Individual Lab Report

Erik Sjoberg

Team C – Column Robotics

Rohan Thakker, Job Bedford, Cole Gulino

IRL 9

March 17, 2016

Individual Progress

Designed and installed B-level hallway netting enclosure

The lack of a large netting enclosure has been a challenge as our team moved from testing automated stable flight to testing point-to-point movement. To enable more effective system development while maintaining the safety of a netted enclosure, I worked closely with John Kozar on several iterations of the design of a larger net for the B-level hallway. The most promising, first design I proposed consisted of two wires strung from wall to wall near the ceiling of the area, creating guide-lines along which clips could be pulled. This would have enabled a large net area which was very easy to shut away when not in use. Unfortunately, the facilities team was unwilling to allow us to extend the wire across the south side of the room due to their concerns about clearances.

The second design consisted of vertical posts at the two corners in order to hold up the two far corners of the net. This design was quite a bit less aesthetically pleasing, however it had the benefit of being easier to justify to the cautions facilities team. Working with John, I installed the new netting and we are now able to perform more complete testing of our system. Figure 1 below shows the newly completed netting enclosure.

Figure 1: Larger net enclosure in B-level hallway

Implemented and tested closed-loop april tag hovering

Using a velocity-based P-controller implemented by a teammate, I coded and tested a ROS node which performed closed-loop hovering above an april tag. The first iteration of this node simply made a single measurement of the april tag location, then updated the set point of the P controller to guide the drone to hover over that location, treating the local reference frame used by the quadcopter as if it does not drift. This was enough to get an initial working system, however landing accuracy was as bad as +-1 meter.

The next step was to read the april tag location continuously and update the local reference frame setpoint once per second. This enabled the system to maintain its position over the april tag over a longer period of time, since gradual drift of the local reference frame could be corrected. Unfortunately, the drone was observed to occasionally drift enough that it no longer has the april tag in the field of view of its camera, resulting in a loss of tracking.

Repositioned and reconfigured wireless infrastructure

In order to ensure proper wireless connectivity between our quadcopter and computers both at our desks in the first room and in the testing location in the rear-most room, I re-positioned our wireless hub and bridge interface to a new location in the 2nd room, borrowing lab space from one of our helpful classmates. As a result of this placement, we no longer need to keep moving the wireless access point back and forth between the two rooms and have reduced a significant amount of wasted time spent on re-configuring the wireless bridge SBC.

Challenges

Lack of a spacious testing environment

Not having access to a net enclosure large enough to fly our drone from point-to-point resulted in a lack of progress on integration during the past weeks. Relatively simple tests would also end up taking much longer to complete because slight mistakes in maneuvering the quadcopter resulted in immediately hitting the walls of the enclosure. When the quadcopter does crash with the netting, it's often necessary to pull out a ladder and climb up in order to un-tangle the quadcopter to allow us to continue. This type of crash also necessitates restarting the quadcopter to reset it's internal position estimates, and the restart sequence can take several minutes due to the slow filesystems on our single-board computer. Fortunately, the solution to this problem is now at hand with the larger netting installed in the B-level hallway.

Testing conflicts with other quadcopter teams

We also found that testing schedules overlapped between our team and the other quadcopter team attempting to dock to the ceiling-mounted contraption in the 3rd lab room. On 4 separate occasions, we were forced to wait for testing as the other team was in the middle of debugging their own code and developing their system. The second testing net will also help to alleviate this problem.

Teamwork

With the entire team focused on enabling the automated landing functionality, we experienced some problems with integrating code which was developed concurrently. Cole was required to go back and re-write some of Job's code pertaining to the april tag coordinate transforms, since unfortunately the way Job wrote it did not meet the requirements of the separate node. This resulted in two versions of our april tag node which had to be coordinated between our two quadcopters in order to ensure consistency.

Rohan's work on the P-controller, however, was quite easy to integrate with the other team's code since our version control system makes conflict resolution and merging seamless. This week we made progress, but it was clear that 4 people working on a single problem does not result in four times as much progress. Coordinating work amongst members can take up a surprising amount of time.

Plans for Upcoming Work

Over the next two weeks I will be working to implement our point-to-point search pattern and begin integrating the various potions of our full solution. With the new net enclosure, there is no longer any external blocking factors keeping us from putting the entire system together. Rohan is planning on leveraging kalman-filter updates to more consistently integrate april tag measurements, while Cole and Job continue work to increase the accuracy of our landing sequence.