Lab3 Analysis

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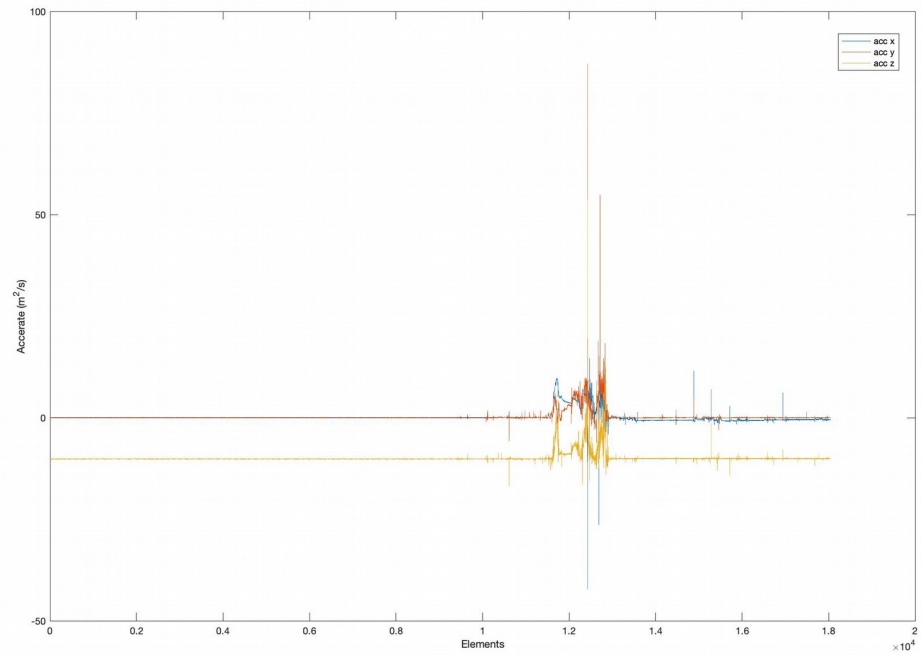
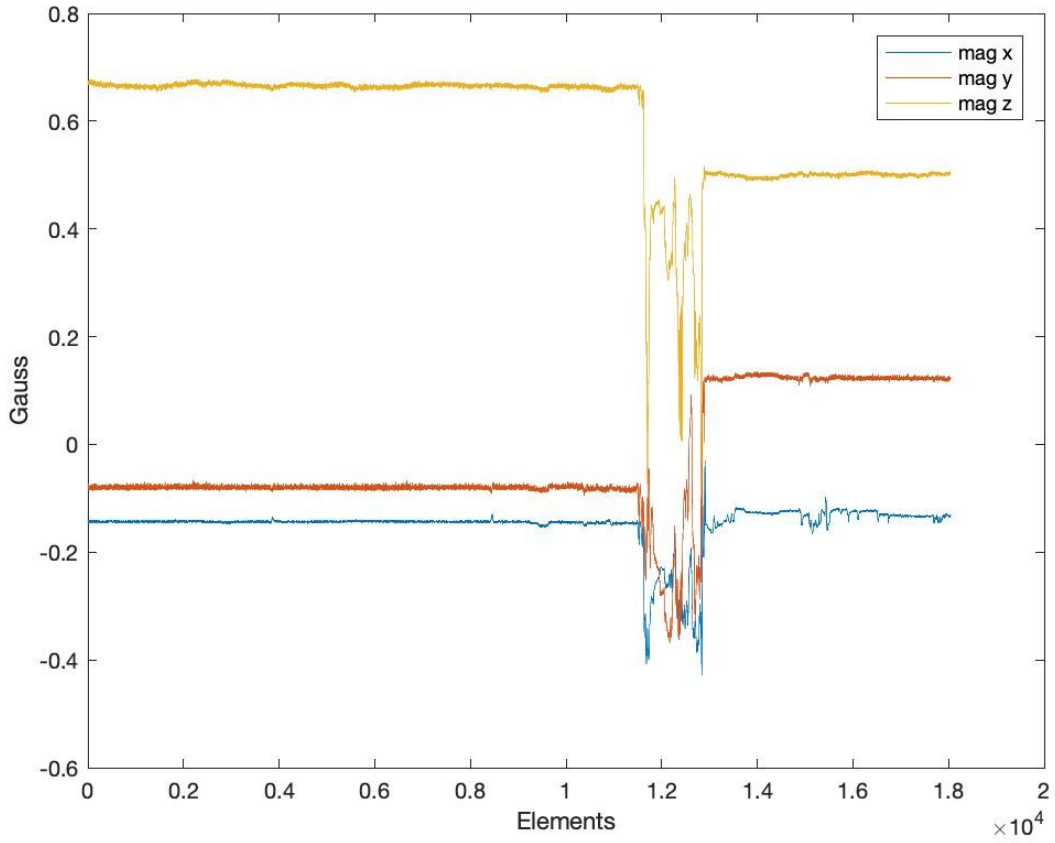
Stationary accelerate



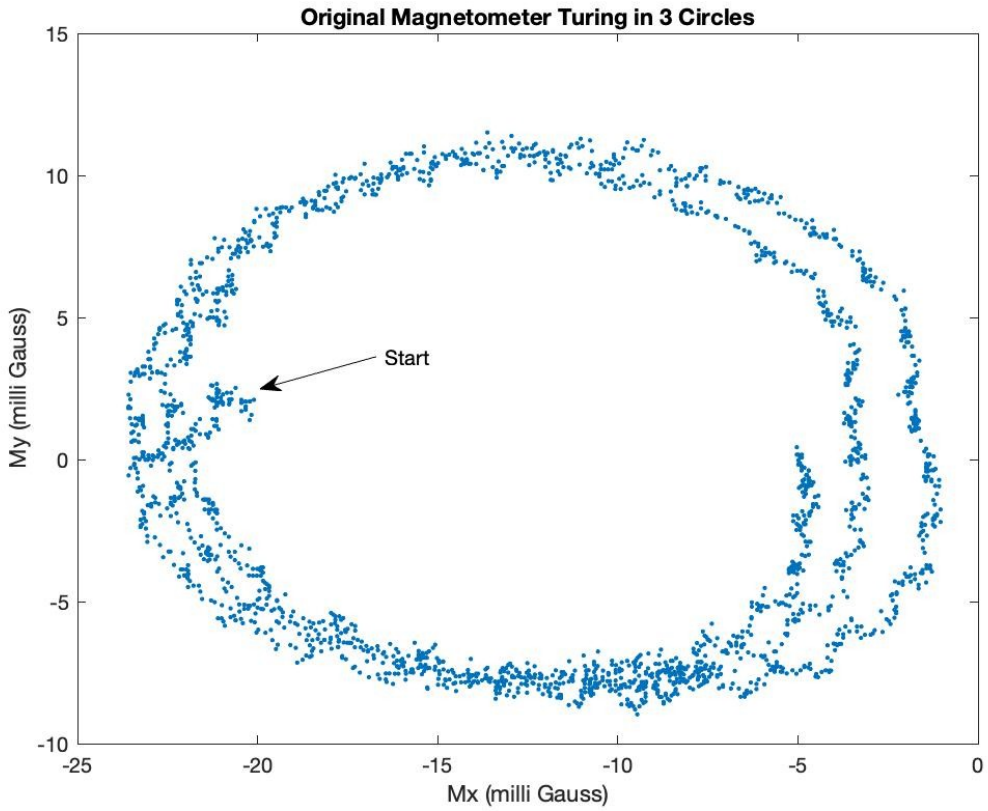
- Stationary accelerate is expected to be zero on acc_x and acc_y
- acc_z is expected to be -9.8 which is the gravity of the earth
- The noise seems effect x, y, z at the same time when IMU is stationary
- The element around 1.2*10^4 the IMU has been move

Stationary Magnetometer



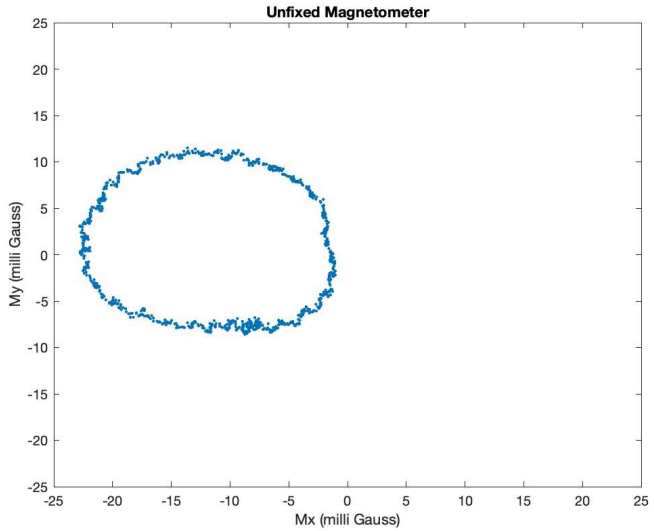
- Stationary Magnetometer are also expect to be in a range of value of each magnetometer unit.

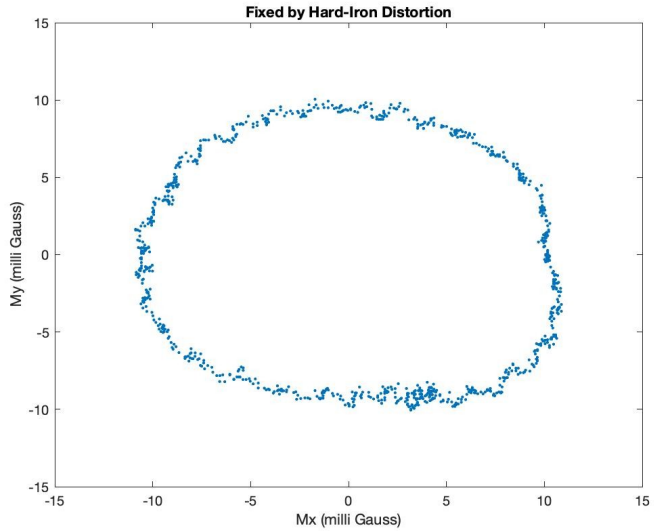
Magnetometer Original Data



- Drive circles with x as forward direction on Syntanic cirle beside Ruggles T station
- Plot x as mag_x, y as mag_y showed wich 3 ellipses which may effected by hard-iron distortion and soft iron distortion.

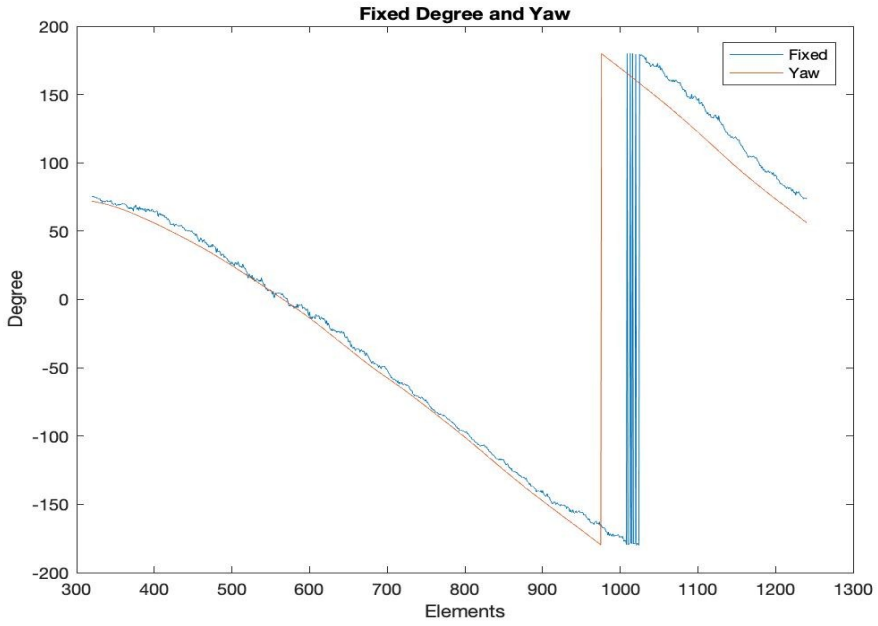
Analysis on of the circle

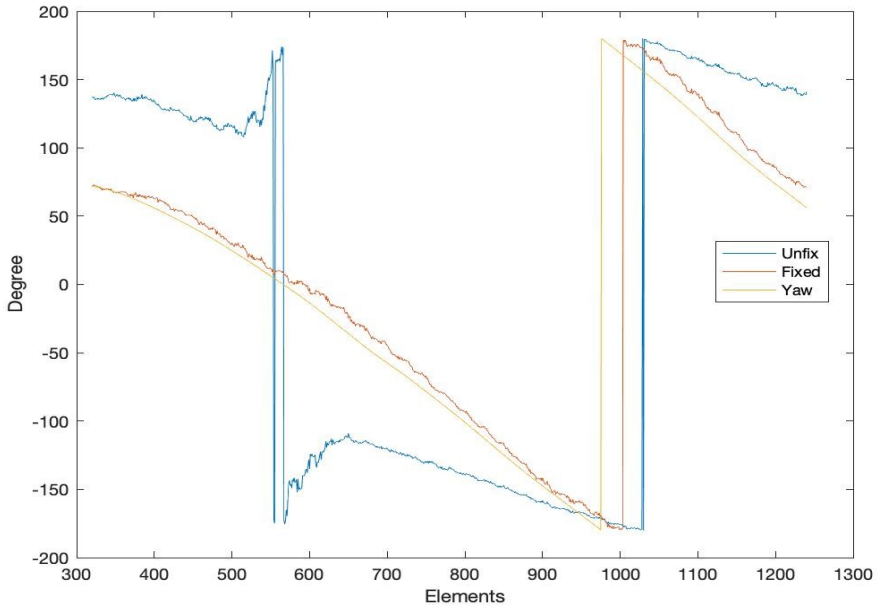




- Two plot shows that the on of the circle which are unfix and fixed
- Left plot shows that the unfix data center is not on (0,0)
- Right plot shows that the fixed plot center on (0,0)

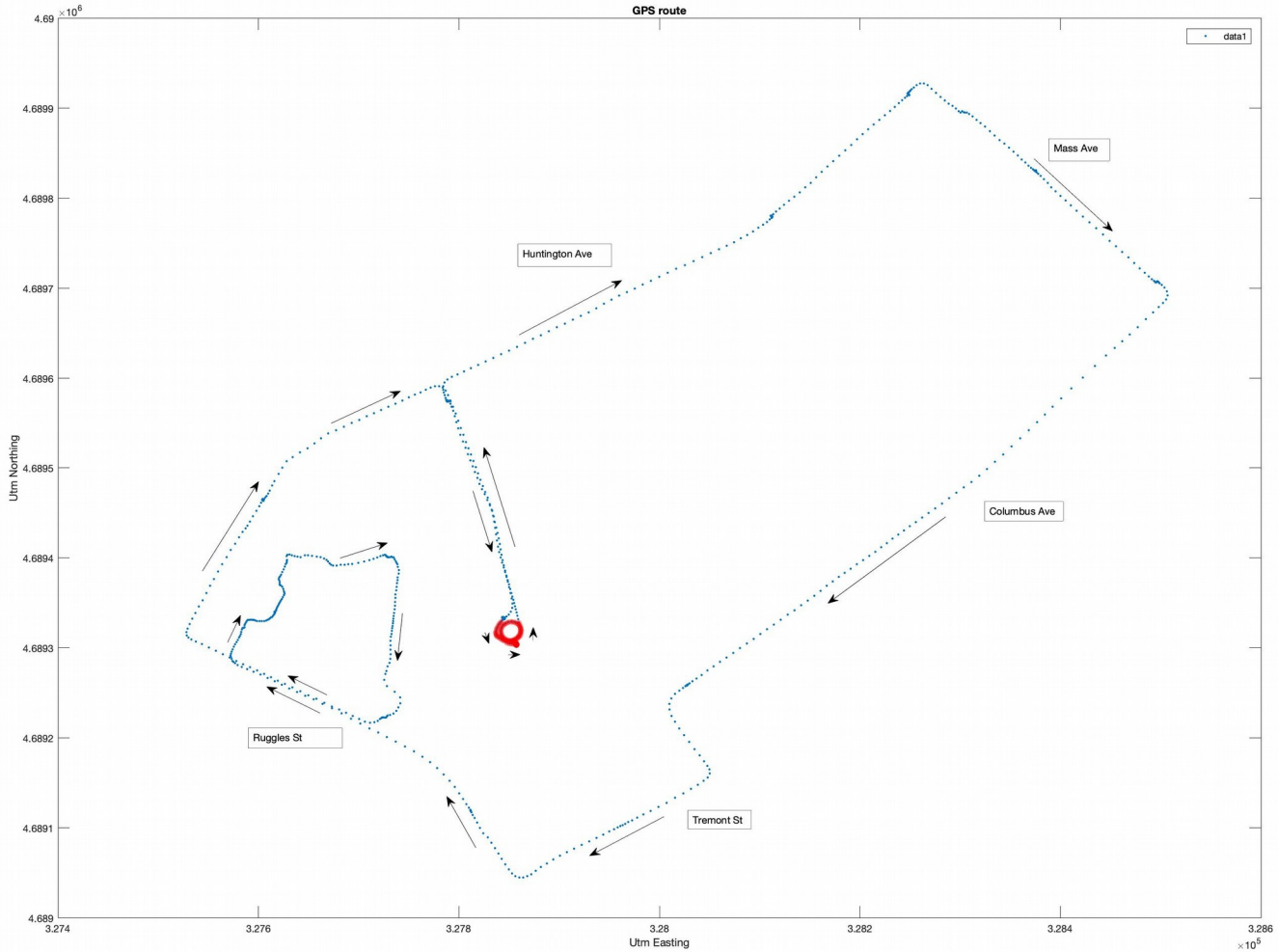
Fixed Magnetometer Degree and Yaw





- The plot showed that the estimate yaw angle calculate by fixed magnetometer and the yaw angle catch by IMU
- Two plots shape similar but fixed plot show with some error with latency. This may caused by unfixed with accelerate meter.
- Compare with original (Unfix) yaw estimate, fixed data seems more match to IMU catch yaw.

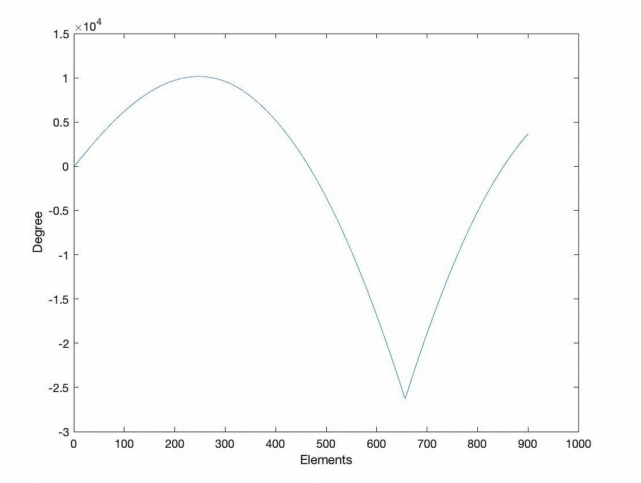
GPS Route Map



Integrate Yaw rate

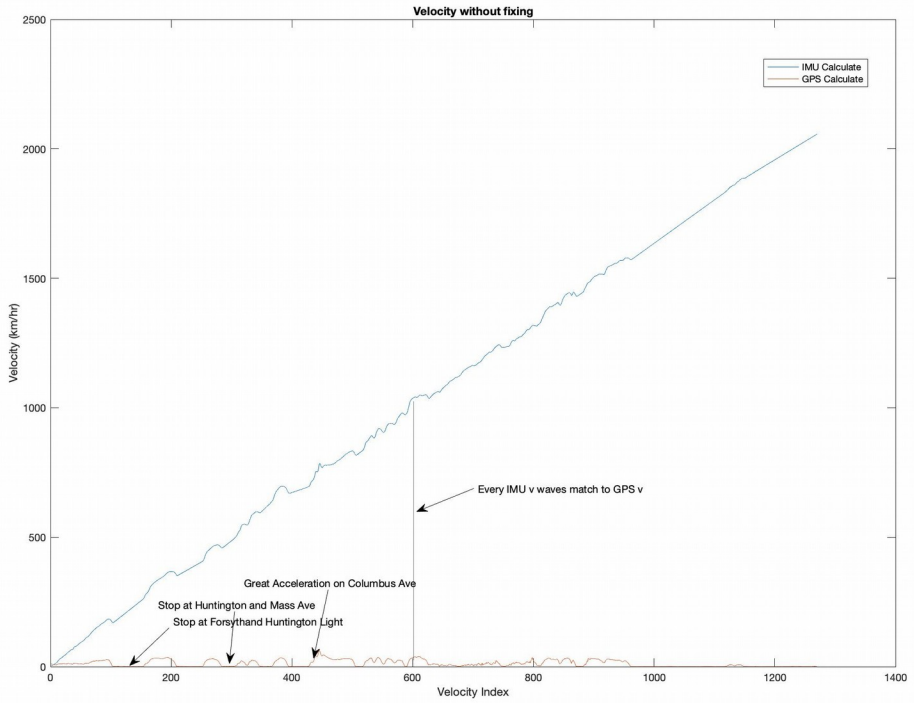
- Integrate the yaw rate will get the turning angle.
- Integrate on of the circle elements. (Supposed to be 360 degrees)
- Using trapz ans cumtrapz in MATLAB
- Trapz shows the total integrate in range. Cumtrapz shows each divided part of intergration

- Trapz show near 624.1644 of gyro_z which should be expected to 720 degrees for 2 circles.



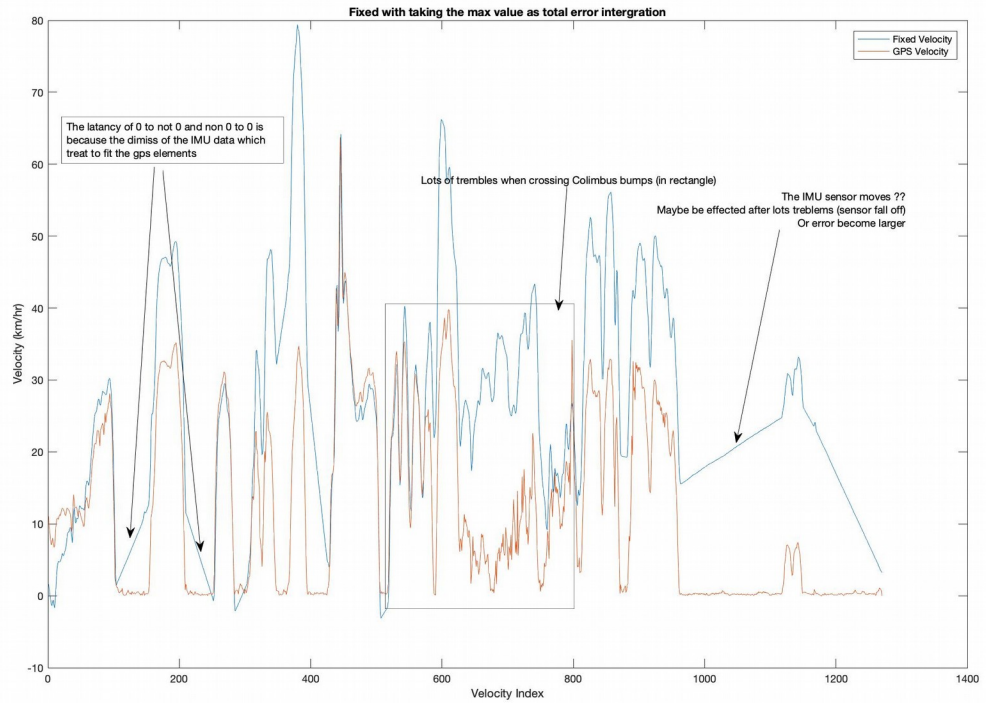
- Cumtrapz show each divied part of intergration

Velocity without fixing



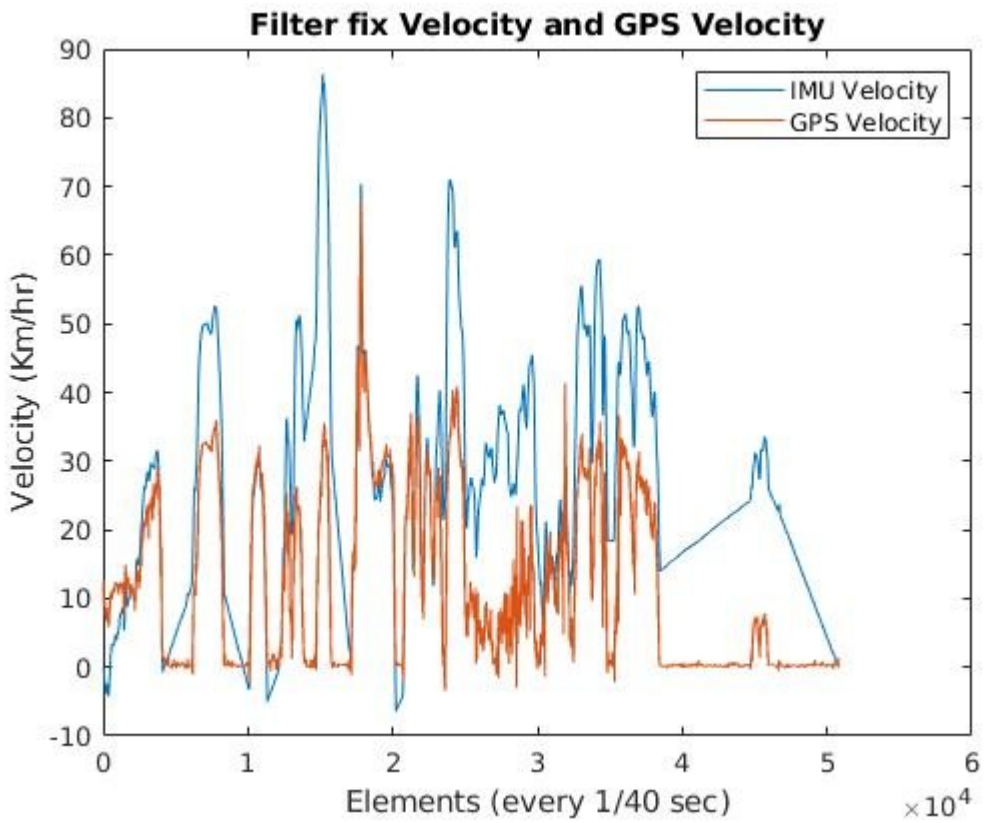
- The plots show that the IMU calculate and GPS calculate Velocity
- Obviously that the curves looks similar
- The increasing IMU Velocity is because the integration of the errors.
- The data was got when we put the IMU outside of the car. The temperature is at -5 Celsius degree and it is snowing. This might cause the error in this huge range.

Fix the Velocity from IMU



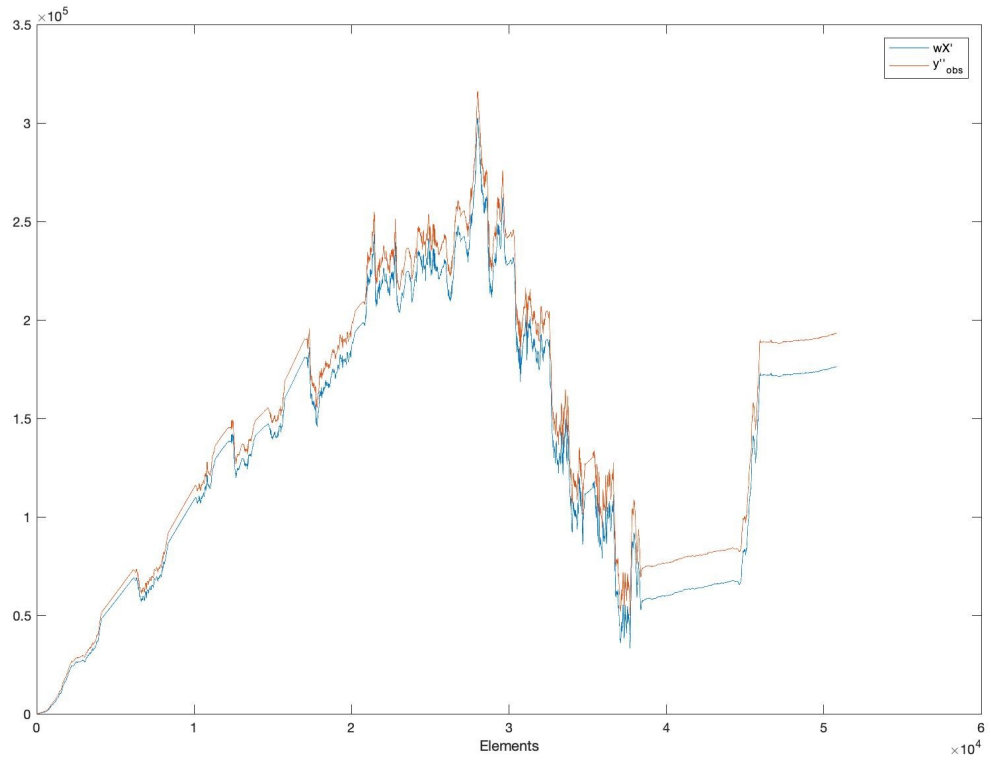
- Fix assuming that the error integrate in linear
- The data seems more match than before
- Most of the data looks similar except in the rectangle and the last few data
- The point that is worth it to notify is that the data on drive on Columbus Ave (lots of trembles). The data seems more unstable.

Filter Fixed acc_x and gps velocity



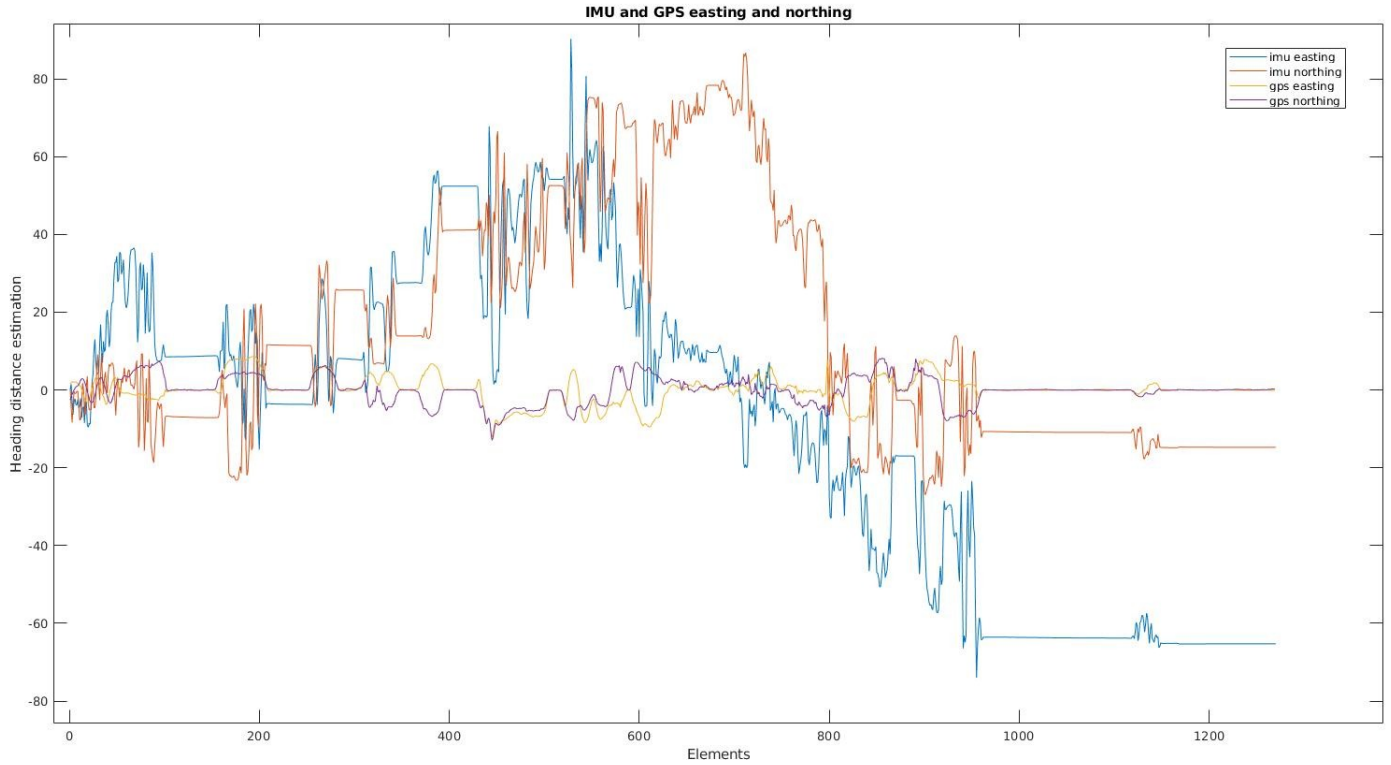
- The filter fixed IMU velocity shows that the other method for fixing the IMU velocity.
- This method shows that the noise and the other error are excepted

Displacement from IMU and GPS



Assuming that the Y’ is 0, that the X’ is the integrate of the acc_x
The plot shows that the wX’ and the y’’obs. Which are come from the equation of the y’’obs = Y’’ + wX
The difference might be cause by the skidding of the side way because we ignore the Y’ may have non-zero value. Or at the start of the point. The vehicle might be not on the flat surface. Thus two plots have difference.

Easting and Northing collect by GPS



The plot show that the estimation of the IMU easting ans northing.

Information from the IMU including the noise the the integration of yaw *velocity will move from the original stop status.

That the blue line and the orange line is not at the 0 in the end. (caused by the noise and error of IMU)

Xc near to 0.3 integration to the error if IMU estimation.

Conclusion

For the accelerate and movement situation, IMU could be a good sensor too estimate the vehicle movement.

For the right position on distance movement, IMU has a lot of errors and noise that is not a good sensor for it. Thus, the GPS sensor roles as the essential character on movement and the correct position on the map.

IMU could estimate he heading, including the accelerate meter the heading could be more accurate.