Amphibious Drone

NEW MEXICO TECH
SCIENCE • ENGINEERING • RESEARCH UNIVERSITY

Autonomous Flight & Aquatic Systems Laboratory

Background and Objective

Marine research currently requires a complex infrastructure that demands an immense amount of resources. Modern drones contribute greatly to reducing such strain on resources but there is a notable lack of functional amphibious drones. Having a modifiable amphibious platform would greatly increase research capabilities while reducing the overall human interaction.
Our objective is to develop an aerial drone with the ability to carry a secondary aquatic drone to various remote locations with a focus on structural health monitoring (SHM).

Benefits:

- Cost effective
- Modifiable
- Versatile
- High accessibility
- Reliable
- Multi-purpose
- Reduced footprint

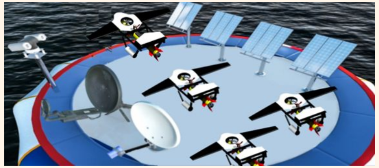

Figure 1: Hypothetical drone launching platform

Specifications

- Aerial drone with 2 meter wingspan capable of carrying a 3 kg autonomous underwater drone (AUV).
- Vertical takeoff and landing (VTOL).
- AUV capable of autonomous operation, and underwater SHM.
- Final design capable of full autonomy across all components.

Previous Work

- Worm gear tilt-rotor system designed, tested, and evaluated.
- Magnetic “claw” designed to better fit drone underbelly.
- SunnySky v5208 motors selected for improved performance.
- Electronics mapped out and tested for aerial drone.
- Prototype front underbelly constructed.
- Wingtips designed and printed for wing reconstruction.

Progress of Drone System

UAV Wing

The wing size of the UAV has been reduced to 2 meters for manufacturing purposes, and all other components were adjusted to fit this new size. The wing has been constructed from a fiberglass composite. Mission Planner has been used to program the drone and determine an autonomous flight path.

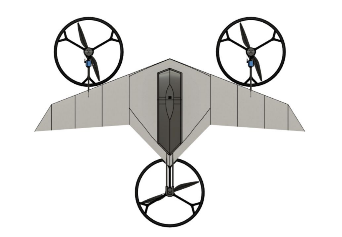

Figure 2: Two meter aerial drone and underbelly.

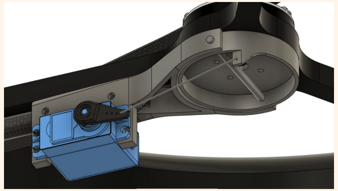

Figure 3: View of the entire assembly of the front motor mount, with emphasis on the linkage and pivot point.

UAV Tilt Rotor

The tilt rotor design and motor mounts have been finalized. The tilt rotor has been adjusted to actuate individually. Due to this, the rear motor mount no longer needs a tilt mechanism. A model of this system was printed for testing purposes and the results were promising. Gyroscopic torque calculations were completed to determine 100 oz-in of torque is required to actuate the tilt-rotor.

AUV System

For the AUV this semester, a piston ballast system has been chosen and modeled. Piston ballasts are effective and relatively cheap to manufacture. Various control surfaces have been decided upon. These surfaces include rudders, stern planes, fins, and a sailplane.

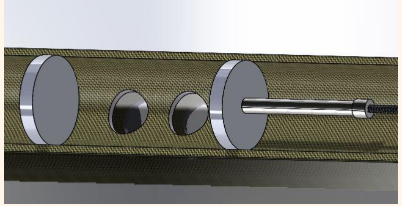

Figure 4: Expanded view of piston ballast model

Results and Conclusions

All of the components required for flight of the UAV have been tested on a mock frame using a hexacopter setup. Wingspan has been changed from a 3 meters to 2 meters for ease of fabrication. This will also help reduce the price of materials, keeping our drone cost effective. The team found a suitable underwater camera for AUV; this will allow the AUV to view structures underwater and assess their strength. Improved the conceptual design for AUV control surfaces so that the drone will be able to operate autonomously underwater. Began modeling various individual components so they can be ordered and tested.

Figure 5: Drone concept assembly

Future Work

For the UAV we will continue to 3D print and fabricate the underbelly and tilt-rotor components, test electronics, complete aerodynamic center calculations, and model and integrate the magnetic claw mechanism in future semesters.
Moving forward with the AUV we will continue to work on the conceptual design, finalize materials, work on connecting fins to the main body, finish weight estimations, and test ordered electronics.

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