Spring Sprint 3: Iris+ April Tag Detection, Frame Transformation and Autonomous Decent

Individual Lab Report #8

Job Bedford

Team C: Column Robotics
Eric Sjoberg, Rohan Thakker, Cole Gulino

ILR8
2/25/16

Individual Progress

These past 2 week, I transfer the April tag detection node from the AR.Drone to the Iris+ Drone, developed a coordinate frame transform for the detection of the April tag, and wrote an autonomous descent script as a precursor to autonomous dock.

Iris+ Drone April Tag Detection:

The April Tag detection node was transferred to the Iris+ drone and integrated into the Drone's system. The detection package written by Palash was download from github into the workpace on the odroid. I modified the code to construct and publish april tag poses on an '/april_pose' topic. The code would then read a '/camera/image_raw' topic published from the downward facing camera to detect the april tags in it's field of view.

Frame Transformation:

In order to coordinate the drone's movements form a global frame to position it in a predock orientation above the tagged dock. One possible method of control for the drone is via set points in a global frame. In order properly direct the drone's movements towards the April tag in the global frame, we must be able to properly detect the April tag's pose from a global frame of reference (p_A^G) using the cameras viewpoint. We are given the pose of the drone's body in the world frame (T_B^G) from 'mavros' local position topic. The camera's pose relative to the body frame can be calculated via measurements (T_C^G). The April tag detection node grants us pose estimation of the April tag from the downward facing camera's viewpoint (p_A^C). From this knowledge, the transformation can be solved for.

$$p_A^G = T_B^G \, T_C^G p_A^C$$

A node was programmed to do this transformation calculation. The node is still under development due to miscalculation of the drone's body frame to its down camera frame. Regardless, the framework has been created and is operational

Autonomous:

In order to understand the Iris+ drones landing capabilities, the drone decent characteristics must be observed and studied. For this sprints demo, I modified a node to send downward command velocities to the drone in an attempt to see land. The drone was manually operate to a position above a landing platform, then switched into autonomous hover mode. The ros node was activated the drone began to autonomously descend. The drone would shift less than a meter from vertical position above landing platform. Thou there was an instance where the downward facing lights tampered with its optical flow sensing thus messing up its position estimation.

Challenges

Major challenges this week was interrupting the orientation of the drones body frame. Although the pose of the drone's body were given by the 'mavros' node, the measures received didn't align with the drone's physical position in space. The 'mavros' utilizes an extended kalman filter on the drone IMU coupled with optical flow from a downward facing camera to achieve a state space estimation. Initial the optical flow sensor was giving use false reading when we were testing it in close proximaty to the ground. The bright lights form the bottom of the quad interfered with the optical flow readings. The lights are now taped shut. Documentation on the orientation of the drone body coordinate with respects to the global frame are sparse, so most of our knowledge of it orientation was gain from repeated testing.

Teamwork

This sprint the team united to work on autonomous descent on the Iris+. Since I was to attend a conference last weekend, I transferred the April tag detection node early in the week so the team could begin working with it during the weekend.

Unfortunately integrating of the April tag node was not as straightforward as hoped and required addition work with setting up the camera. I remotely helped my team but the efficiently of the complete integration took longer than expected. Over the weekend, Erik, Rohan and Cole worked on finalizing autonomous hover mode and the switching into ros node control mode. They also sync the code sceme on both drone to have the same files and packages. When I return, we all (myself, Erikc, Rohan, and Cole) contributed our time to interpreting the frame transformation, debugging the mavros messages, and programing and autonomous descent protocol.

Upcoming Week

Complete autonomous docking of the Iris+ into our dock and point to point flying will be the goals for this upcoming sprint. Team C will break up into two sub-teams. Erik and Cole will work on point to point flying with the Iris+. The drone will exit the auto hover state and proceed to transverse form set point A to set point B. Rohan and I will be work on autonomously docking using April tag servoing with command velocities. The drone will start in a autonomous hover mode in the airspace of the dock, then will proceed to slowly descend into the dock using the April tag as a goal marker.