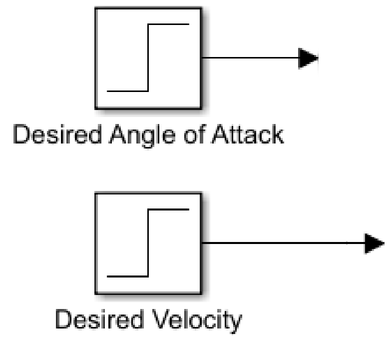
Glider Block Diagram



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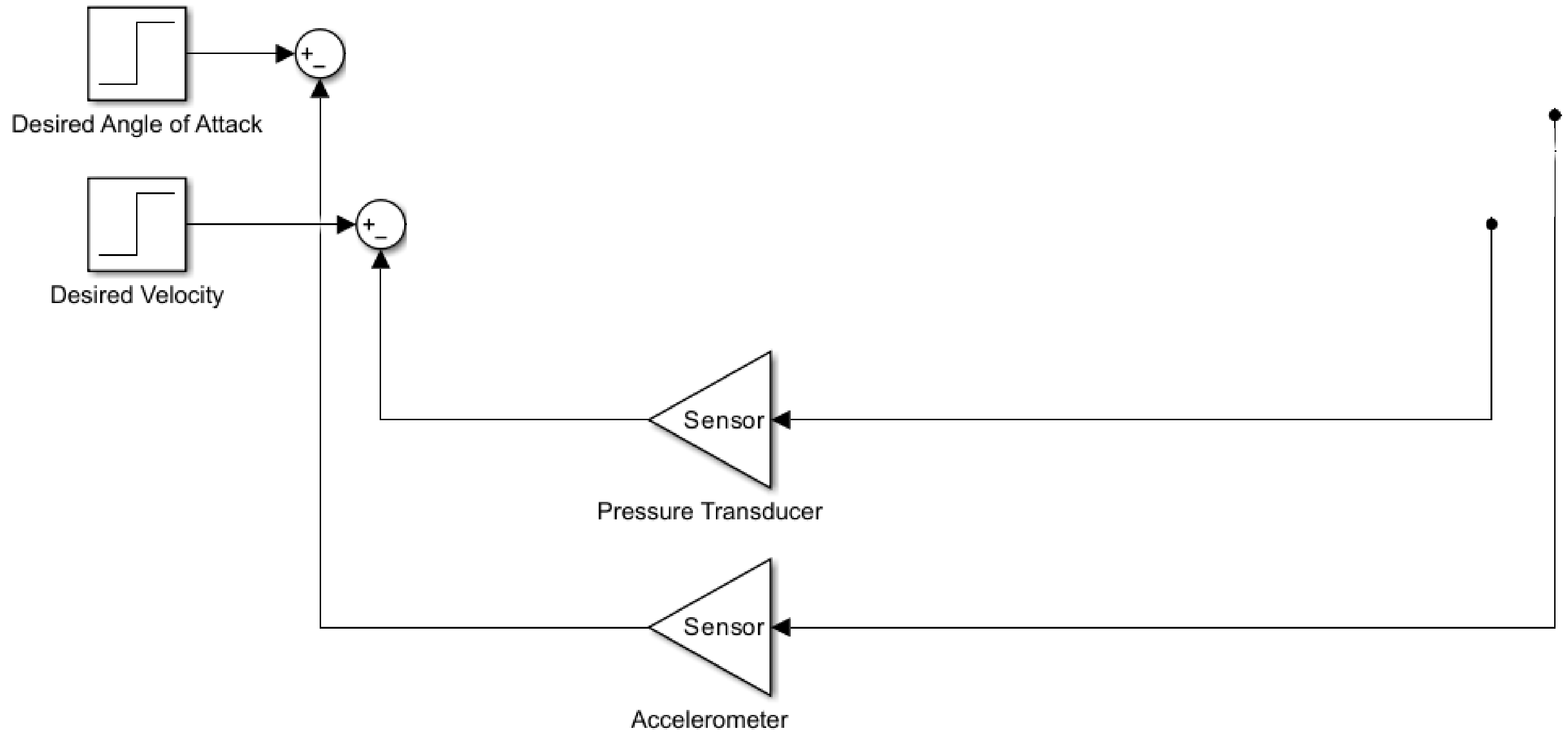

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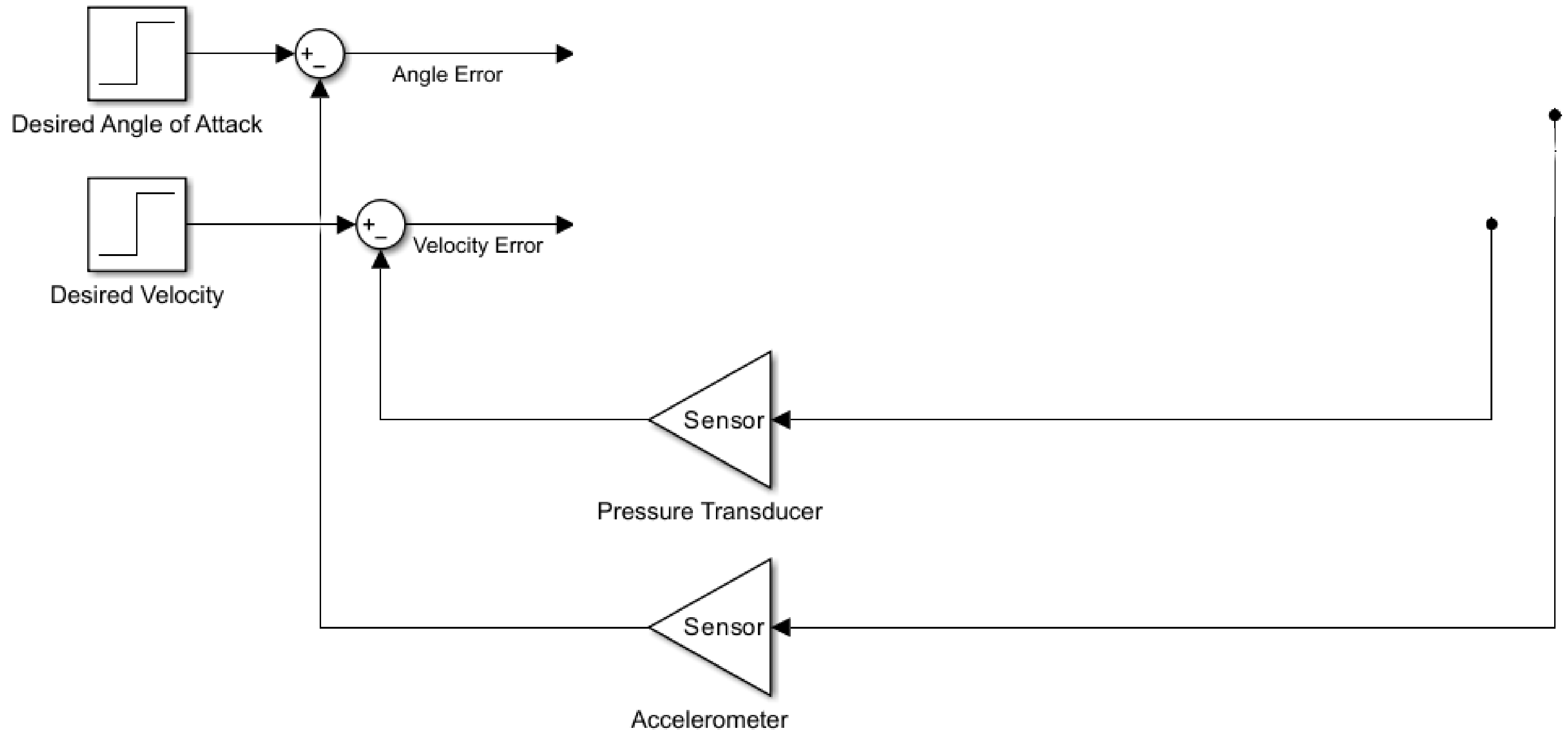

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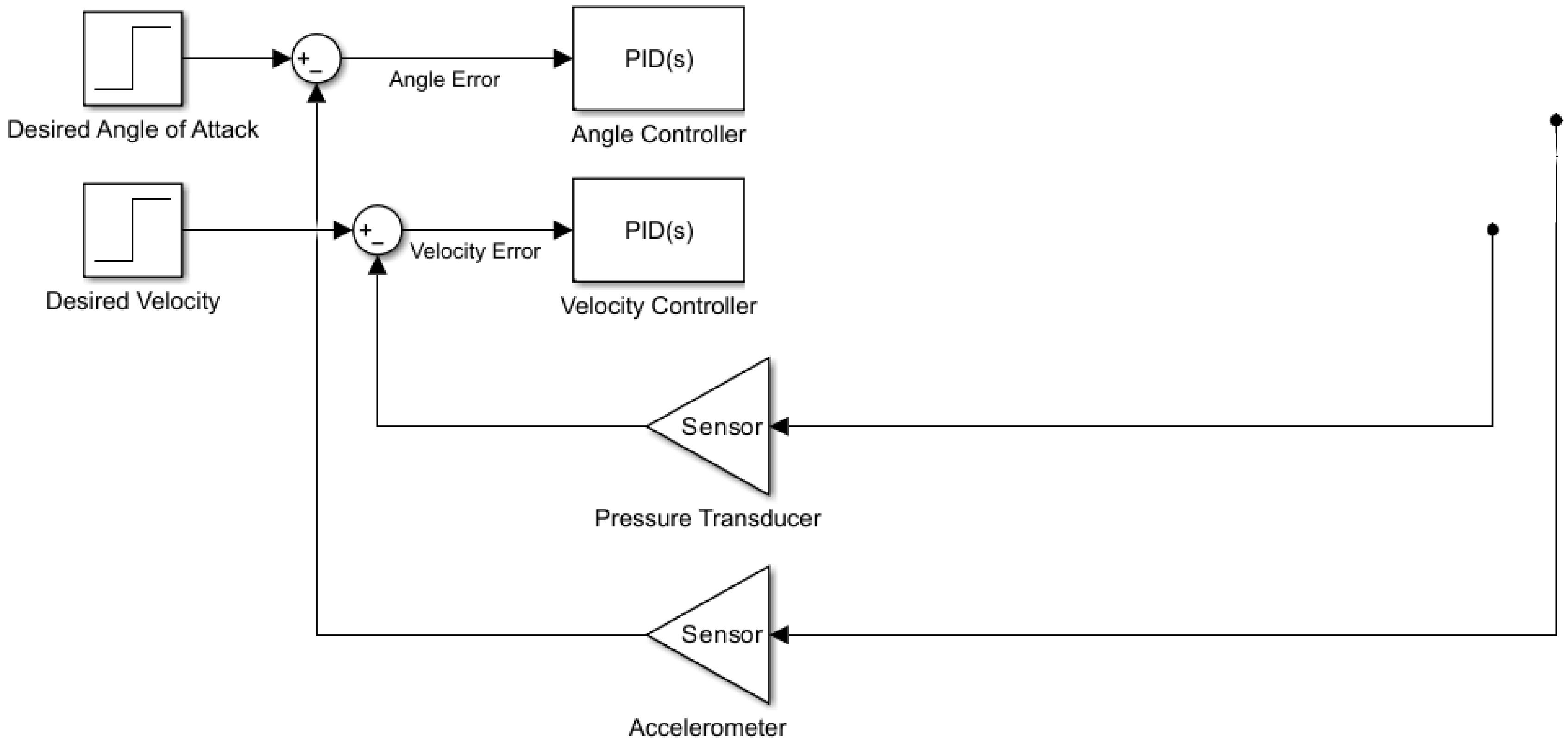
Glider Block Diagram



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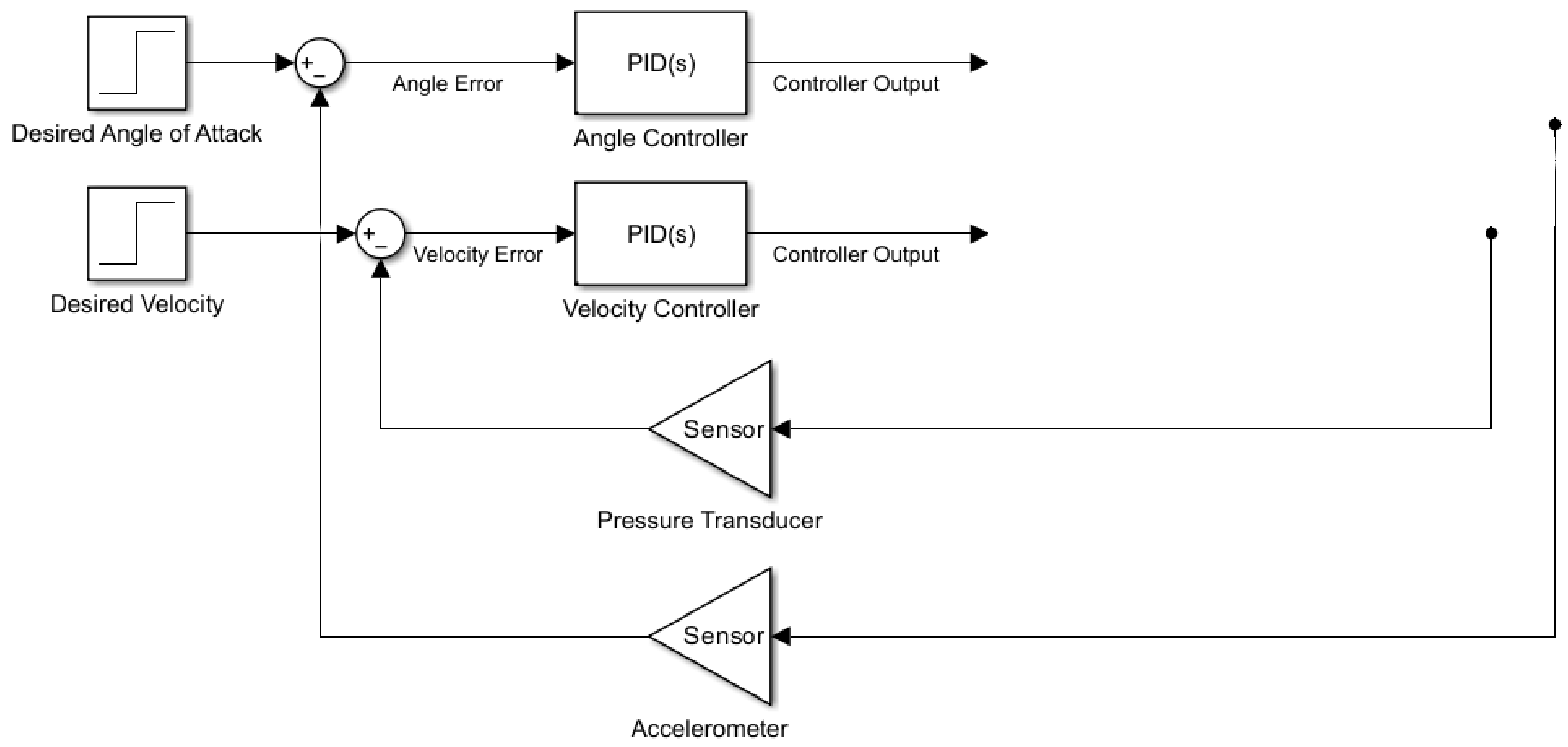

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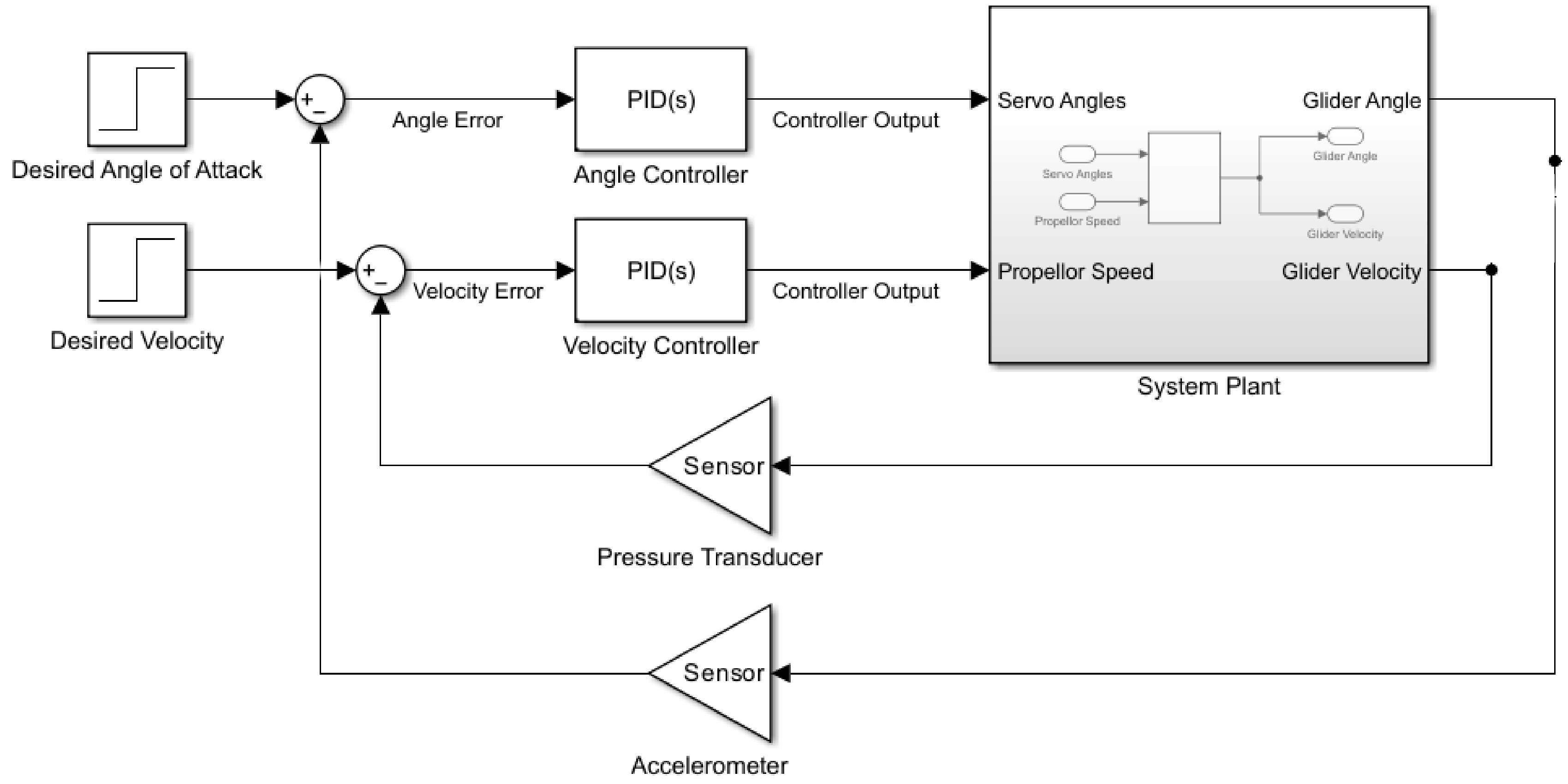

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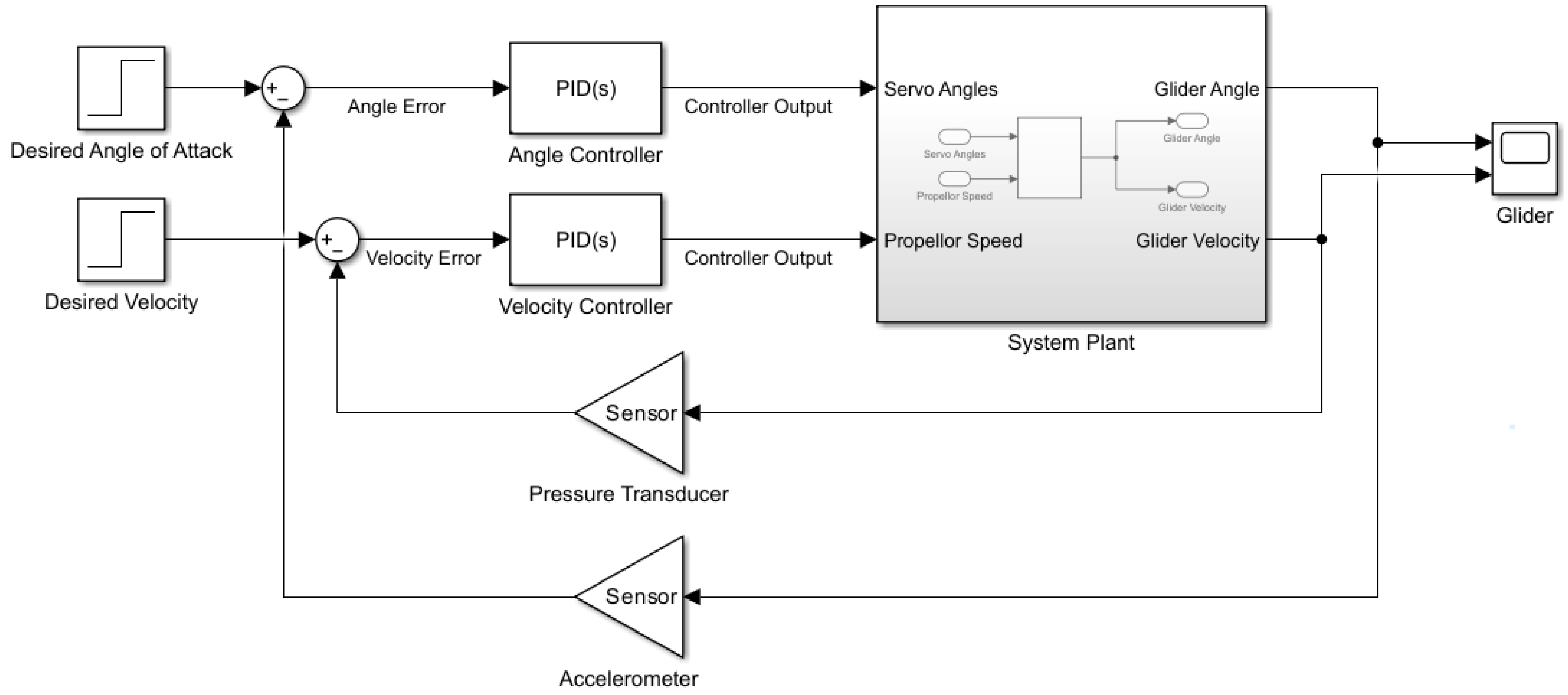

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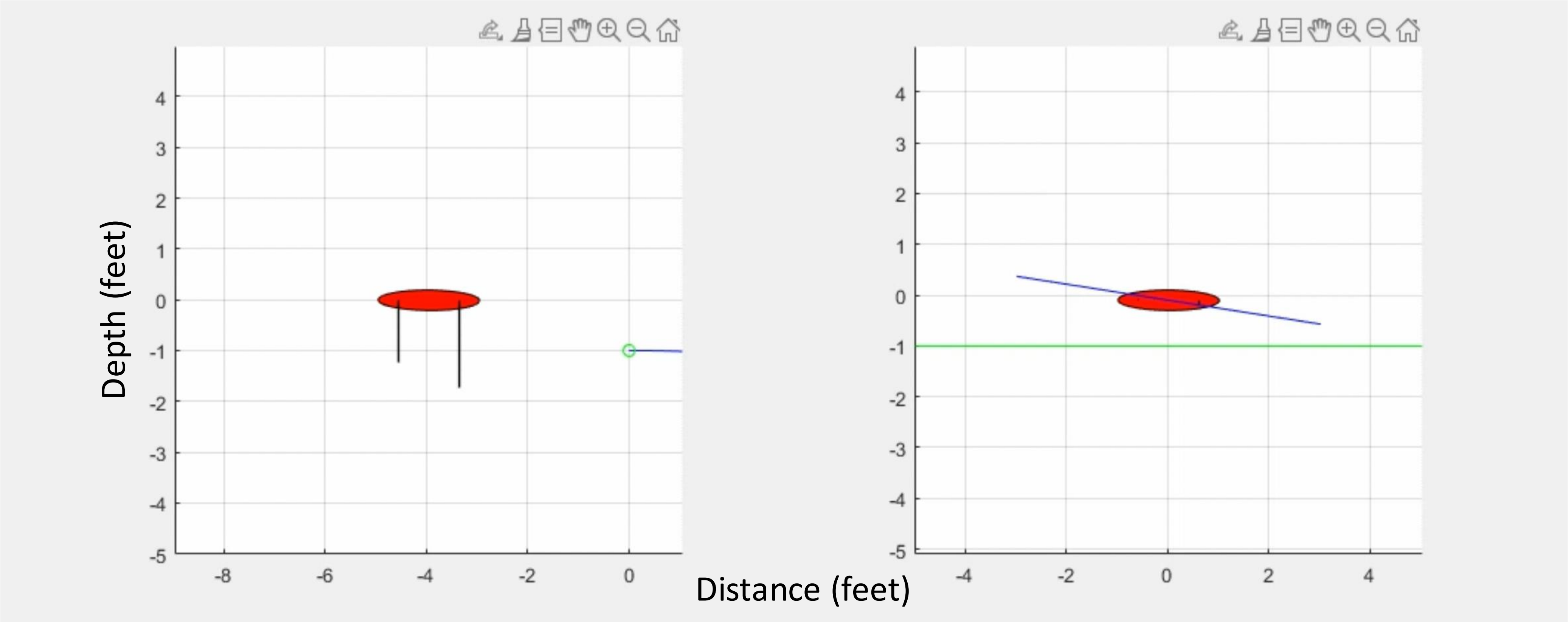
MATLAB Simulation

Old Model

Updated Model



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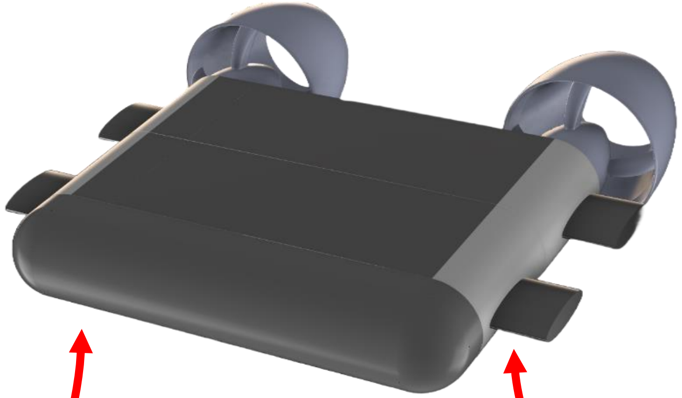
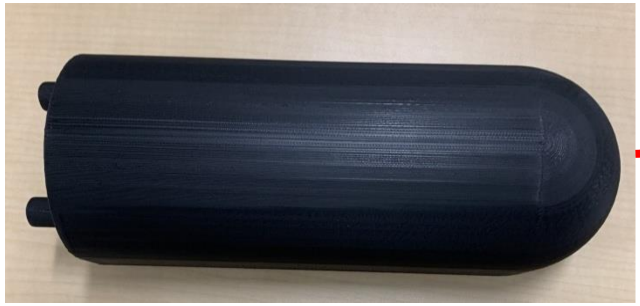
Manufacturing





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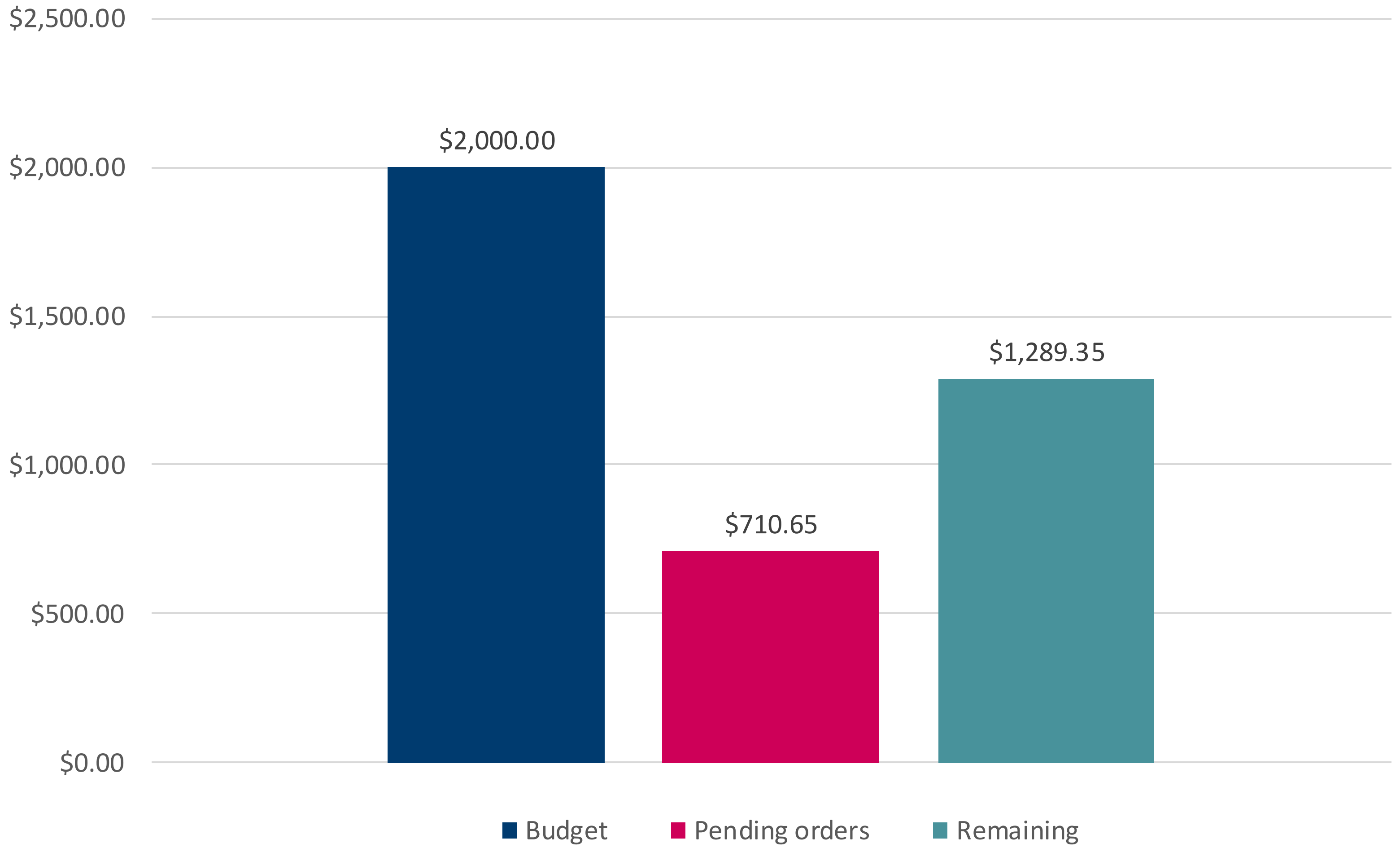
Budget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$2,000.00
$1,500.00
$1,000.00
$500.00
$0.00
$2,000.00
$710.65
$1,289.35
Budget
Pending orders
Remaining

Future Work

Order Parts

Construction
- 3D Print
- Install Inserts
- Epoxy Coat

Improve code
- Convert Code to C from MATLAB
- 3D Simulation

CFD
- Glider Transient Simulations
- FEA, Thermal

Testing
- Determine Areas of Improvement

Iteration
- Improve Underperforming Areas

Connect on LinkedIn

Jake Burns

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Nicolas Lorin

Justin Sepulveda

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