Development and Integration of a Modular Avionics Bay for SWIFT Unmanned Aerial Vehicle Electronics

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ARTS-Lab
Adaptive Real-Time Systems Laboratory

Motivation/Introduction

Why have an adjustable avionics bay?
Traditional fixed avionics bays limit balancing options within the aircraft; a modular and movable bay allows for real time adjustment to the aircrafts center of gravity to ensure optimal flight stability and aerodynamics regardless of changes in the payload.

Requirements/goals:
- Create a centralized enclosed shield to protect electronics; such as flight controller, sensors, batteries, and wiring.
- Designing a movable bay ensures the system can be transferred into different sections of the fuselage to adapt to different loads without a full redesign.
- Isolating the electronics into a singular bay allows for a more streamlined process of trouble shooting and significantly reduces maintenance times.

Figure 1. Avionics bay depicting lower slots for holstering batteries and rails for upper platform.

Weeks 1-3 were dedicated to learning tools and designing the avionics bay

End of week 3 and beginning of week 4 were used to design and print the upper platform.

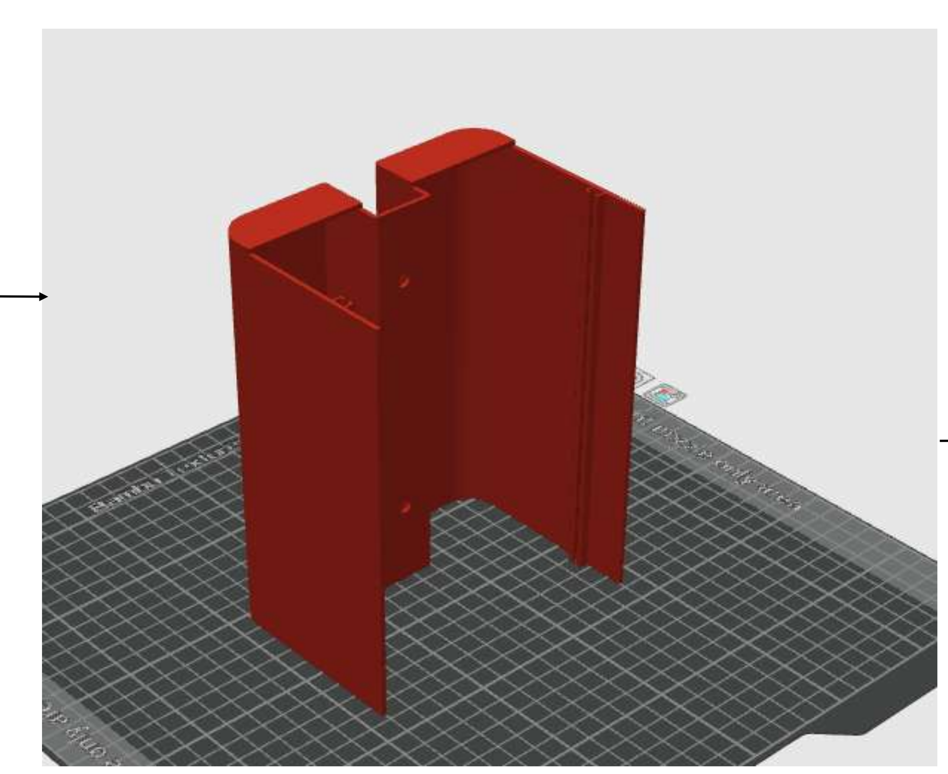
Methodology

CAD Modeling:
- **Adaptive Parametric Design:** Created a multi-part avionics enclosure in Autodesk Inventor that dynamically adjusts to future fuselage updates.
- **Dual-Tier Layout:** Features a sturdy base tray with a rear lip for secure battery placement, paired with a low-profile rail system.
- **Sliding Upper Tray:** Maximizes internal volume via a slidable upper deck that houses the flight controller, sensors, and routing for wiring.

Printing Optimization:
- **Lightweight Structural engineering:** Designed thin-walls to optimize printing, utilizing minimum material volume to maximize the aircrafts Payload capacity without needing to sacrifice the physical protection of the electronics.
- **Stress-Optimized Print Orientation:** Oriented the high-stress sliding rails parallel to the build plate to align print lines with the load path, maximizing inter-layer shear strength

Figure 2. Upper platform designed to slide along the rails of the avionic box

Figure 3. Avionic box in a vertical position to maximize printing efficiency



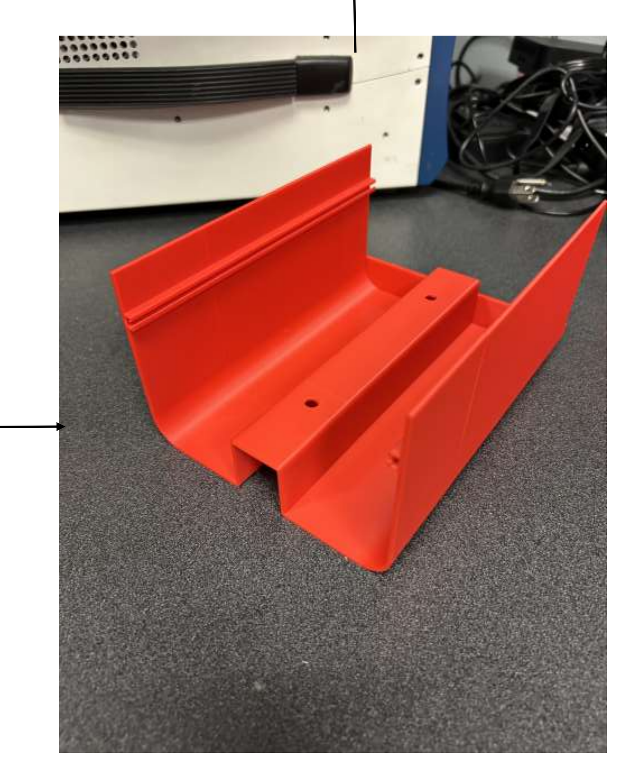
Progress/Results

- The multipart avionics box is fully finalized, including the sliding tray dynamic, which will scale alongside any structural modifications
- Maximized the internal volume by creating a dual tier design, holding the batteries at the base, while the upper portion is for electrical components
- The avionic box allows for clean wire routing, precise interlocking tolerances, and possible smooth translation along future interior rails.

Equipment Utilized:

- **Autodesk Inventor**: Utilized for it high precision 3D modeling and ensuring tight tolerance for the internal electronics.
- **Bamboo studio**: used to slice the 3D models and optimize print parameters
- **YouTube**: Leverage as a quick, self-education platform to master CAD workflows, slicing techniques, and troubleshooting problems.

Figure 4. Avionic box printed out from the Bamboo lab H2D



Conclusion

This project helped to deliver a modular, adaptive avionics box which seamlessly integrates within the UAV's fuselage while simultaneously protecting critical flight electronics. While this is already effective, next generation versions of the avionics box can use a carbon fiber Nylon to reduce mass while also improving the ridged of the overall structure

Figure 5. Final Avionic box with the slidable upper platform attached

Final metrics:
Length 178.750 mm
Width:132.000 mm
Height: 90.000 mm
Thickness: 1.000 mm
Mass: 154.000 mm

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