An Open Source Quadcopter Platform for Simulink

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1 Abstract

The Faculty of Aerospace Engineering at the Technion offers an advanced control lab course to undergraduates (Control Lab 085705). The course teaches students how to design autonomous flight control and estimation algorithms for a quadcopter. The current course is structured around the "Parrot Minidrones Support Toolbox" from Simulink. Recently, the Parrot drones and their components were taken off the market which makes them obsolete. This project's goal is to design a new drone platform that can be substituted directly into the course and used in quadcopter controller research. The drone should be based on open-source firmware, interchangeable off-the-shelf electronics, and a custom frame that can be integrated with testing hardware. A study was conducted to decide which open-source flight control package would be used as the framework. The study focused on how key requirements for the course would be implemented. These features include integrating the students' Simulink controllers as the primary motor controller, robust two-way communication, and optical flow integration. "Ardupilot" (Arducopter) was chosen among the major open-source flight control packages. Our Simulink wrapper is based on a custom flight mode. The mode pulls raw sensor data from the onboard accelerometer, gyroscope and an external optical-flow module. Additionally, it pulls XYZ estimations from the onboard extended Kalman filter which has been configured to reference the optical-flow measurements. The students interface with the platform through two Simulink models: the *Flight Control System* and the *Dashboard*. Students construct their algorithms in the Flight Control System where they can invoke the firmware compilation and uploading. The Dashboard hosts a display for signal logging and basic flight control. Behind the dashboard is a python script connected by either Wi- Fi or USB to the drone. The current drone is based on a BETAFPV F405 20 Amp AIO Flight Controller. The all-in-one (AIO) combines the flight controller, power distribution, and motor controller (ESC). The flight controller is connected via UART to an ESP Wi-Fi module that has been flashed with support for standard MAVLINK communication. A Micoair MTF-02 optical flow and lidar module is connected via a single UART connection to the flight controller. The drone created in the project fulfils the goals of replacing the Parrot drone system. In doing so, we also deliver a strong framework for implementing Simulink onto an affordable open source quadcopter platform. This feature allows the drone to be used as an accessible testing platform for more advanced research.