

# Ducted-Fan-Prototype

## Flight control system for hovering a 'Ducted-Fan' prototype

### Students



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**Introduction:** For hovering flying objects, the following variables must be controlled: pitch, roll, yaw, and altitude. Any translational movement is a result of the pitch and roll angles. In a standard quadcopter, these motions are controlled by at least four propellers and engines. However, it is theoretically possible to get an object to hover stable with only one propeller and four flaps mounted directly in the engine's airflow. In this configuration, the aircraft's engines must produce enough power to lift the entire aircraft. This project aims to develop a prototype capable of hovering by itself.

**Approach:** We designed the entire prototype in Fusion 360, and 3D printed the parts in PLA. After the hardware was completed, we began to write the software components. We simultaneously developed both the iPad app to monitor the prototype and the flight computer software. The iPad app allows us to configure the control parameters in the field, runs diagnostic checks on the prototype and monitors it in flight. The flight computer has three main tasks, reading all necessary sensor data, calculating the positions of the flaps and sending all telemetry data to the iPad.

Parallel to the software development, we measured the physical aspects of the prototype (centre of gravity, torque and mass). Further, we created a Simulink model to simulate the prototype in flight with this data. In the final phase, we tested the prototype and tuned the control parameters to get a smooth hover.

**Result:** The result of the project is a flying prototype. The pitch, roll, yaw and altitude controllers are working in keeping the prototype hovering upright. The flight time of the prototype is about 1.5 min. We

never flew higher than 1.5 meters above ground for safety reasons. The flight computer software can adjust the flight controls based on the IMU and the altimeter data 100 times per second. All flight data is logged to the iPad and an onboard SD card.

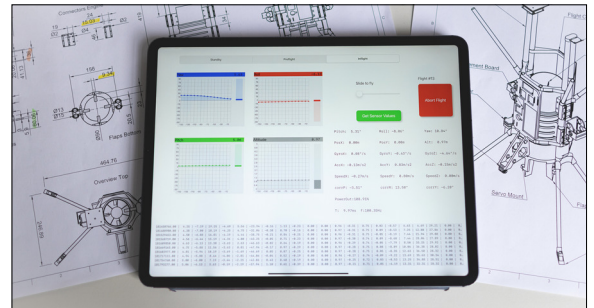
### The prototype in flight

Own presentation



### The iPad application

Own presentation



### The final prototype before a flight test

Own presentation



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