DEPARTMENT OF MECHANICAL ENGINEERING

TEAM 22
See Food

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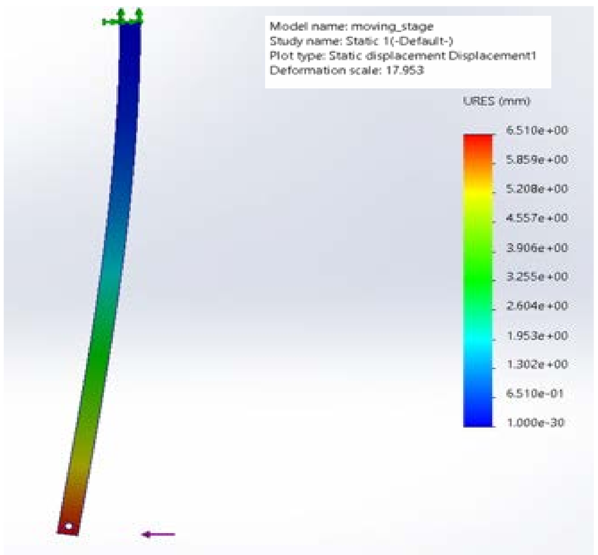
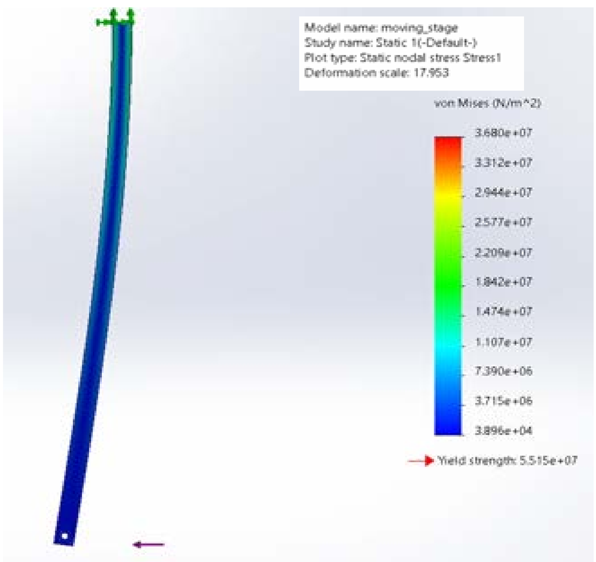
Problem Definition

- **Our team is designing an adjustable sonar mount that integrates with an ASV designed for oyster monitoring**
  - Mount platform holds a sonar sensor and a GoPro camera
  - Our mount can extend and retract autonomously from above the surface of the water to 3 feet below the surface of the water
  - The payload platform can tilt the payload 16-45 degrees
  - The mount will need to be able to withstand high drag forces created by the boat moving up to 2 m/s through the water
  - The project is being used to reduce dredging to minimize damage to the ecosystem in the bay


Design Calculations & Analysis


FEA Results: Displacement


FEA Results: Von Mises Stress

Finite Element Analysis (18x Scale):

- 70N force applied at bottom
- Maximum deflection at the bottom is 0.2563in (6.51mm), under worst case conditions
- Deflection elsewhere very close to zero (1e-30mm)
- Yield strength of 6061 Aluminum is 5.515e+07
- Max stress is ~1.8e+07
- No failure from stress

Distance Per Revolution of Motor	
1.4	in/rev

Number of Revolutions	
26	rev

Extension Motor Force Demands

Force along extension axis	6.8	lbs
Weight	5	lbs
Total	12	lbs

Pivot Mechanism Motor

Drag force at 45 degrees (moving while retracting)	9.7	lbs
Torque	36	in-lb

Extension Force

Pulley Reduction (GR)	4	
Sprocket Radius (r)	0.90	in
Sprocket Torque (Ts)	16	in-lb
Sprocket Force (Fs)	18	lb

Extension Speed

Angular Velocity Sprocket (ws)	3.9	rad/s
Distance/Sprocket Rev	5.6	in/rev
Extension Velocity (V)	3.5	in/s

Drag Force

$$F_D = \frac{1}{2} C \rho A V^2$$

Sprocket Force

$$F_s = \frac{T_m \times GR}{r}$$

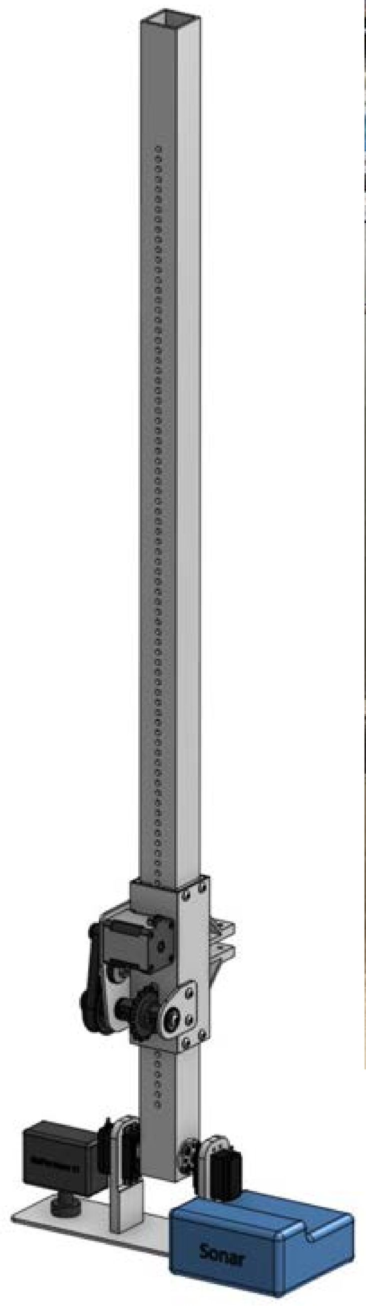
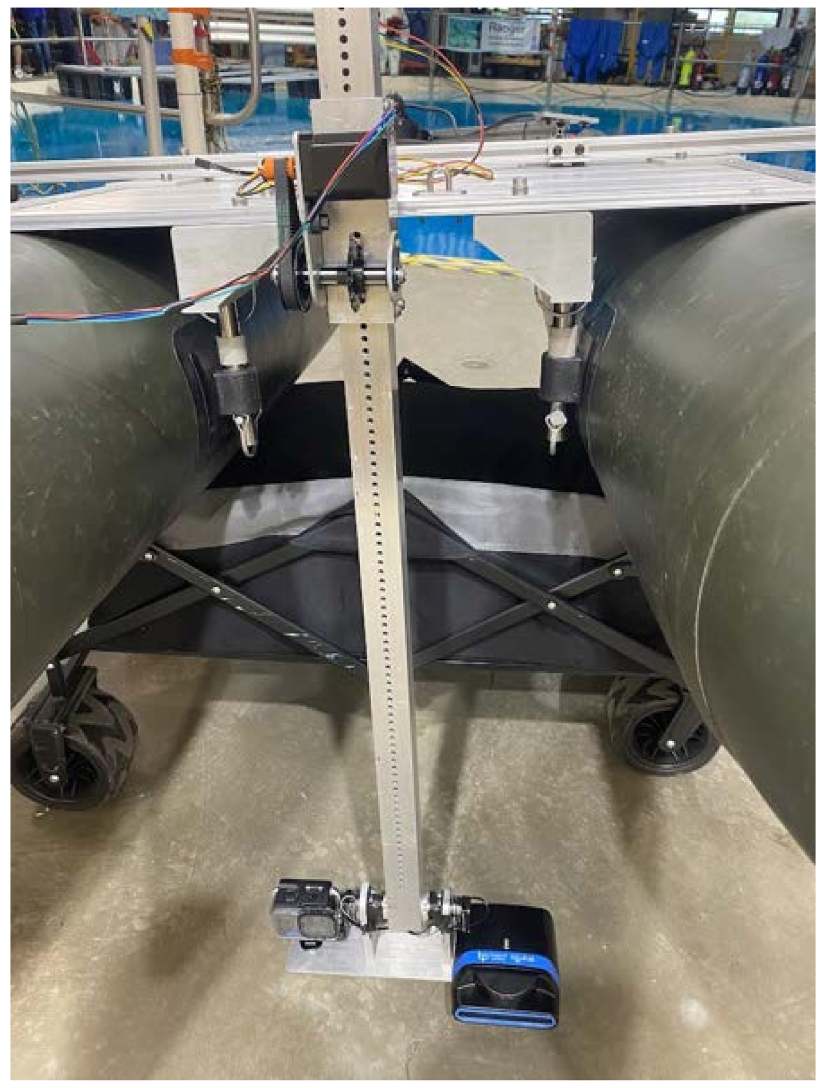
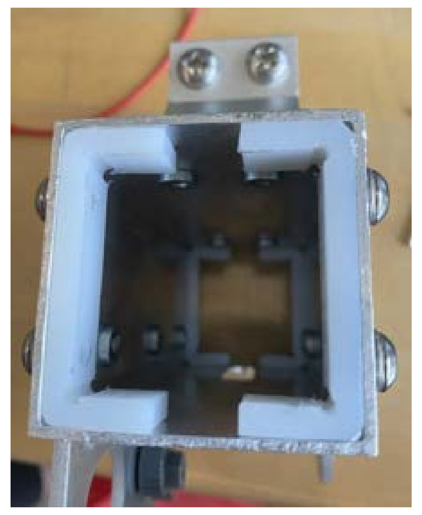
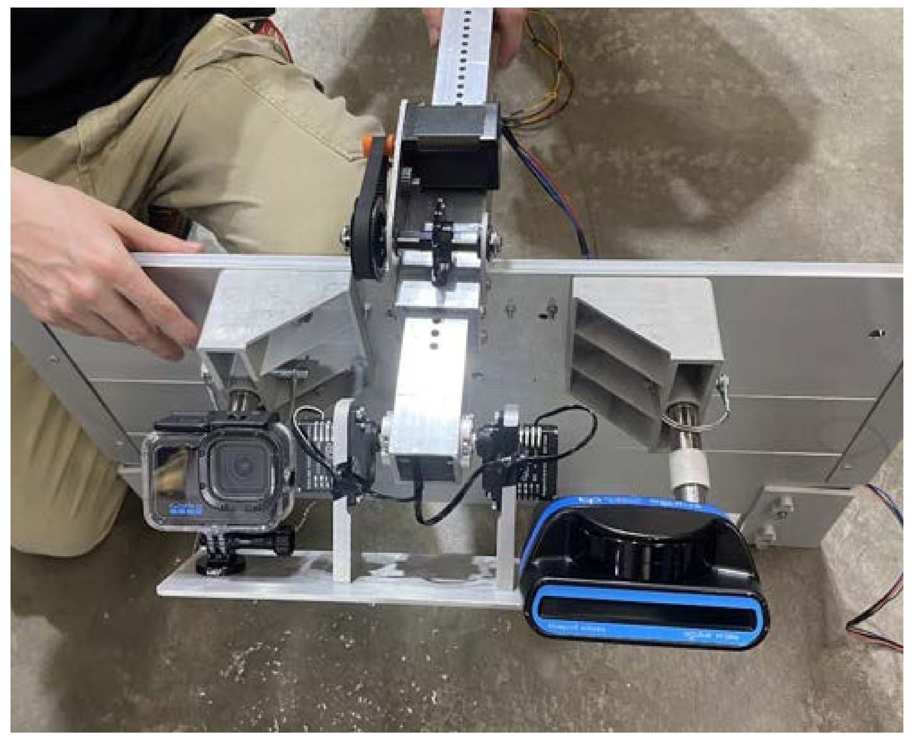
Extension Velocity

$$V = r \times \frac{\omega_m}{GR}$$

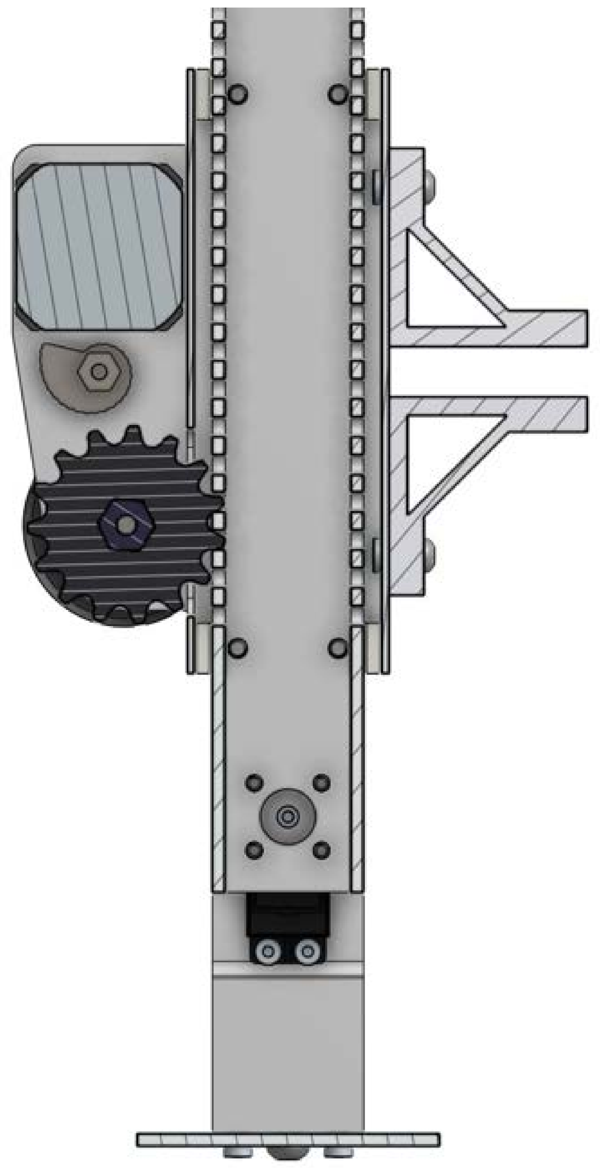
Motor Revolutions

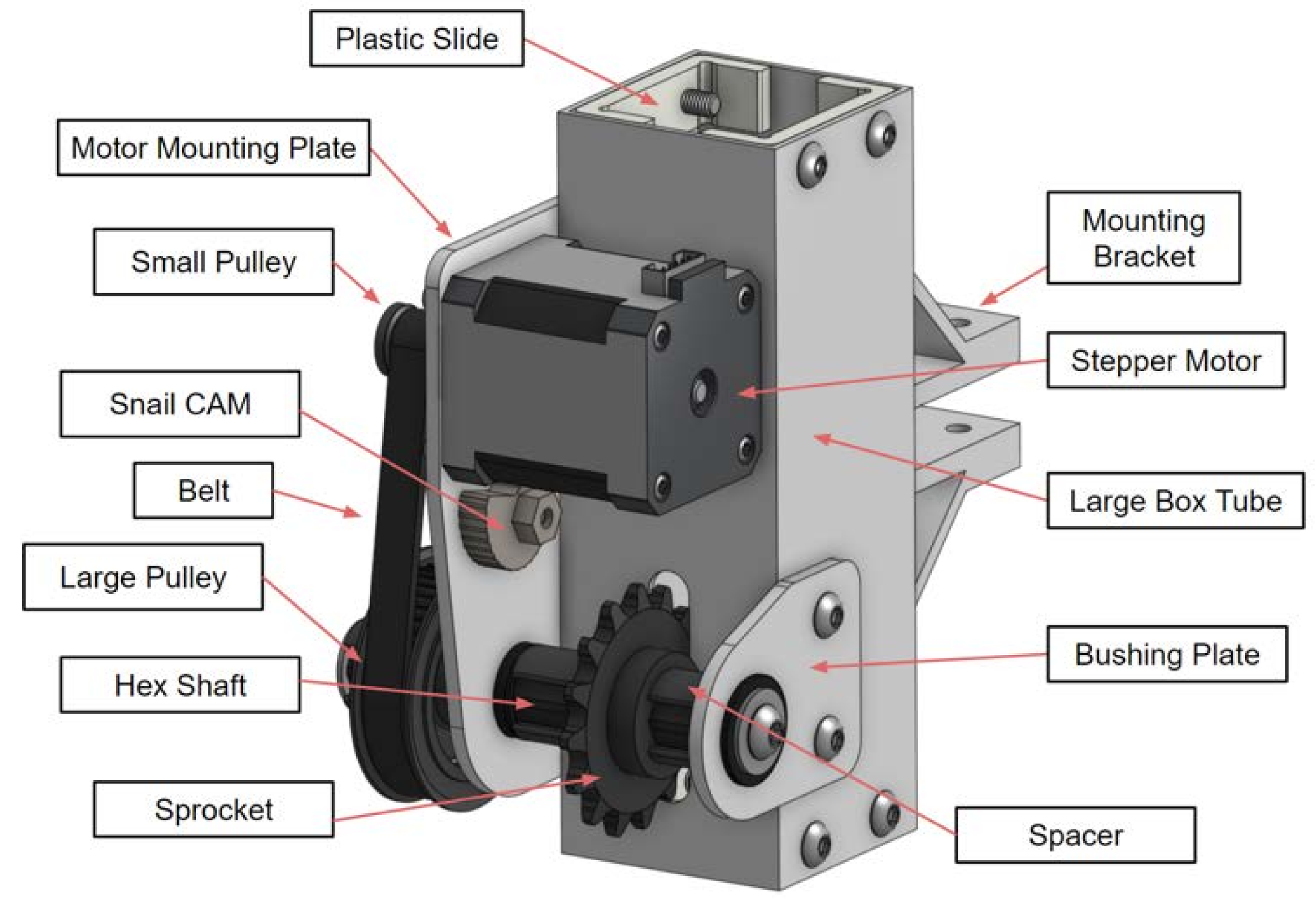
$$N_m = GR \times \frac{36''}{2\pi r}$$

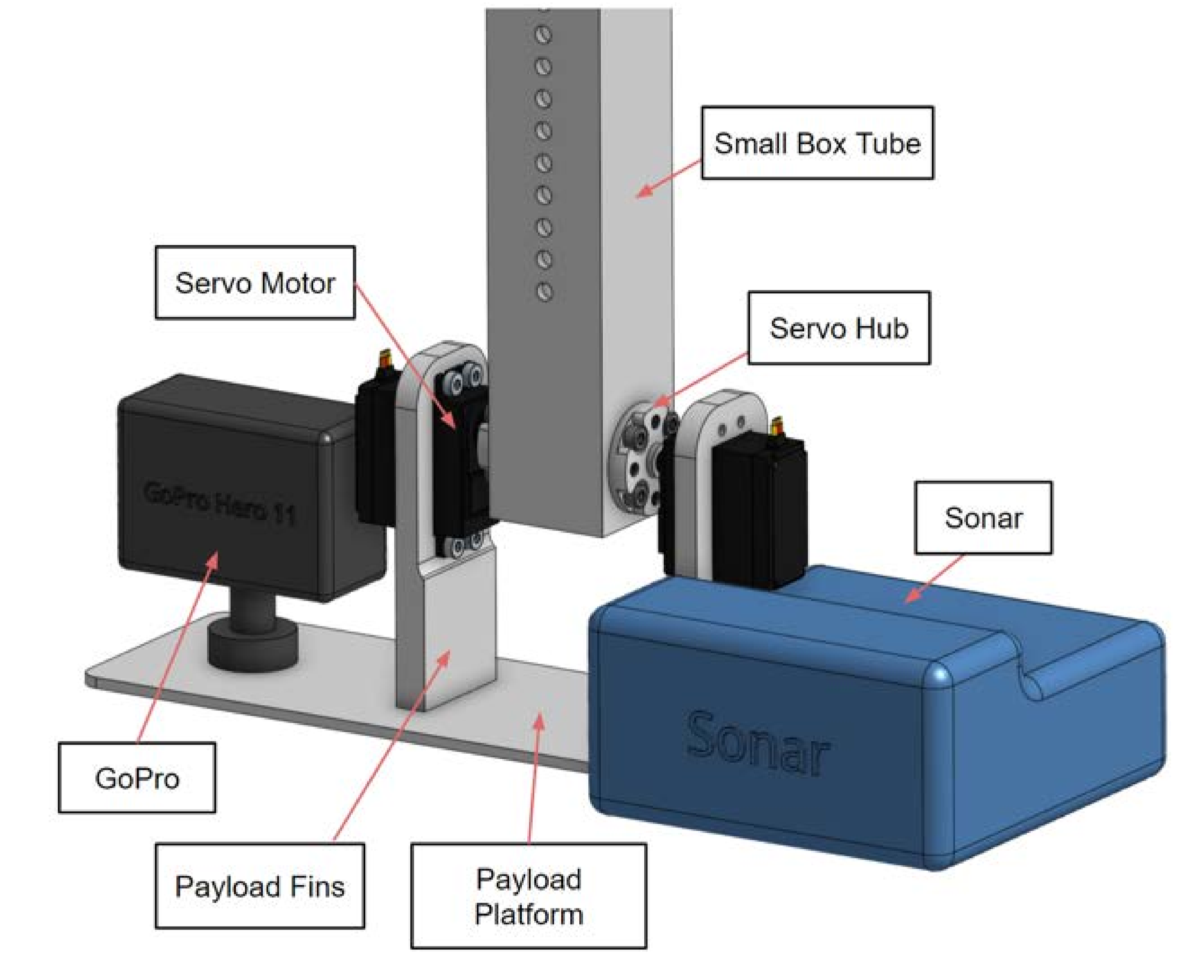
Final Design

- Telescoping box tube assembly extension up to three (3) feet
- Pivoting payload platform base
- Extension transmission: stepper motor connected to belt & pulley drives sprocket
- Sprocket meshes with holes in moving stage, like a rack & pinion mechanism
- Payload angle controlled by mirrored servo motors

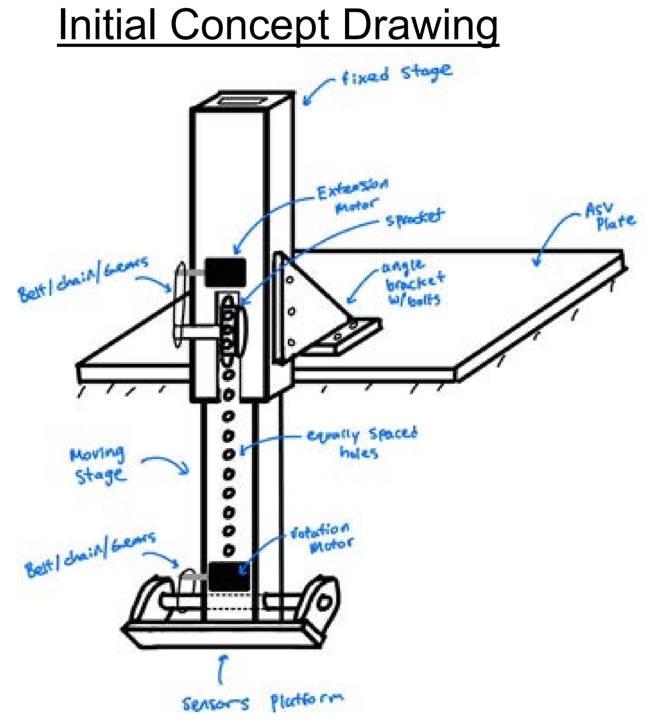






Prototype & Test Results

Initial Concept Drawing

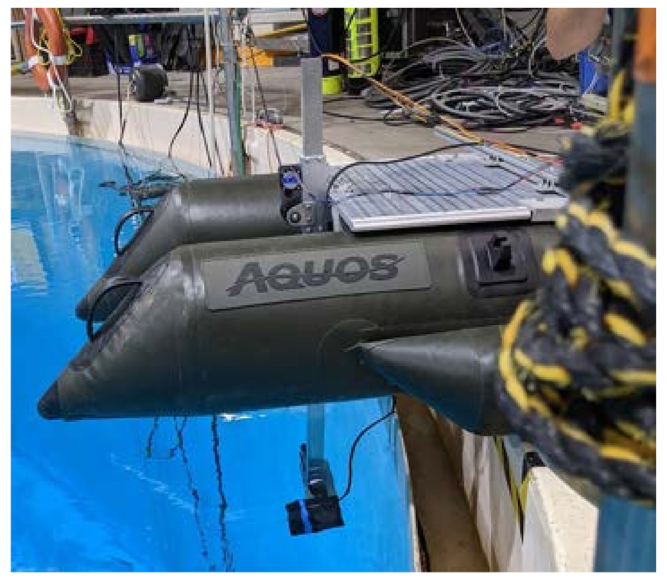


- Initial concept sketch
- Combines main elements and ideas from team
- Identifies critical components and supporting hardware

Low Fidelity Prototype

- Made of household materials
- Served as a proof of concept
- Helped define some of the problems and constraints to overcome in later prototypes: mechanisms and clearances

Full System Waterproof Testing

- Tested waterproofing of motors and soldered connections for the servo motors
- Integrated brackets and circuitry with the current ASV
- Determined that motors produce enough torque to extend, retract, and tilt with payload while submerged
- Compiled lessons learned for future implementation