NORTHEASTERN UNIVERSITY

GPS-IMU

A LOOK AT EXISTENCE

BY DARSHAN JAIN

GITLAB LINK

In choosing what to include in your slides, opt for powerful and interesting visuals and large, colorful fonts. These will make your presentation fun and lively.

EQUIPMENT USED

OS: Ubuntu 16.04

GPS: BU-353S4

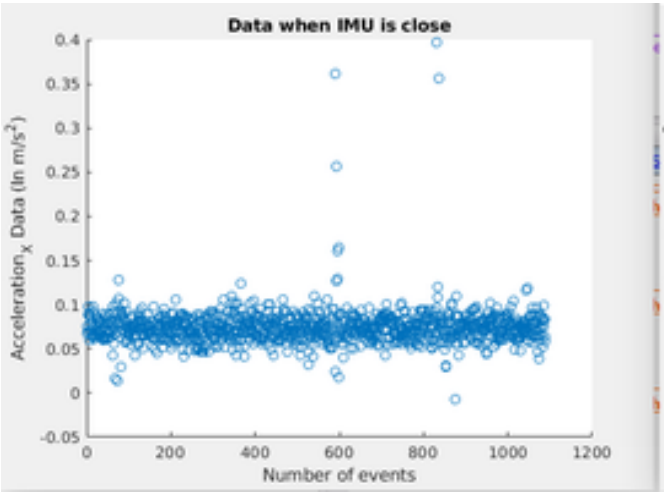
IMU: VN-100

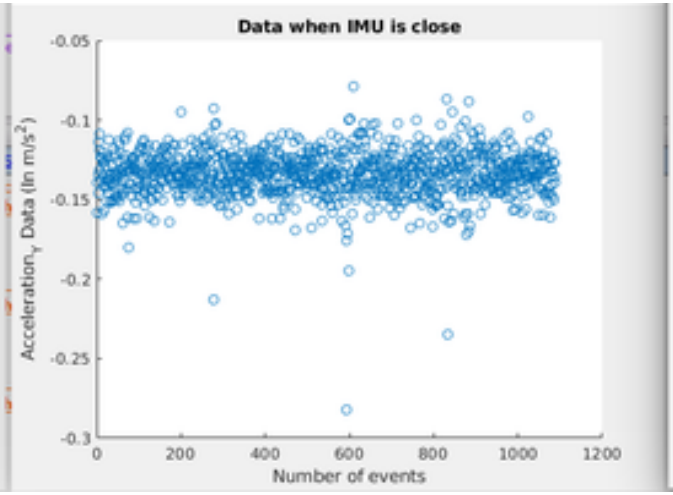
Software: LCM 1.3.1

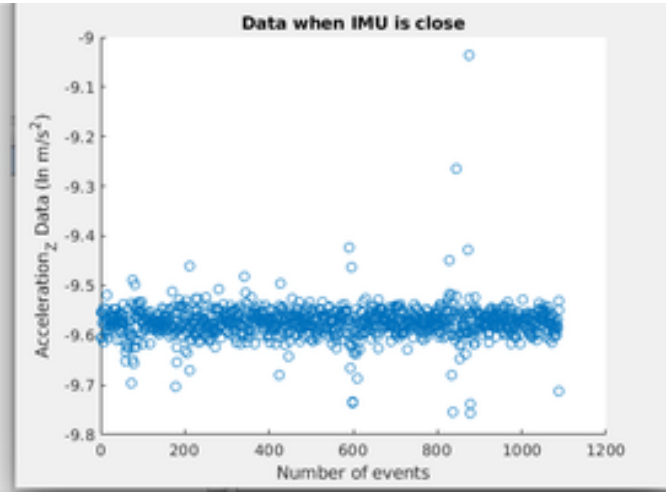
LIST OF TOPICS

#1 IMU Stationary Data
   i) IMU is close
   ii) IMU is far
#2 Magnetometer
#3 Gyroscope Yaw
#4 Complementary FIlter
#5 GPS Plot

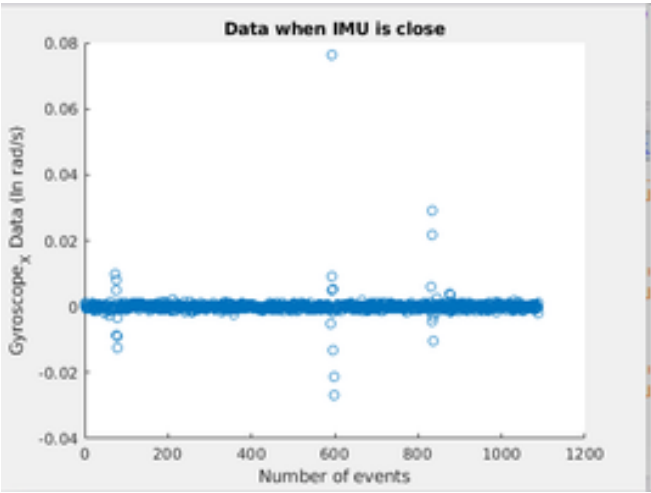
IMU - CLOSE

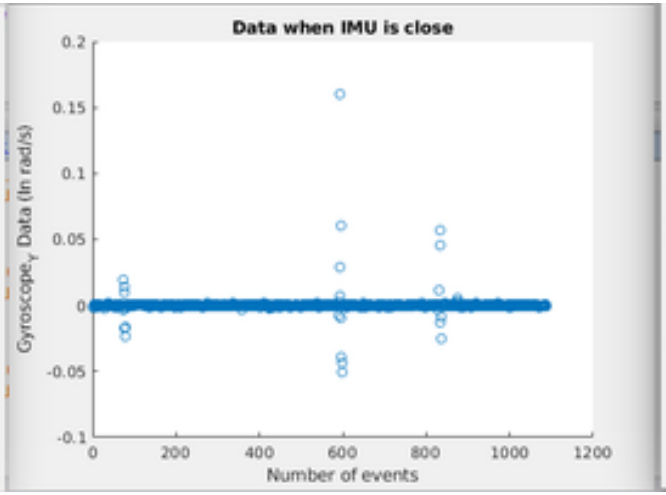

Data when IMU is close
Acceleration$_X$ Data (In m/s^2)
Number of events

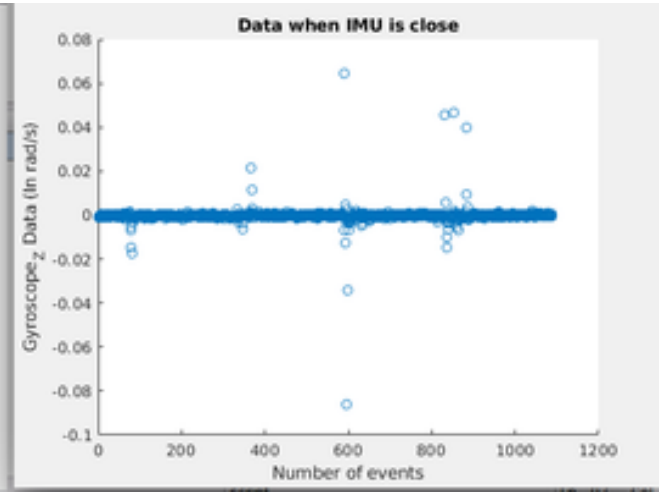

Data when IMU is close
Acceleration$_Y$ Data (In m/s^2)
Number of events


Data when IMU is close
Acceleration$_Z$ Data (In m/s^2)
Number of events

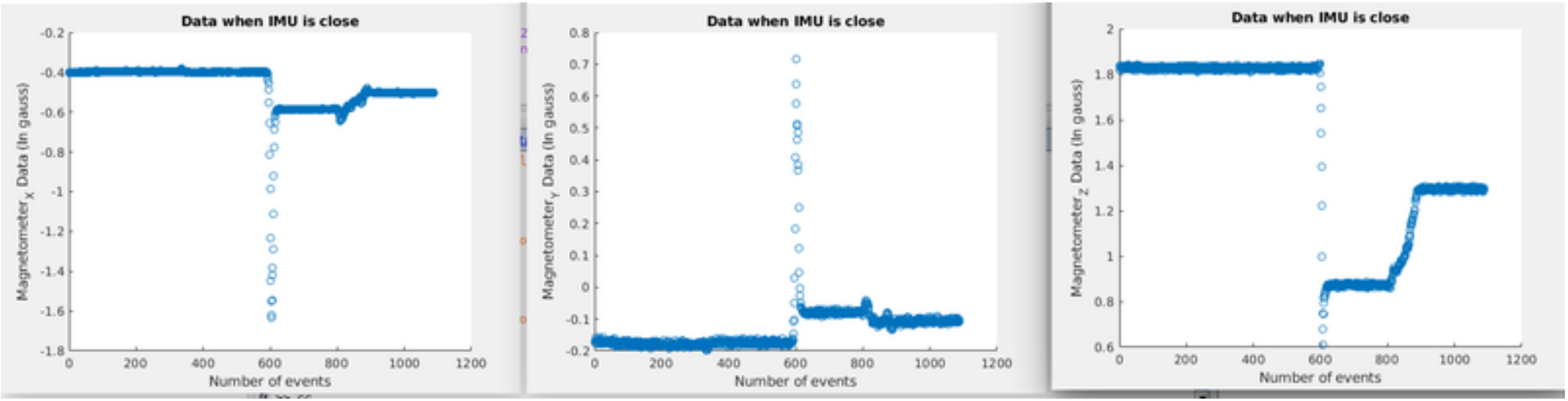
IMU - CLOSE


Data when IMU is close
Gyroscope$_X$ Data (In rad/s)
Number of events

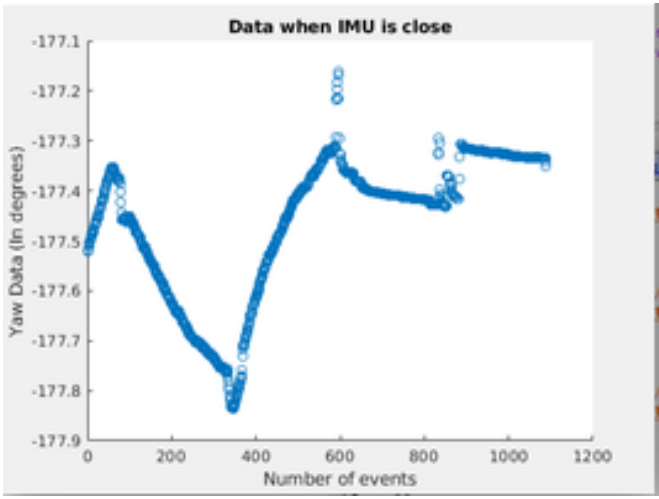

Data when IMU is close
Gyroscope$_Y$ Data (In rad/s)
Number of events

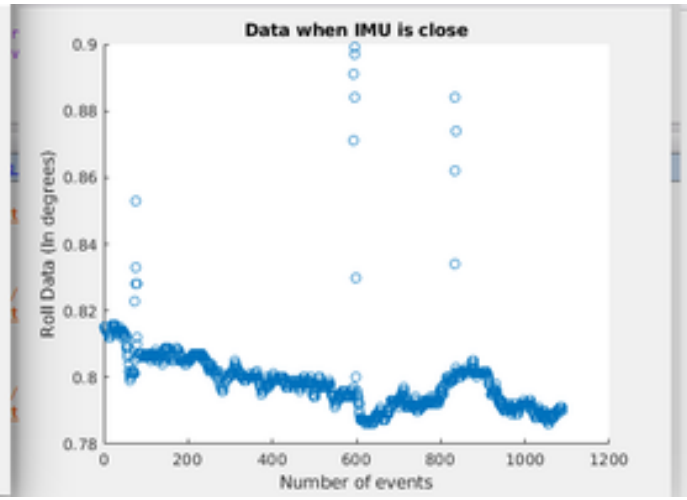

Data when IMU is close
Gyroscope$_Z$ Data (In rad/s)
Number of events

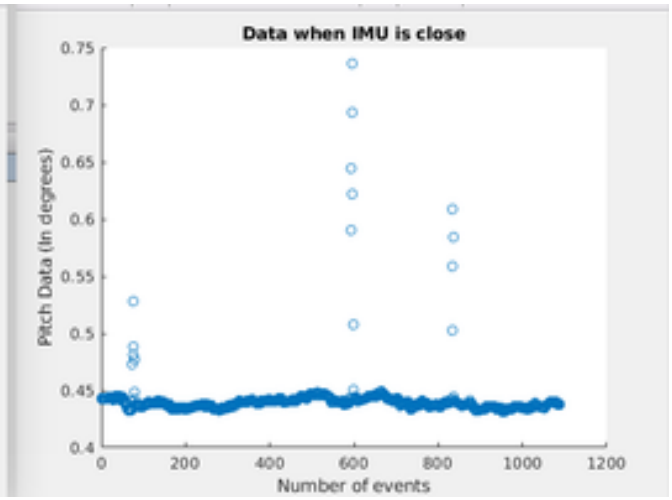
IMU - CLOSE


Data when IMU is close
Magnetometer$_X$ Data (In gauss)
Number of events
Data when IMU is close
Magnetometer$_Y$ Data (In gauss)
Number of events
Data when IMU is close
Magnetometer$_Z$ Data (In gauss)
Number of events

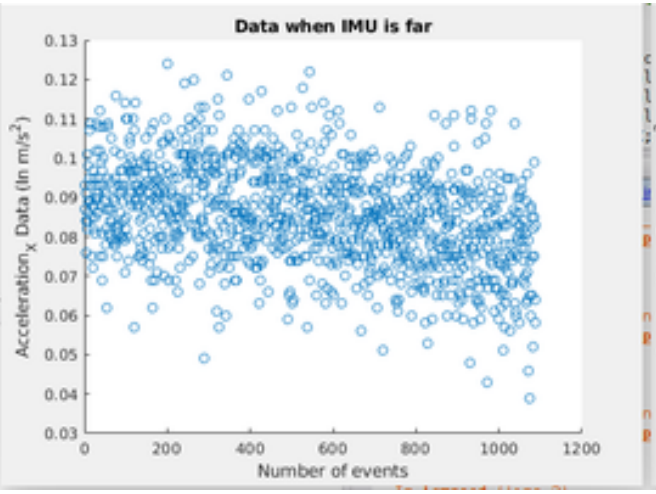
IMU - CLOSE

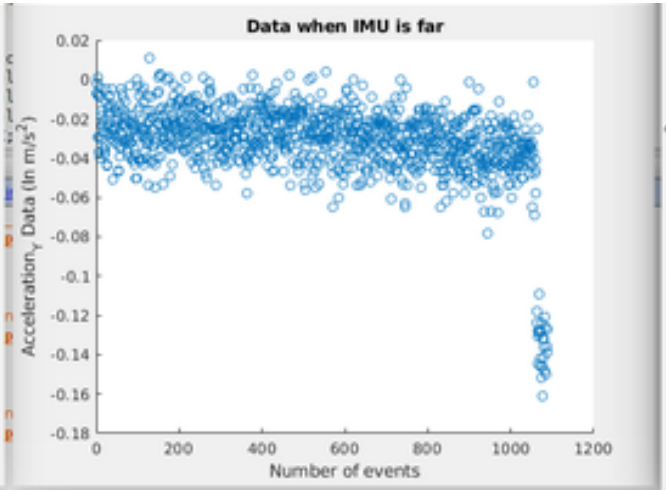

Data when IMU is close
Yaw Data (In degrees)
Number of events

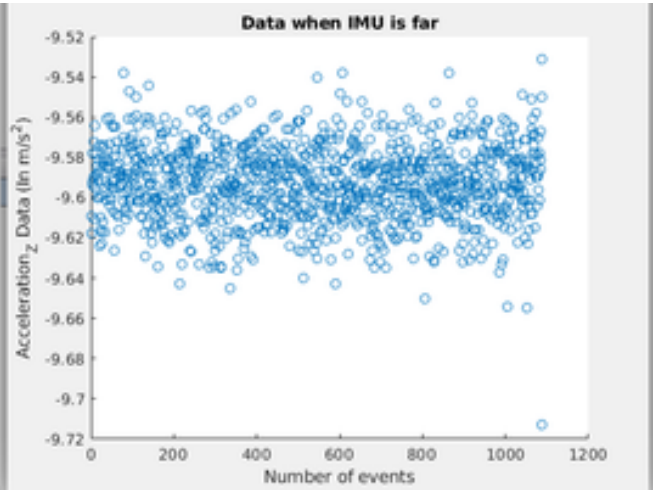

Data when IMU is close
Roll Data (In degrees)
Number of events


Data when IMU is close
Pitch Data (In degrees)
Number of events

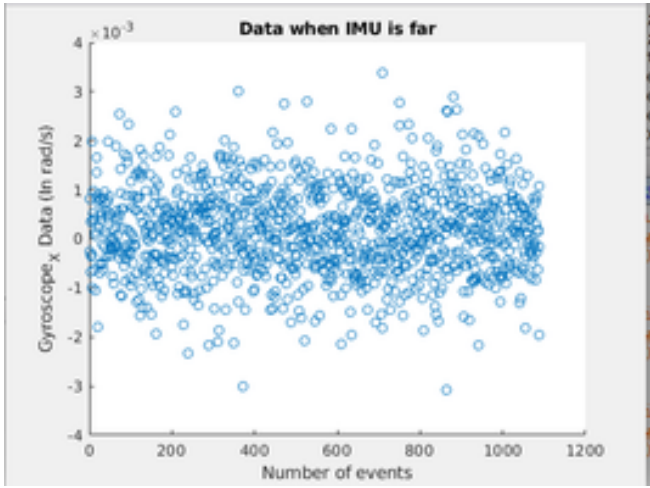
IMU - FAR

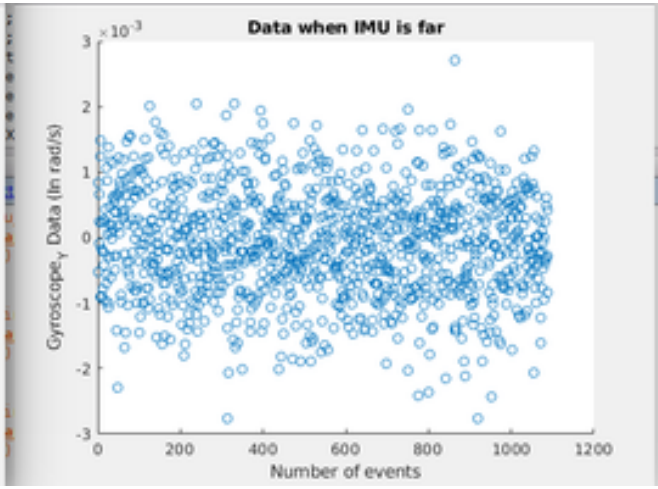

Data when IMU is far
Acceleration$_X$ Data (In m/s^2)
Number of events

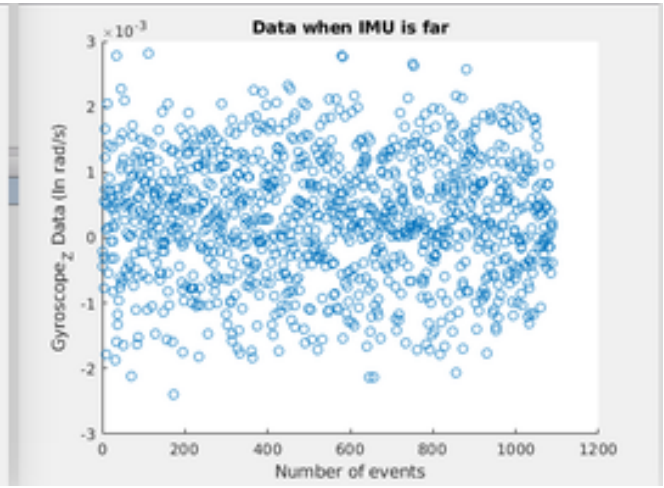

Data when IMU is far
Acceleration$_Y$ Data (In m/s^2)
Number of events


Data when IMU is far
Acceleration$_Z$ Data (In m/s^2)
Number of events

IMU - FAR


Data when IMU is far
×10^-3
Gyroscope_X Data (In rad/s)
Number of events


Data when IMU is far
×10^-3
Gyroscope_Y Data (In rad/s)
Number of events


Data when IMU is far
×10^-3
Gyroscope_Z Data (In rad/s)
Number of events

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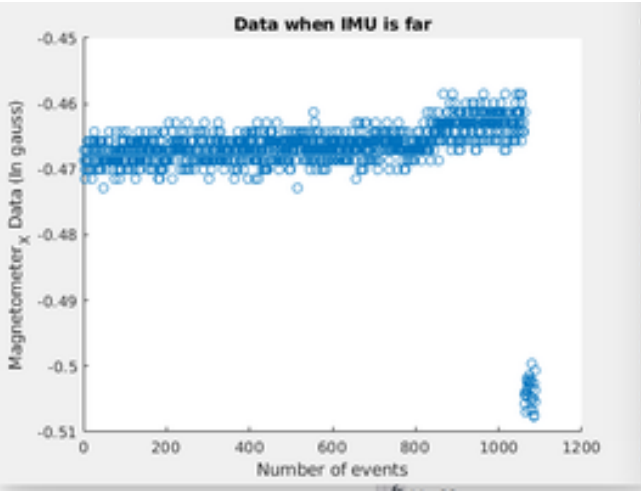
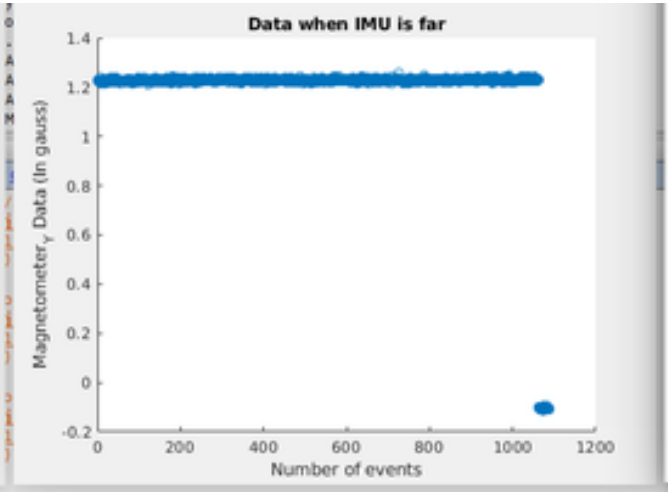
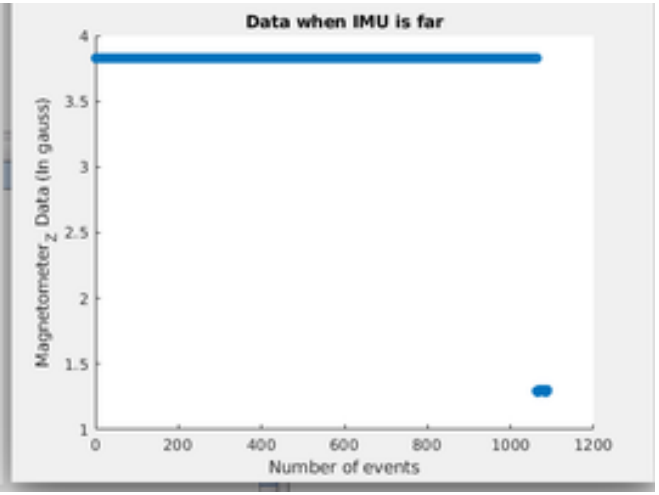
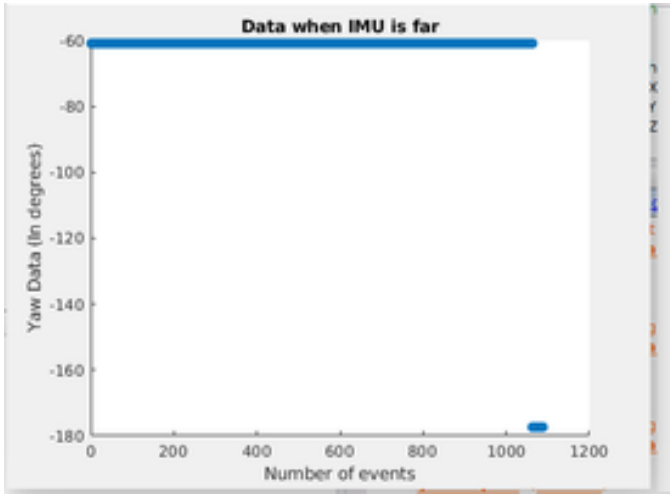
IMU - FAR

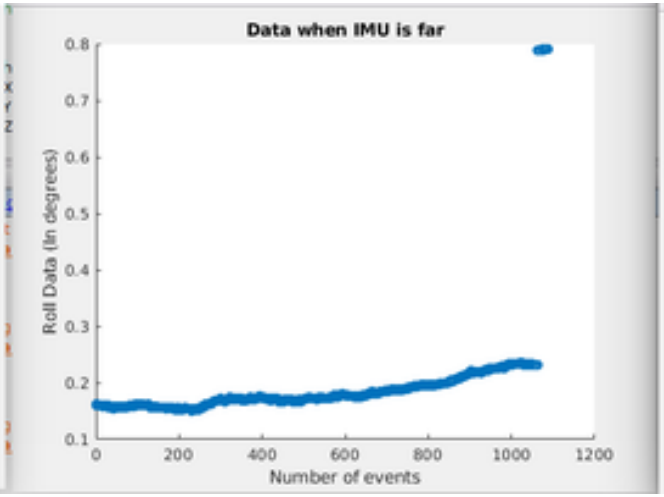


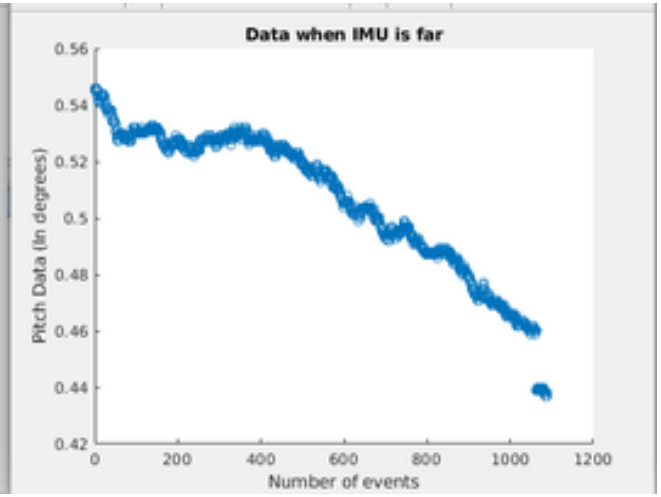




IMU - FAR


Data when IMU is far
Yaw Data (In degrees)
-60
-80
-100
-120
-140
-160
-180
0
200
400
600
800
1000
1200
Number of events


Data when IMU is far
Roll Data (In degrees)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
200
400
600
800
1000
1200
Number of events


Data when IMU is far
Pitch Data (In degrees)
0.56
0.54
0.52
0.5
0.48
0.46
0.44
0.42
0
200
400
600
800
1000
1200
Number of events

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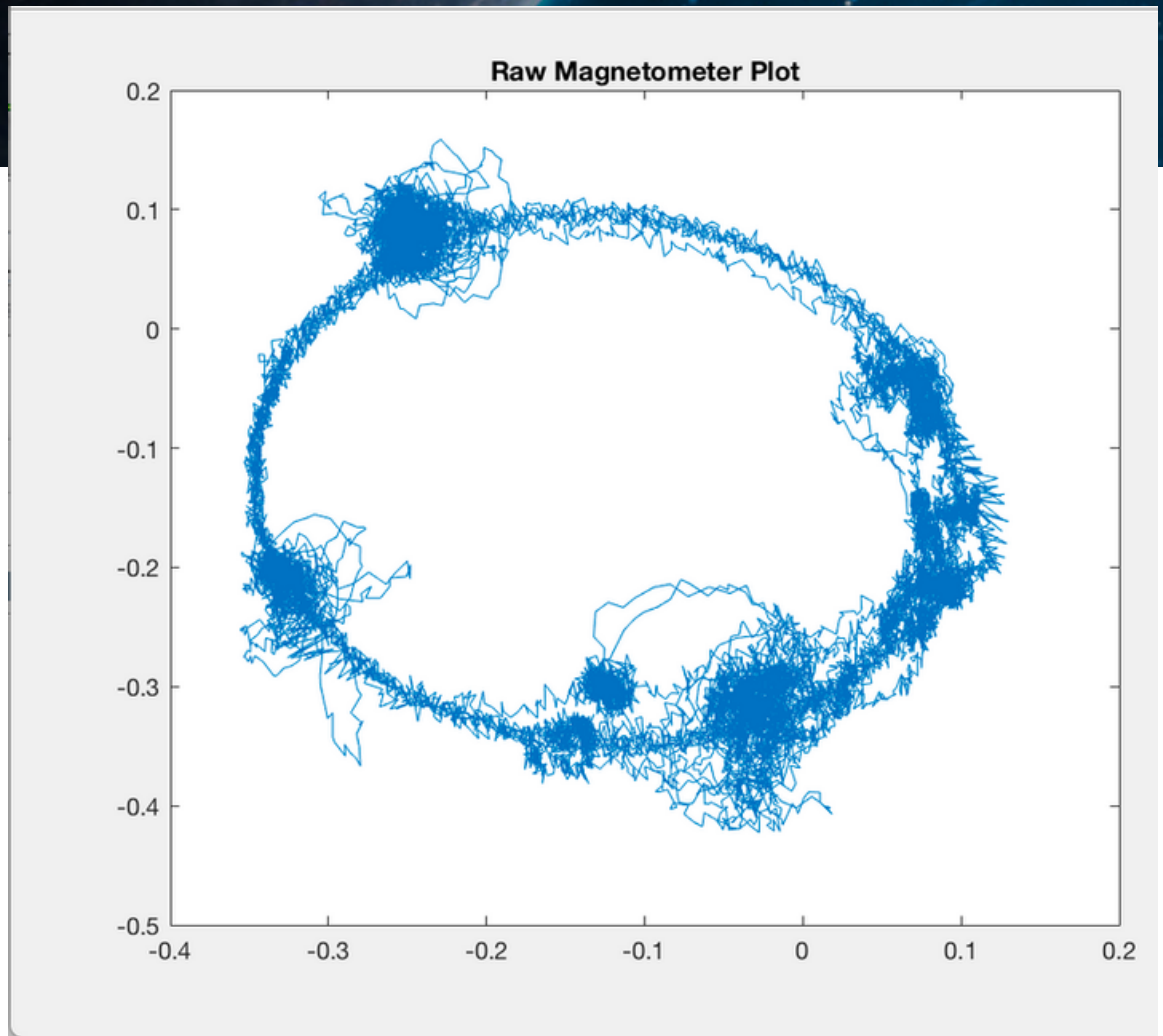
MAGNETOMETER



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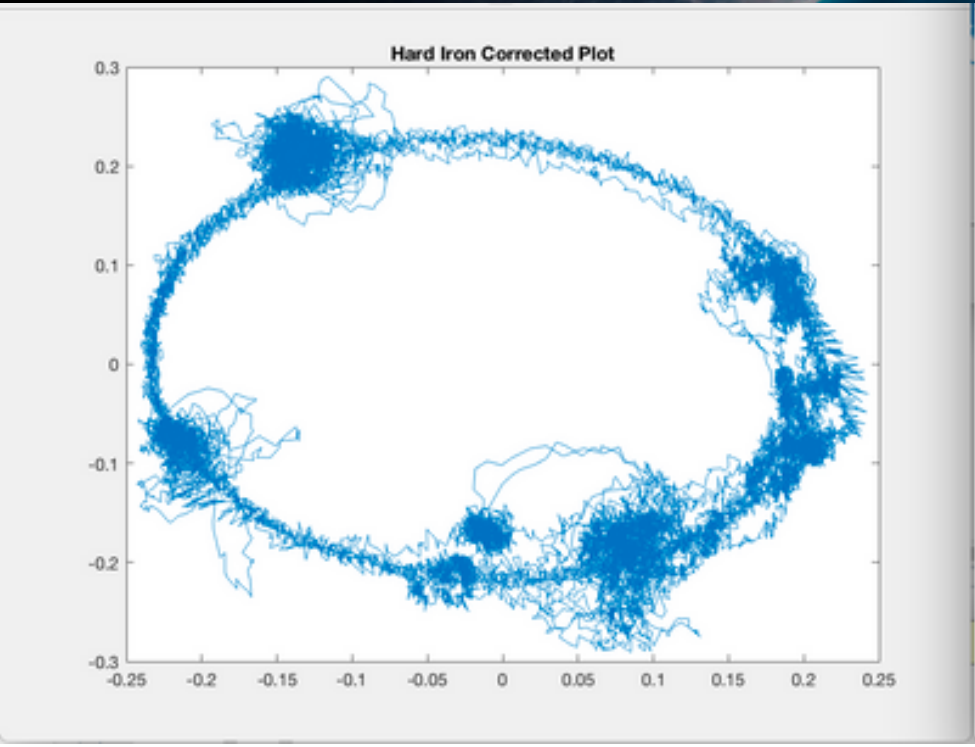
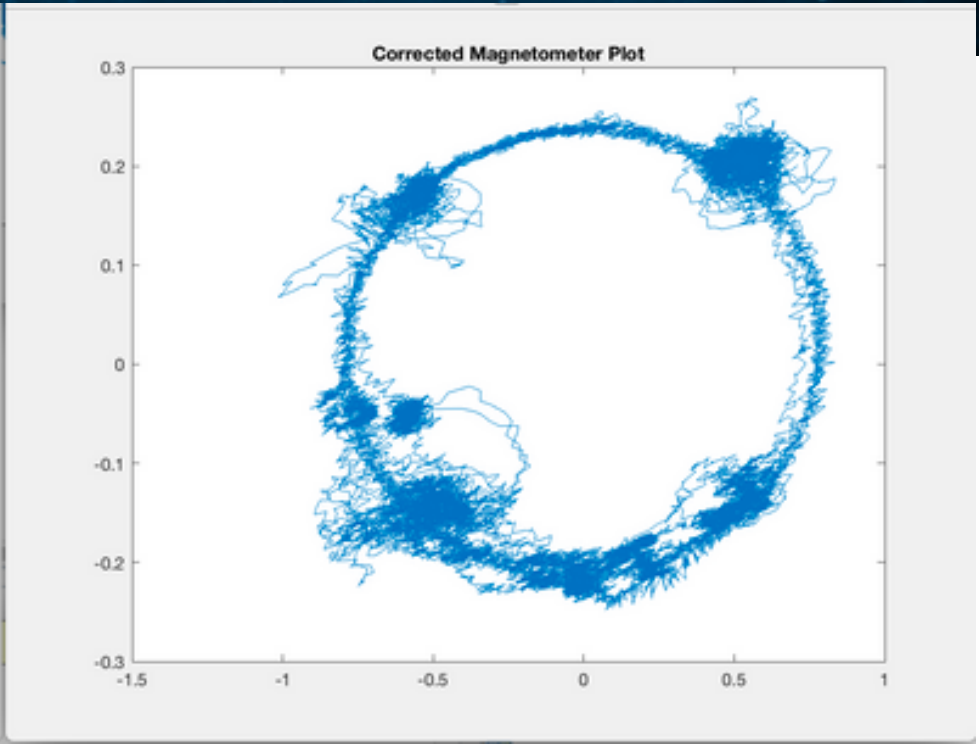
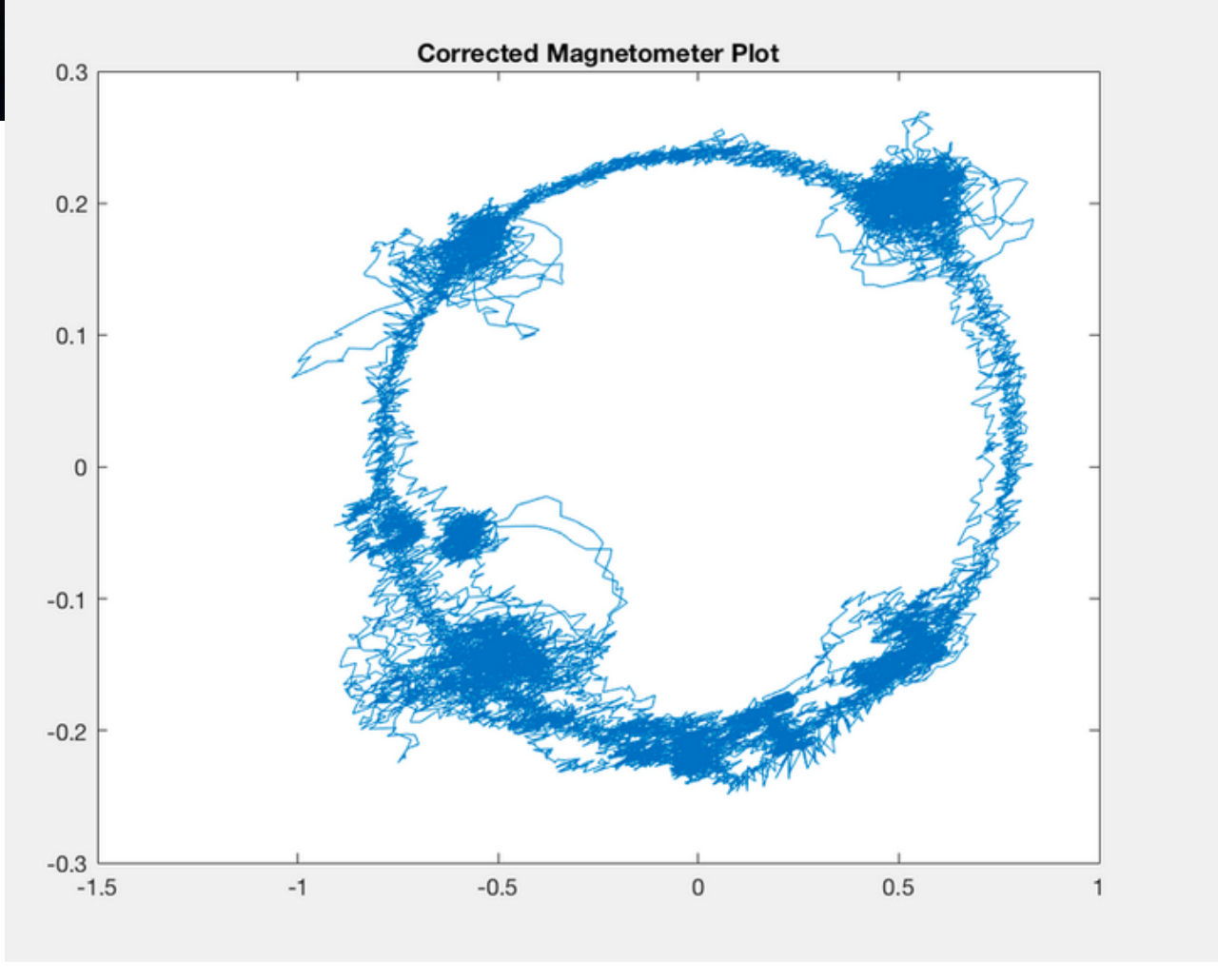
GALAXIES





MAGNETOMETER



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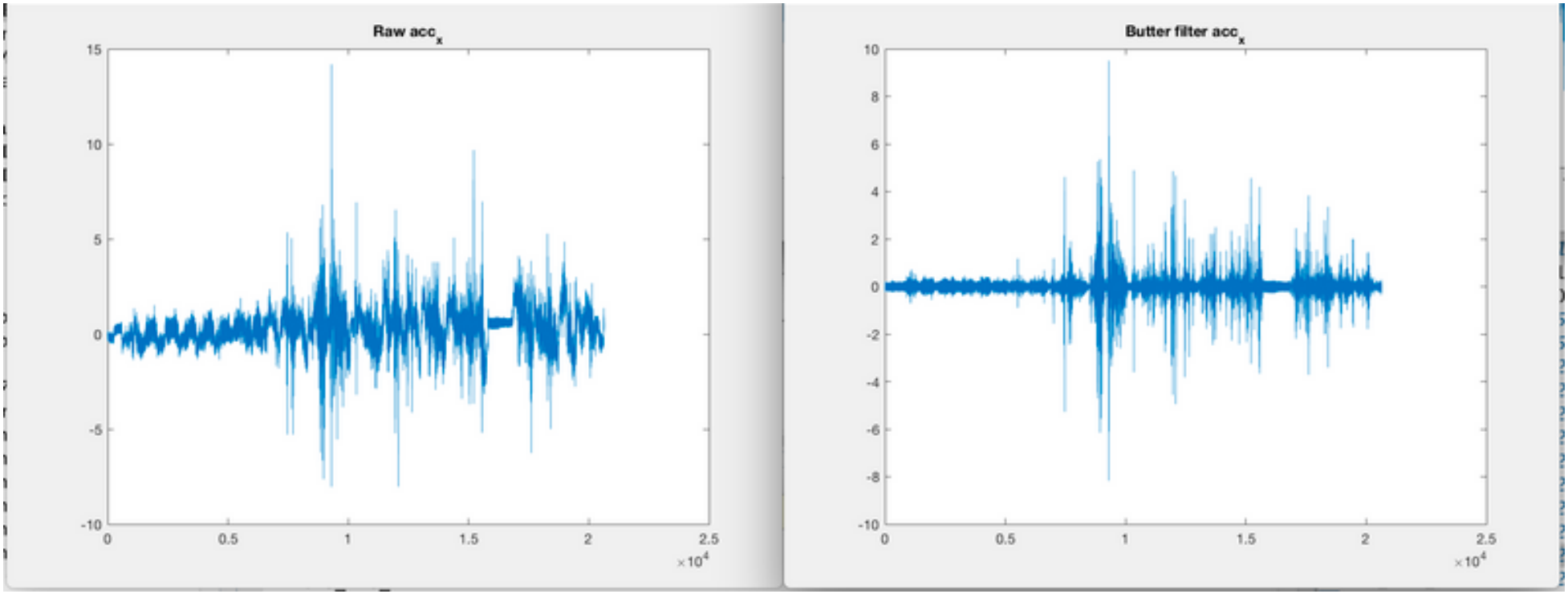
ACCELEROMETER



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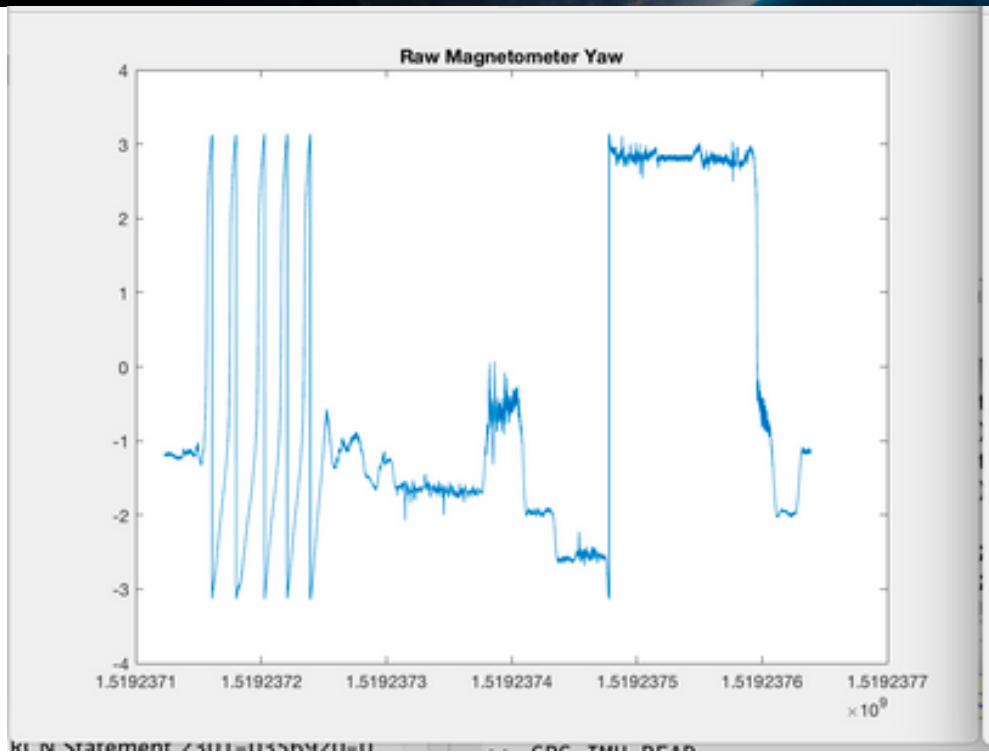
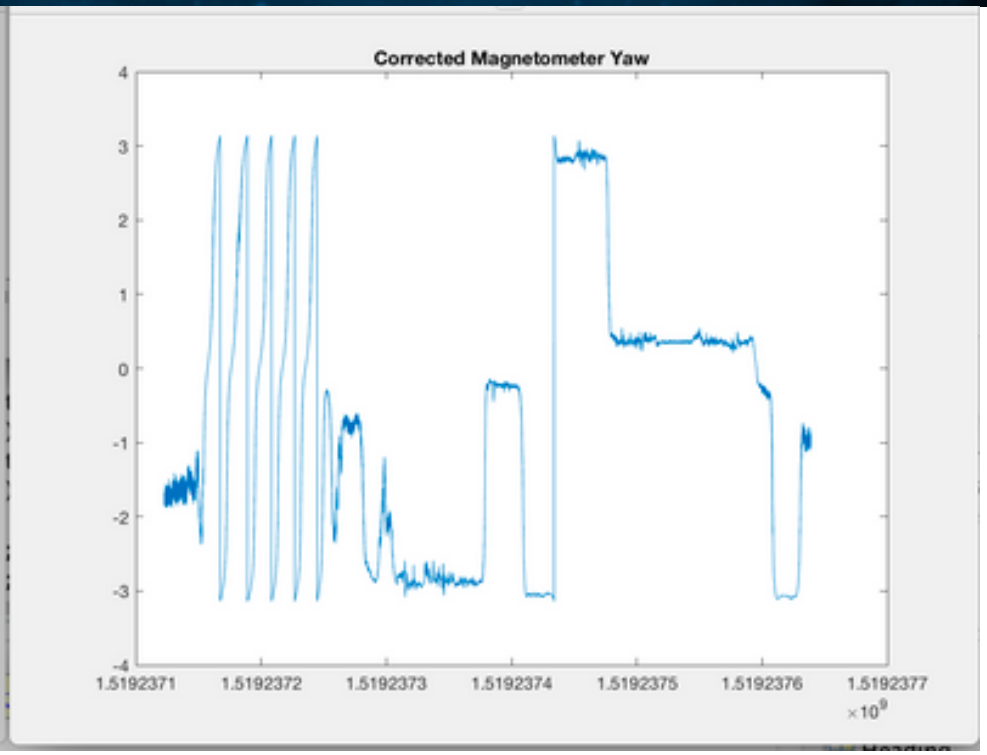
MAGNETOMETER





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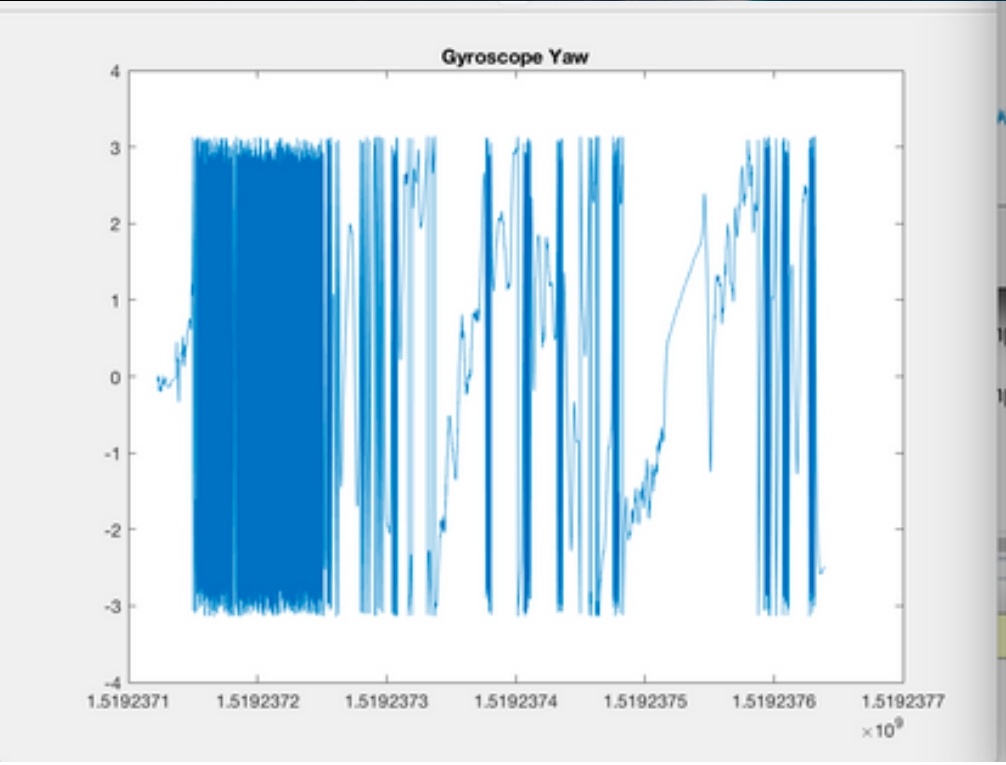
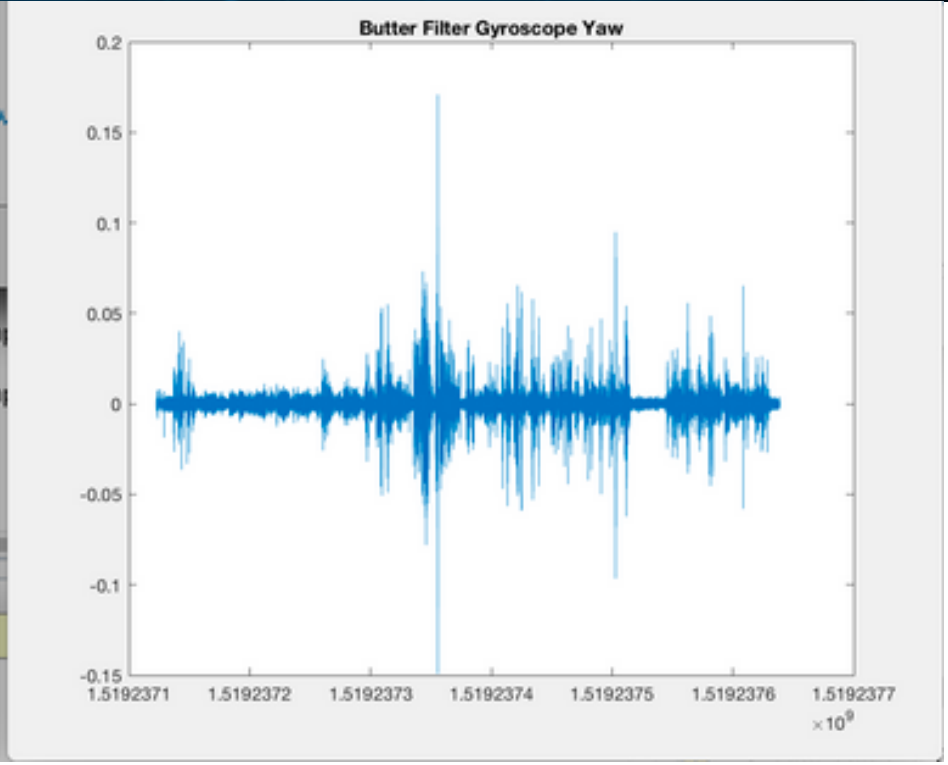
GYROSCOPE





CUMTRAPZ WITH BUTTERWORTH

Using butterworth filter before using cumtrapzs removes the high frequency changes made by the gyroscope.

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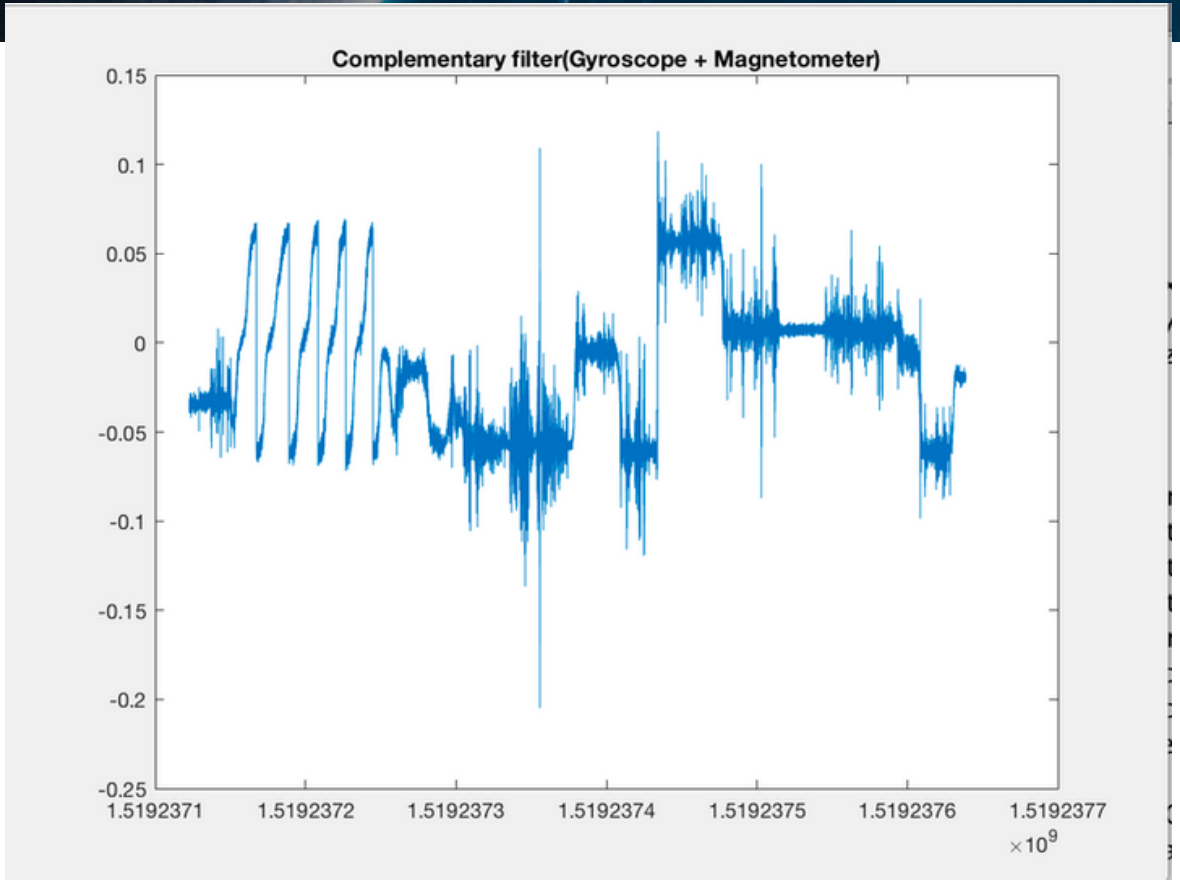
COMPLEMENTARY FILTER



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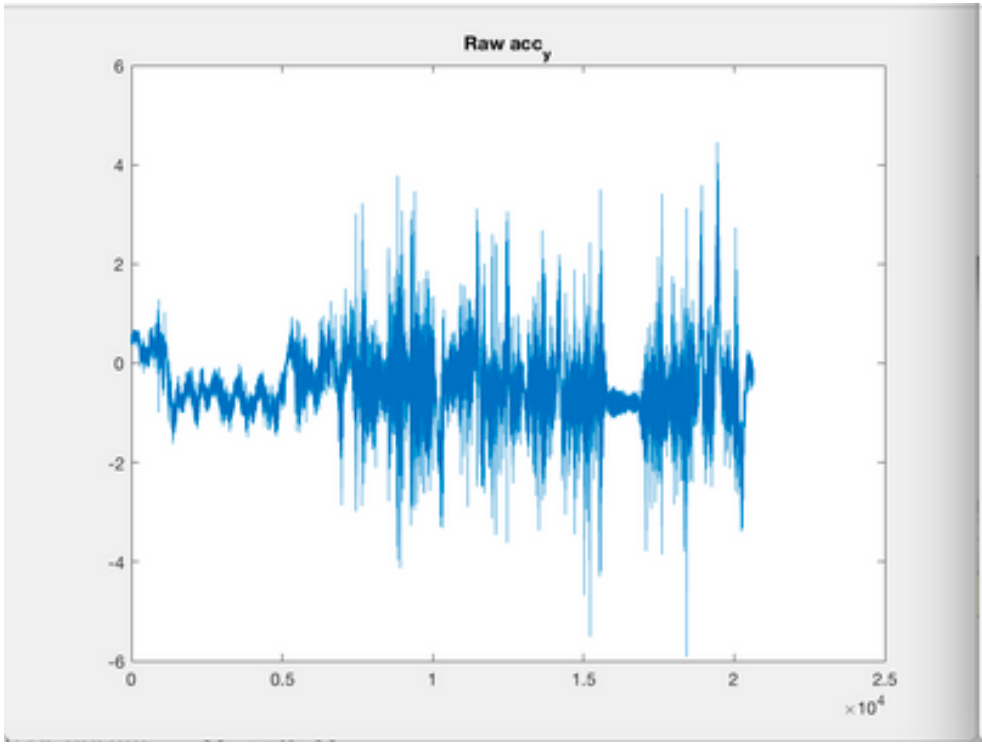
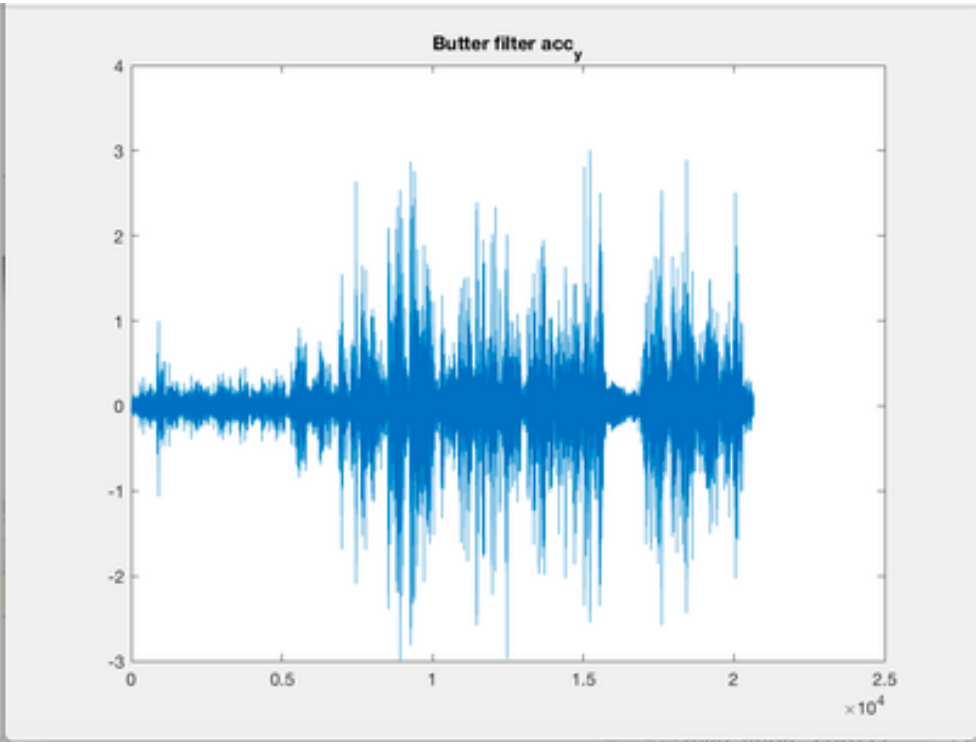
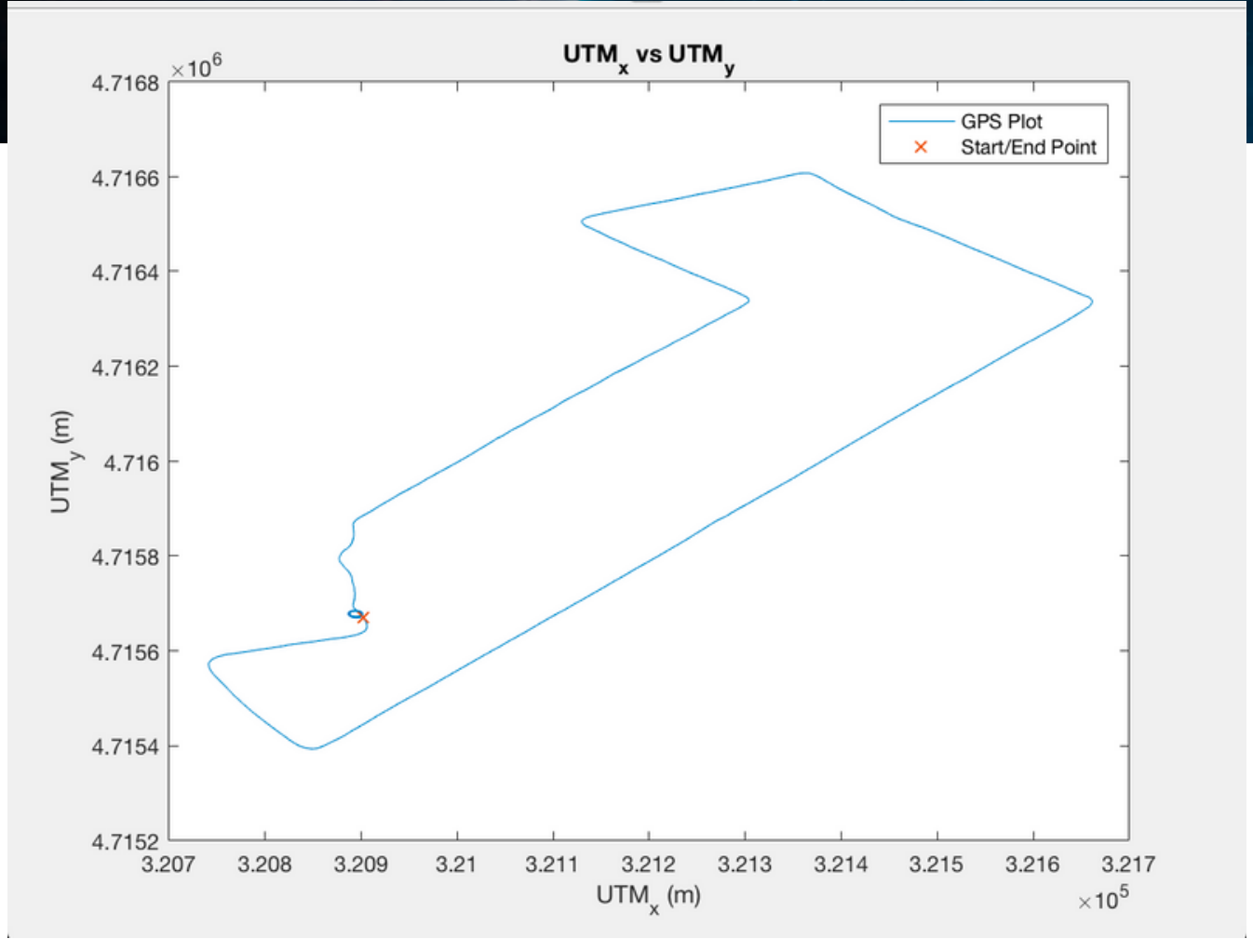
ACCELEROMETER



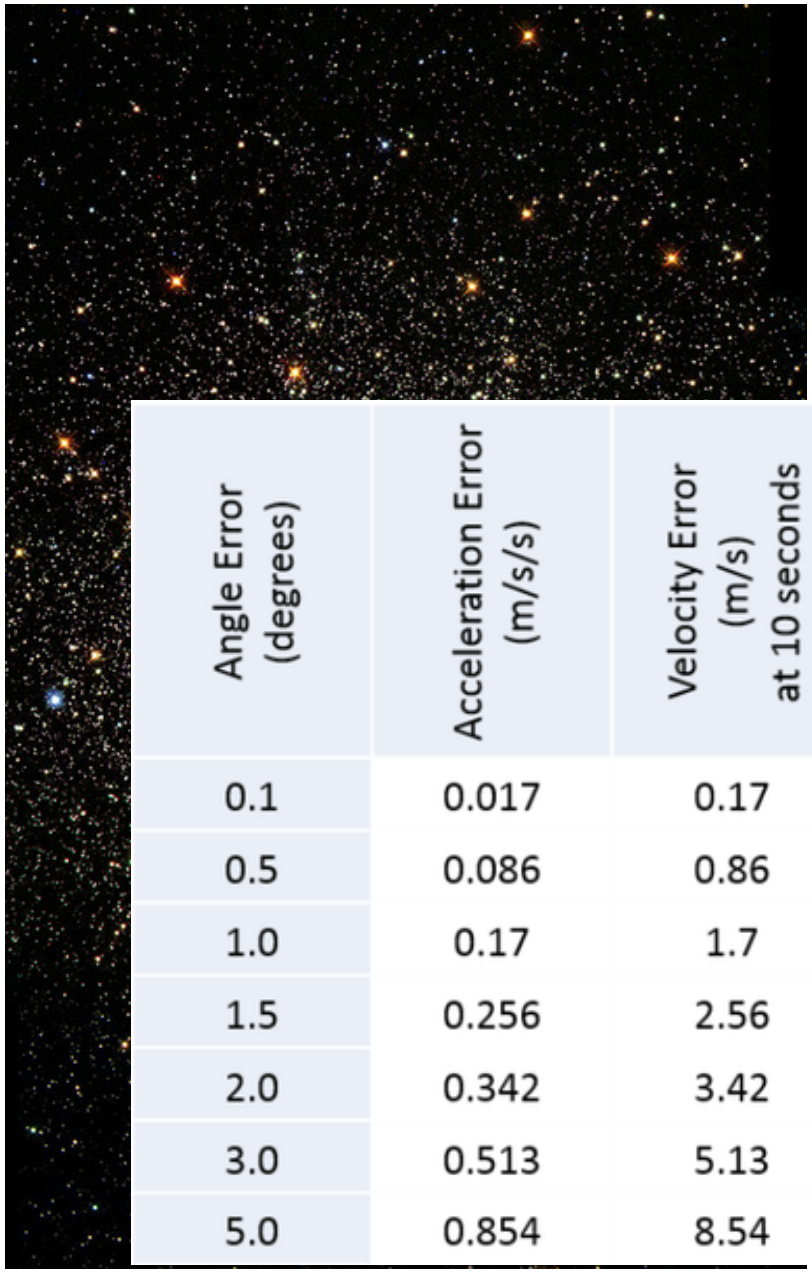


GPS PLOT


UTM$_x$ vs UTM$_y$
GPS Plot
Start/End Point
$\times 10^6$
4.7168
4.7166
4.7164
4.7162
4.716
4.7158
4.7156
4.7154
4.7152
UTM$_y$ (m)
3.207
3.208
3.209
3.21
3.211
3.212
3.213
3.214
3.215
3.216
3.217
UTM$_x$ (m)
$\times 10^5$

COMPARISON BETWEEN WXD AND YDD

the difference occurs because the assumptions made by us are not exactly correct, like, we have not placed IMU at the center of mass of the vehicle.



ERROR ANALYSIS

Angle Error (degrees)	Acceleration Error (m/s/s)	Velocity Error (m/s) at 10 seconds	Position Error (m) at 10 seconds	Position Error (m) at 1 minute	Position Error (m) at 10 minutes	Position Error (m) at 1 hour
0.1	0.017	0.17	1.7	61.2	6120	220 e 3
0.5	0.086	0.86	8.6	309.6	30960	1.1 e 6
1.0	0.17	1.7	17	612	61200	2.2 e 6
1.5	0.256	2.56	25.6	921.6	92160	3.3 e 6
2.0	0.342	3.42	34.2	1231.2	123120	4.4 e 6
3.0	0.513	5.13	51.3	1846.8	184680	6.6 e 6
5.0	0.854	8.54	85.4	3074.4	307440	11 e 6