Project 2

Due: Project 1 will be demonstrated in lab on Thursday December 11. The report for the project will be due at 5 pm on Friday December 12.

The goal of this project is for students to implement a new capability using the Pixhawk autopilot with the ArduCopter firmware. In particular, students must implement a vision-based tracking algorithm. Details of the specific algorithm to be implemented and details for how it is implemented are up to the students. The multi-rotor aircraft with Pixhawk autopilot and supervisory Raspberry Pi computer will be provided for use by the class.

Teams

The project will be carried out in teams. There can be three total teams for this assignment. With 16 registered students, that means two teams of 5 students and one team of 6. Each team submits one version of the report assignment (detailed below). Teams are encouraged to collaborate with one another and to share insights.

Task

Student teams are to implement a **vision-based tracking** capability:

- A red helium balloon will be placed randomly in the workspace of the RECUV motion capture lab. The height of the balloon will be fixed and known (1 m). The balloon will be held in place by a weight attached to a 1 m string.
- Teams will have access to the balloon in advance in order to calibrate image detection algorithms.
- The quadrotor will be placed on the ground at a random location and orientation.
- A camera is fixed to the quadrotor and to be used to detect and track the balloon.
- The camera will not likely be aligned with the symmetry axes of the quadrotor. It will remain in the same location on the aircraft for the entire semester.
- The RECUV motion capture system can be used to calibrate cameras and control algorithms.
- Final demonstration of tracking of the balloon **can** use the motion capture system. Data can be stored on board the aircraft from the motion capture system during flight for the purposes of analysis.

Hardware

RECUV will provide one or two Pixhawk autopilots for use for this project. The main effort for the project will be implemented on the RECUV multirotor platform. Development should be performed using the software in the loop capability first. All teams will be provided with a Raspberry Pi and Pi Camera similar to the hardware on the robot.

Software Architecture

Students will develop code to implement their approach on an aircraft using the ArduCopter firmware with the Pixhawk autopilot. Students may make changes to the ArduCopter firmware and/or use communication APIs (mavproxy, droneapi, mavlink) to communication with the autopilot from an onboard supervisory computer. The decision on what to modify in firmware and what to modify on the supervisory computer is a design decision of the team.

Assignment

This assignment has only one phase, a report due for each team. The report should describe the following: the specific control algorithm designed by the team, simulation results in Matlab and/or SITL that show expected performance, block diagrams of the software implementation of your algorithms, plots and discussion from flight experiments, final recommendations (successes and failures) based on your experiences. A single report is due for each team at 7 pm on Sunday Dec. 14, 2014. Each team will perform a live flight demo in lab on Thursday Dec. 11. Results in the report do not have to be from the flights performed for the demo.