Team F: FALCON EYE

Individual Lab Report 11

Progress Review 12

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1 Individual Progress

My primary contribution to the progress was to get the GPS working with the EKF and test it outdoors. Yuchi and I worked on making the drone survey and faster. Also I worked alongside Danny to fix the IMU issues and re-calibrate it.

1.1 GPS Fuse with EKF

GPS drift has been the major reason our system has not been ready for a complete dress rehearsal. The major reason we assumed were that, it could be because the GPS is broken or the GPS fusing node in ekf is configured incorrectly. To check whether the GPS is working fine we did a plot of the GPS values using an app after collecting gps data outside wean as a bag file.

To our surprise, the drift was relatively less and the covariances produced were repeatable, in the sense that there was a pattern in the drift. The GPS would always drift to a peak value and then start to reduce to a lower value above which it follows the same pattern. All we did was to average the GPS values over the minimum and maximum values and it worked surprisingly accurate to 1m. This gave us the clear indication that the GPS is working fine. At this stage the Husky was able to reach all its goals avoiding obstacles successfully as seen in Fig.1 below. Fig.1. shows the costmap created by husky while reaching the goal, blue path is that of ekf and red one indicates raw wheel odometry. Black spots in the map indicate the obstacles.

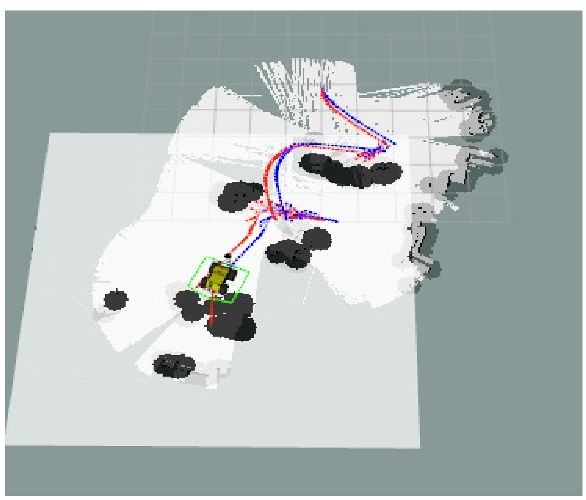

Fig.1. Costmap after Husky had reached its goal

To make this more repeatable, we made a change to the transforms with respect to which the ekf was being calculated. Initially all the calculations were with respect to map frame. We came across a post online which suggested that using odom frame makes the system covariances a bit less erratic. We implemented the same and it gave us a good improvement on the system's performance. Now the navigation stack is robust and repeatable under most conditions.

Now the husky is capable of accepting waypoints and plan its path accordingly, avoiding both dynamic and static obstacles. We implemented a code into Husky's navigation stack where it takes gps points from a topic published by drone and remap it to a map point in odom frame and plan towards it appropriately.

1.2 Improving the drone's performance

The drone's survey algorithm was all set to work from last PR but it wasn't fast enough to validate the effectiveness of our system. It was intuitive that increasing the height of drone's flight is a major criteria to satisfy to make the process faster. We tried several ways to achieve this. We printed out the april tags in A1 size, the biggest we could find. It was made to be a little less reflective than the usual paper kind giving us few centimeters more to increase the height. Now we were able to fly a bit more than 5m and still successfully identify tags.

Also we made several attempts to fix an optimal height for drone's flight and included a functionality that enables the drone to fly higher if it is able to detect the tags with ease. Now that we have a higher field of view, we could detect many tags at once and move faster, making the exploration faster.

1.3 IMU issues fix and re-calibration

The old IMU we used had issues with the internal axis alignment. We realized that the two axes were wrong and when we referred the data sheet, we realized the axes printed were different from the actual. We got a new IMU which was axis aligned for reference and re-calibrated the IMU. The calibration solved the drift in the IMU and gave much stable, usable values. We were able to correct the max and min ranges of the accelerometer, magnetometer and gyroscope and zero offset for the gyroscope. For accelerometer, we fixed IMU on an axis and then rotated around that axis very slowly to read the range of accelerometer in that axis as show in fig.2. where the min and max for all three axis are shown. The same was repeated for all axes.

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accel x,y,z (min/max) = -5.37/0.37  30.40/42.48  -258.91/-244.14
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Fig.2. Min and Max accelerometer value

2 Challenges

Our biggest challenge continues to be the weather for testing the system outside. For this PR we had two good days to test and we were able to successfully fix our system. We are planning to make use of good weather whenever it turns out to be and complete testing the integrated system. Also since it is the end of the semester, all the deadlines are closing in giving us a hard time to give more time to this project. Nevertheless we are confident that we will successfully make the system functional as expected.

3 Teamwork

Strong team coherence has helped us get through all the tough deadlines to make the systems work. We make sure to complement each others work and constantly take turns to keep working on the project one way or the other rather than abandoning it to finish other course work.

Yuchi and I worked in improving the drone's performance and Yuchi also worked completing the communication layer of the drone. Pulkit, Pratibha and I worked to fix the Husky navigation stack issues. Danny and I worked on fixing the IMU issues and recalibrate it.

4 Future plans

Now that the individual systems are working as required, we now need to integrate them. Pulkit, Pratibha and I will be working on Husky's communication layer. Meanwhile, Danny and Yuchi will work on drone's communication. Then we will come together to do our final testing and have the system ready for SVE.