



# Counter UUV Net



MIDN I/C Courtney McCloughan, Carmen Rangel, Shaan Sandhoo, Nicholas Shedd, J.J. Wohlbach  
Prof. Andy Gish, Department of Naval Architecture & Ocean Engineering

## Problem Statement:

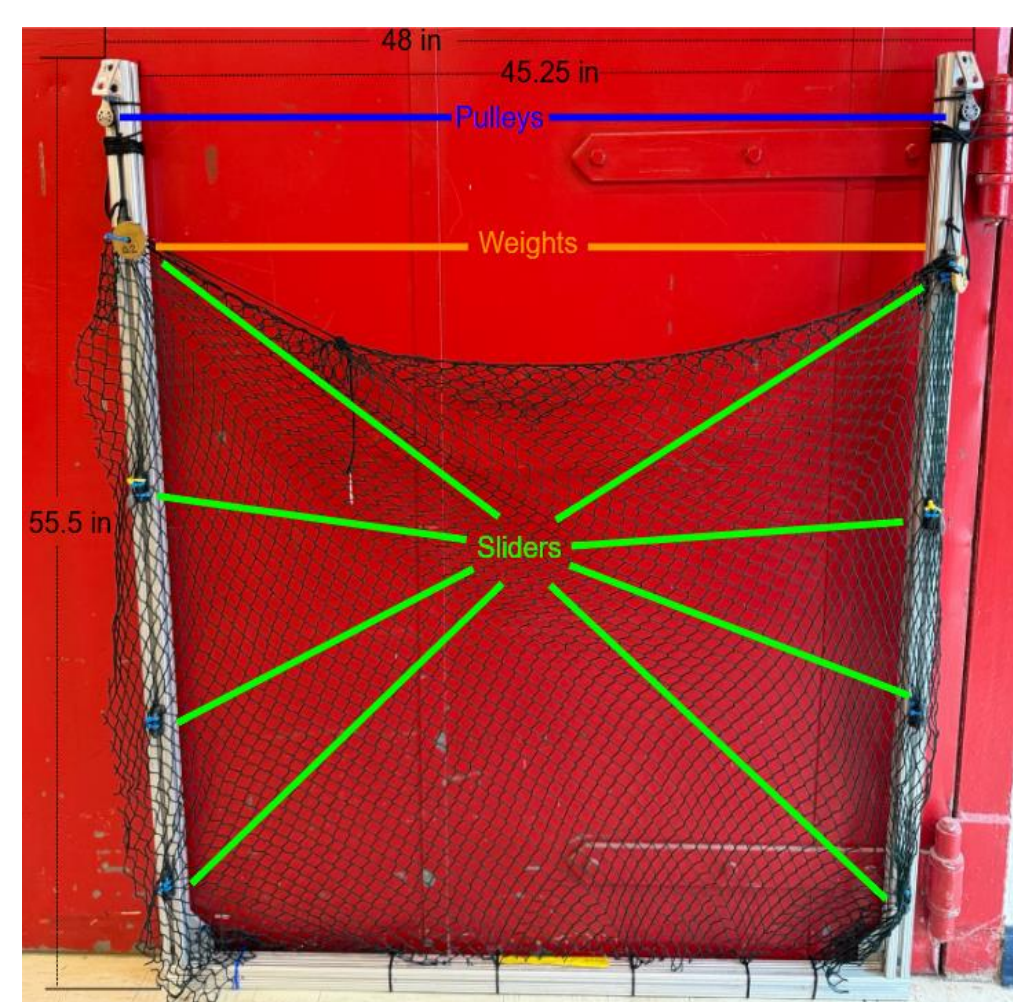
Unmanned Underwater Vehicles (UUVs) pose a significant threat to Naval ports and maritime infrastructure. The objective of this project is to design and demonstrate a counter UUV neutralization system that is low-cost, light-weight, and will disrupt an incoming UUV's mission after positive identification as an adversarial UUV.

## Background:

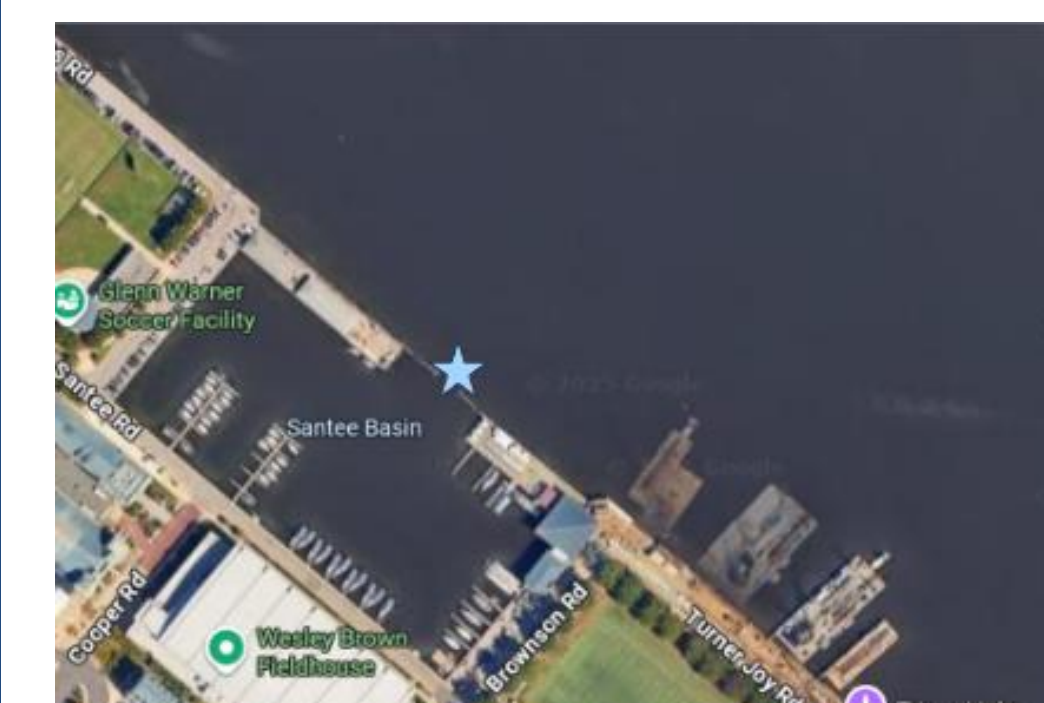
- Subsurface autonomous vehicles provide an increasing threat in smaller sizes and greater numbers
- These low-cost UUVs can attack in swarms similar to aerial drones causing naval ports and other maritime infrastructure to be in danger
- A focus on medium to small size UUVs

## Prototype:

Name	Depth (m)	Endurance (hrs)	Max Speed (kts)	Length (cm)
Bluefin-9	200	24-36	6	241.8
Seaber Marvel-Lumen	300	8	6	130
Seaber Yuco-Scan	300	8	6	98
RIPTIDE	300	44-80	10	63.5-182.9
REMUS	305	10-30	5	230
Aquabotix	100	N/A	5	N/A
Hydrus UUV	300	2	1.5	47
EcoMapper UUV	100	8-10	4	152.4-215.9



## Site:



## Scaling:

$$\text{Length Scale} = \frac{\text{Length of Site}}{\text{Length of Prototype}} = \frac{567 \text{ inches}}{45.25 \text{ inches}} = 12.5$$

## Dynamic Loading:

$$V_{25\%} = 1.27 \frac{ft}{s}$$

$$KE = \frac{1}{2} \left( \frac{30.20lb}{32.2 \frac{ft}{s^2}} \right) (1.27 \frac{ft}{s})^2 = 0.757 ft-lbf$$

$$F_{impact} = \frac{KE}{disp_{net}} = \frac{0.757 ft-lbf}{0.25 ft} = 3.028 lbf$$



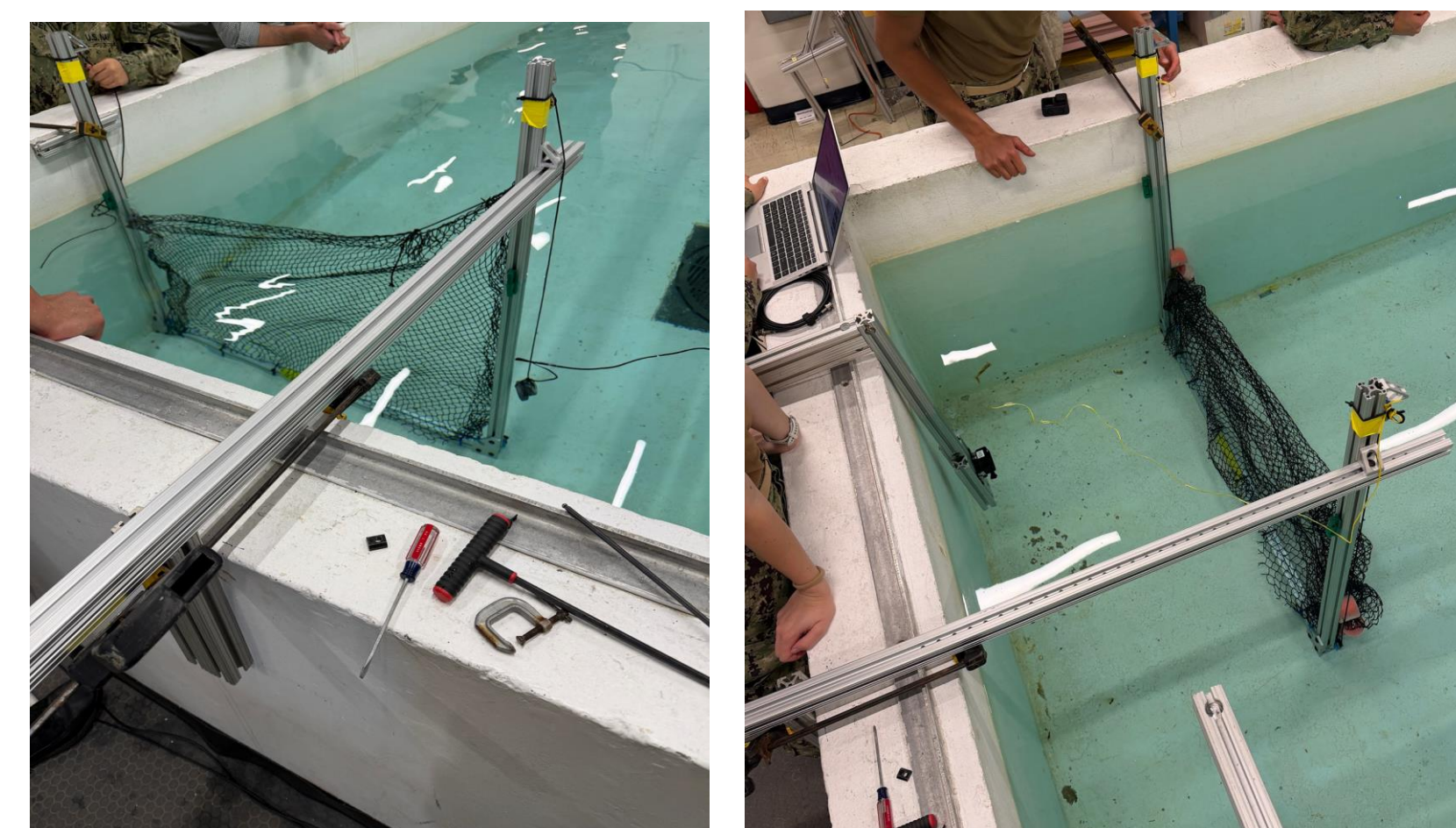
Blue Robotics ROV



## Testing:

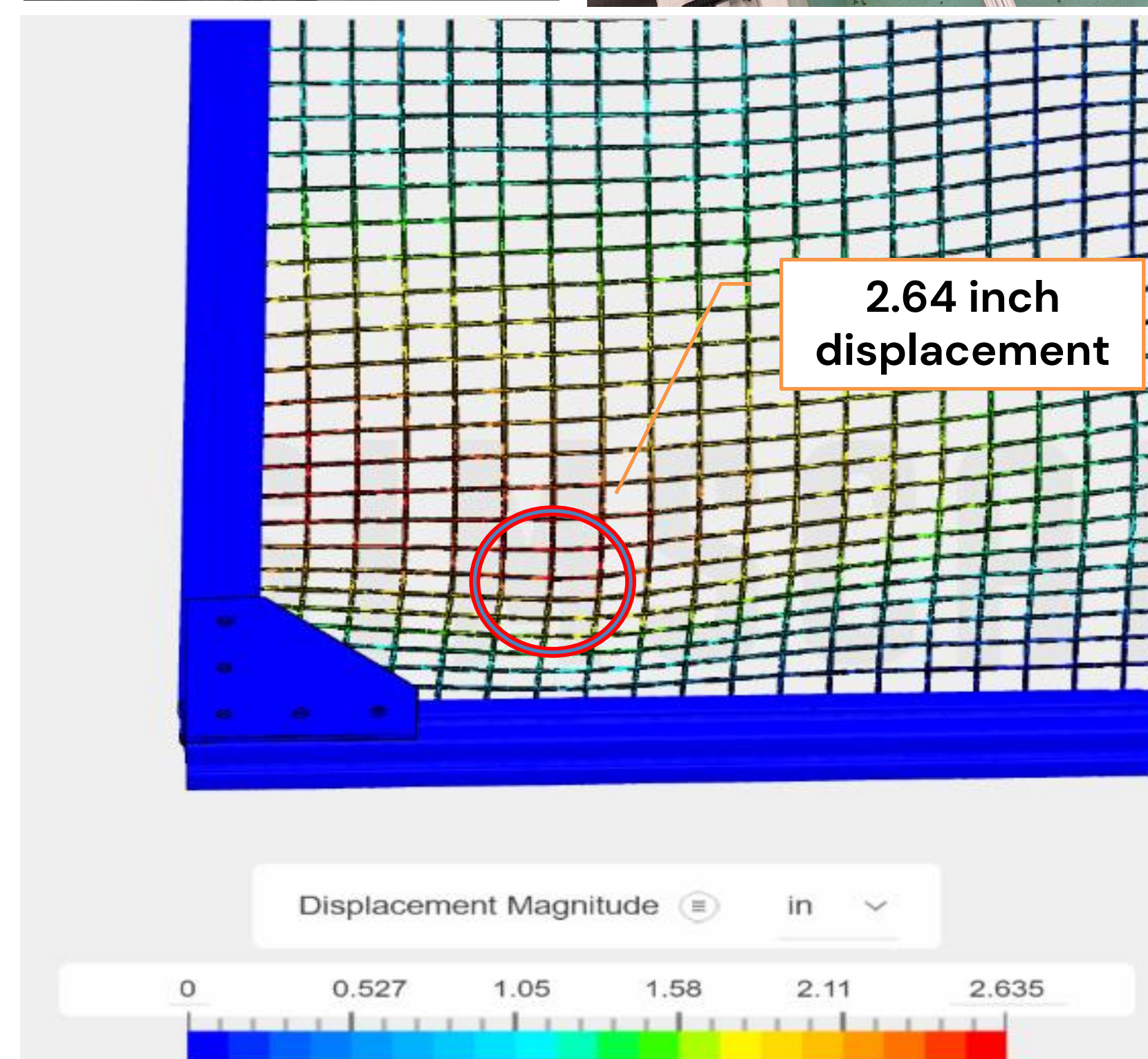
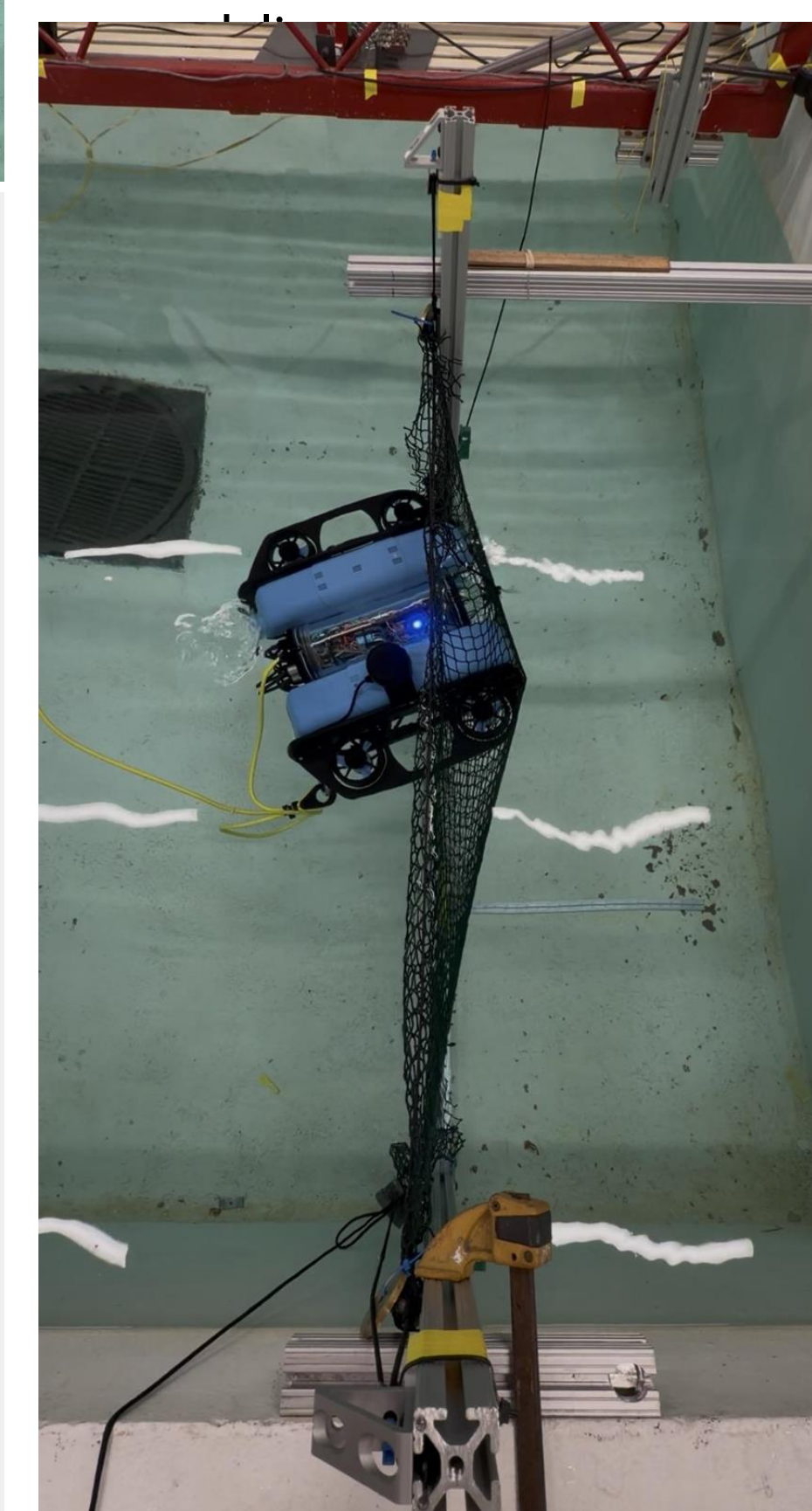
- 10 consecutive trials run to analyze which method had the quickest response time
- 5 designated impact areas on the net for the incoming Bluefin Robotics ROV
- 5 trials at 25% and 75% speed
- Videos taken to analyze net deflection
- Qualitative data observed

## Drop Weight: Buoyancy:



## Results:

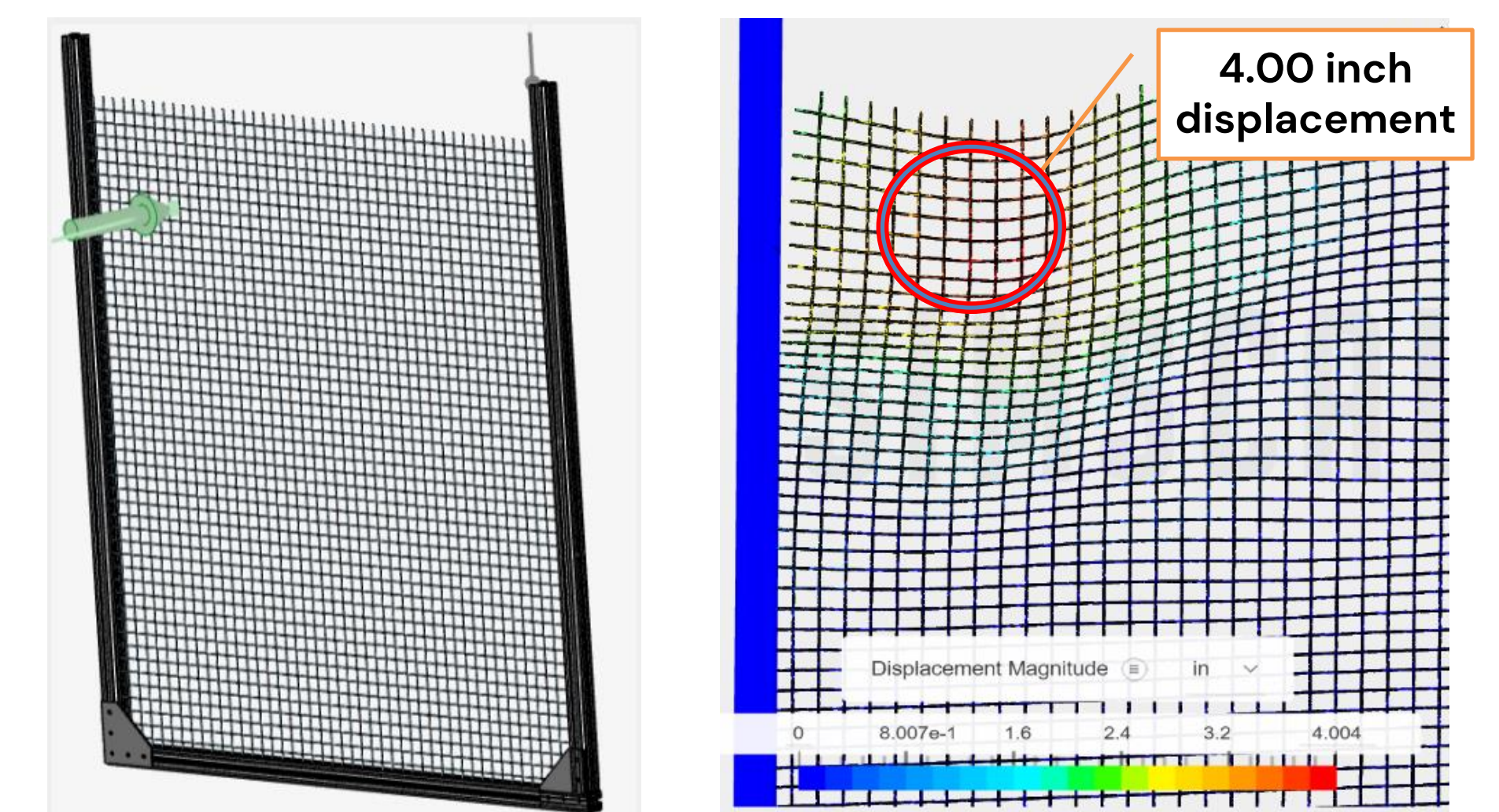
- Average deployment time
  - Drop weight: 2.2 sec
  - Buoyancy: 6.22 sec
- Dropping weight method used for ROV test
- ROV effectively stopped by net
- Net deflection: 2-4 inches verified by simulation



Side by side comparison of simulation and experimental results of ROV contact with net

## Simulation Modeling:

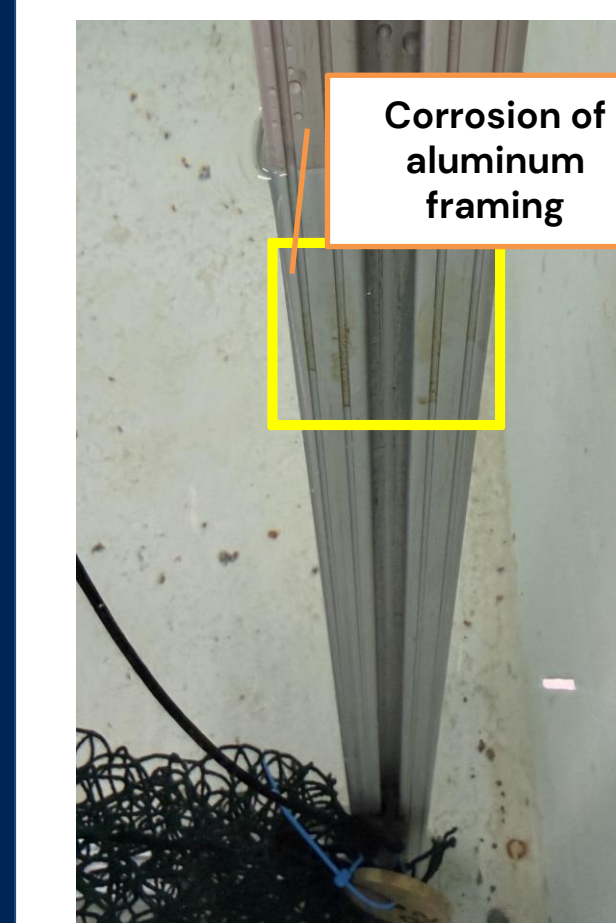
- How trial was run:
  - Defined 19.8 lbf thrust force static load in the middle, top left corner, and bottom left corner of impact zone
  - Assumed fixed support at the top surface of both vertical 80/20 frames
- Results:
  - Analyzed deflection of model
  - Displacement of 4.00 inches in top left corner
    - Validated the displacement observed during ROV trials



Max displacement of 4.00 inches in simulation by static 19.8 lbf force applied in top left corner of model

## Conclusions:

- Net successfully stopped ROV from advancing further
- Tested two rapid deployment methods
- Weight drop method was more effective as it deployed 3x faster than buoyancy
- Simulation modeling verifies displacement
- Corrosion formed on aluminum framing after five days in the static pool

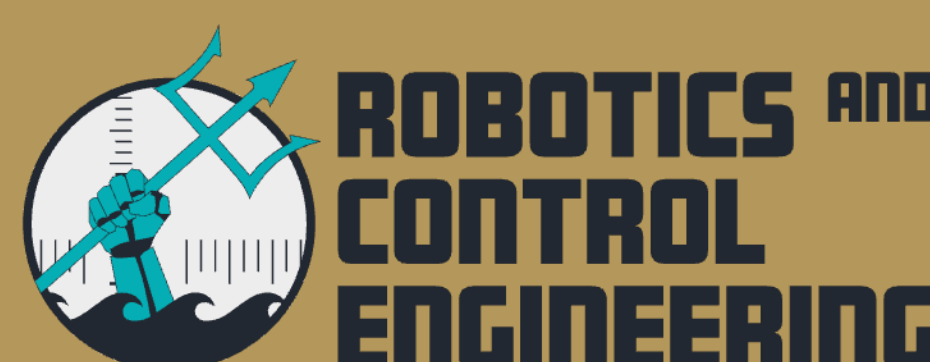


## Future Recommendations:

- Advancement of current design
  - Automated release system for drop weight / buoyancy system
  - Motorized/automatic deployability and retractability
  - Utilize materials less susceptible to corrosion and biofouling
- Increase scaling to size of Naval Port



## Acknowledgements:



## References:

