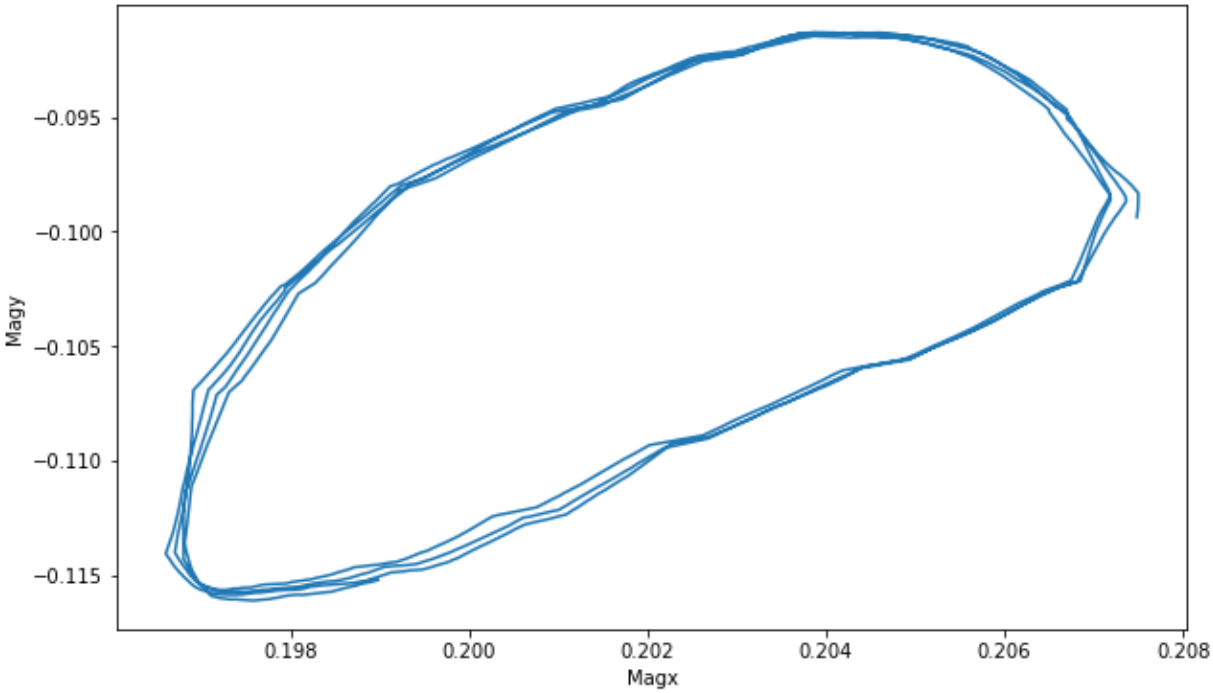
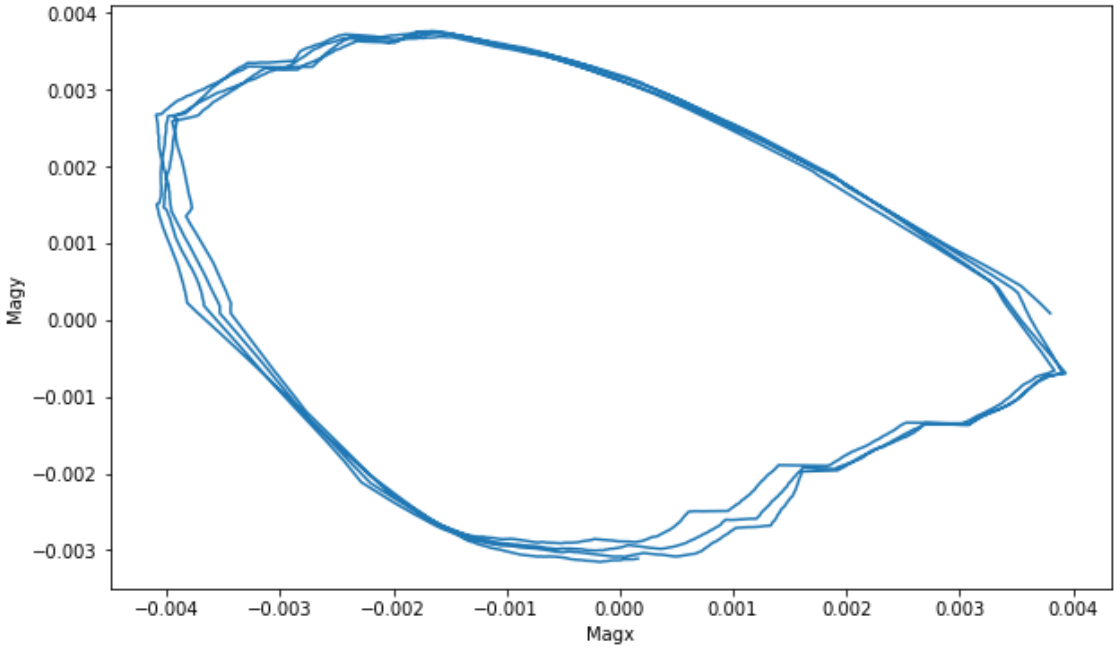
LAB 4 - Navigation with IMU and Magnetometer

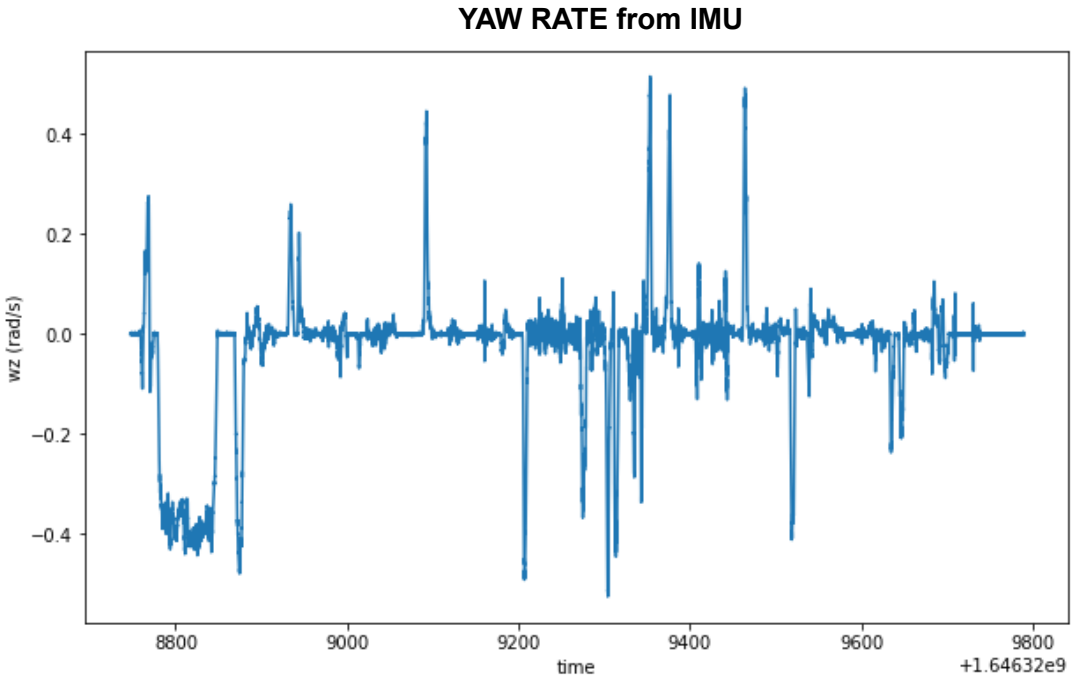
Magnetometer Data

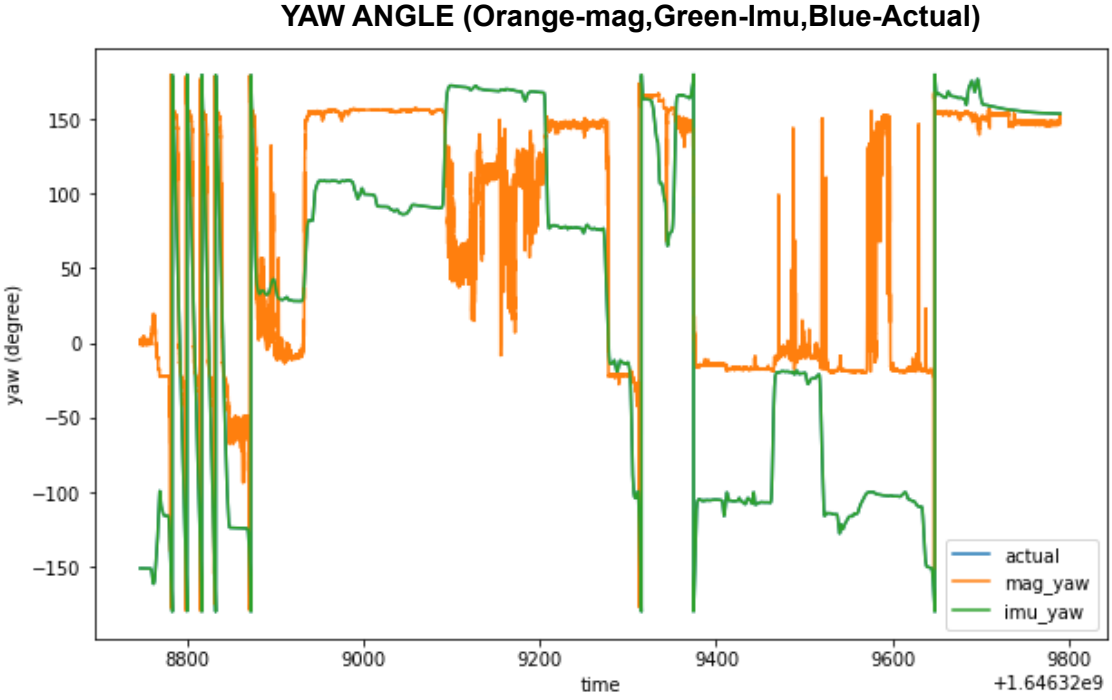




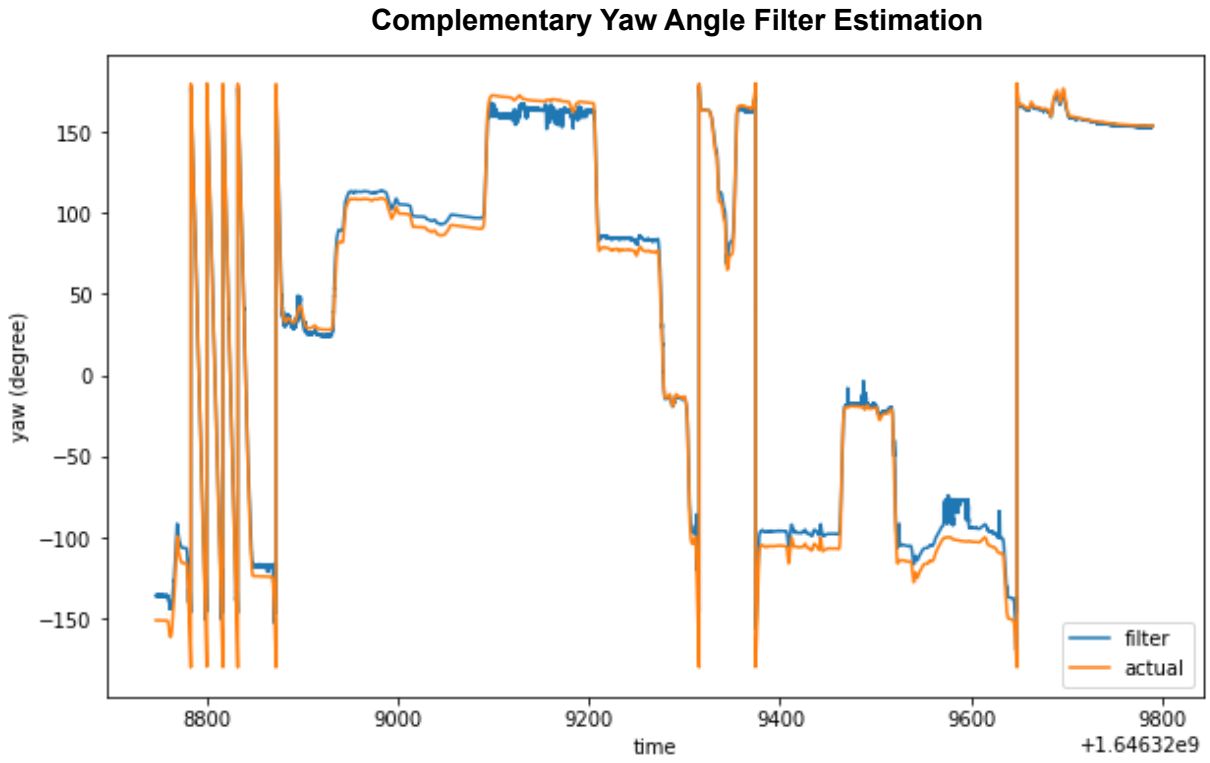
The first two figures show the x-y plot of magnetometer data. After adjusting for the hard-iron and soft iron effects, the circle shifts to (0,0) as shown. The soft and hard effect is removed for the entire data.

1. Yaw Angle Estimation:



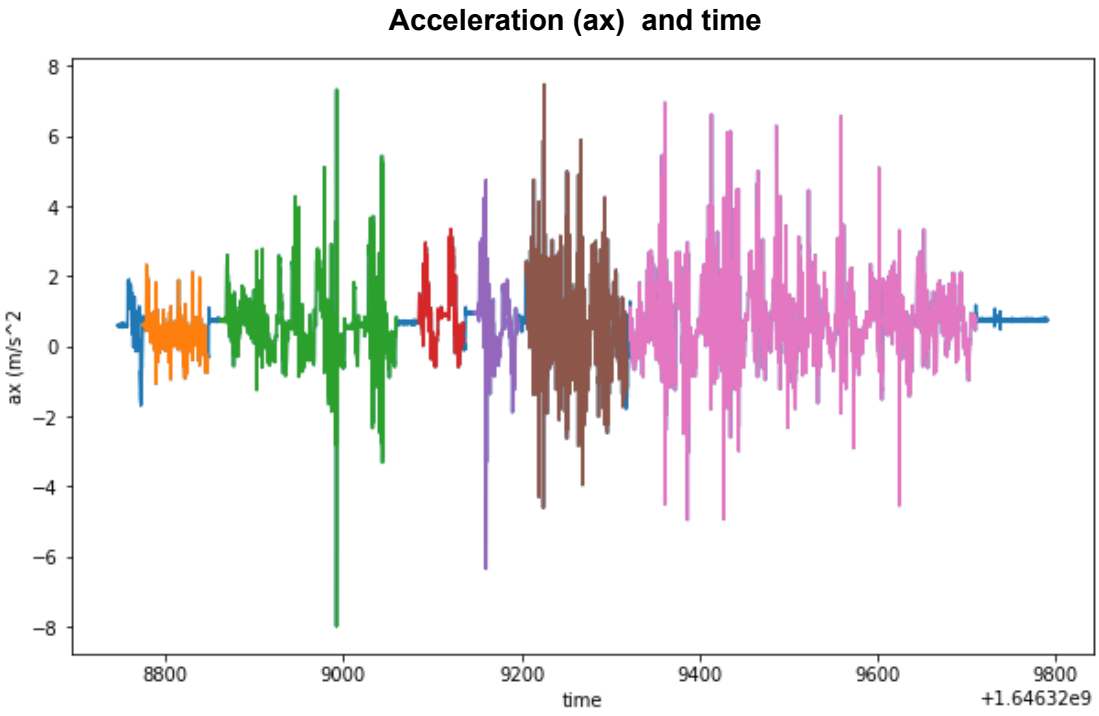


The yaw angles from the corrected magnetometer readings were obtained and have been plotted along time in the figure shown.The yaw angles obtained by integrating the yaw rate sensor readings have been plotted along time in the below figure.

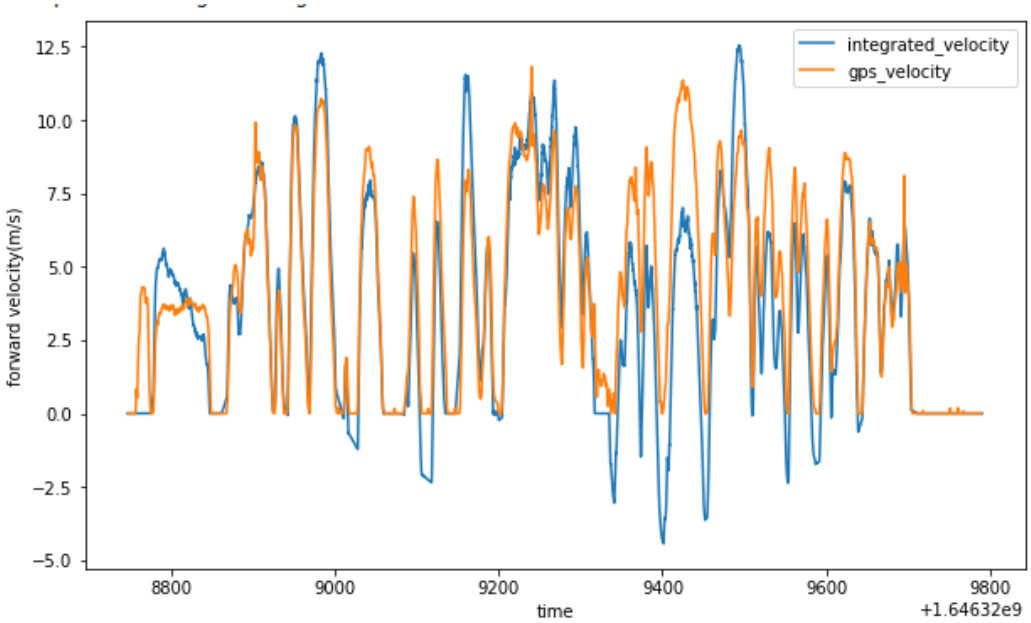


In this figure,we see that the yaw angle values from the complementary filter are a mix of the values from both its components. The magnetometer adds some degree of variation in the constant-seeming lines of the gyro readings.

2 . Forward Velocity:

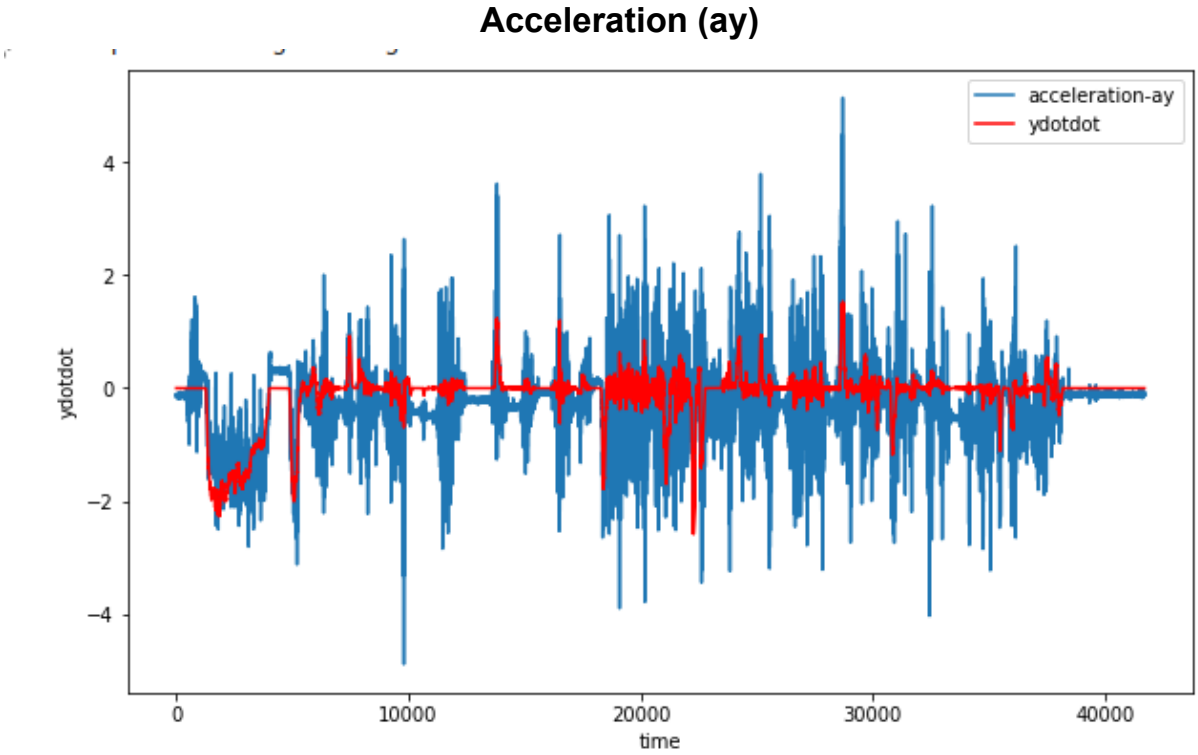


The acceleration plot is split into 6 windows and forward velocity is calculated for each window by integrating the ax component w.r.to time and combined for all the windows.



The forward velocity approximately matches the gps velocity which is calculated from the gps coordinates and time.

Dead Reckoning:

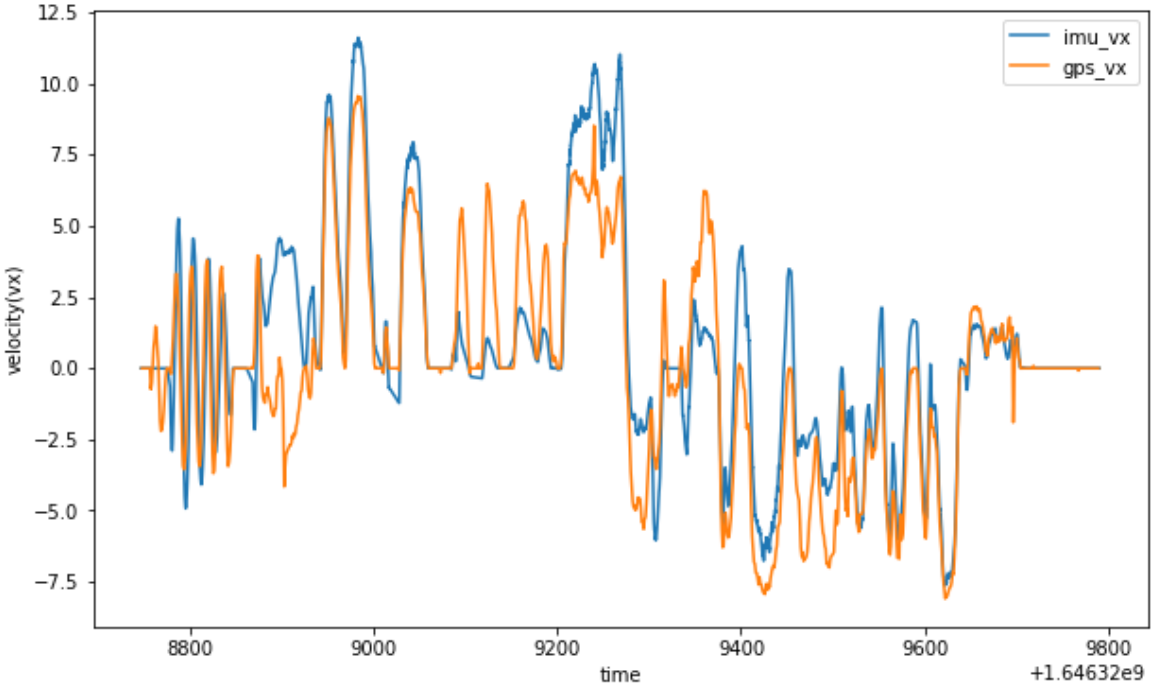


Here, we notice that there is a slight offset in the calculated (w*X_dot) values compared to the actual observed readings. This can be easily noticed at instances where the vehicle was stationary while collecting the data. This offset is slowly increasing from one stationary point to the next as time passes. Another observation is the higher magnitude and variation noticed in the calculated values. The reasoning for this could not be ascertained with strong reasoning, but the primary reason is thought to be due to the offset x_c between the center-of-mass and the IMU device in the vehicle.

GPS Plot and Imu Trajectory Plot

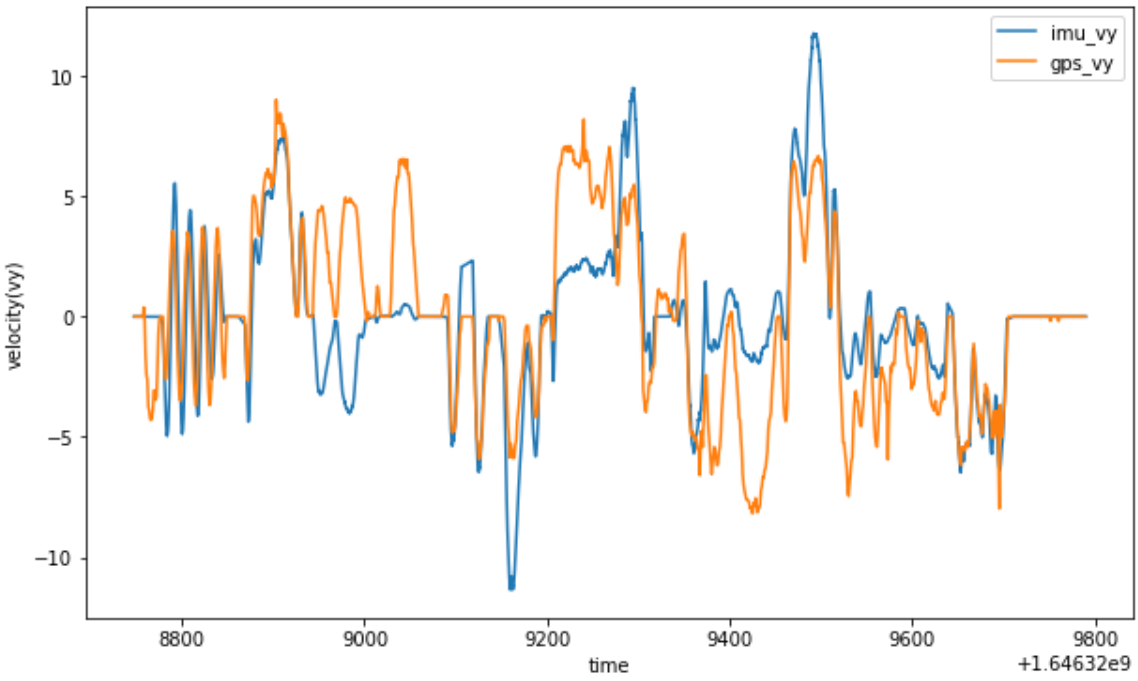
Imu Vx and GPS vx:

imu_vx = v*cos(yaw)



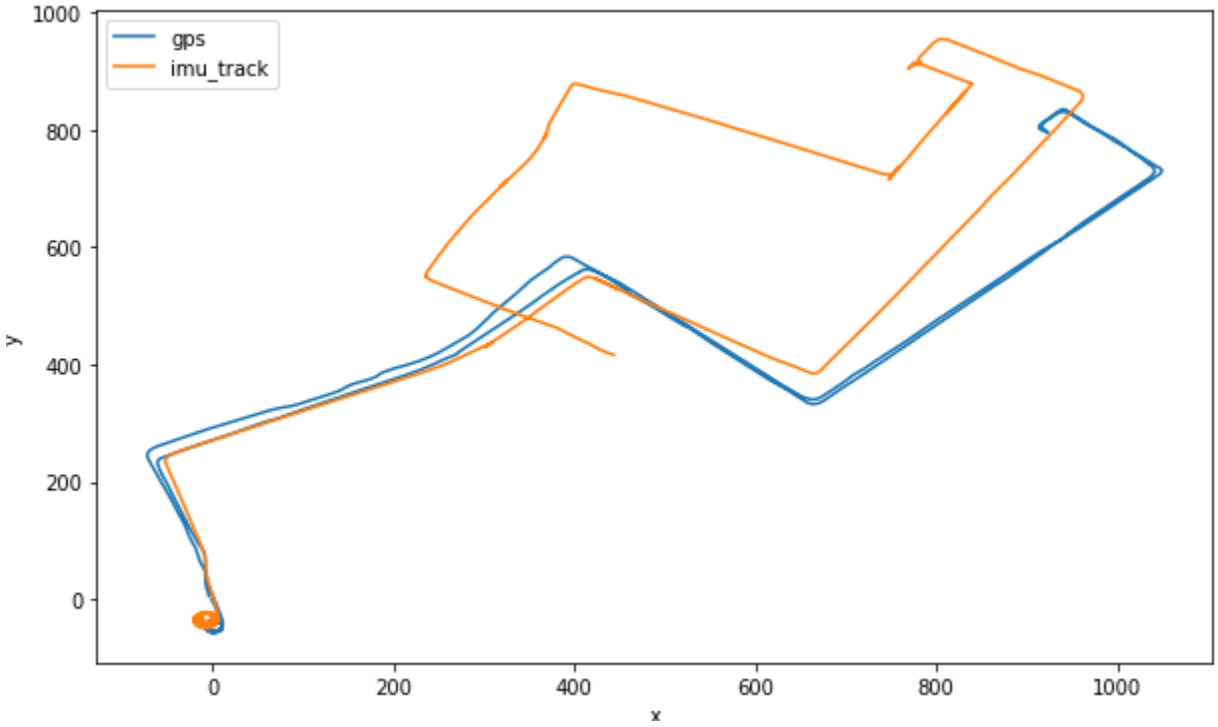
Imu vy and GPS vy:

imu_vy = v*sin(yaw)



Both imu velocities in x, y directions shows good accuracy w.rt gps velocity

Trajectory Plot



Integrating the imu_vx and imu_vy velocities results in the displacement plot and compared with the gps plot. Rotation of 45 degree is used and with scaling of 0.9. Initially a good correlation is seen for forward direction.

Xc Calculation:

Assuming ydotdot is zero we have

wdot * Xc = yobs - wXdot

Xc = (yobs-wXdot)/wdot

Xc = mean(xc)

From this calculation xc is found to be around -0.18m

The IMU sensor is kept on the dashboard of the car, as per the prediction of xc is behind the sensor by 18 cm which is a reasonable estimate for a car with front engine drive.