Positive Operative Buoyancy Submersible (POBS)

TEXAS A&M UNIVERSITY Engineering

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TEXAS A&M UNIVERSITY ROBOTICS TEAM & LEADERSHIP EXPERIENCE

Methodology

By developing a positively buoyant submersible which is versatile in many applications within aquatic environments, we can enhance the safety, sustainability, and ease of task in these domains.

Surfacing

- Rapid Emergency Surfacing: In the event of an emergency, the submarine can quickly rise to the surface without the need for complex ballast adjustment.

Efficiency

- The positive buoyancy can help the submarine maintain a higher position in shallow waters, reducing drag and making navigation easier.
- Maintaining positive buoyancy can reduce the energy required to counteract the weight of the submarine.
- The need for elaborate ballast system does not exist, allowing for greater energy conservation.

Sustainability

- Positively buoyant vessels are less likely to sink, meaning less waste on our ocean floors while saving valuable data and equipment.
- The simple submersion technique means that short explorations consume less energy than traditional submarines.
- Positive buoyancy ensures that the submarine remains afloat even if there is a loss of propulsion.

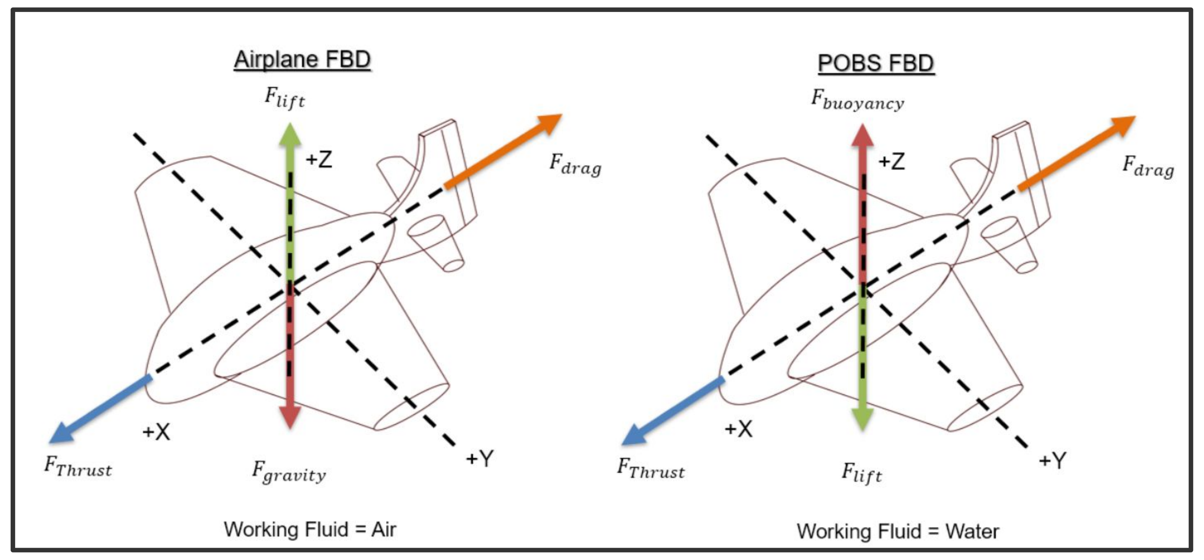


Figure 1: *POBS' forces compared to a plane's*

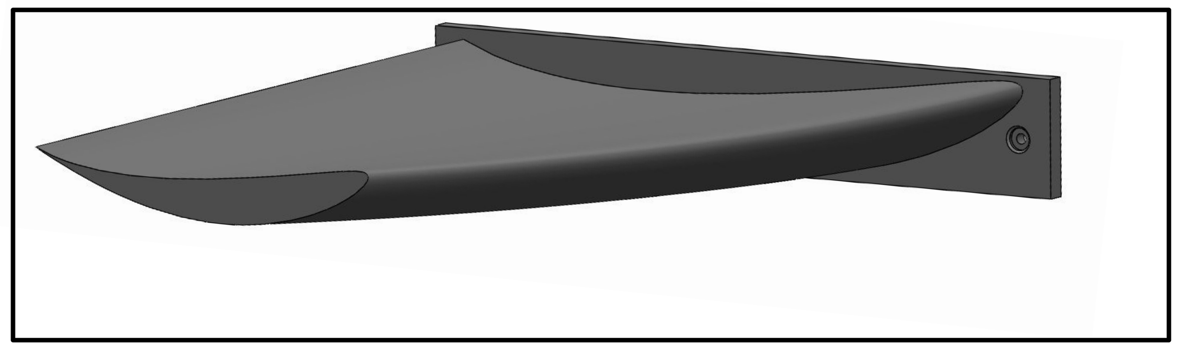


Figure 3: *Hydrofoil design*

Chassis

To produce a submersible chassis capable of resisting the pressure forces of water while housing the equipment for propulsion and navigation, we spent the semester brainstorming and designing innovative concepts for a new Chassis design. Learning from the lessons of previous POBS iterations, we implemented several new concepts, including:

- A more streamlined shell for better hydrodynamics and ease of movement in dense, friction inducing water.
- Chassis components separated into screwable parts to simplify inserting and removing electrical components.
- Use of stabilizing fins to counteract the spin produced by the propellers.
- A slot for insertion of antennae and attachment area for sonar equipment for RC and navigation.

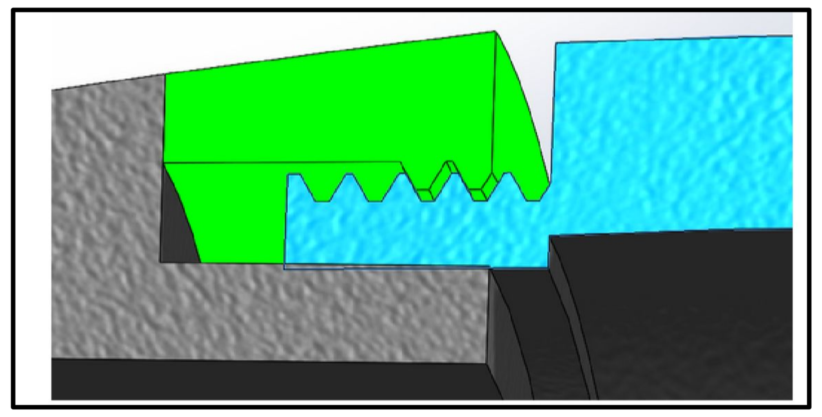


Figure 4: *Waterproof locking screw*

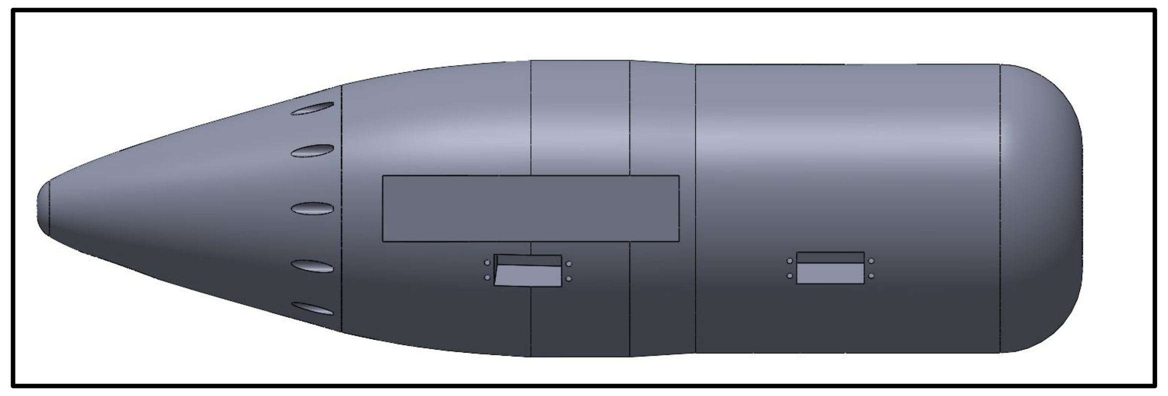


Figure 5: *Chassis design*

Electrical

This semester, we spent our time getting to know the electronic components of POBS and learning how they operate. Currently, we are using the following components:

- Zeee 6S Lipo Battery 22.2V 100C 6000mAh
- Blue Robotics T200 Thrusters
- ANNIMOS 20KG Digital Servo
- Raspberry Pi 4B
- Blue Robotics Ping Sonar Altimeter and Echosounder
- Adafruit Ultimate GPS
- Teyleten Robot GY-MS5837-30BA High Precision Waterproof Pressure Sensor

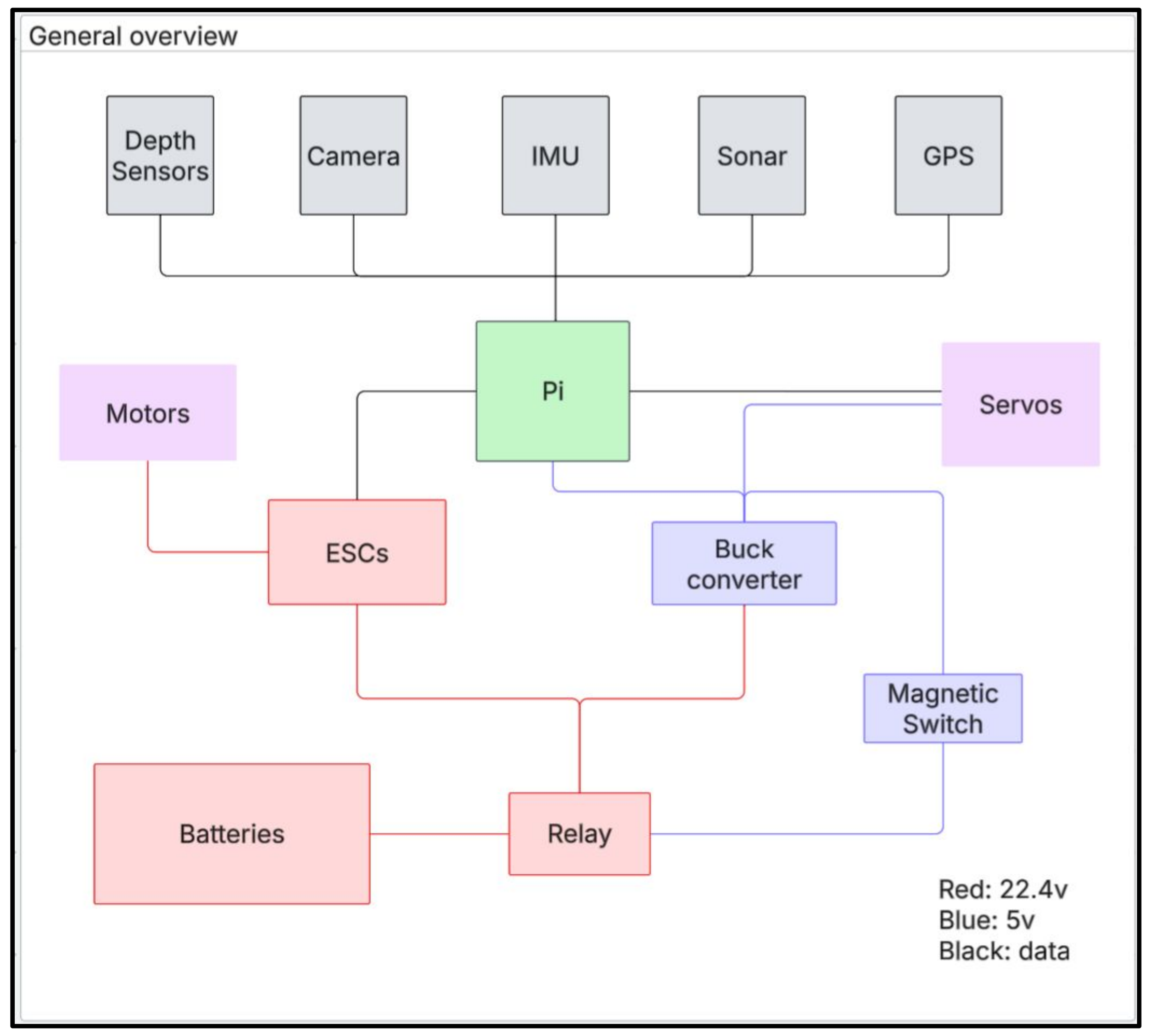


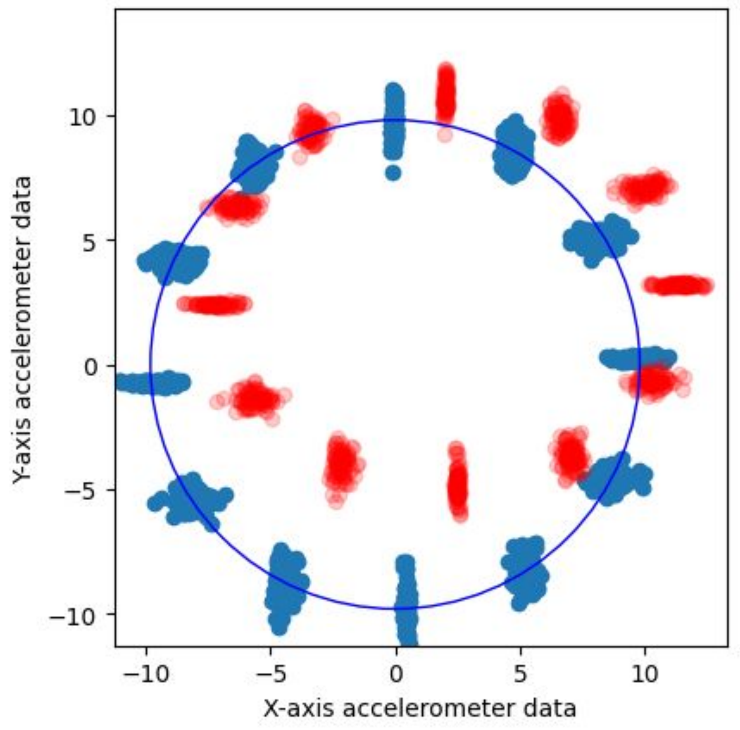
Figure 6: *Electrical Diagram*

Controls

The robot keeps a local position of itself when it is submerged to allow it to place the sonar pings it receives in the world. This position estimate slowly drifts over time when using just an IMU, so we will periodically resurface to get an absolute position measurement using GPS. This allows us to keep with in our relatively large error bounds.

Given just the IMU, we are unable to maintain a close enough position to accurately map a space. We fix this using 5 pressure sensors to determine the current rotation and velocity. Unfortunately this misses the yaw, however now that we have absolute pitch and roll the data from the IMU gives us our yaw.

(Right) Figure 6: *Comparison of corrected IMU data to expected*



Next Steps

In the coming semester, our team plans to continue developing and refining our submersible. Our focus will be on completing Version 1 of the design, ensuring that it is fully waterproofed and capable of operating effectively in real-world conditions.

We also plan to integrate new electrical components, including the **GPS module** and data tracking. Alongside this, we'll refine and test the **control system** to ensure stable and predictable motion during ascent, descent, and hovering.

Competitions

Due to the buoyant nature of POBS, it meets the requirements for most boat racing competitions. We plan to use this fact to gear POBS up to participate in RoboBoat next year. In order to participate we need to add a physical emergency stop button and a way to preform manual controls.