Individual Lab Report 10

Progress Review 11

Pulkit Goyal

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Team F - Falcon Eye
Pulkit Goyal
Pratibha Tripathi
Yuchi Wang
Rahul Ramkrishnan
Danendra singh

Individual Progress

I mainly contributed towards navigation stack of husky, integration of GPS in the EKF node along with IMU and odometry.
The system is locally working fine with odometry and IMU but fusion of GPS is important in EKF in order to do the GPS based movement and also have a better localization estimate of the robot. Danny, Pratibha and Rahul, contributed to different parts of this testing.

IMU Sparkfun Razor 9Dof M0

The local EKF with IMU and odometry data is working pretty perfectly.

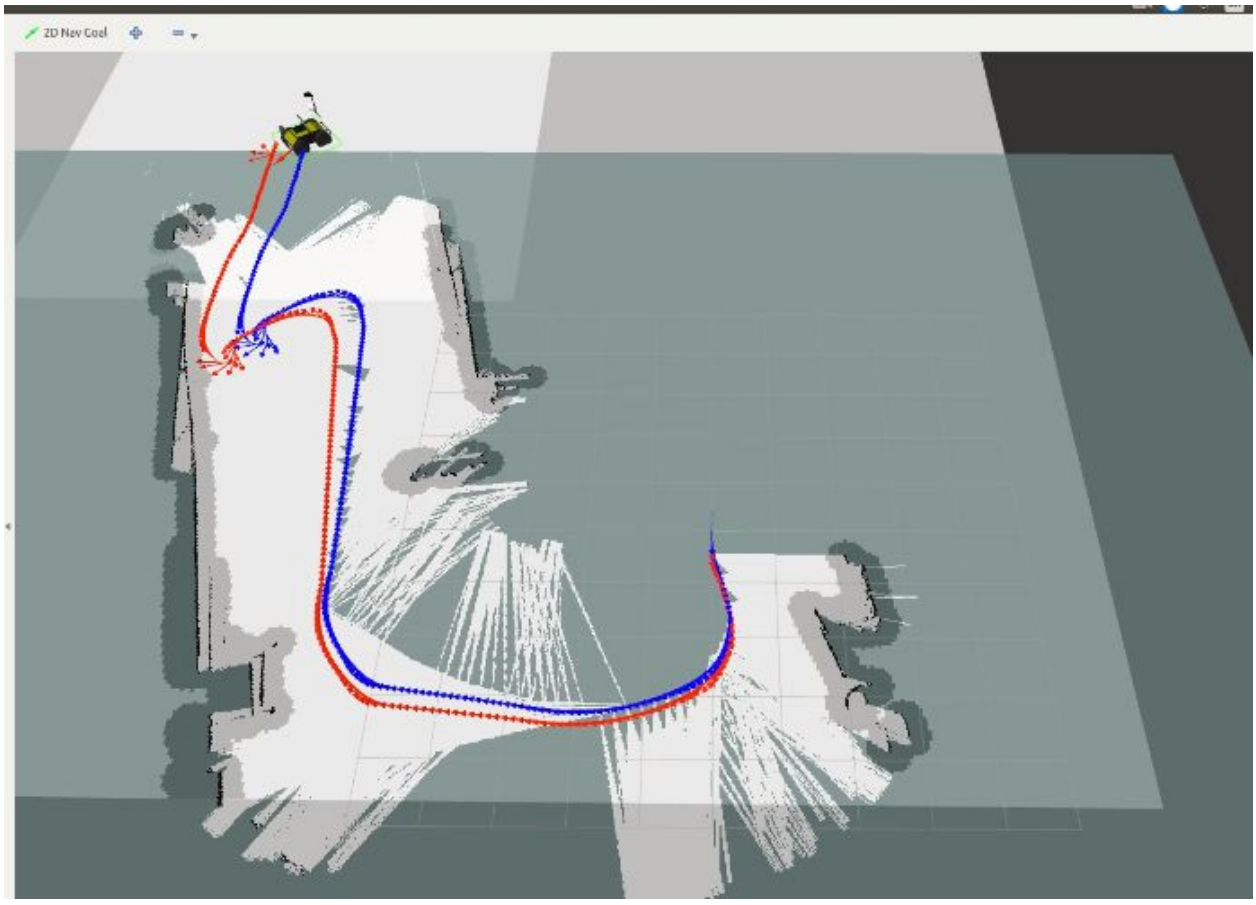

Fig 1: Blue is EKF output and Red Odometry data from wheel

The Local EKF is reading data from Accelerometer and Gyroscope of IMU and odometry then performs dead reckoning for the state estimate, which works pretty good as shown in Fig 1.
Right now there are two EKFs running on the system, one fuses IMU data with odometry and other fuses the local estimate of first EKF with GPS global estimate after transforming the position from GPS to local frame.

Challenges with IMU:

This IMU uses MPU-9250 chip which has Gyro, accelerometer and magnetometer.

9.1 Orientation of Axes

The diagram below shows the orientation of the axes of sensitivity and the polarity of rotation. Note the pin 1 identifier (•) in the figure.

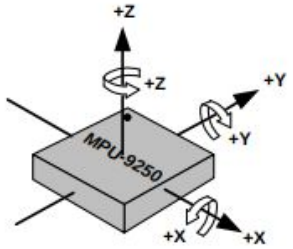

Figure 4. Orientation of Axes of Sensitivity and Polarity of Rotation for Accelerometer and Gyroscope

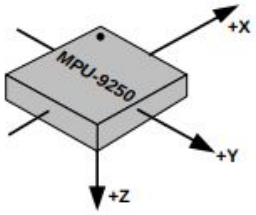

Figure 5. Orientation of Axes of Sensitivity for Compass

Fig2: Axis orientation of the sensor

The x, y and z of the sensor is supposed to be aligned with the axis orientation of the robot. The axis orientation of magnetometer is different from that of accelerometer and gyro. Right now the sensor is mounted as per the axis of gyro and accel. I applied transforms to magnetometer data in order to get the correct yaw, pitch and roll values. But this was not expected and we were using some predefined ROS package for this sensor to do the conversion to the final yaw, pitch and roll values. The calibration of magnetometer is also a big problem. As of now after the transformations, the data is little bit correct but we still need to do proper calibration and put proper offsets.

GPS SE 100

There was a lot of debugging involved in the GPS also. The data we are getting from the GPS is very erroneous and scattered even when the robot is stable, as shown Fig3. We collected the set of points from GPS and plotted them on Google Maps to visualize the data. The error is around 3-4 meters as of now with the sensor.

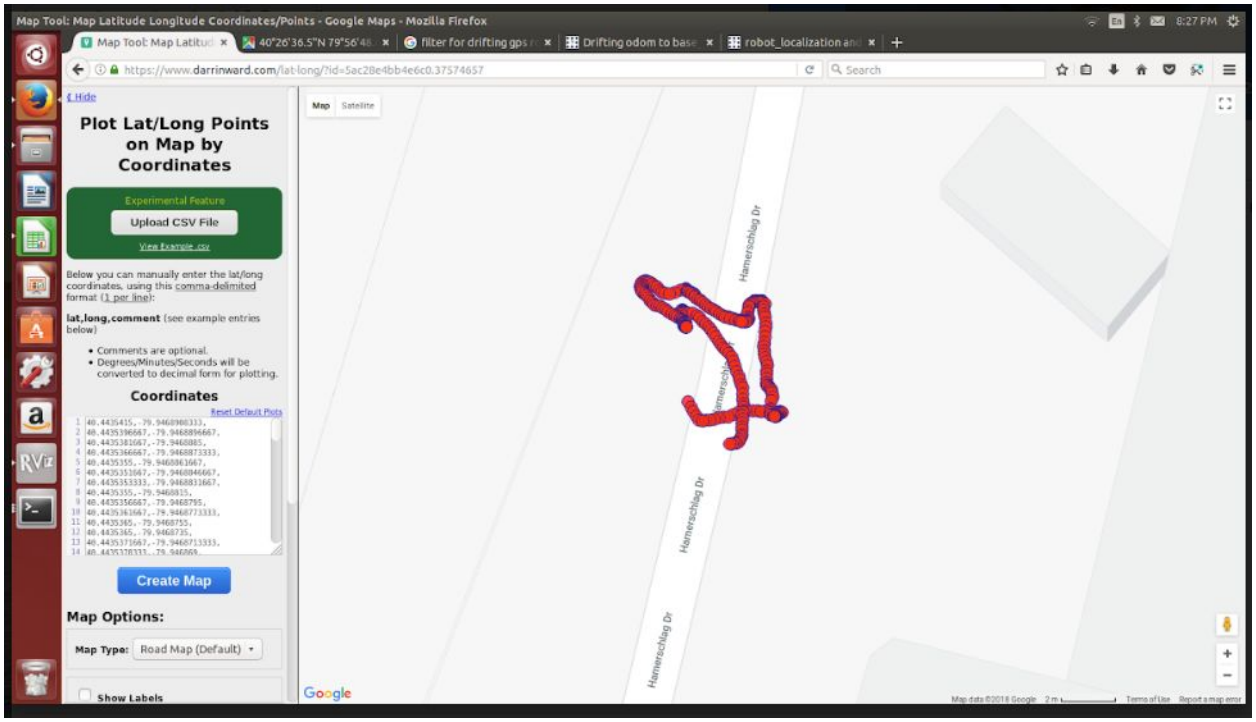

Fig3. GPS data

Even after a lot of Covariance tuning the second EKF is jumping along with GPS values at discrete positions we still need to work on this part. This takes the Yaw value from the IMU for the direction as GPS data does not have any orientation. Logically GPS values being published by the GPS sensors should have it's own covariance which can be taken into account while fusing the data in covariance, but that's not happening.

IMU and GPS from Phone

Connected the phone using ROS ALL SENSORS application via the wifi to the ros master running on the robot. The frame in which the gps and imu topics published data was /gpu and /imu but '/' is not recognised by the ros.

For fusion with EKF these frame ids were required to be changed. I wrote a code to subscribe to these topics and then publish them with the correct frame ids. Those were then subscribed in both the EKFs. I still need to tune the parameters for fusion of phone imu and gps data with the EKF.

Challenges

1. Weather was a very big challenge for all these developments as development was required to be done on GPS now. It was difficult to get GPS fix in such random weather. If I could go back in time and opt for a problem statement that didn't involve much of outdoor testing. We are mostly working with 2-3 Ros bag files which had relatively better GPS fix.
2. It was quite difficult to narrow down the issue of different axis of sensors in IMU

Teamwork

1. Danendra worked on Integrating velodyne to costmap, imu calibration and data reading and mechanical refurbishing.
2. Yuchi worked on drone testing and calculating next tag for agv.
3. Pratibha worked on IMU calibration, mechanical refurbishing and fixing husky ros navigation stack issues.
4. Rahul worked on Segregating controllers, Velodyne costmap, imu data reading, mechanical design.

Future Plans

We specifically plan to work on the following tasks:

1. Yuchi and Pulkit - Integration: Following the GPS waypoints as given by Bebop. We need to figure out the sequence of steps for waypoint following.
2. Pratibha and Pulkit - We need to tune the Covariance matrix in order to integrate the GPS, we can avoid GPS in the EKF node altogether if fusion does not work after spending some time. Change and try other params as well.
3. Danny and Rahul: Testing the IMU and GPS values coming out from phone and integrate them with the EKF.