F-16 Airplane Instrumented Process Report

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ECE 413

F-16 Capstone Team 5

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1. Installation

1.1. Battery

The original airplane has a spot that fits the battery in and secures it with two strap closures so we just placed the battery there as a starting point.

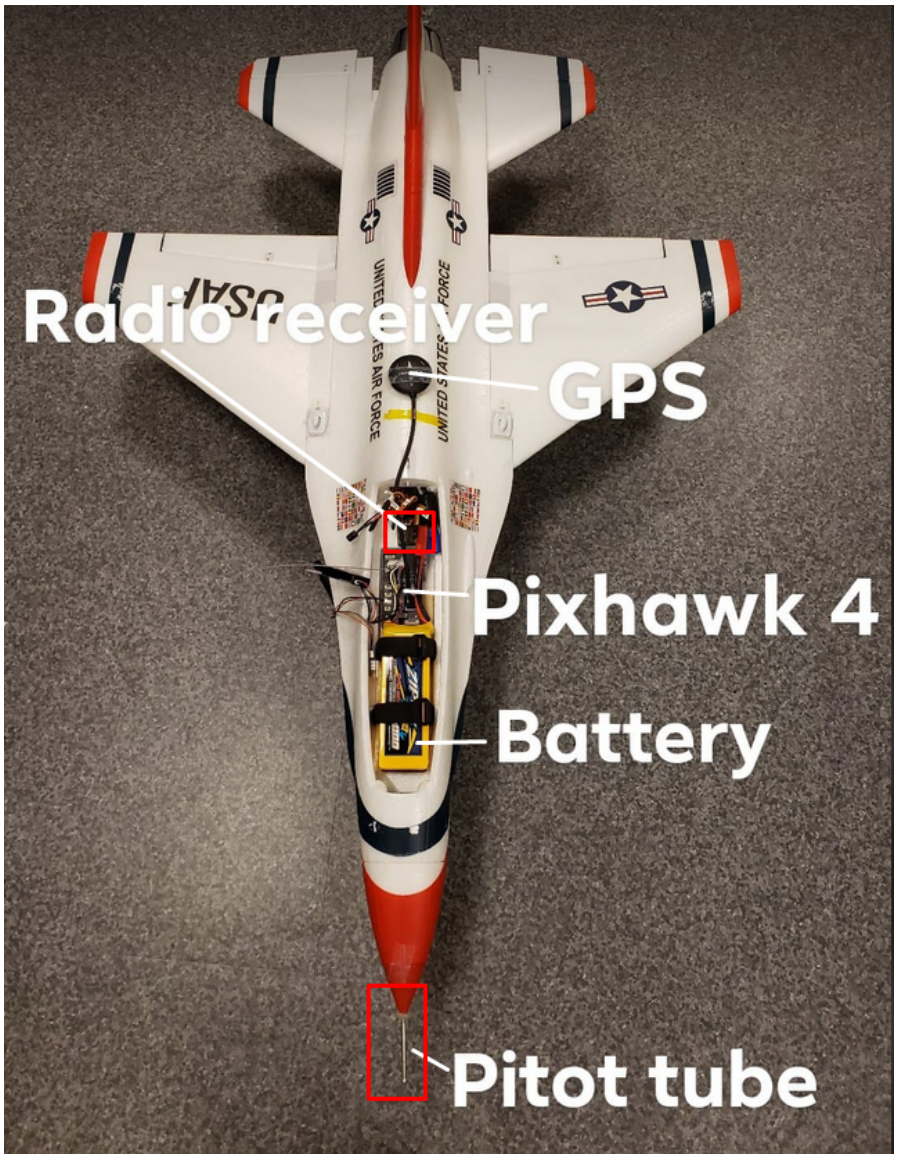

Figure 1: F-16 model with battery and other components attached

1.2. Pixhawk 4 Mini

In Figure 1, the Pixhawk 4 was placed next to the battery temporarily where it's convenient to be connected to the battery, power board, and other parts. The Pixhawk 4 will be later replaced with a smaller, compact version of Pixhawk 4 mini to have more space and reduce weight in real flight testing

1.3. Spektrum Radio Receiver

The Spektrum Radio AR631 Receiver was positioned near the servo wires permanently so that we don't need extra work to extend the wiring cable.

1.4. GPS

There was not much space to fit in the GPS inside the airplane so we mounted it outside with glue and tape permanently (shown in figure 1). The issue was that the GPS cable is a little short for us to connect to the Pixhawk inside and we did not have much choice to place it. Therefore, we had it pointing backward and then added -180° degree to the autopilot software so it can read data correctly.

1.5. Telemetry Radio

The telemetry was first placed temporarily next to the Pixhawk 4 for initial calibration but then we cut through the pilot seat to attach it there to have a better communication signal to the ground control station rather than inside the airplane (shown in figure 2).

Figure 2: Fully assembled F-16 airplane

1.6. Airspeed Sensor

At first, we cut a hole in the nose cone to attach the pitot tube with hot glue as a usual airspeed sensor's position for most aircraft, and then drilled a channel for the silicone tube to go through the nose to the airplane body and connect to the airspeed module, which was mounted permanently next to the Pixhawk 4 mini. However, we figured out that the placement was not stable enough for high speed flight so we moved the pitot tube to the right wing area and cut a channel for the silicone tube so it will not have any

effect on the airfoil (shown in figure 3). Then secured everything with tape and stabled the pitot tube with extra hot glue.

Figure 3: Pitot tube

1.7. Power Management Board

The power board can be placed either in pilot seat or inside the body if we got space for all wires and cables

1.8. Angle of Attack Sensor

- Printed 3D wind vane
- We got the AoA setup and working properly but then somehow it got burned out
- Broken AoA sensor was sent back to the manufacturer for a replacement
- Status: incomplete

1.9. Calibration

After having everything in place, we performed a full calibration of the sensors and Pixhawk 4 mini in QGroundcontrol and a RC controller calibration

2. Power Management Board Connector

2.1. Procedure

The original manufacturer's power board included the cable to connect to the battery only (shown in figure 4), so we need to make a new power split cable to connect the battery to Pixhawk 4 and ESC together. We desoldered the provided cable from the power board module and removed the old plug, then added new plugs at two ends of the cable with additional wires that connect to the Pixhawk 4 mini (shown in figure 5).

Figure 4: Original Power management board with cable

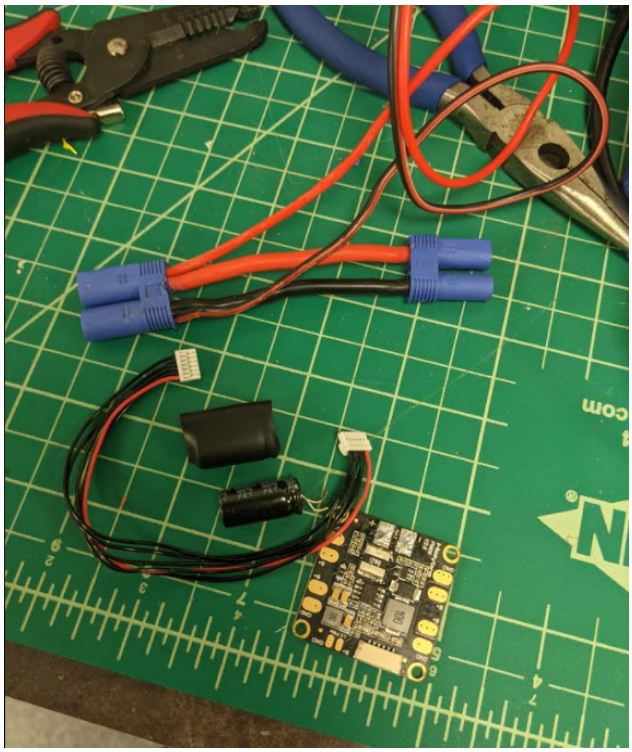

Figure 5: New power split cable

2.2 Testing

Conducted a complete battery testing to verify that the new power split connector between Pixhawk 4 mini and ESC/servos is working properly.

3. Battery Connection

3.1. Convert Battery Plugs

We had to create a new battery plug to make it compatible with our new power split cable. The process was removing the old battery plug and soldering it with a new one that fits with the power cable.

3.2. Charger Adapter

We also need to make a new charger adapter for new battery plugs

4. Moment of Inertia Measurement

- Mounted all components temporarily and measure the airplane's weight
- Setup experiment to measure the moment of inertia for roll, pitch, and yaw moment
- Measure hook-up string length, distance between two strings
- Record data in Excel sheet and convert the time to seconds

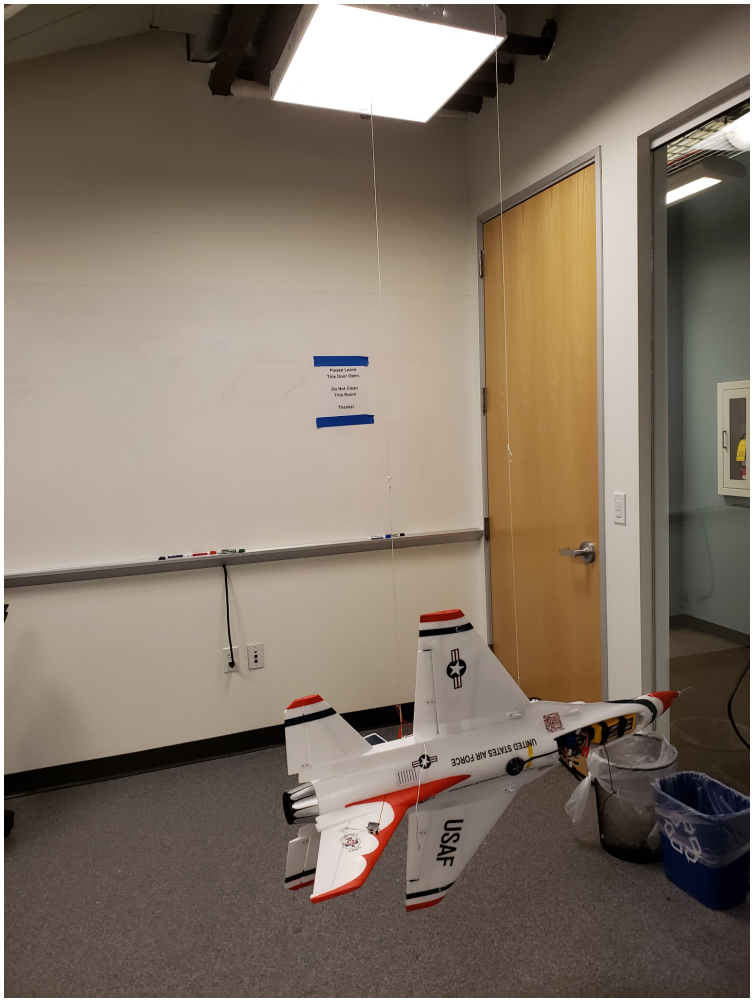

Figure 6: Inertia moment measurement setup