Individual Lab Report – 10

Progress Review 11

By Pratibha Tripathi

Team F – Falcon Eye

Team Members:

Danendra Singh
Pulkit Goyal
Rahul Ramakrishnan
Yuchi wang

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Individual Progress

I was responsible for following tasks:

1) Mechanical structure refurbishing
2) Calibrating IMU again as the axes printed on the IMU were incorrect
3) Fixing the Husky ROS navigation stack issues

Mechanical Structure Refurbishing

We had initially made the structure as per our previous problem statement. We were supposed to take off the UAV from the Husky top and land it back there. So, we had a platform at 28cm heights and then for providing the clear field of view to the LIDAR, we kept it at 75 cms height. Because of this much height, there was a lot of jerk on LIDAR link. Since we don't need the platform anymore we removed that and placed the LIDAR at a lower height. We made provisions for powering the LIDAR, WiFi mesh router from the Husky. So now everything is powered by one battery as is secured inside the Husky. Rahul and Danendra worked on this with me.

Calibrating IMU

We had calibrated IMU earlier but as soon as we took the Husky for outside testing we were noticing that it is jumping a lot and EKF is not working properly. Whereas when we were testing it inside the wheel odometry and EKF were aligning perfectly. We were debugging the GPS, thinking it's just because of it. We then recorded multiple bag files some with GPS outside, some without GPS and with filtered IMU and with raw IMU. We realized that the two axes were wrong and when we referred the datasheet, we realized the axes printed were different from the actuals. We then recalibrated the IMU. We are still facing the issues with Husky outdoor GPS based navigation. I'll discuss those details in next section.

Husky Outdoor Navigation

We tested Husky inside and the EKF is working perfectly fine (Fig 1). But outside we are facing issues the whole EKF output was jumping around with the GPS. I also tested the GPS independently to check it's accuracy (Fig 3), but the plotting shows that it is within 3m. It is well within our expected range, but we are still not able to pinpoint the issue.

Rahul and Danendra integrated the the Velodyne (VLP-16) with the Husky. So, we are able to do obstacle avoidance and whole navigation stack is working fine without GPS. I worked on debugging this issue. I calibrated the IMU again and tested it with the GPS outside but there is still some drifting around. I also tested the system by using my phone IMU and GPS, the results are better but they are still not as desired. I tried changing the covariances and other parameter is our ekf_se odom and ekf_se map param files. Also modifying the navsat transform file. The only issue which I've been able to point out is that the axes were not proper and I was defining the RPY in urdf file according to these wrong axes. So, when we are testing inside everything is initialized relative to each other and that's why the whole system works fine but there is no absolute value for correction. But as soon as we take it outside the GPS starts to act as that ground truth and then it becomes for the robot to find the it's true position as wheel odometry and IMU are giving some other initialization and GPS is not in agreement with that. This is still all my hypothesis around which I'm working currently to fix the issue. For the same reason I'm testing with my Phone's IMU and GPS. I'm still working on this issue.

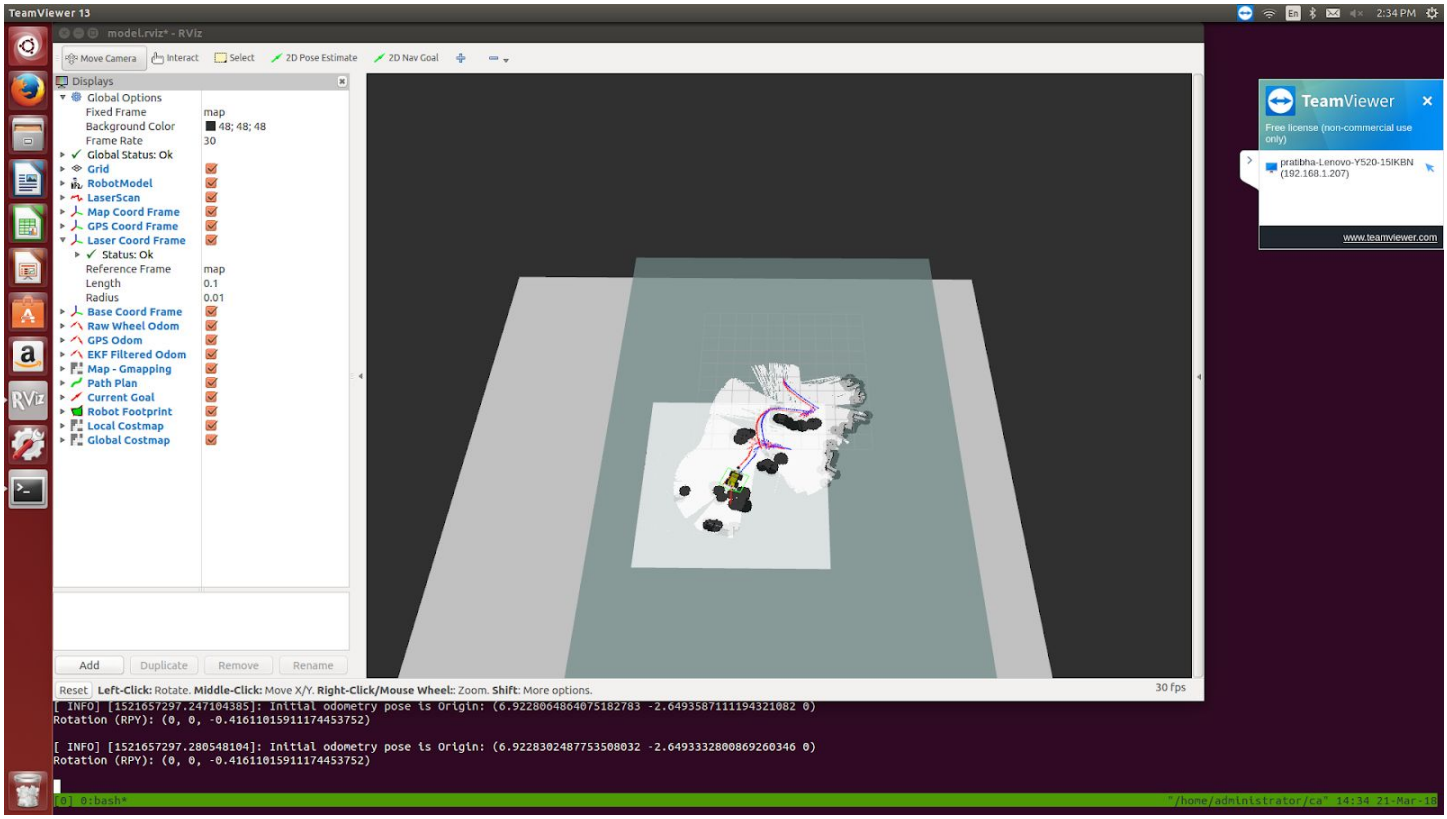

Fig 1 : Indoor autonomous navigation by Husky

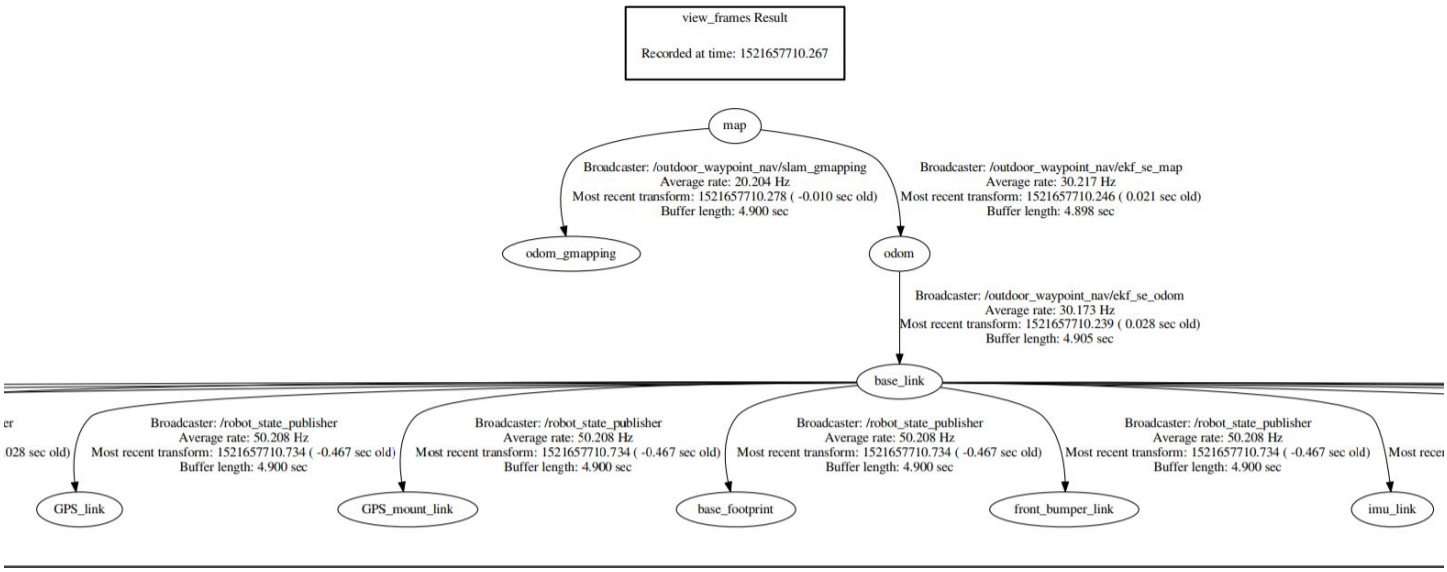

Fig 2: tf_view frames results

Fig 3: GPS points plotted

Challenges Faced

Some of the Challenges are:

1) One of the major challenge is on testing husky outside, we are having issues when we try to fuse the GPS in the EKF. We have tried changing covariances, testing with phone's IMU and GPS and other solutions, but we are able to pinpoint the issue. The last resort would be implement the ROS navigation package from scratch, but that will be very consuming, so we are currently focussing on debugging existing stack.

2) Another problem is the weather, we can't frequently test husky outside. It's really chilly outside, but we still sit outside and test it, which and additional pressure above the issue we are trying to fix. We have tried to record bag files and work with them, but when we are making any major changes we need to go outside either to test or to record bag files.

3) Another major challenge in overwhelming coursework, as I'm taking Deep learning and SLAM. Assignments for both Deep learning , SLAM and robot autonomy are released almost together, so it's like 4 assignments to be worked on in two weeks and all of them have good difficulty levels.

4) Similar situation is faced by rest of the team members, which causes stretched working hours.

Team Work

Danendra and Rahul worked on developing costmap, integrating velodyne and segregating controllers.
Pulkit, Rahul, Danendra and I worked on integrating and debugging the husky navigation package.
Danendra, Rahul and I worked on mechanical refurbishing.
Yuchi tested beebop outside and worked on calculating next april tag for AGV.

MRSD Project Progress and Future Plans

We have to work on the following tasks:

1) Debugging the issue with Husky Navigation package. If that doesn't work we will have to implement the ROS Navigation package from scratch. I'll be primarily working on this.
2) Communication layer between Husky and Bebop. So that we can read the GPS locations read by bebop on husky. Currently, when we give various target to husky they are stored in a text file and are

executed sequential. We have to implement something similar to store the gps points registered by bebop.

3) Integrating the complete UAV and AGV subsystem and testing. Complete team will work on this together.