TEC-V

Preliminary Design Review

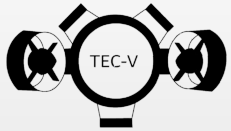
TECV.ROV

Our Website!

Our Insta!

Introduction

• Stephen Coster (OE)	Systems Engineer
• Henry Hill (OE)	ROV Technician
• Mike Dowling (CSE)	Software Integration Technician
• Gabor Papp (ME)	Mechanical Design Engineer
• Zealand Brennan (CSE)	Simulation Analysis



Meet TEC-V!

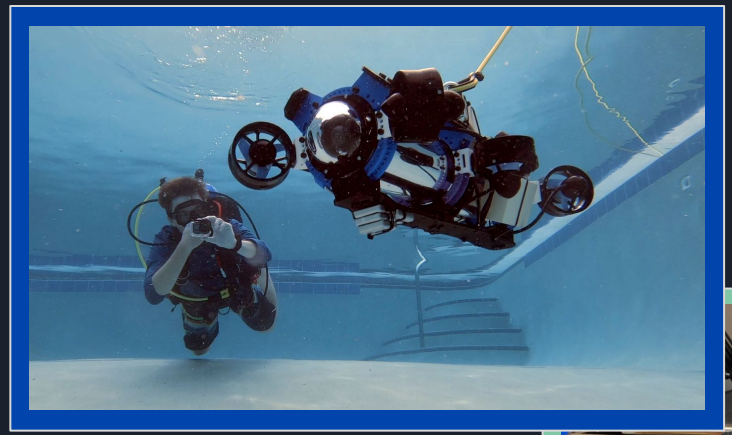
TEC-V ROV

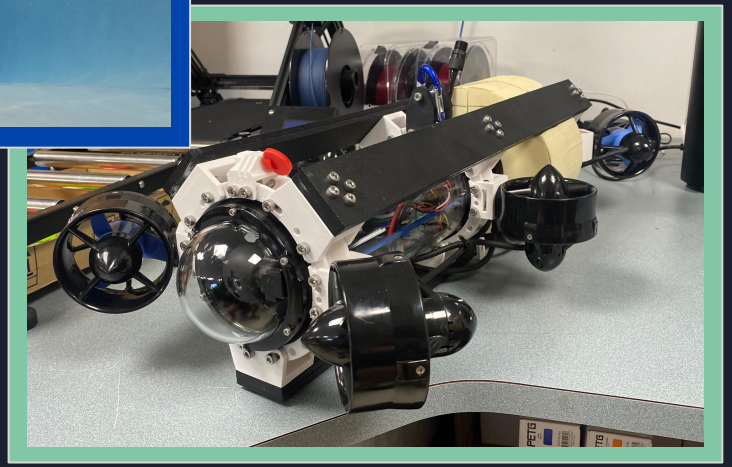
Topographic

Exploration

Cave

Vehicle





Mission Statement

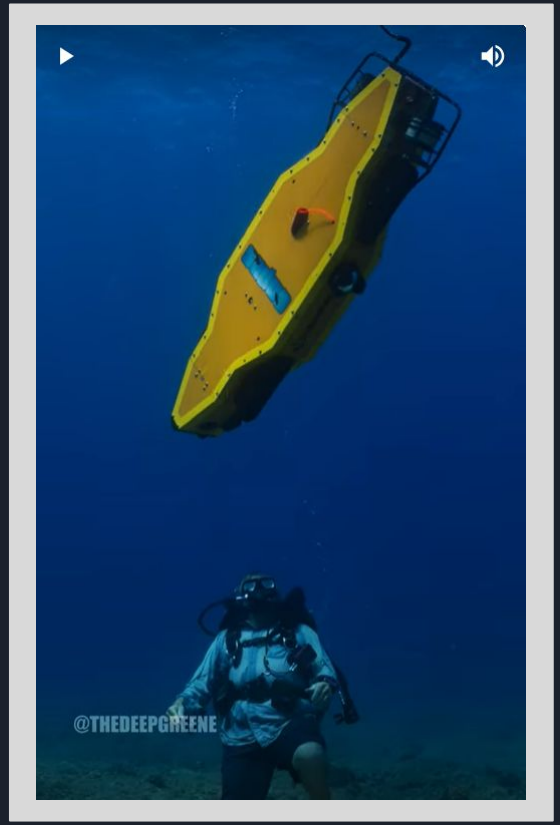
Develop an optimized scanning and mapping system for use in enclosed underwater environments through the integration of instrumentation onto the TEC-V platform

- Applications
  - Enclosed Environmental Mapping
  - Cave Exploration
  - Port and Harbor Monitoring
  - Under-Ice Surveying
  - Entry Level AUV

Research

Sunfish AUV

- SLAM
- Sonar
- Photogrammetry
- 6 DOF
- Neutral Buoyancy in All Axis

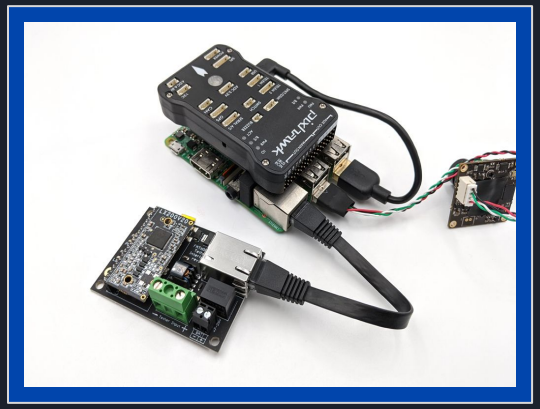


TEC-V

Sunfish AUV: https://www.youtube.com/watch?v=0MY099C1PxQ&t=61s

Electronics Research

- BlueROV Platform
- Cerulean Sonar
- UTL

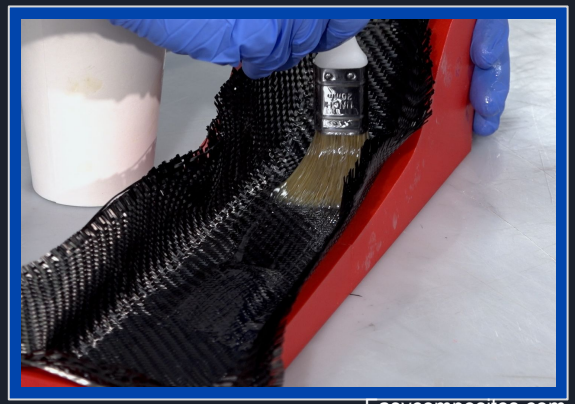


Bluerobotics.com

Ceruleansonar.com

Composites

- EasyComposites
  - 3D Printed Molds
  - Vacuum Bagged Hand Lamination
- Dr. Reichard
  - Structural Composites



Easycomposites.com

Environmental Concerns

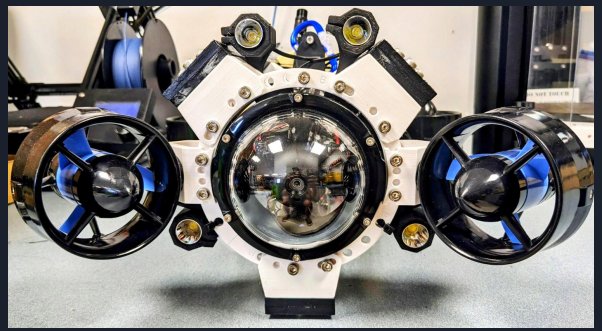
- Marine Life
- Wildlife Preserves
- Entanglement
- Lipo Batteries

Floridastateparks.org

Overview

Vehicle Frame

- Two Chambers
- 6 Thruster Configuration
- 5 Degrees of Freedom
- Modular Design
- PETG, Starboard, and Stainless Steel Construction



TEC-V

vs

BlueROV2

28 in x 13.5 in x 7.5 in

Similar to an AL80 Scuba Tank

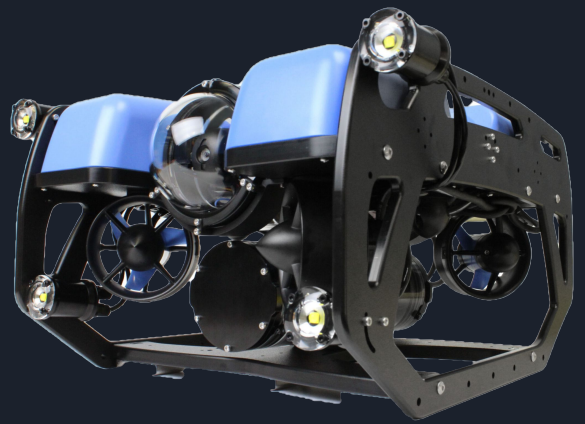
-Dimensions-

18 in x 13.3 in x 10 in

23.4 lb

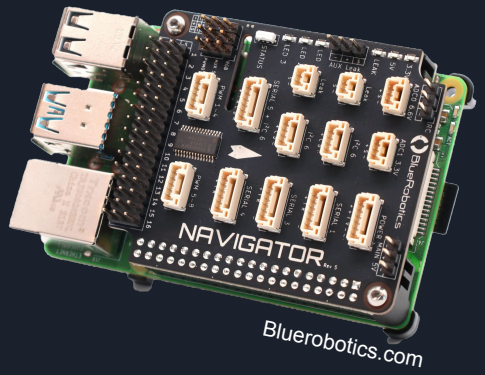
-Weight-

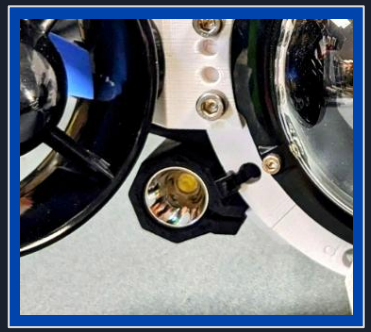
32.0 lb

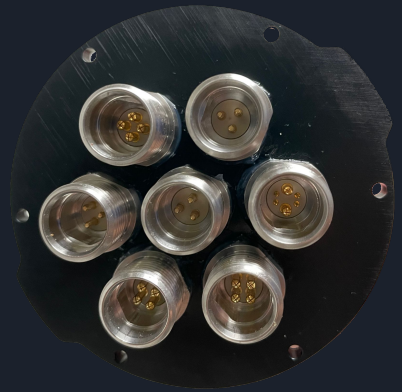


Components

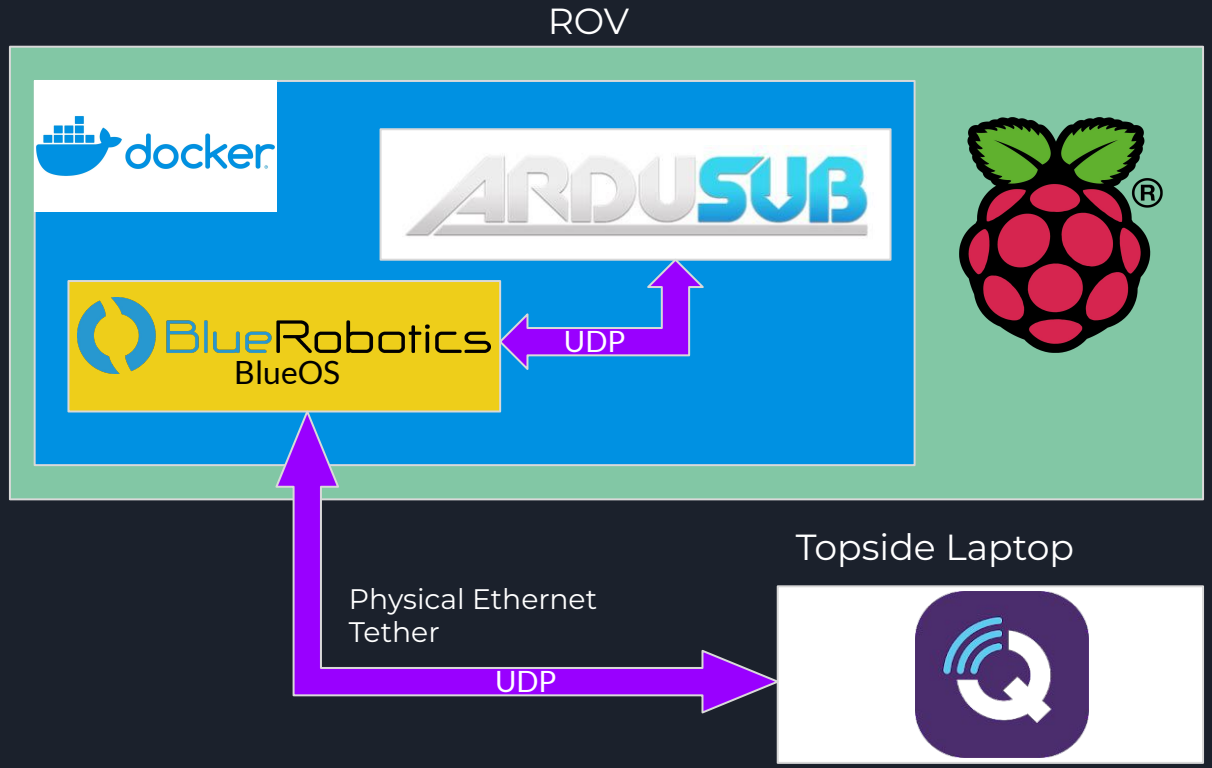
- Raspberry Pi4
- Navigator Board
- Fx-Ti
- BlueTrail Bulkheads
- Custom Spotlight Lumen LED’s







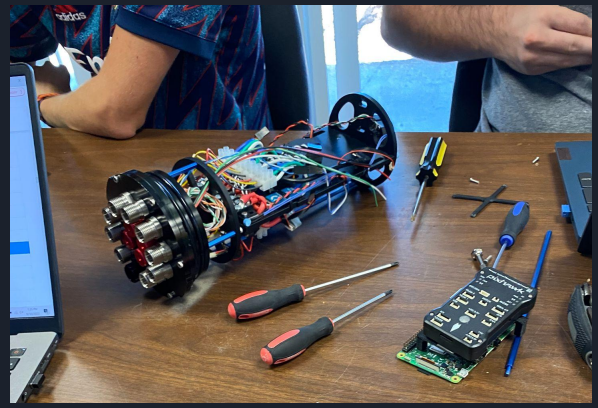
Software

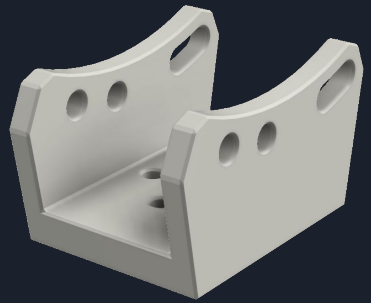


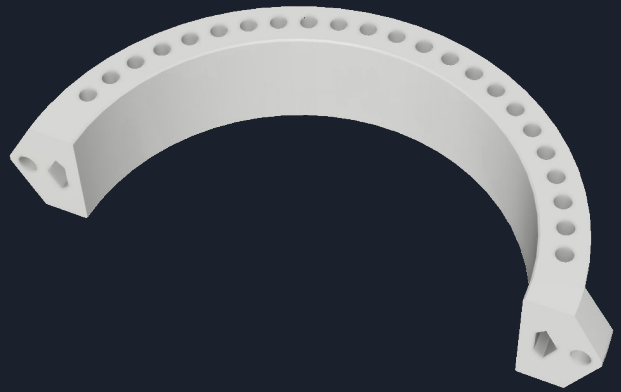
History

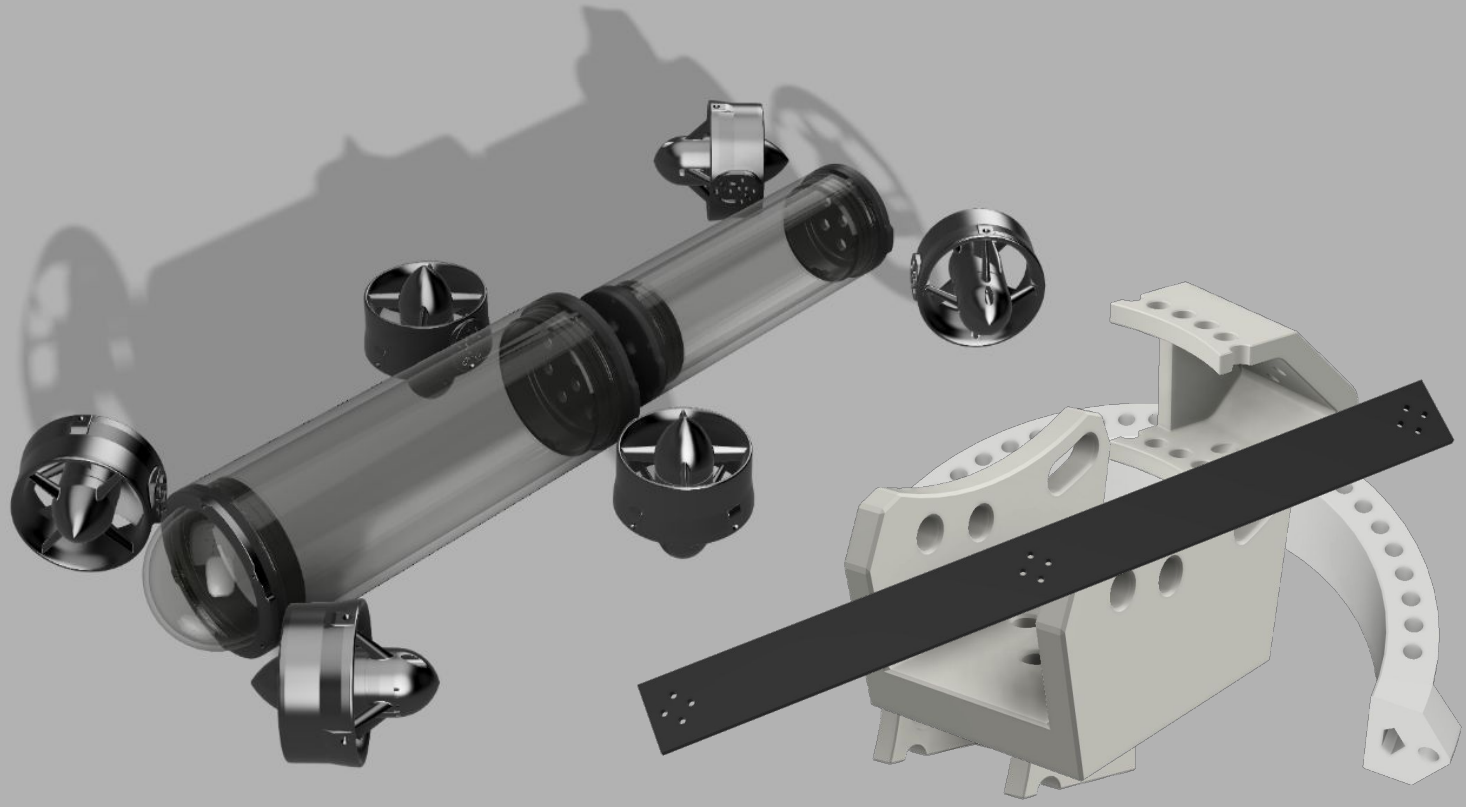
Frame Assembly

- 2x Chambers
- 3D Printed
  - Brackets
  - Braces
- Laser Cut
  - Starboard Rails









Buoyancy Study

$$M = F \times r$$

Buoyancy Volume

↓

Buoyancy Force/Weight Force

↓

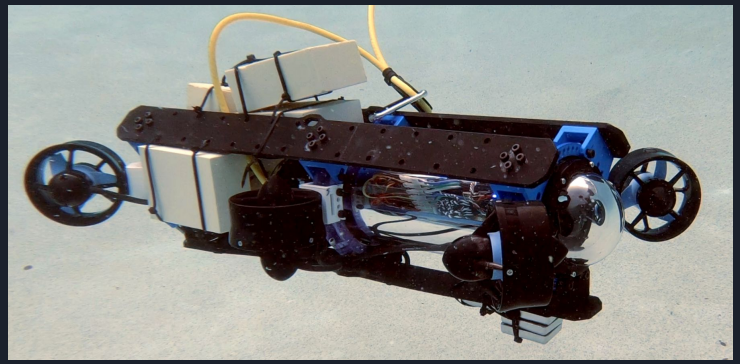
Distance Vectors

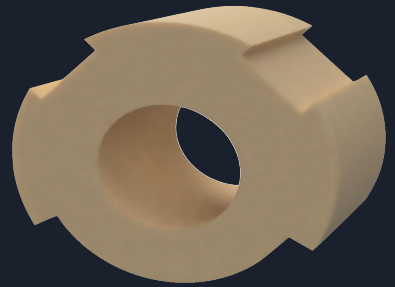
↓

Moment Calculation

↓

Force Location

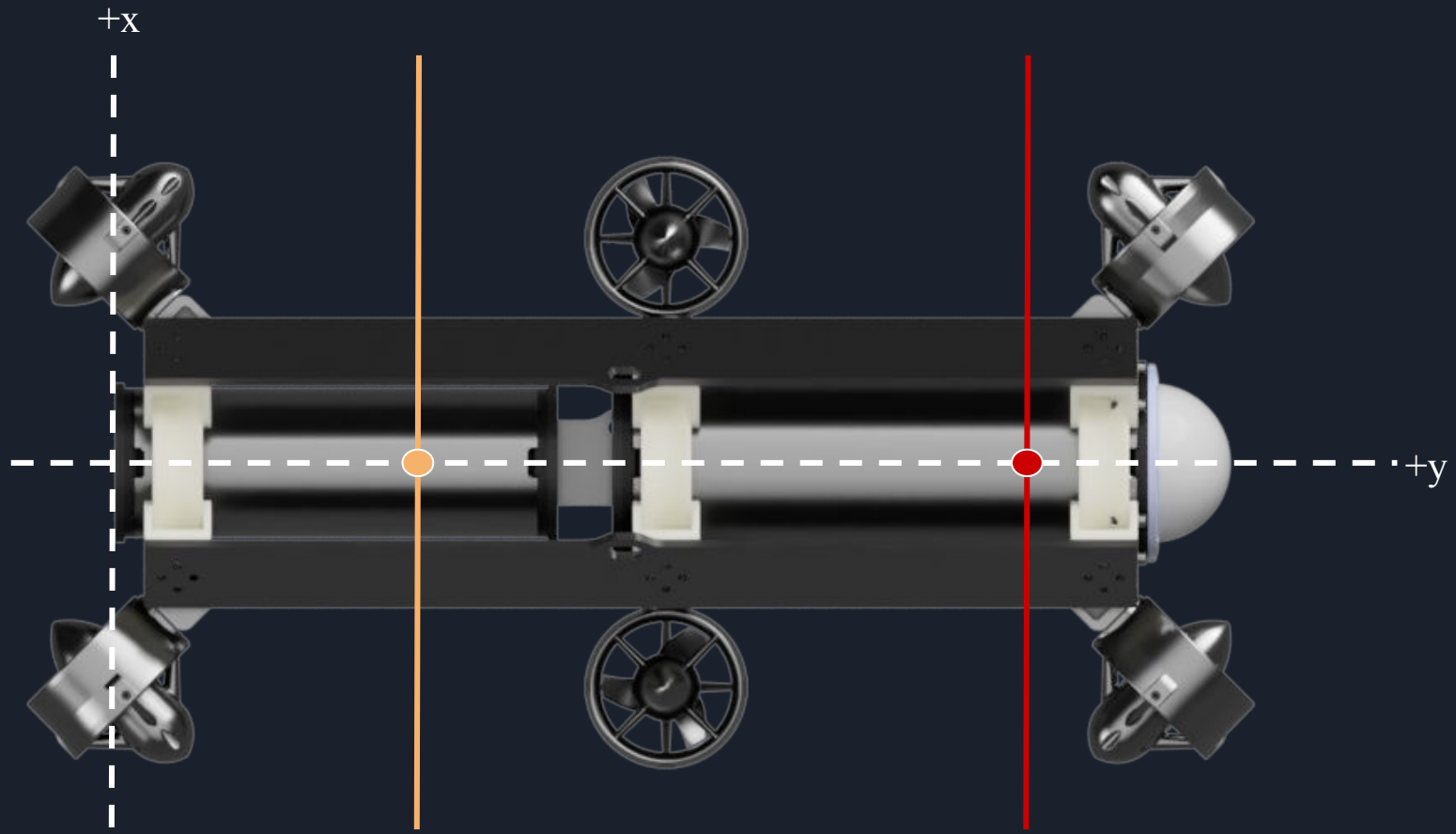




Subsea Buoyancy Foam R-3312

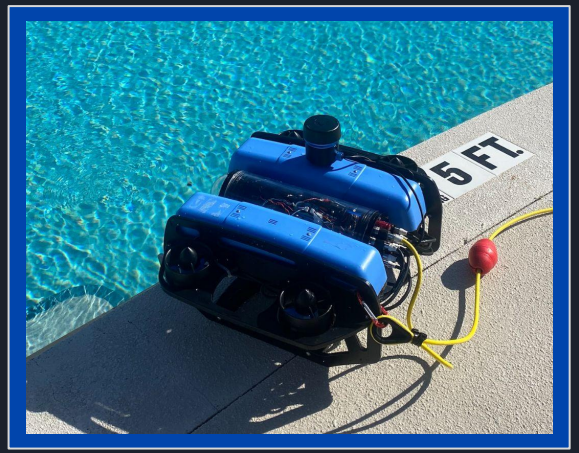
Center of Buoyancy

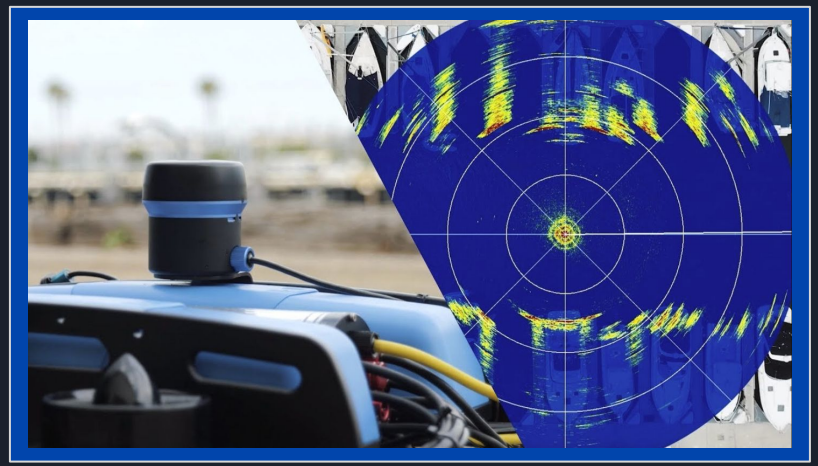
Center of Ballast Weights



Ping360 Sonar Study

- Utilized Koda →
- Ping Viewer
- Started Mapping



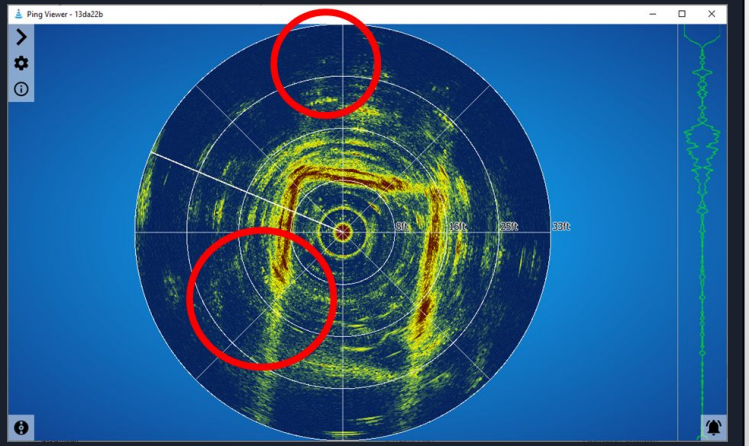


Bluerobotics.com

TEC-V

Mapping

- Loop that asks for the Intensity Values at “x” Degree to be Returned
- Intensity Values 0-255
- Range 1200 in Array



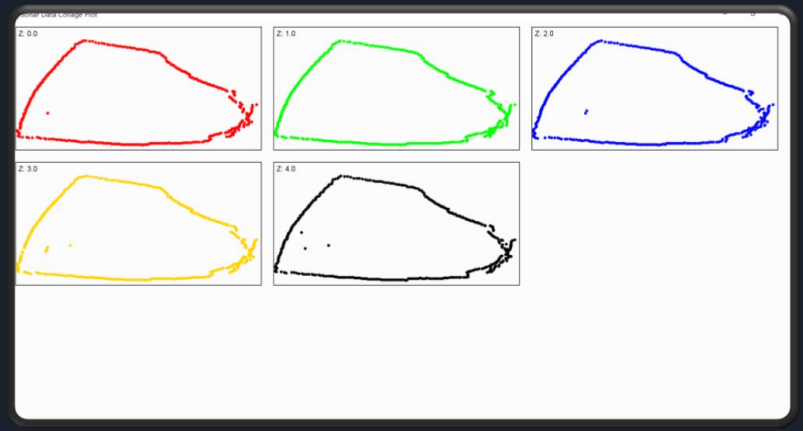

```
for currentAngle in range(400):
    # Read a single iteration of intensity data
    ping_data = ping360.transmitAngle(currentAngle)

    # Extracting intensity as integer values
    intensity_data = [(struct.unpack('!H', int(data).to_bytes(2, byteorder='big'))[0], i)
                      for i, data in enumerate(ping_data.msg_data)]

    # Store the raw data for the current angle
    raw_data[currentAngle] = intensity_data
```

Mapping - Transcription

DataRead.cs | data.csv

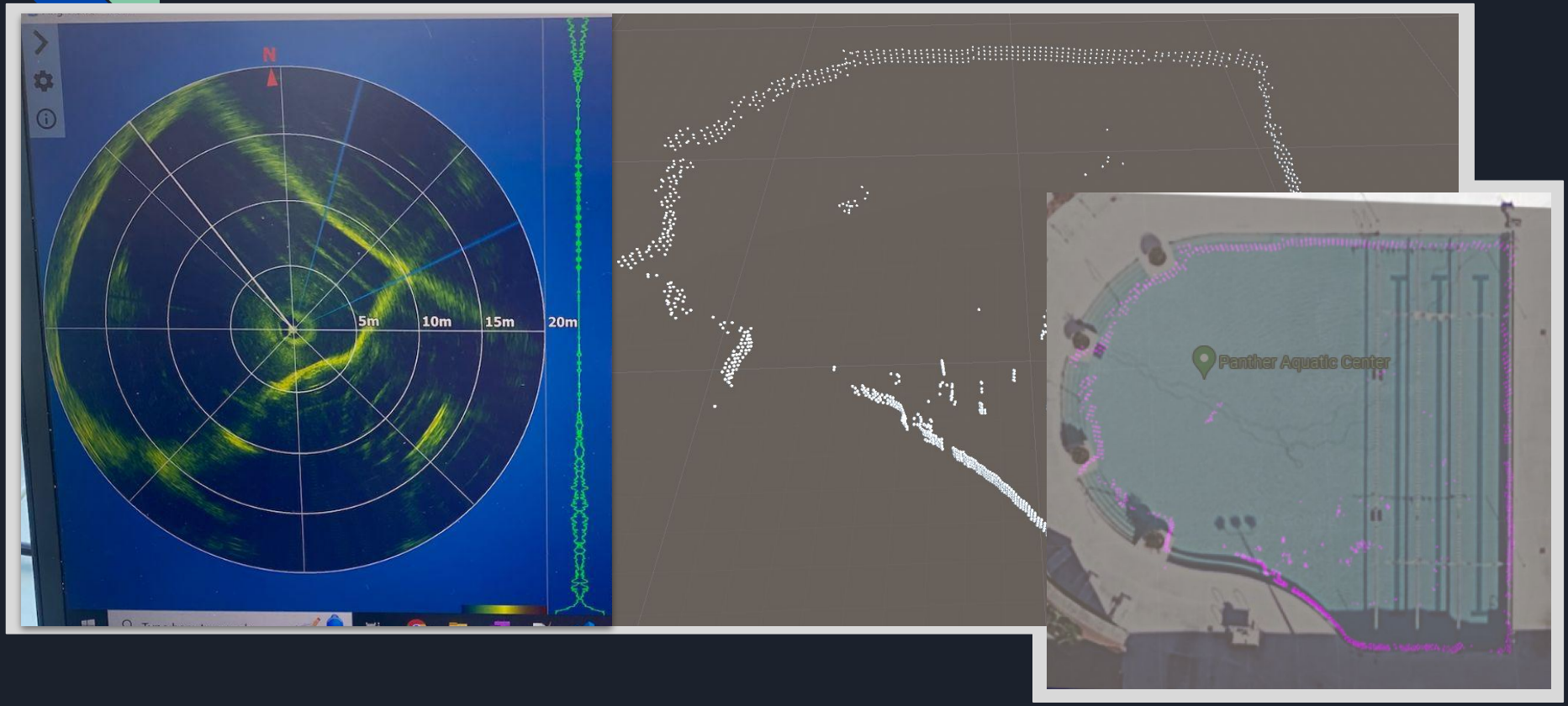
Assets > data.csv

```
1   0,0,5.16552375
2   0,1,5.116406249999999
3   0,2,4.993612499999999
4   0,3,4.9526812499999995
5   0,4,4.846259999999999
6   0,5,4.739838749999999
7   0,6,4.690721249999999
8   0,7,4.657976249999999
9   0,8,4.592486249999999
10  0,9,4.543368749999999
11  0,10,4.4778787499999995
12  0,11,4.396016249999999
13  0,12,4.3632712499999995
14  0,13,4.314153749999999
15  0,14,4.29778125
```



TEC-V

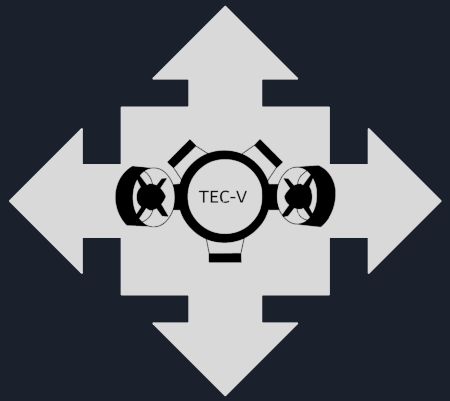
Mapping Efforts



Senior Design Aspirations

Sonar Integration

Mapping Software



Fairing

Buoyancy

TEC-V

Introduction

Research

Overview

History

-Senior Design-

Sonar

Mapping

Fairing

Buoyancy

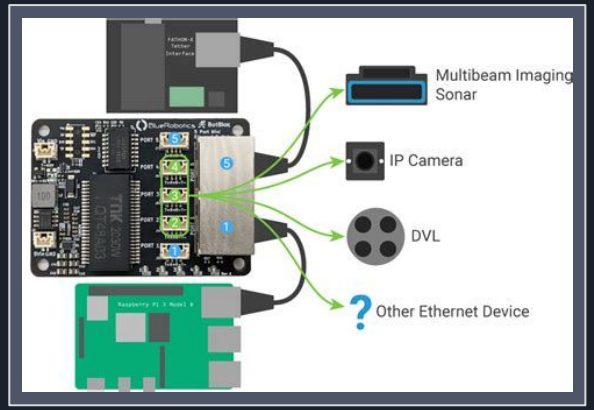
Timeline

Budget

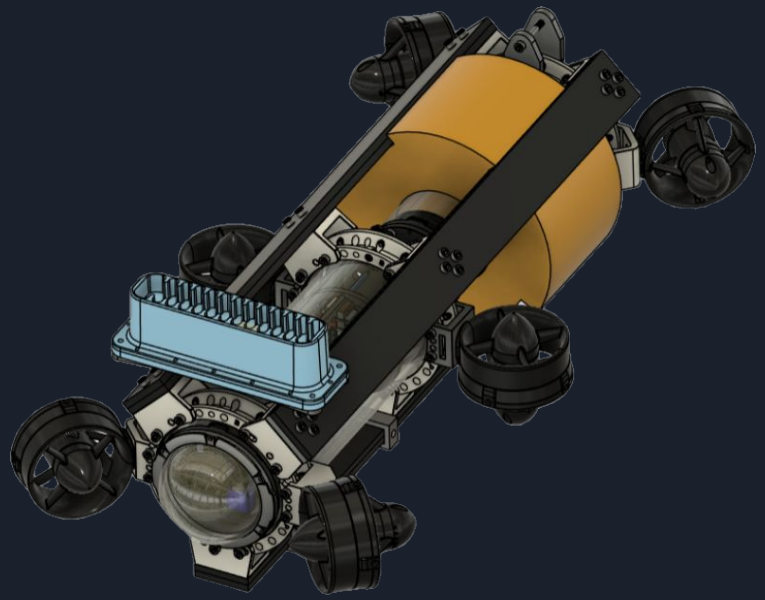
Sonar Integration

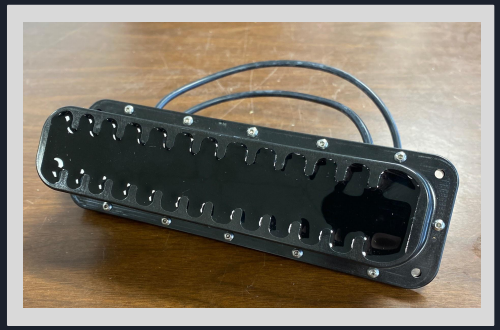
Sonar Integration

- Cerulean Omniscan FS
- Terminations
- Ethernet Switch

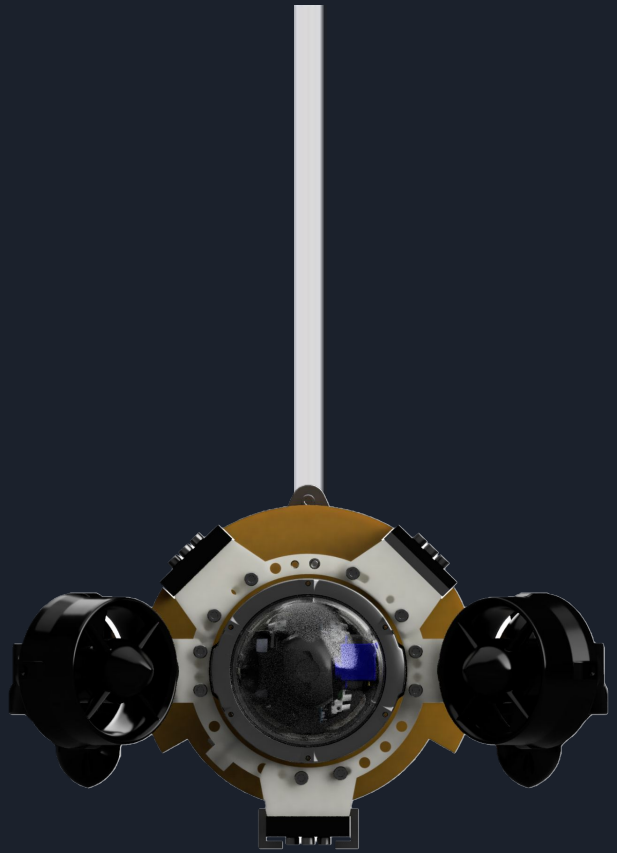


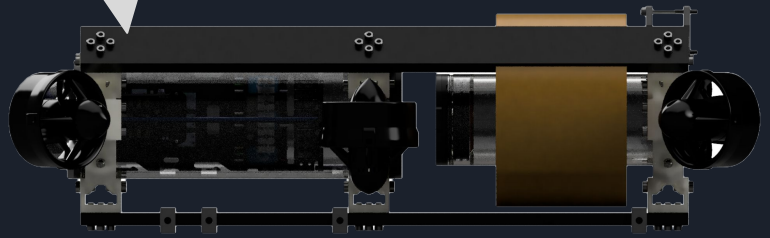
Bluerobotics.com





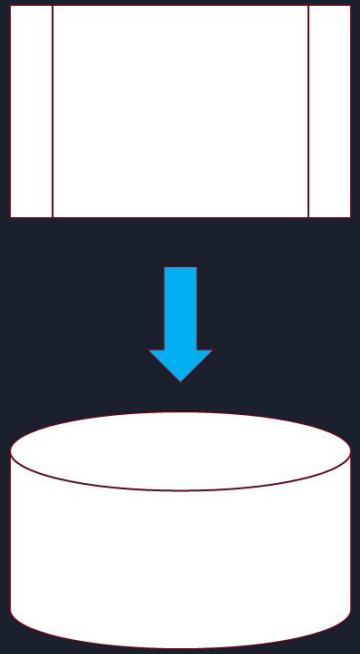
TEC-V



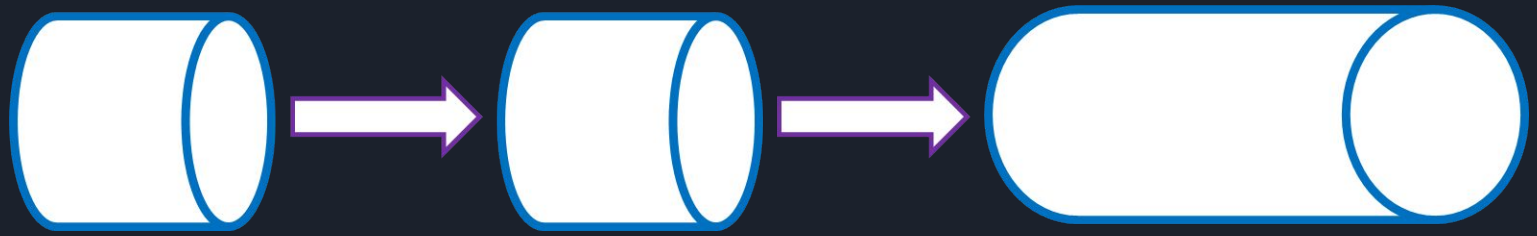


Mapping Software

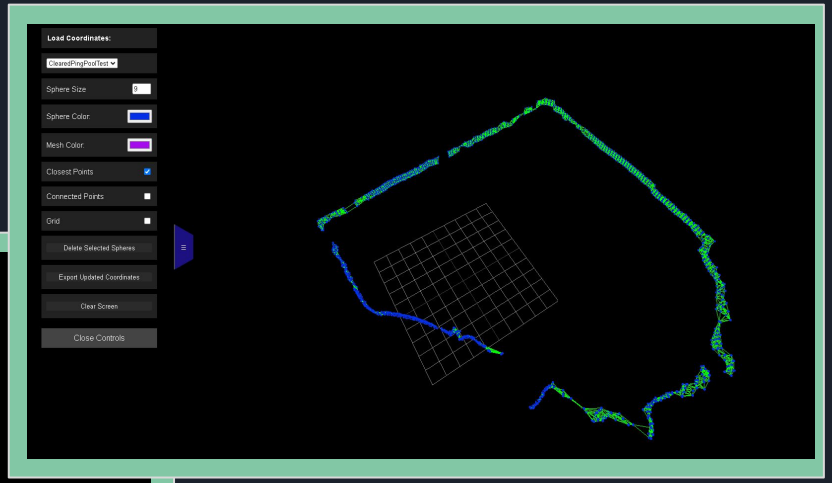
Cylindrical Mapping

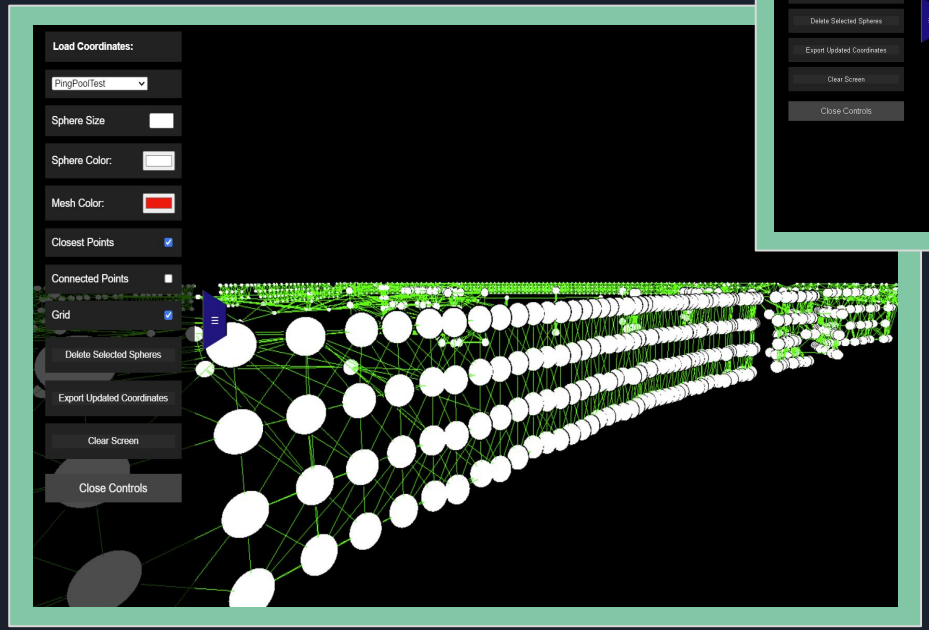


- Roll Maneuver
- Take Scanned Plane < > Bend
- Connect each scanned module



Mapping Website



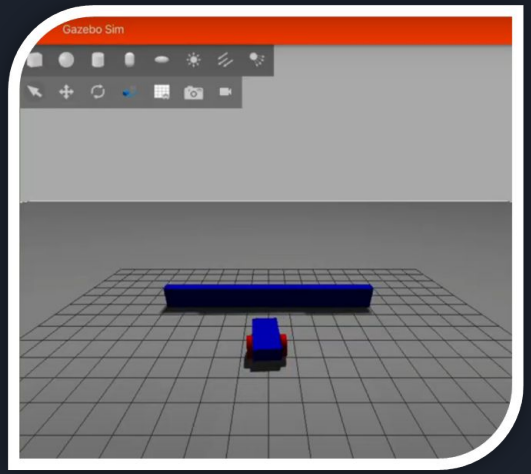


Mapping Website!

TEC-V

Gazebo

- IMU
- Contact Sensor
- Lidar



Fairing

Fairing

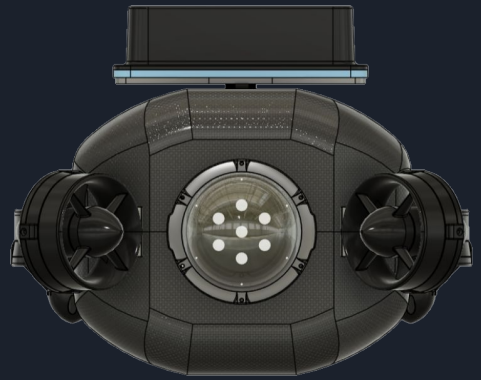
- Protection and Vehicle Hydrodynamics
- CF Composite Lay-up
- CFD Simulations

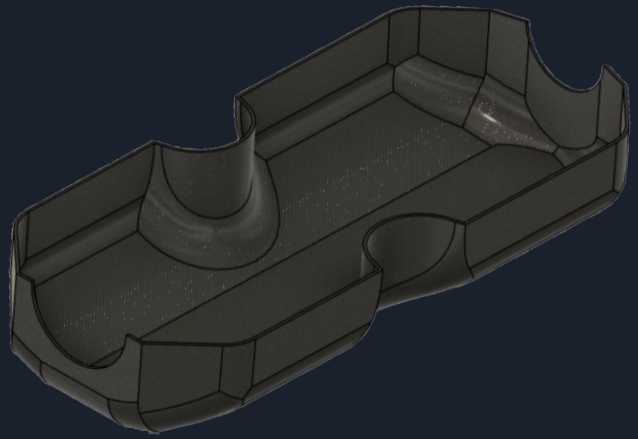
Ansys

TEC-V

Fairing Design

- Flat Sides → Increasing Yaw Drag
- Cylindrical → Decreasing Roll Drag
- Symmetrical → No Lift



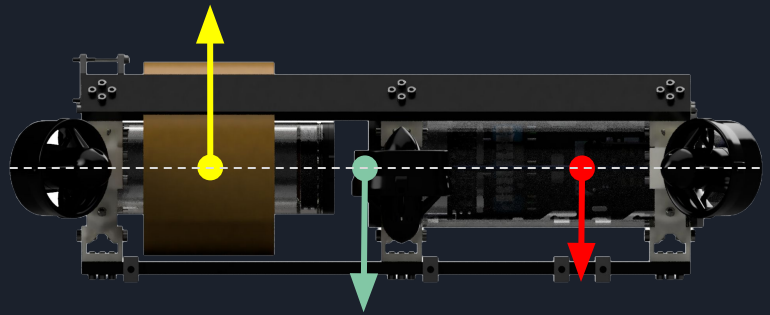


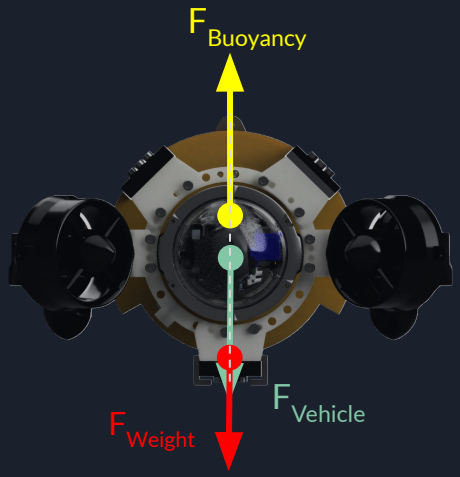
TEC-V

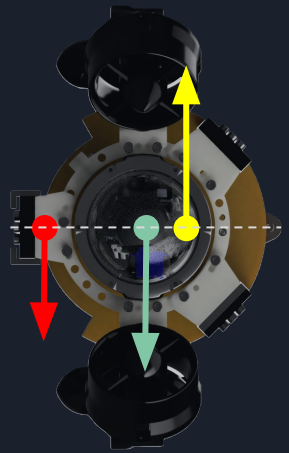
Buoyancy

Buoyancy

- Modify Existing Foam
- Reduce Moment Along Roll Axis
- Adjust Buoyancy for Saltwater
- Utilize MatLab to Calculate Change in Moment Due to Sonar



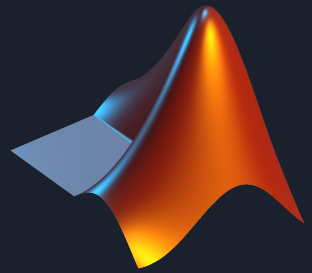


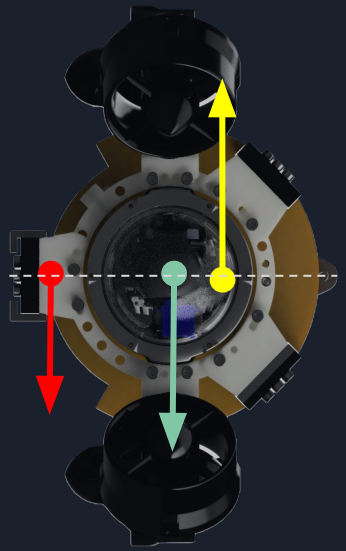


TEC-V

MatLab

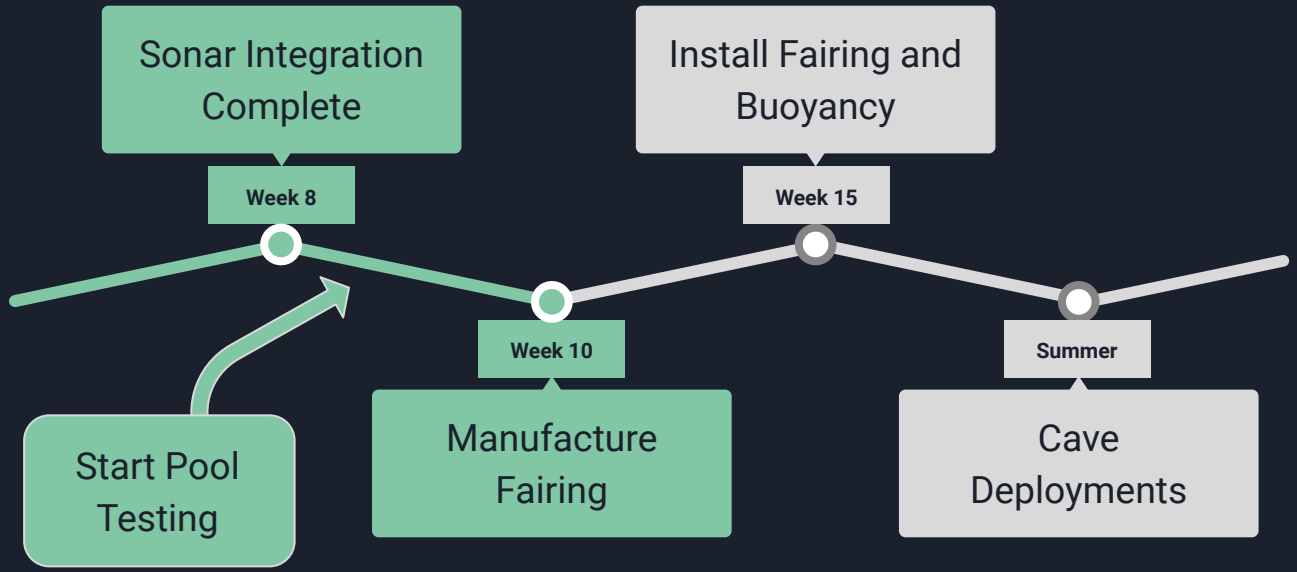
- Calculate Righting Moment for Pitch and Roll Motion
  - M=F x r
- Determine Change in Restoring Moment
- Roll Calculated at a 90 Degree Position
- How Much Foam to be Removed?





Timeline

Timeline



Gantt

WBS NUMBER	TASK TITLE	TASK OWNER	PCT OF TASK COMPLETE
1	**Sonar Integration**		
1.1	Research Sonar Solution	Stephen	100%
1.1.1	Purchase Sonar	Stephen	99%
1.2	Design Sonar Bracket	Gabor	90%
1.3	Integrate Sonar Electronics	Henry/Stephen	40%
1.4	Pot Sonar Termination	Henry	10%
1.5	Test Sonar using PingViewer	Mike	0%
1.6	Design and Test Mapping Code	Mike	50%
2	**Fairing Design and Manufacture**		
2.1	Integrate Sonar into Rendering	Gabor	85%
2.2	Finalize Design	All	90%
2.3	Perform CFD	Henry/Stephen	0%
2.4	Print Mold	Stephen	0%
2.5	Fabricate at Structural Composties	Henry/Stephen	1%
2.6	Post Processing	Henry/Stephen	0%
2.7	Installation	All	0%
3	**Buoyancy**		
3.1	Redo Math	Henry/Stephen	75%
3.2	Brainstorm Solution for Neutral B	All	80%
3.3	Fabricate Solution	Gabor	0%
3.4	Design/ install new weight sled	Gabor	0%
3.5	Install	Henry	0%
3.6	Pool Test	All	0%
3.7	Saltwater Test	All	0%

Budget

BOM

Sonar is 85% of Budget!

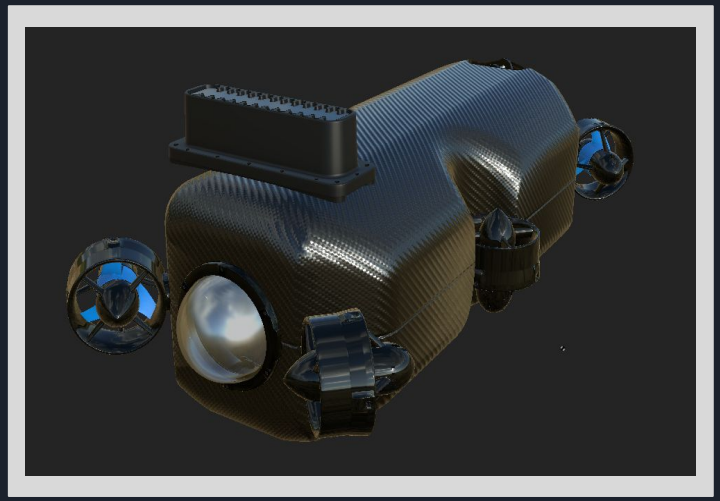
TEC-V

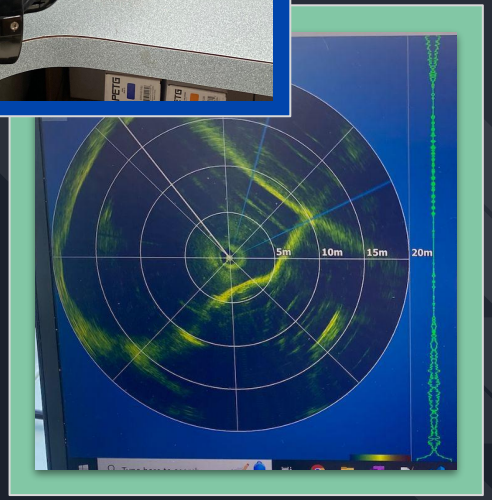
Bill of Materials

Item	Description	Source	Pt #	Qty	Unit of Meas	Unit Price ($)	Total Price	Link	Notes
Spring 24									
	Crulean Omniscan 450 FS Sonar	Crulean Sonar	9015.8	1	Unit	$2,110.50	$2,110.50	https://cerulea	Includes Shipping and Discount
	Composite materials	Structural Comp		0	n/a	$0.00	$0.00	https://structu	Supplied by Structural Composites
	Blue Robotics Ethernet switch	BlueRobotics	BR-100457	1	Unit	$175.00	$175.00	https://bluerob	
	Vaccum bags						$0.00		
	PETG filament	Amazon	B08ZB6X2M6	4	Unit	$25.00	$100.00	https://www.a	
	JB Weld Marine Potting compound	Amazon	B00R2CDVIW	1	Unit	$7.12	$7.12	https://www.a	
	BlueTrial 3-pin termination	BlueTrail Eng	COB-3130-SS	1	Unit	$25.00	$25.00	https://www.b	
	BlueTrial 3-pin bulkhead	BlueTrail Eng	COB-1130-SS	1	Unit	$42.00	$42.00	https://www.b	
						Subtotals:	$2,459.62		

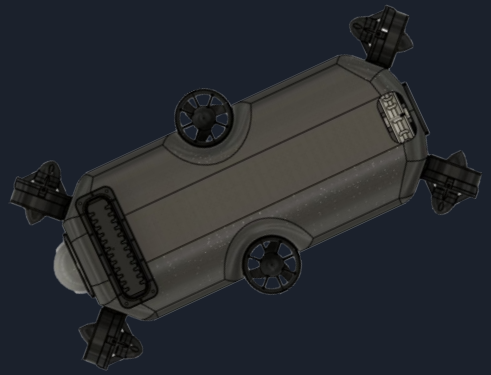
$2,460

Questions?





Appendix

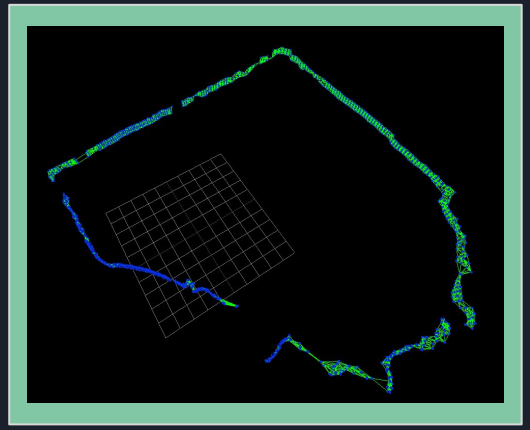


Goals → Integrate Sonar, Improve Buoyancy,

Manufacture Fairing, Develop Cave Mapping Software

Budget → $2460 out of $2500

85% is Sonar



Our Website!

TECV.ROV

Our Insta!

Mapping Website!

TEC-V