EML 4552/EEL 4915C: RoboBoat 2020

Testable Requirements

Team Introductions

Brandon Bascetta
Mechanical Design Lead

Courtney Cumberland
Manufacturing Lead

Toni Weaver
Systems Lead

Team Introductions

Madison Penney
Electrical Design Lead

Mark Hartzog
Software Lead

Peter Oakes
Integration Lead

Advisors

EE Mentor/Academic Advisor
Dr. Geoffrey Brooks
Electrical Engineering,
FSU Panama City

ME Mentor/Academic Advisor
Dr. Damion Dunlap
Mechanical Engineering,
FSU Panama City

Brandon Bascetta

Advisor

<u>Technical Advisor</u>
Dr. Joshua Weaver
Senior Scientist of Autonomy, NSWC

Brandon Bascetta

Objective

Create a new boat for the 2020 RoboBoat competition.

Peter Oakes

Project Scope

The scope of this project is to manufacture and wire a competition ready boat. This project will also involve basic software for the future RoboBoat competition.

Madison Penney

Work Breakdown

- Sensor Design - Brandon
- Manufacture - Courtney
- Power – Madison/Peter
- Sensor Integration - Peter/Toni
- Software – Mark/Toni

Madison Penney

Project Inspiration

Peter Oakes

Project Inspiration

Roboboat is an autonomous boat competition, created by Robonation and Sponsored by Office of Naval Research, Naval Information Warfare Center as well as by several corporations.

Peter Oakes

Project Inspiration

Last year, a team of FSU and Gulf Coast students participated in RoboBoat's 2019 competition

Peter Oakes

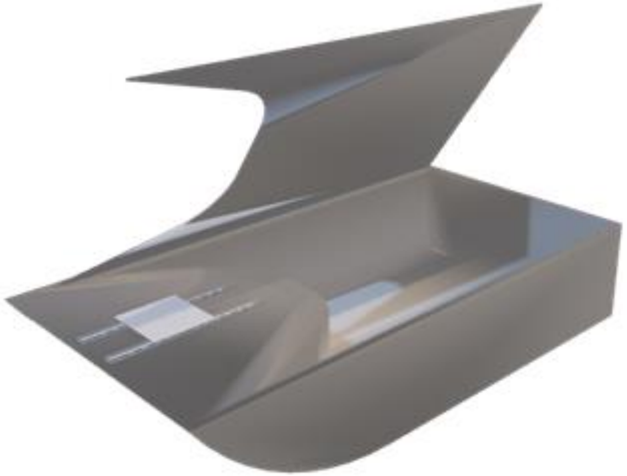
Boat Manufacturing Plan

Courtney Cumberland

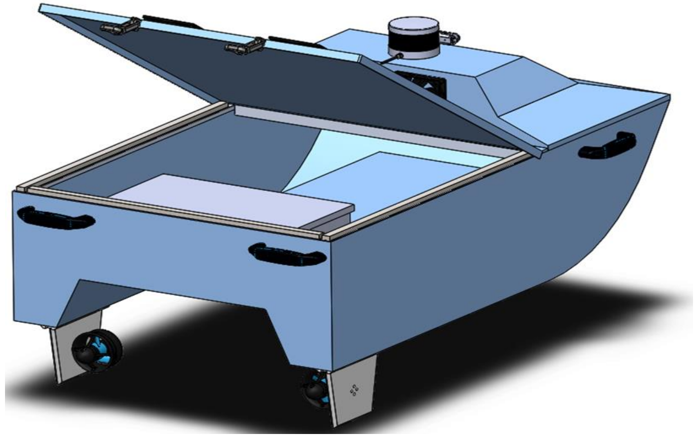
Manufacturing: Previous Work

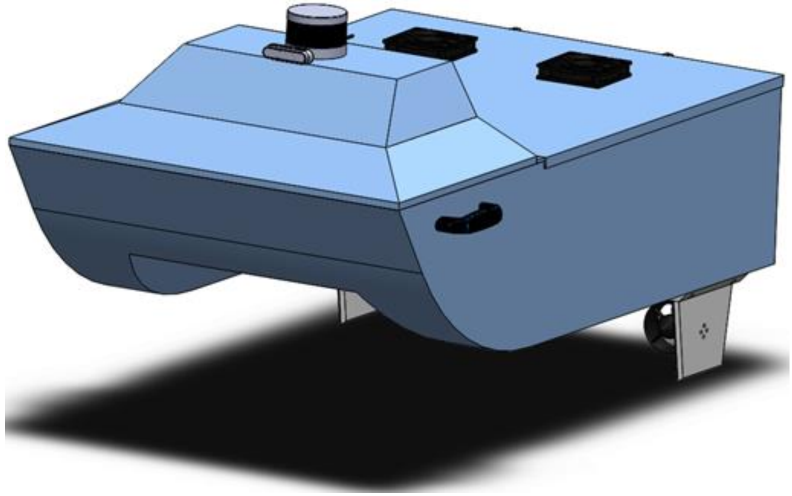
Hull Design

In previous semesters, the engineering design process was utilized to finalize a boat hull that met the needs of the competitors and fit within the rules of the competition. The result is a hybrid monohull-catamaran which incorporates the strengths of both boat types.



Initial Boat Design



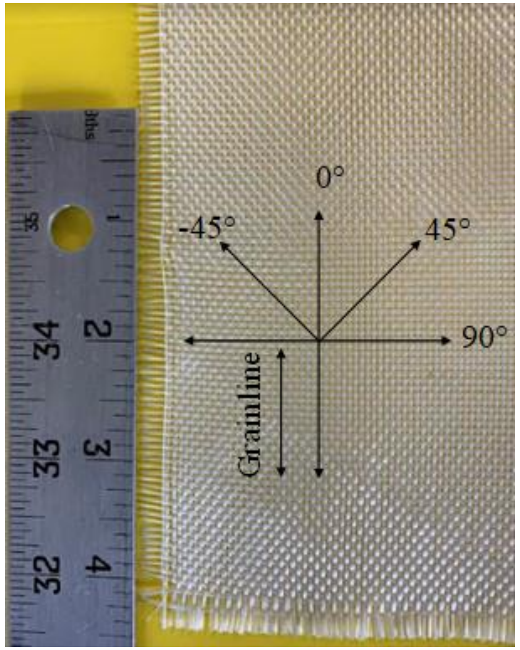


Final Boat Design

Courtney Cumberland

Manufacturing: Previous Work

Material Selection



Composite Chosen: 6 oz Plain Weave Fiberglass Cloth, Fiberglass Mat and Epoxy Resin!!

Reasons:

- Low Cost
- Easy manufacturability
- Anti-Corrosive
- High strength to weight ratio

Plain Weave Description:

- Weight : 6 oz per square yard
- Thickness: 0.0093”
- Weave: 1 over-1 under

Mat Description:

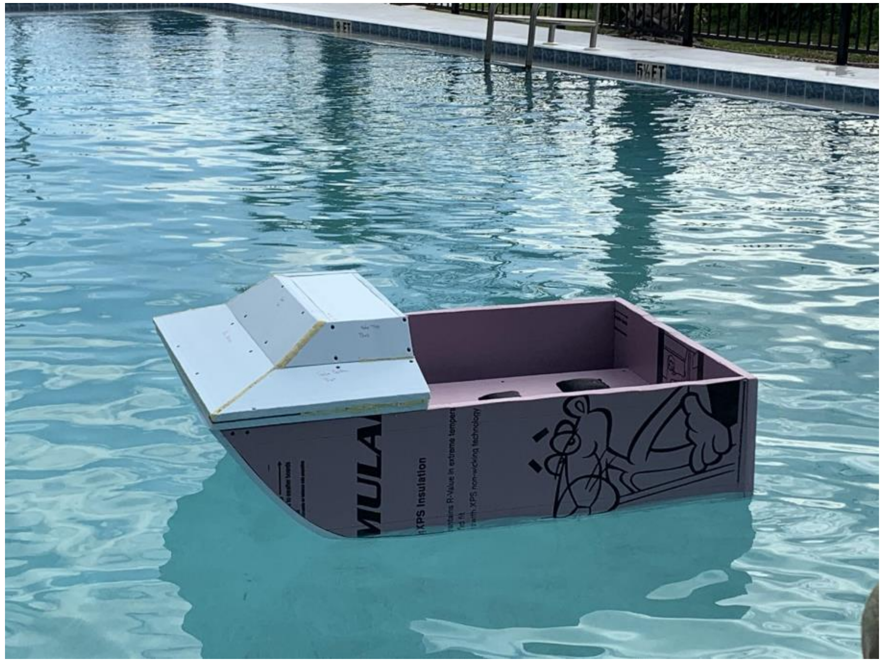
- Weight : 13.5 oz per square yard
- Thickness: 0.013”
- Weave: omnidirectional

Courtney Cumberland

Manufacturing: Current Work

Manufacturing Plan

To manufacture the boat hull, a foam mold was created for the top and bottom sections. It was tested for buoyancy in a pool and floated while supporting 12 pounds of weight. Next, the fiberglass cloth and fiberglass mat layers will be applied with epoxy resin. Three layers of cloth and one layer of mat will be used. The cloth will have grainline directions of 0º, 45º, 90º, one layer each. The fiberglass mat does not have a grainline direction. The fiberglass hull will then be removed from the mold and sanded down to a smooth finish. The final step will be to paint the fiberglass with a marine grade paint.



Courtney Cumberland

Boat Hull: Testable Requirements

Requirements:

- Will the boat hull float or sink?
- How much weight will it be able to carry?
- Will the boat hull take on water at any location?
- The fiberglass will have limited deflection
- The hull will be as lightweight at possible.

What will constitute a passing score?

- The boat floats.
- The boat will carry 15 pounds.
- There will be no leaks in the hull
- Deflection will be less than ⅛”
- The boat will weigh less than 20 pounds

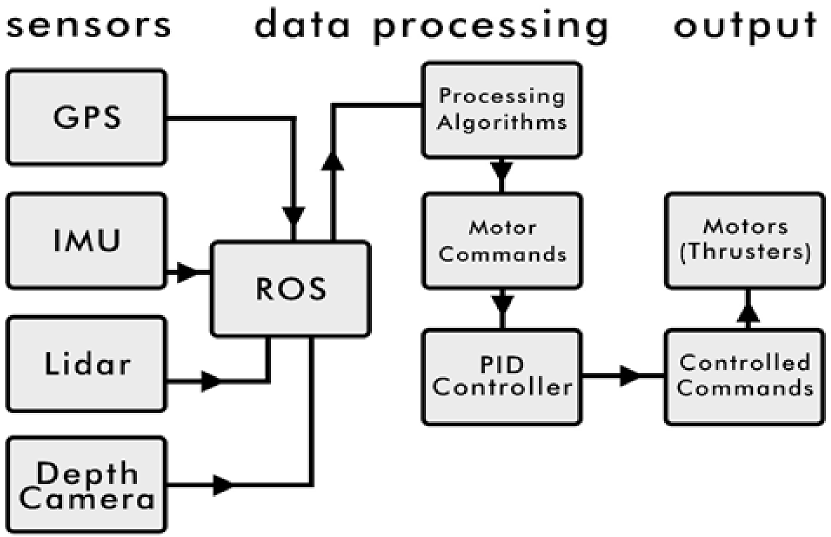
Courtney Cumberland

Boat Wiring and Device Integration

Peter Oakes/Madison Penney

Hardware: Previous Work

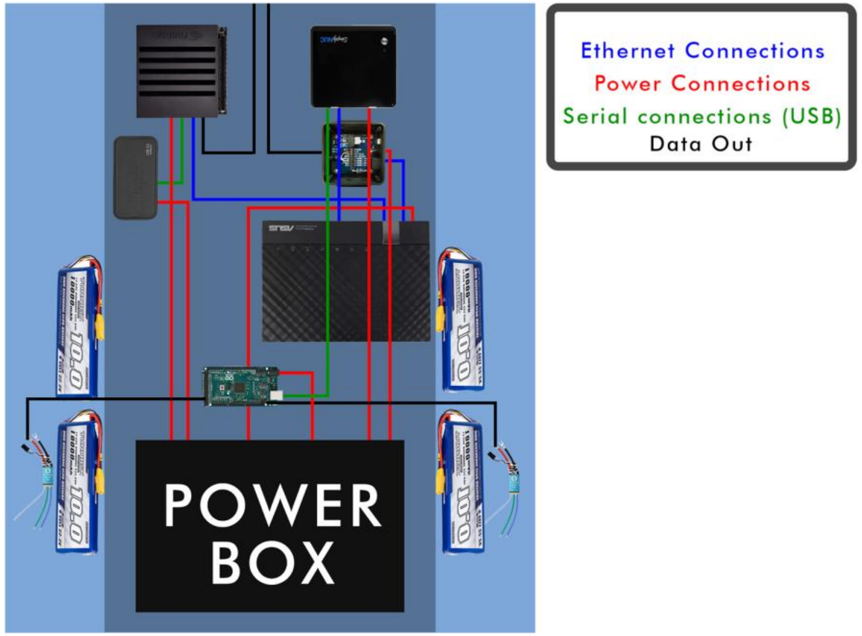
To begin the testing and prototyping of the software, the hardware needed to be assembled. For our team the hardware specifically consisted of sensor devices, networking devices, microprocessors, and computers. These sensors needed to be wired to the computer using USB and network connections as seen in the figure to the right.



Madison Penney

Hardware: Previous Work

Device
Computer #1 (Simply NUC)
Computer #2 (Jetson Xavier)
LiDAR
Router
ESCs (x2)
Arduino Mega (x2)
DC Fan
USB Hub (includes RealSense camera)



Madison Penney

Hardware: Testable Requirements

- The power box is setup and constructed in order to provide power on any test boat used
- Power source is providing correct voltages for each components
    - The power source is providing 19 volts for computer #1
    - The power source is providing 19 volts for computer #2
    - The power source is providing 24 volts for LiDAR
    - The power source is providing 19 volts for Router
    - The power source is providing 16 volts for ESCs (x2)
    - The power source is providing 24 volts for Arduino Mega (x2)
    - The power source is providing 12 volts for DC Fan
    - The power source is providing 12 volts for USB Hub
- Batteries are charged to provide an adequate amount of power for a physical test
- Each components can be powered on and run smoothly when drawing power from the power source
- The computers and LiDAR have successful ethernet connection to the router

Peter Oakes

Sensor Design

Brandon Bascetta

Sensor Design: Previous Work

- Mounts already created:
  - Modular thruster fin mounts.
  - Shell for Intel RealSense.
  - Baseline for Visual Feedback (LED).

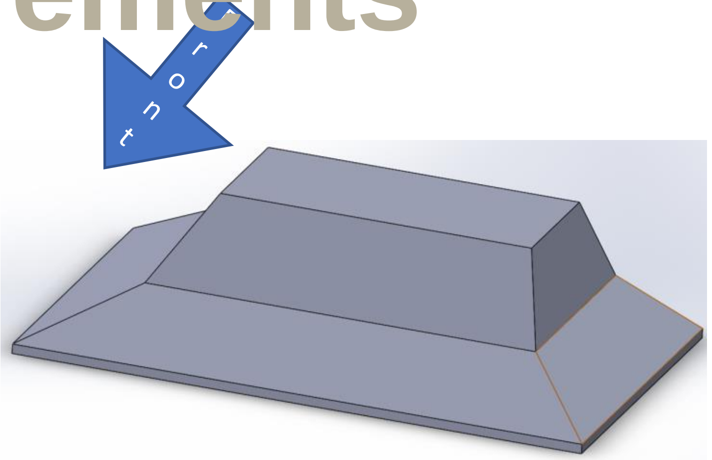
Brandon Bascetta

Sensor Design: Future Work

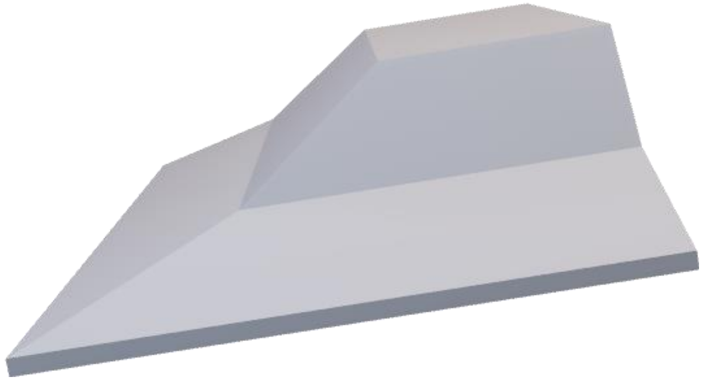
- Mounts needed to be created:
  - Ouster OS1 Lidar.
  - The rest of Intel RealSense.
  - Final touches for Visual Feedback (LED).

Brandon Bascetta

Sensor Design: Testing Requirements



- Sensors mounts will be securely attached to the boat.
- Sensors will be able to be rotated by 30°s.
- The sensors will be placed on the hull safely away from waterline.
- Mounts will not block field of view of sensors.
- The sensors will be adjusted to have full view for objects of interest.
- Mounts will be able to have routes for cords.
- Mounts will be easily replaceable and manufacturable.

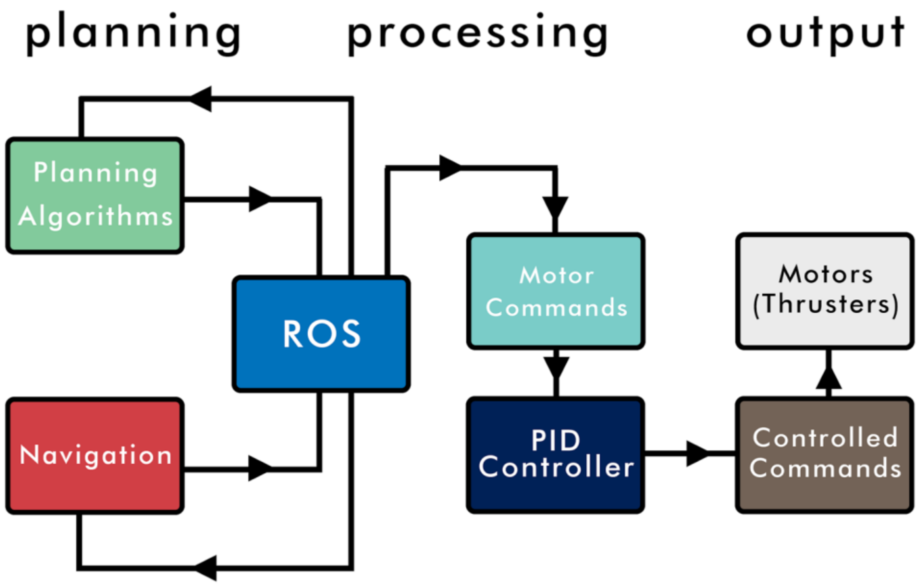


Brandon Bascetta

Software Development

Toni Weaver/Mark Hartzog

Software Development: Previous Work



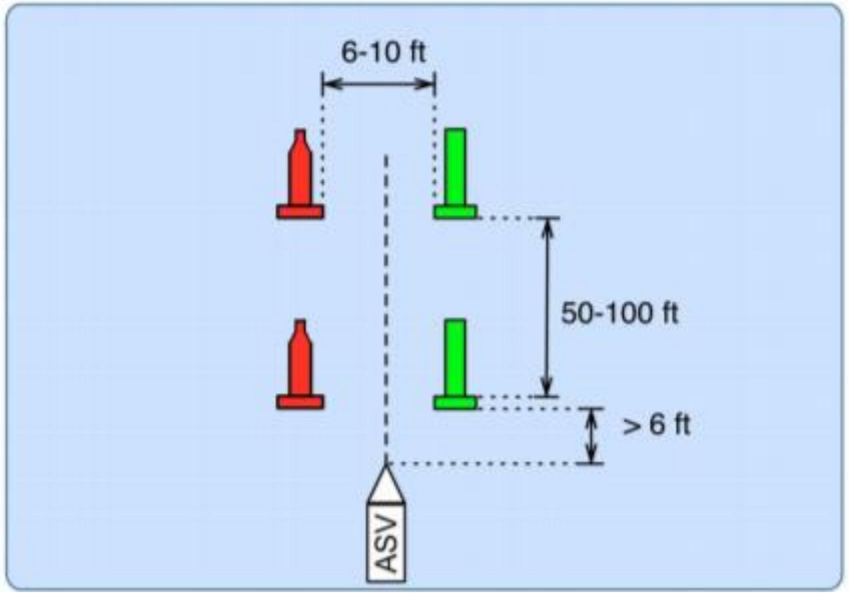
The development software environment used in both past and future work for this project is called ROS (Robotic Operating System) This open source software contains functions and abilities only available within ROS. This functionality, such as the navigation stack allows our team to integrate multiple sensors to work together to create the appropriate software to accomplish our goals. The workflow for the ROS environment is shown graphically on the right.

Last semester the senior design team created a pid controller in order to drive the boat. This controller allows the boat to correct its heading based on the inputs from sensors. This controller was written in C++ and tested in simulation software.

Mark Hartzog

Software Development: Future Work

This semester the software team will focus on creating software that will localize the boat within its environment. This is with the aim to complete the “mandatory navigation channel” task as set down by the RoboBoat competition rules.



Mark Hartzog

Software Development: Testable Rqmts

- Sensors are fully configured and mapped to static addresses
- Sensors are fully integrated into ROS
- Sensors are fully connected through the transform tree within ROS and accurately reflect the proper setup required for localization as specified by the ROS Navigation documentation.
- VectorNav IMU data output is repeatable
- Sensors are capable of detecting obstacles.
- Confirm that the localized vehicle does detect obstacles and the navigation stack is accurately reflecting obstacles in the ROS coordinate from.
- Software is capable of creating a simple forward command velocity.
- PID controller is capable of creating smooth continuous motion.
- Provide a waypoint to the vehicle within the ROS visualization (RVIZ) environment.
- System is capable of simplistic waypoint navigation.

Toni Weaver

Questions??

Thank you for your time.