AquaBorea

ESE Senior Design 2025-26 | Team 16 (ISD)

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Aerial-aquatic robots can enhance...

Monitoring & Navigating Natural Environments

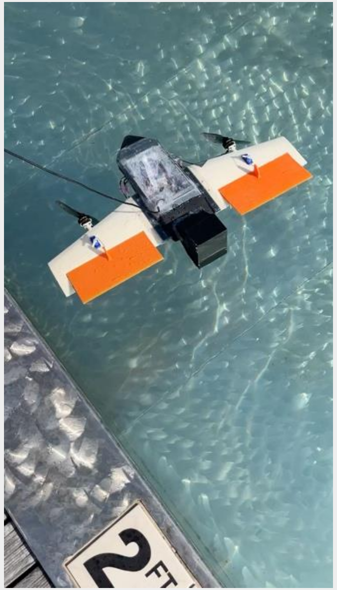
Inspecting Offshore Utilities

...and more.

Our Design: AquaBorea

An open-source, teleoperable drone platform that secures payloads in a watertight, flyable aerial-aquatic vehicle.

Flight



Swim

Dive

Constraints & Standards

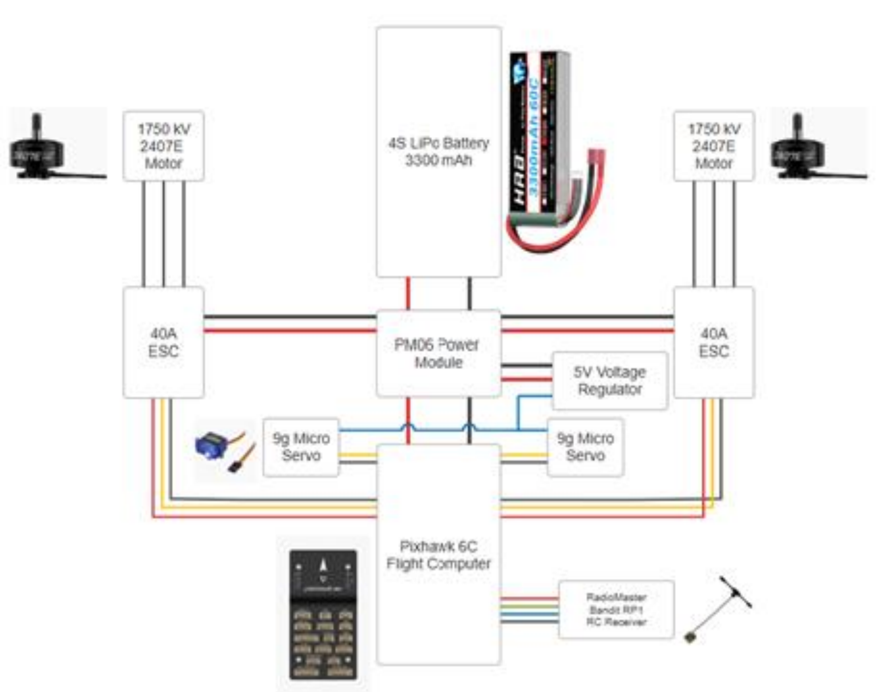
Constraints

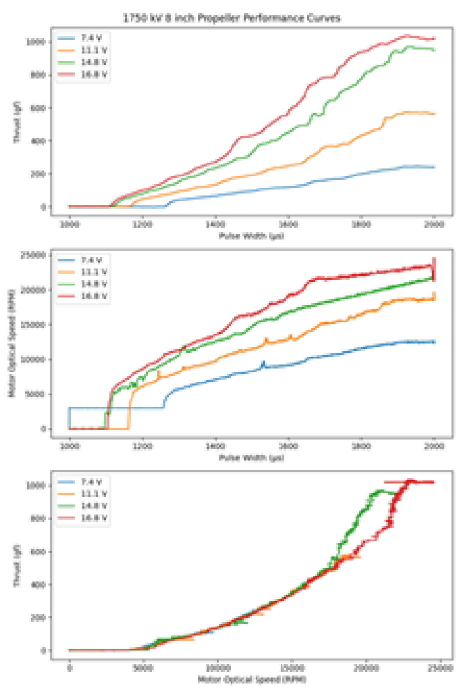
- 2:1 thrust-weight ratio (typical)
- LiPo Battery
    - Minimum of 4S for thrust requirements
    - Maximum of 6S for motors and ESCs
    - Size vs. mAh tradeoff
- Stable and maneuverable in water (~neutrally buoyant)
- Watertight enclosure to protect avionics

Engineering Standards and Regulations

1) **14 CFR Part 107** - Small Unmanned Aerial Systems (UAS) Regulations
2) **IEEE 1936.1** - IEEE Standard for Drone Applications Framework
3) **IEEE 1872.2** - IEEE Standard for Autonomous Robotics (AuR) Ontology

Hardware Subsystem





Find n $[rps]$ to calculate thrust

$$V = \frac{1}{K_v} n + iR_m$$

$$4 * 3.7 = \frac{1}{1750\,[rpm/V]} n + 49[A] * 0.038[\Omega]$$

$$\rightarrow n = 26142\,[rpm] = 435\,[rps]$$

Plug this into thrust equation, 2 motor thrust:

$$T = 2C_T \rho D^4 n^2$$

$$= 2 * 0.1 * 1.225 * 0.18^4 * 435^2$$

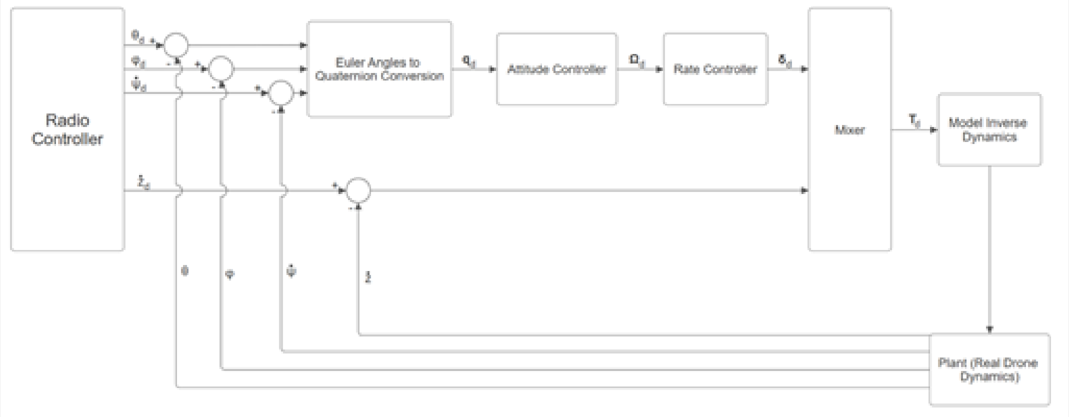
$$= 48[N] = 4800\,[g] \text{ total thrust}$$

2:1 thrust to weight → 2400 [g] weight limit

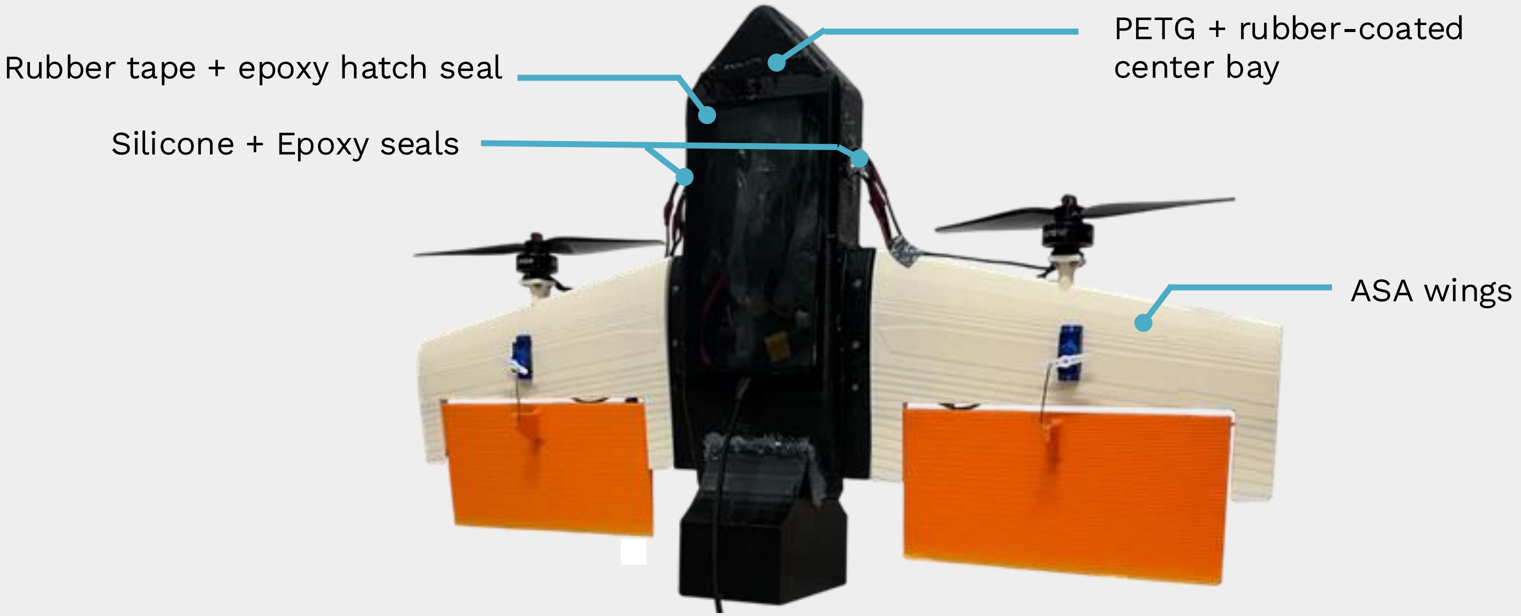
FOS = 1.25 → limit weight to 1800 [g]

Software Subsystem

- Pixhawk 6C flight computer and open-source PX4 software
- Configure control parameters and monitor telemetry via QGroundControl
- Connect via USB-C, WiFi, or radio
- PID and onboard IMU for body rate and attitude control



Structure & Waterproofing



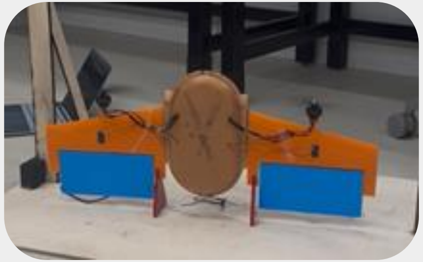
Previous Iterations

v0

Outcomes
- Prove mechatronic interfaces
- Demo feedback response

Points to Improve
- Not durable
- Can’t be waterproof
- Had lift, not controllable

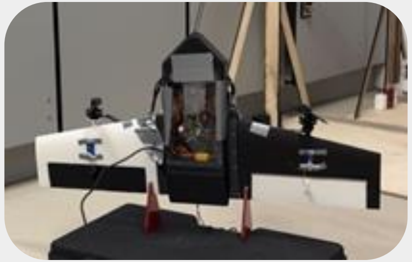
v1



Outcomes
- Improved structure; 3D printed
- Test lift behavior
- Attempt tuning stability control
- Waterproofing via pressed interface + TPU gasket

Points to Improve
- Unreliable waterproof interface
- Hard to access avionics
- Low stability and control authority

v2



Outcomes
- Improved stability margin and control authority
- More robust control loops, takeoff, hover, and maneuverability
- Easier access to avionics

Points to Improve
- Fragile motor mounts (adjust 3D print params)
- Uneven base → unreliable IMU calibration

Conclusion

Ethical Considerations

- Disturbance of wildlife or natural habitats
- Usage with irresponsibly-engineered or harmful payloads

Accomplishments

- VTOL, Stable Hover
- Waterproof to 1.5ft
- Aquatic Maneuverability

Budget

Electronics: $325
3D Materials: $30
Hardware: $71
Total: ***$491***

Future Work

- Integration with Camera + Sensor Payload
- Forward Flight Mode
- Improved Human Interface Design

Thank You!

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