Spring Sprint 6: SVE Dress rehearsal, Integration Polishing .

Individual Lab Report #11

Job Bedford

Team C: Column Robotics
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Individual Progress

These past 2 week, we successfully integrated apriltag servoing into the system's state machine, debugged more of the drones issues like disruptions due to the environment, timing issues, state transitioning, and we continued development of articulated landing

Integrated April Tag Servoing

Last week's sprint, we corrected the quad's framing with respects to the apriltag detection as well as fixed state space updating with respect to the high frequency Mavros updates (100Hz) and the low frequency camera updates (7Hz). With those improvements the drone was able to servo over the april tag effectively. This sprint we integrate the servo into the rest of the drone state machine. During the SVE the Drone will first enter its cone search, and transverse the workspace searching with it's downward facing camera for the April tag. As soon as an April tag is discovered the drone set a new set point to hover over it and then collect as series of tag measurements to better hone in on the target.

The method we were originally using to filter the constant stream of tag detections was unreliable with the rest of our state machine application. The filtered response requires a second or to collect enough data to implement a best fitted RANSAC of the tag estimate. In this time the drone could already be flying away to another location. Thus a substate was added to halt the drone's movement at the first detection. The drone also became increasingly unstable by continually moving to the most recent tag estimation given by the filter. Thus it became more advantageous to discretize the drone movement to once a second, only after averaging a few filtered data points. This discretized movement only occurs twice in our current configuration but yields decent results for positioning before open loop landing. Once the drone is position it immediately drop to the ground, in order to avoid drift that naturally comes with hover and the slight build up of error in the local frame.

Figure 1: Just after landing with discretized position.

Figure 1 above shows the results of this discretized landing. The next steps are to optimize the close loop landing to incorporate discretized update to the apriltag servoing. If this is successful enough, the physical dock can be used for our final SVE.

Debugging

Some of the biggest issues that occurred this week was debugging interruption from the environment. Optical flow is one of the prime sensing methods our drone uses for state estimation. Unfortunately it is like a house of cards and is easily derailed by undue effects in environment. This week the drones cone-search quite working for half a day and we simply could find the reason why. Eventually we discovered that one of the main B-level fluid lights unexpectedly had been off for the past day. The lighting conditions looked sound but to the high frequency optical flow camera it was unfavorable. The fluid lights actually blink rapidly at a frequency faster than 30Hz, were it can only be viewed by a slow motion camera. Each of the three light blink at a different offset, thus summing to near constant illumination, but when one of the lights were off. There ended up being dark patching in the optical flows camera feed, causing it to go haywire.

Since then we also change the flooring of our test arena and added graffiti to denote more major edges for the camera to locate.

Challenges

Collaborating on the same code as team can be challenging from time to time. As teammates change the frameworks, add new parameters or functions, the code is dynamically changing constantly. Much timeis spent reverse engineer code between teammate. We also don't always see eye to eye. Erik might want to get the functional program up and running as soon as possible, while Rohan might want to convert to a more sophisticated state machine. Code contribute to the pool might not be fully developed or even tested. This may cause others collaborator hours trying to debug with no knowledge to where the bug in someone else code is. For me, I spend 4-5 hours stressing test the drone, but there was a problem in the camera filter that we thought was fully functioning, but had never undergone actually testing.

I learned this week to do element by element validation of a system instead of test the overall system as a whole. Problem need to be isolate, and with a complex system it is very difficult to narrow down the problem by test everything at once. Also GIT version control and personal branching is a useful tool for collaborating code between teammates.

Teamwork

This sprint the team as a whole collaborated on integration and testing. Erik continued with development of his cone search, as well as the initial implementation of the final integration. Unfortunately there were aspect of the integrate that were not fully test, and lead to some problem when the other teammate pick up where he left off. The problem were eventually resolved, and Erik spear head a lot of the integration and debugging due to his vast amount of experience isolating and detecting minute' issues with complex system. Cole Rohan and I pick up where Erik left off on the integration discovering issues in the optical flow, the parameter setting and filtering the camera feed. Cole and Rohan continued to debug the RANSAC filtering of the cameras rectified April tag detection. I continued to stress test the integration as a whole. As a team we were successfully in achieving a bare bones performance of the SVE for this weeks PR.

Upcoming Week

This sprint we have a barebones SVE that achieves the basic requirement. We have 10 days until the first SVE. So we will be polishing the performance making stage ready. On the table is possible obstacle avoidance using the front RGBD camera, sharper and more speedy cone search, and possibly articulated landing into the dock. I will be commanding articulated close loop landing into, hopefully, the physical dock. Erik will be commanding obstacle avoidance. Cole and Rohan will be stress testing the current cone search configuration and tuning the systems state machine to respond more effectively and transfer parameter more efficiently. They will also continue to develop their MatLab EKF model of the drone for the groups robot autonomy project.