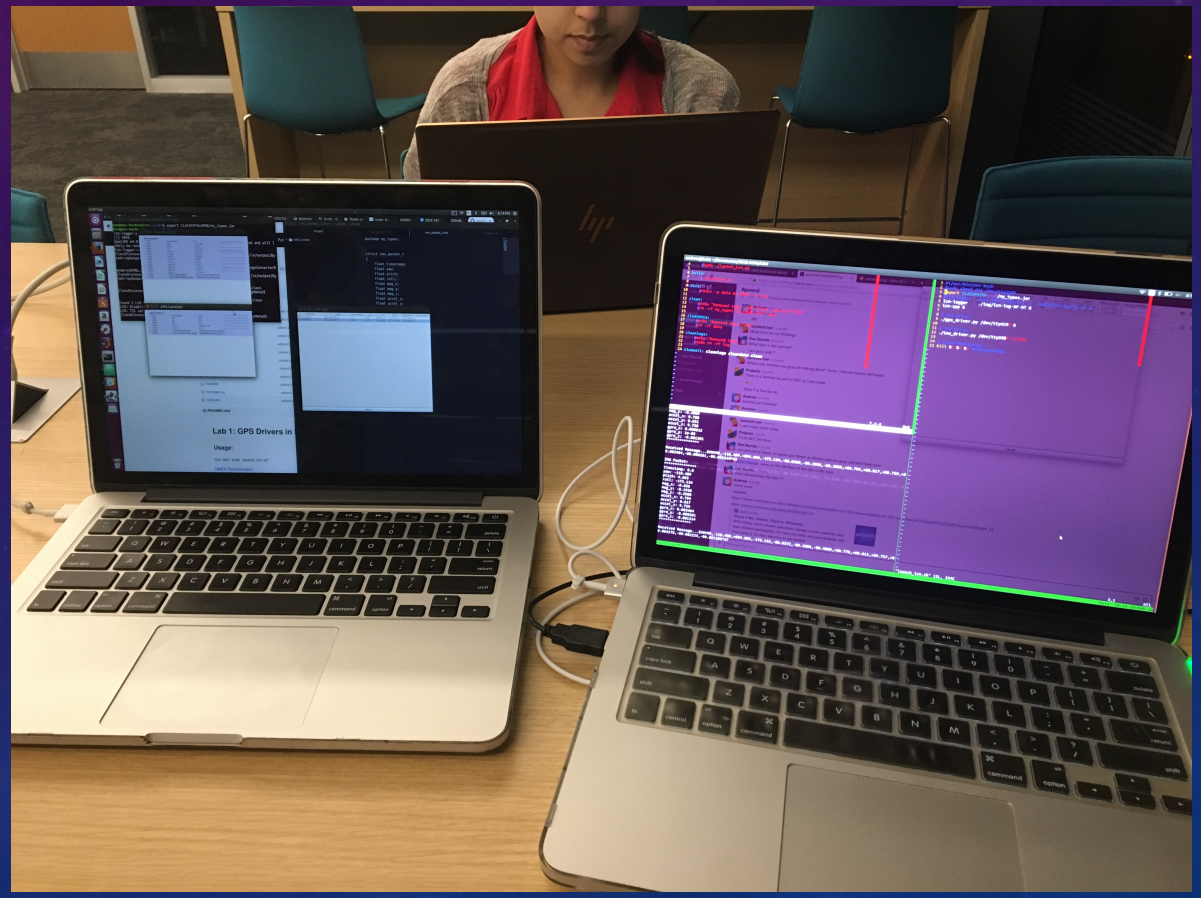
GPS VS IMU DEAD RECKONING EXPERIMENT

ANDREW TU

EECE 5698 ROBOTICS SENSING AND NAVIGATION

NORTHEASTERN UNIVERSITY

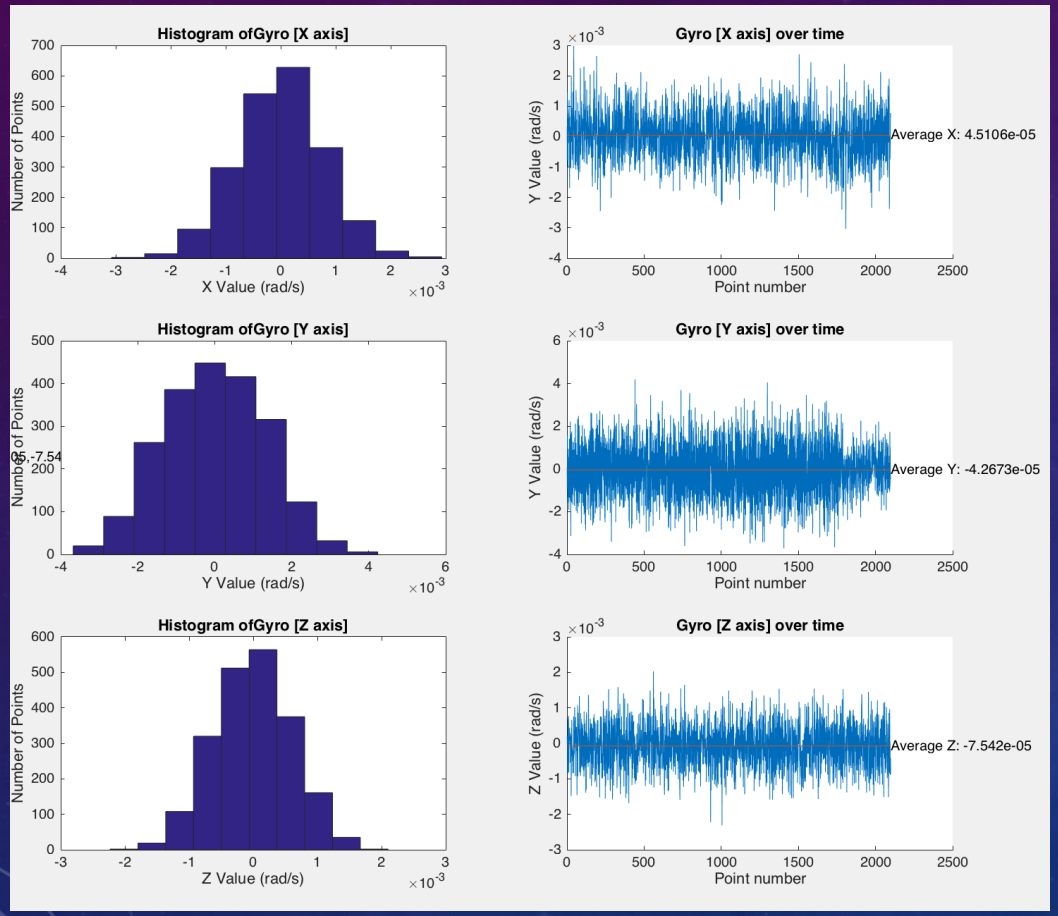
LCM OVER WIRELESS CONNECTION

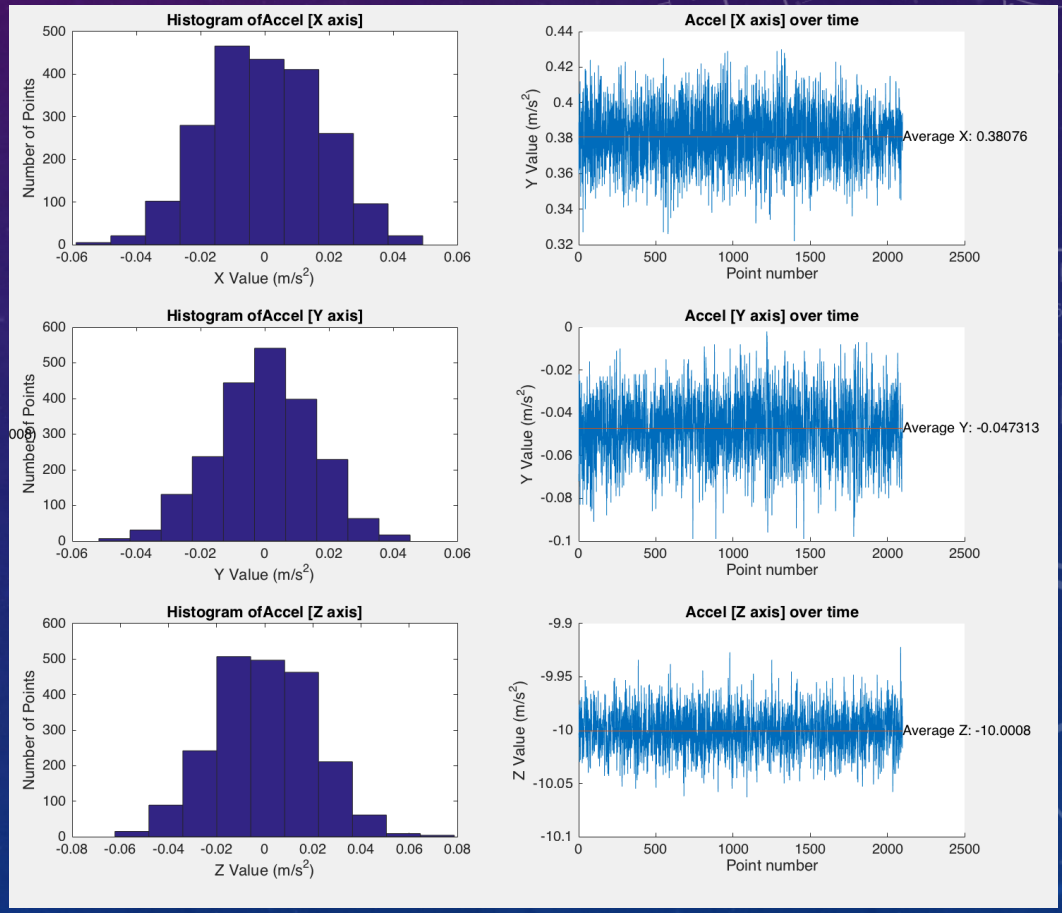


\NOISE CHARACTERISTIC SUMMARY

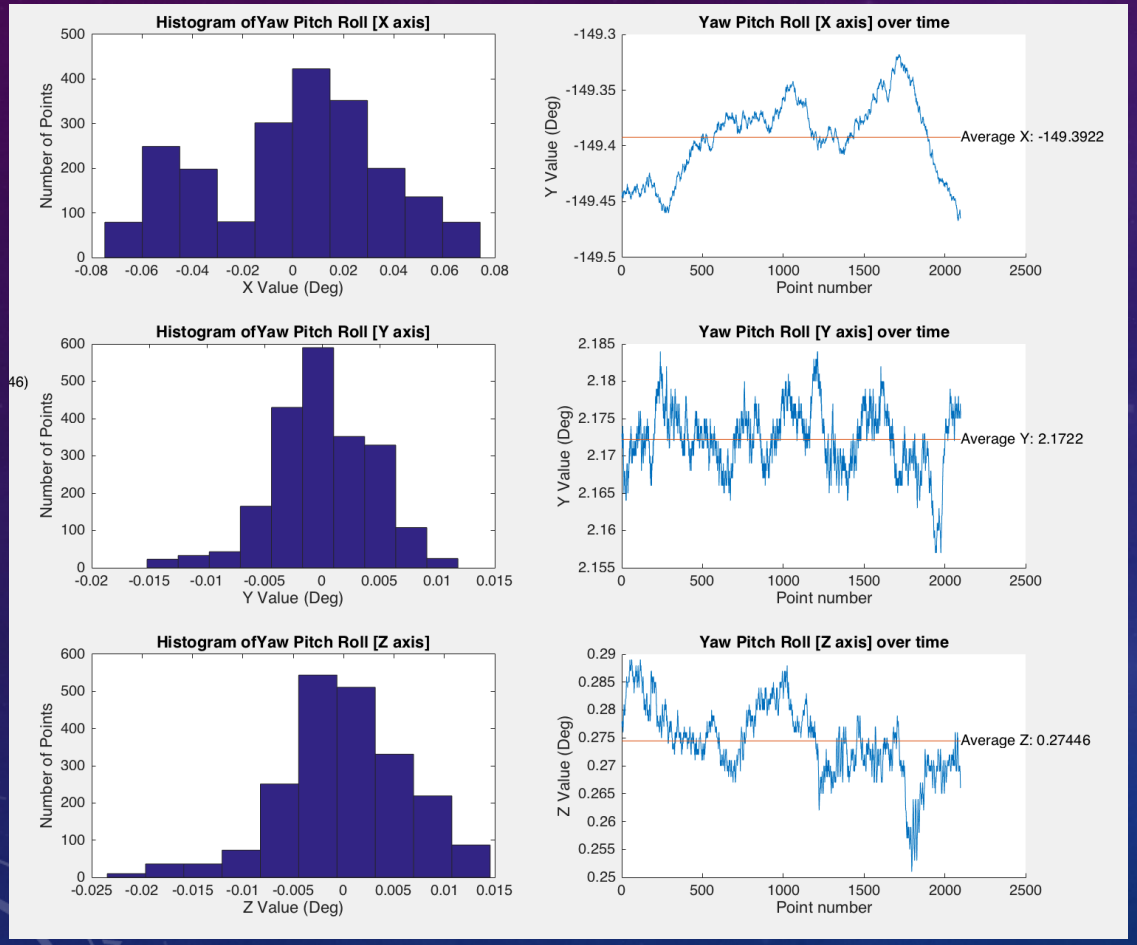
- Most cases: Gaussian error distribution
- In case of gyro and accelerometer, need to zero sensor to account for drift error
- Mag and Roll/Pitch/Yaw sensor doesn’t matter to much b/c those are relative values
- Need to calibrate magnetometer values to account for hard + soft iron distortions

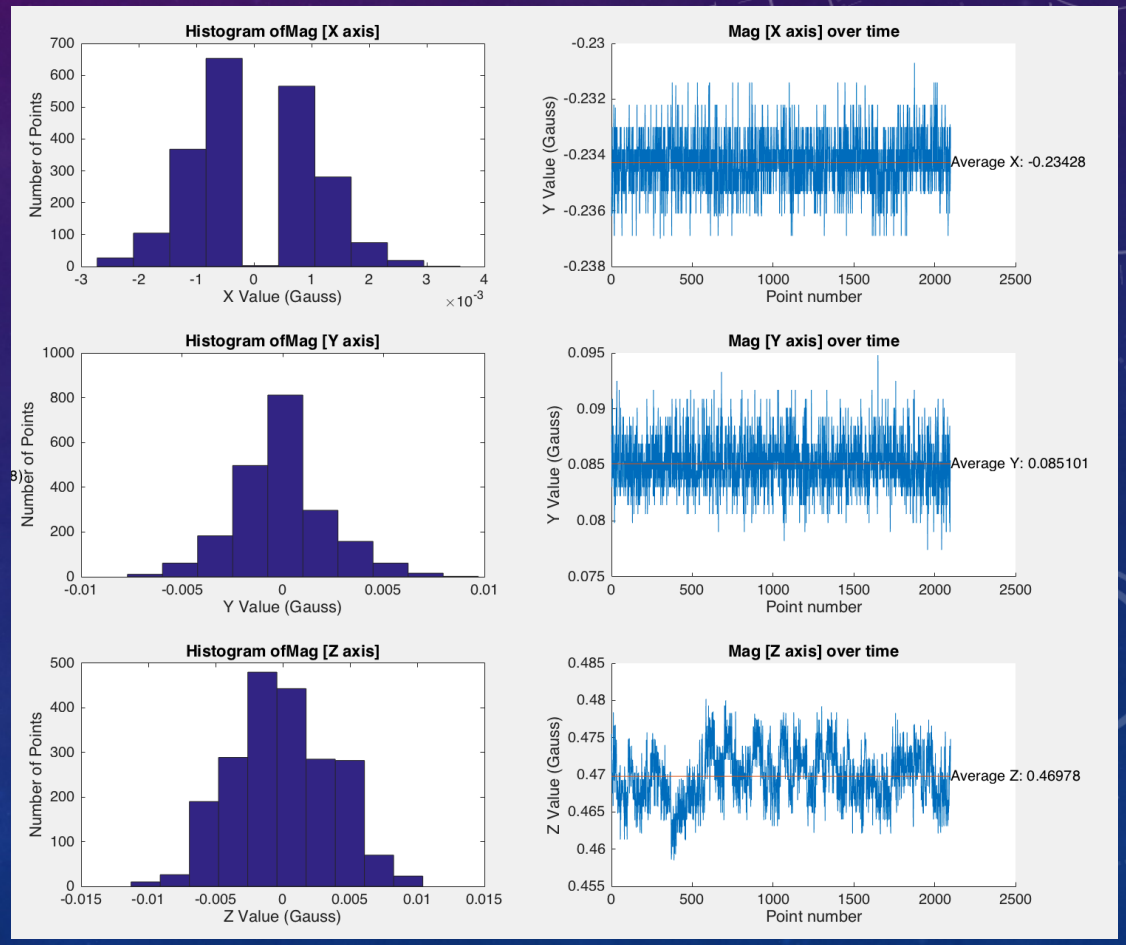
NOISE CHARACTERISTICS OF STATIONARY IN CAR DATA



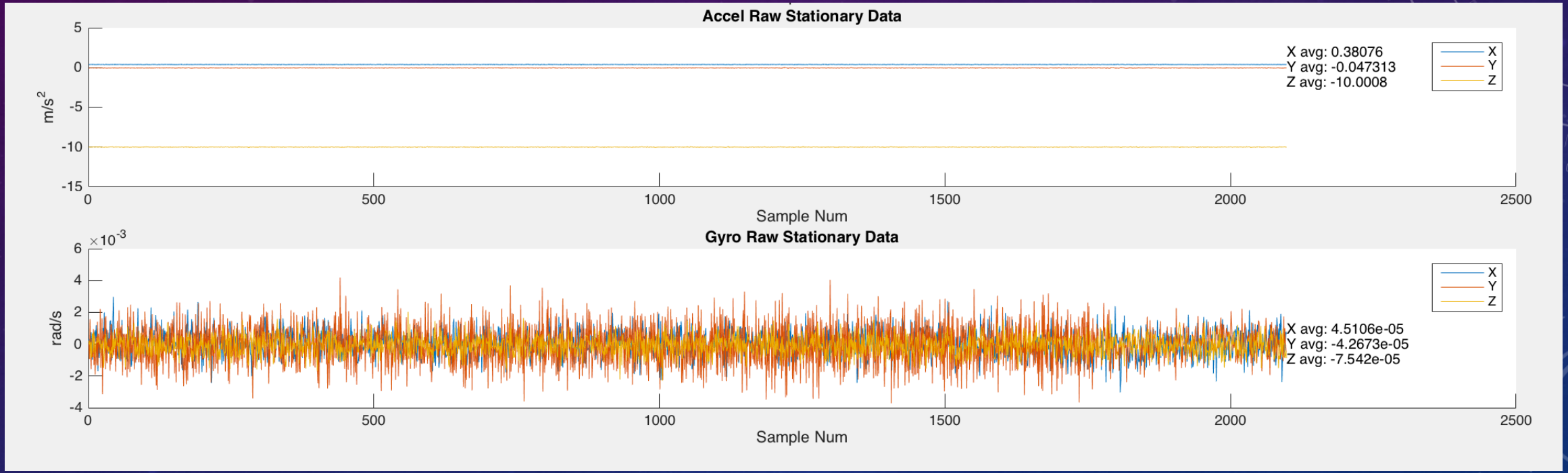


NOISE CHARACTERISTICS OF STATIONARY IN CAR DATA

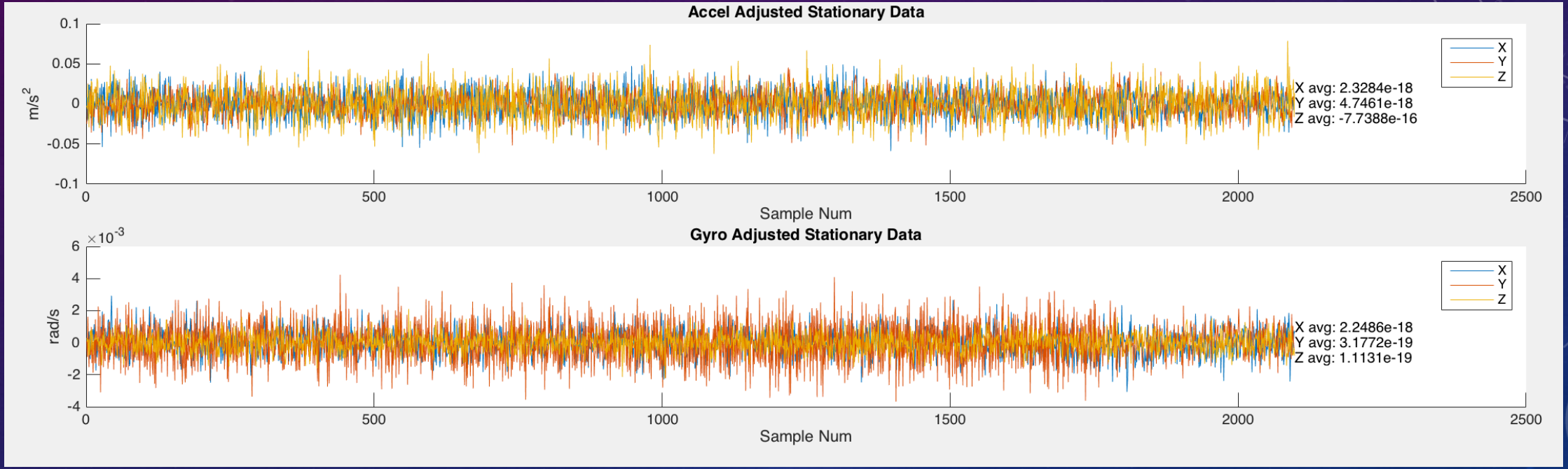




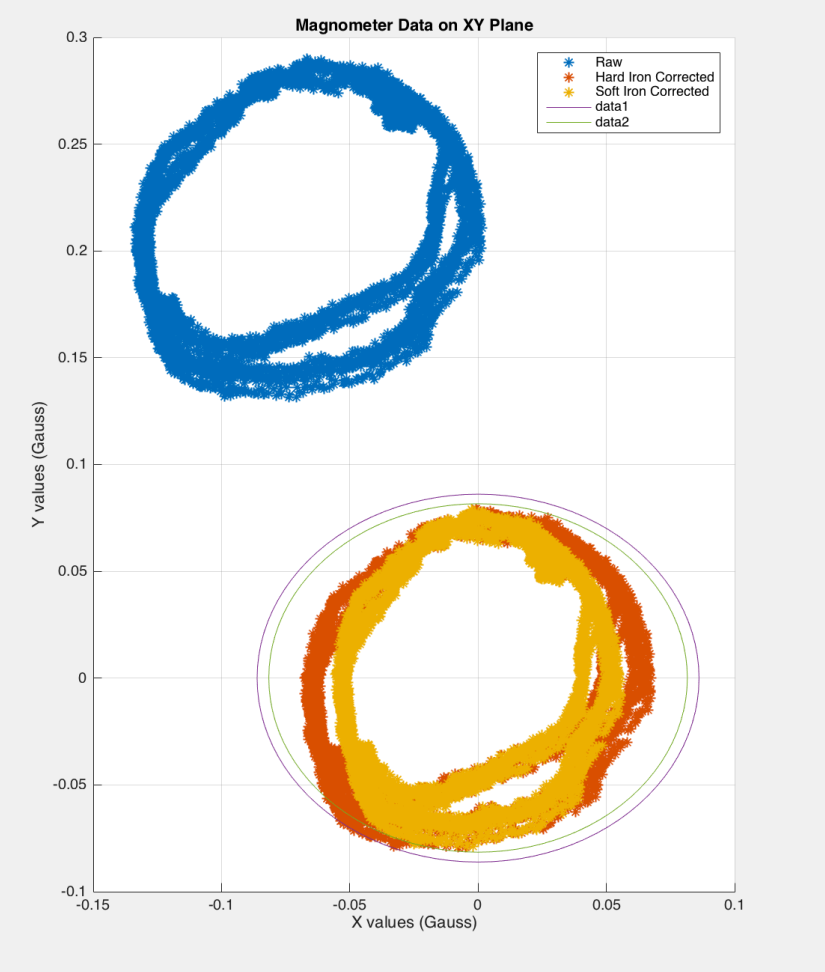
NON ZERO VALUES FOR STATIONARY DATA



ELIMINATING 0 MOVEMENT BIAS IN STATIONARY DATA



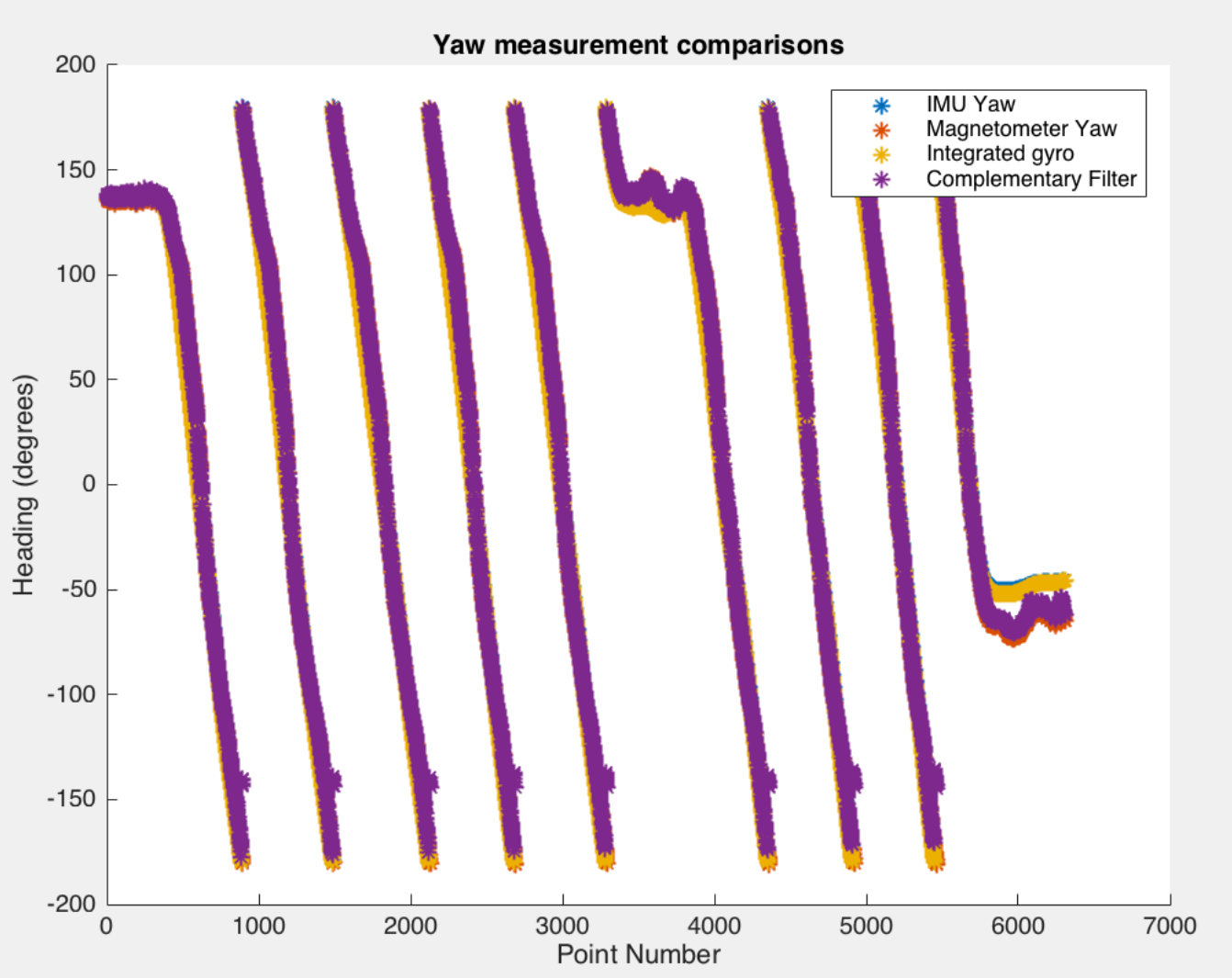
CALIBRATING MAGNETOMETER (HARD + SOFT IRON) (DRIVING IN CIRCLES)



Hard Iron Correction: Shift values to center circle around origin

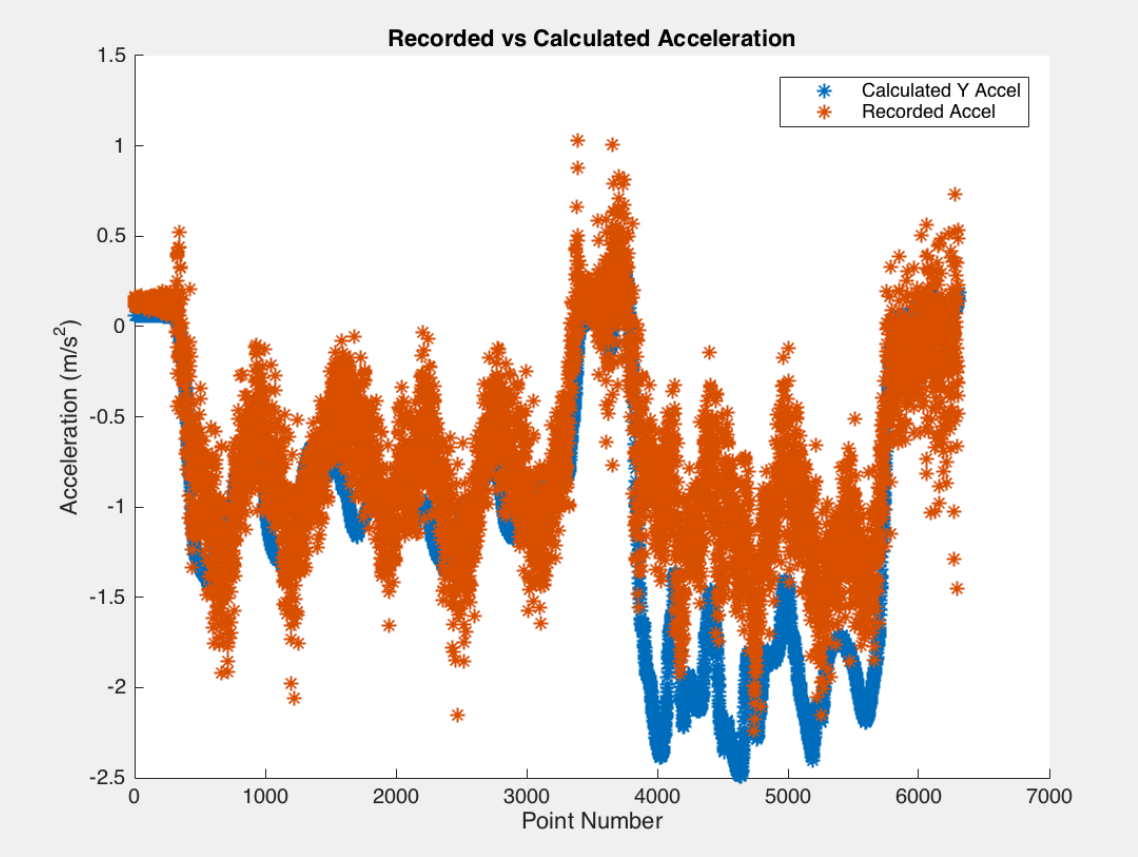
Soft Iron Correction: Scale values to change oval to more circular shape

CALCULATED YAW VS GIVEN YAW (DRIVING IN CIRCLES)



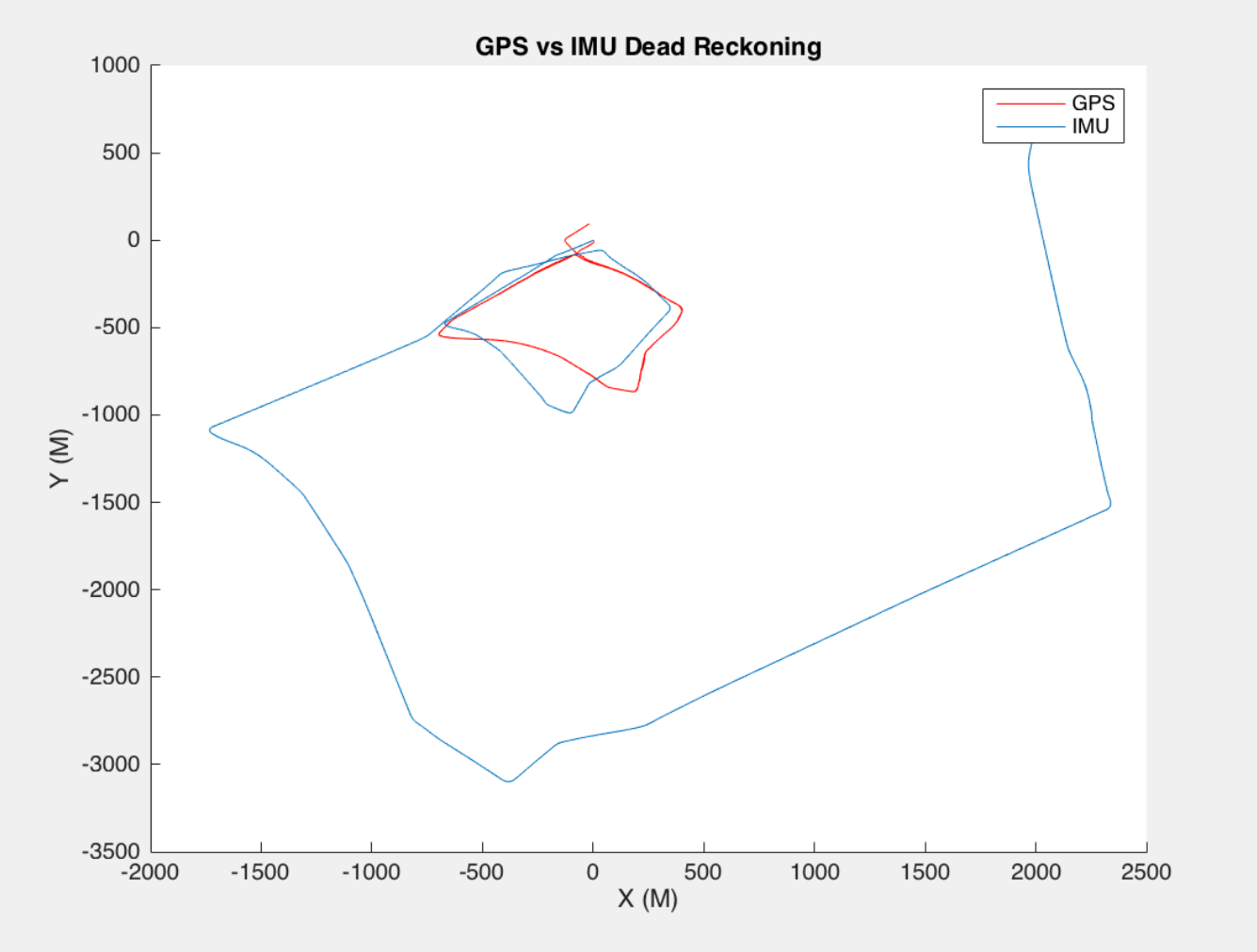
- Integrated gyro data perfectly lines up to the given yaw.
- Magnetometer results are skewed from yaw
- Since Magnetometer data was more heavily weighted (90%) in the complementary filter, combined results are skewed too.
- Skew in magnetometer likely a result of driving over an incline (not account for z error)

CALCULATED VS RECORDED ACCELERATION (DRIVING IN CIRCLES)



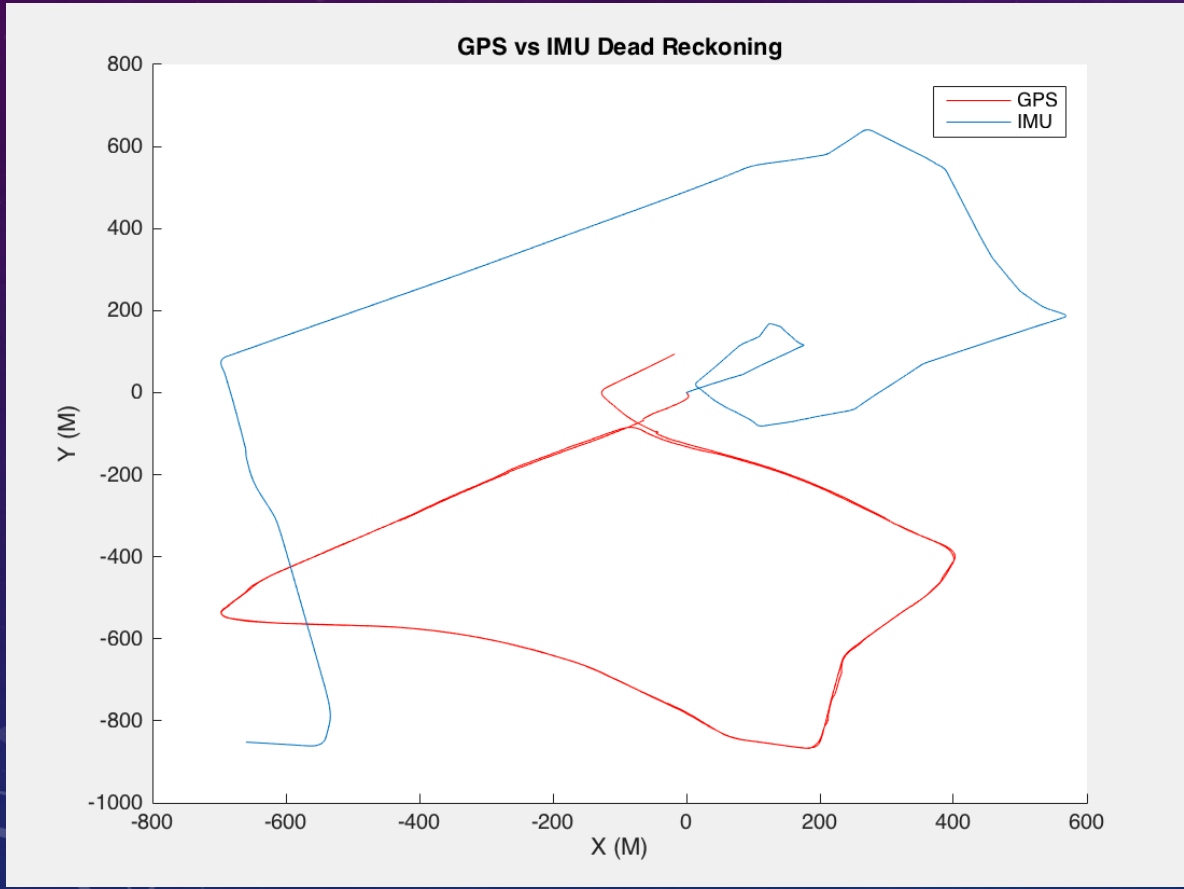
- Scale factor: 1/45 applied to the calculated value
- Recorded signal is noisy compared to the values calculated from the gyroscope
- Calculated value has slightly greater amplitude than the recorded value.
- Calculations will drift over time as a result

GPS VS DEAD RECKONING TRAJECTORIES



- Scale factor of IMU has factor of 1/45 applied
- Drive consisted of two loops
- First loop was accurate in terms of scale– errors mainly occurred when turning
- Second loop: scale error of 2-3x in distance traveled.
- Shape still matches correctly
- Result of accumulating errors in drift (second round through, spent a lot of time stuck in traffic)
- ~80,000 data points for IMU
- ~ 2,000 data points for GPS

ACCOUNTING FOR STATIONARY DRIFT DID NOT IMPROVE RESULTS



- Scale factor: 1/45
- Accounted for the bias found in the stationary data collection
- Resulting data is still not appropriately scaled (now the larger route is roughly the correct scale but the smaller box is too small)

ESTIMATING X_C

Y_(accel observed) = Y_(accel calculated) + wX_velocity + delt_w *X_c

X_c = (Y_(accel observed) - Y_(accel calculated) - wX_velocity)/delt_w

Estimated X_c = ~. 1216 m