INTRODUCTION TO COMPUTER VISION

Lab 7 – Motion Tracking

C14109603

Rahil Modi
rmodi@g.clemson.edu

Introduction:

For this lab we were given a data which included the accelerometer data and gyroscope data. The data consisted of seven values, time, acceleration on x-axis, acceleration on y-axis, acceleration on z-axis, pitch, roll and yaw. The data recorded by an iPhone and sampled at 20 Hz which can be translated to 0.05 seconds interval time. The iPhone was moved along each axis and then kept at rest for around 2-3 seconds and then moved again. With this data we were required to determine from between which time intervals the iPhone was in motion and when it was in rest.

Implementation:

To begin with it was necessary to plot the data to visualize better how is the graph trend as it would help in determining when the iPhone is moving. First the variance of the all the parameters for a given time frame was calculated and exported to a csv file. Once exporting was done, I plotted the graphs of every axis and analyzed to determine where a movement was noticed. All the axis variance graph can be seen in the Results section.

After plotting all the accelerations, pitch, roll and yaw variances on the same graph I tried determining a threshold value for each axis to determine when the iPhone was moving. To determine a movement a loop was ran where any of the axis crossed the threshold it was recorded as the start point and the loop continued and when the variance fall below the threshold value that point was recorded as the end point. Then using the start point and the end point, distance for each time step was calculated by two different integral function one for acceleration and other for gyroscope data, for each axis and exported to a csv and text file.

Variance Window = 10

Sample Time = 0.05

Acceleration threshold = 0.0005

Pitch threshold = 0.005

Roll threshold = 0.05

Yaw threshold = 0.005

Results:

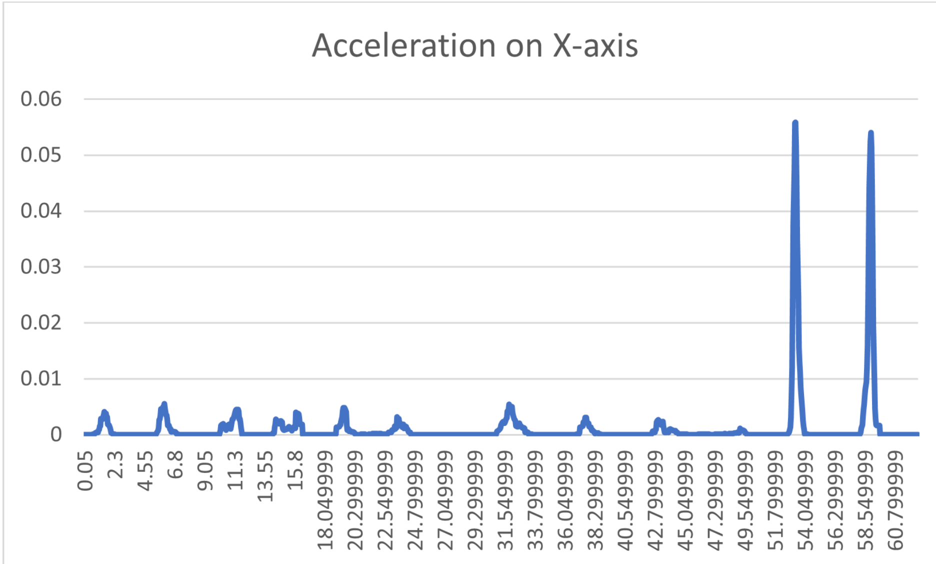

Figure 1

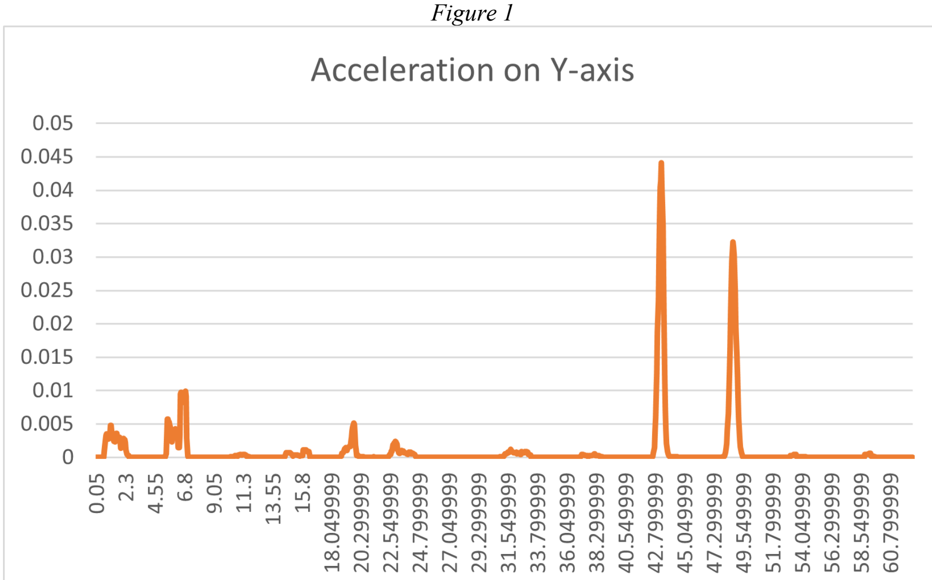

Figure 2

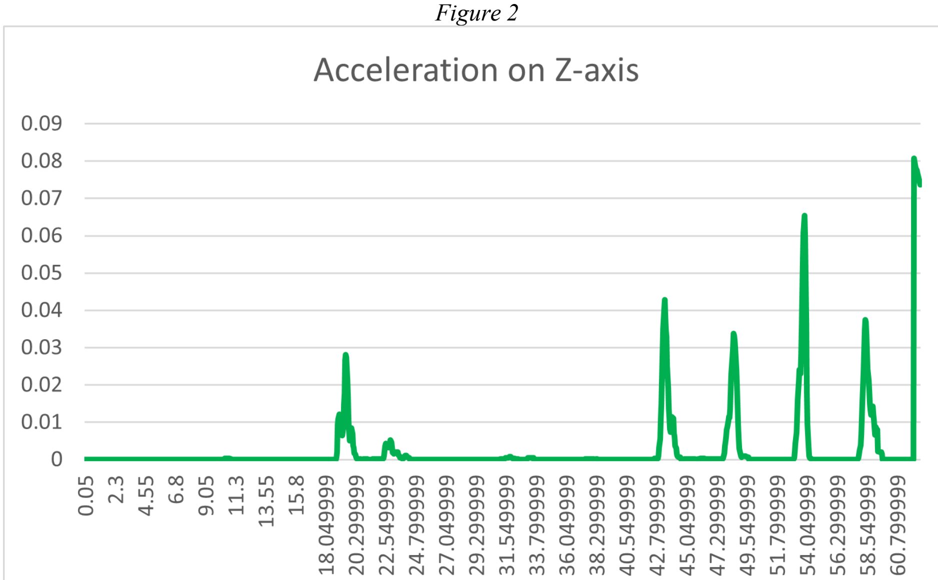

Figure 3

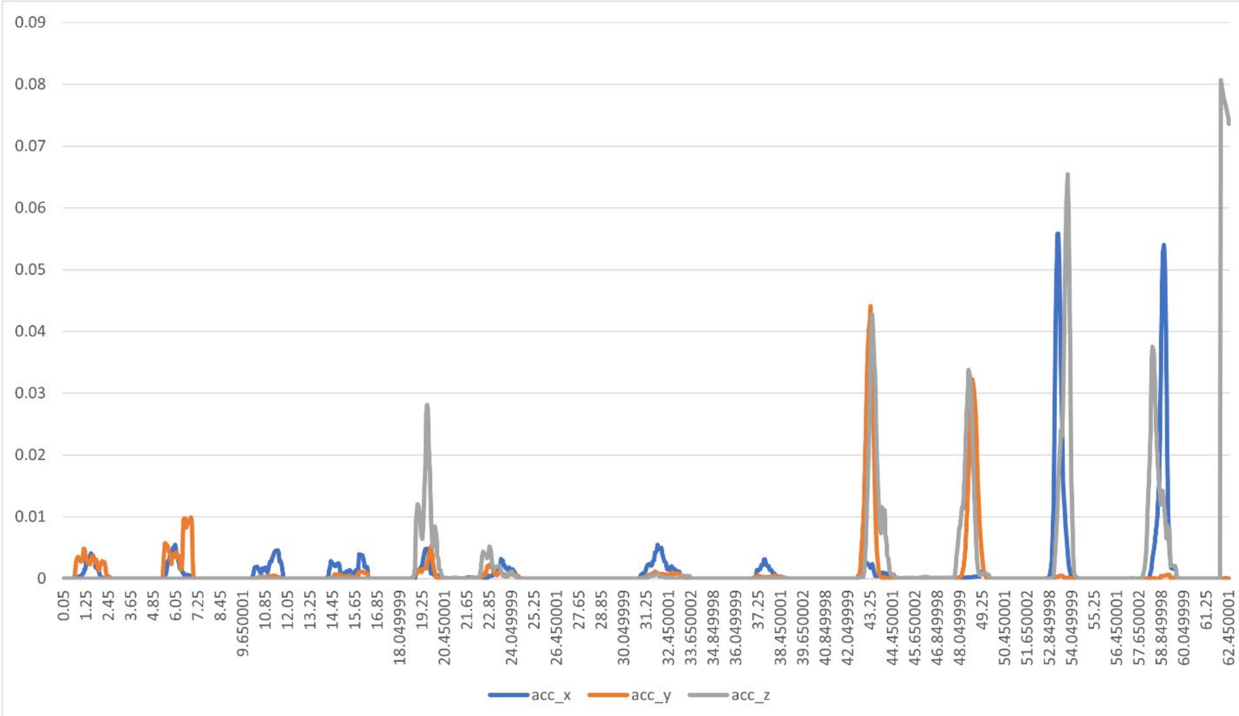

Figure 4 All accelerations variance plot

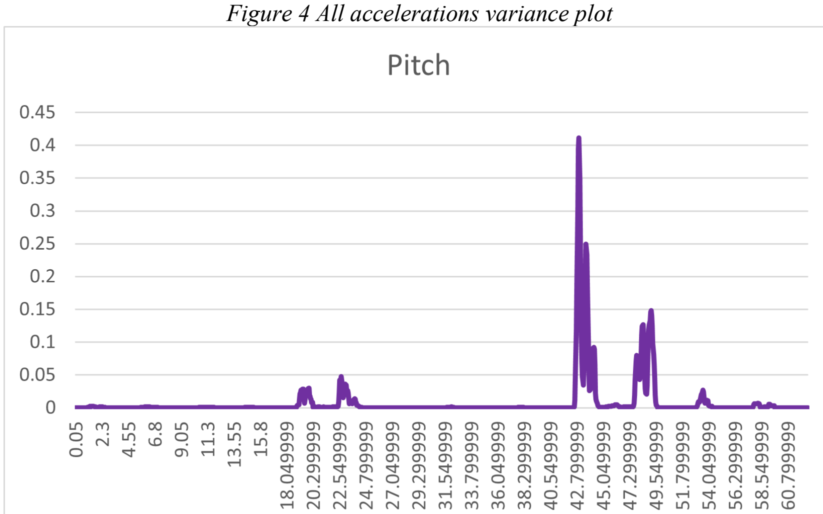

Figure 5

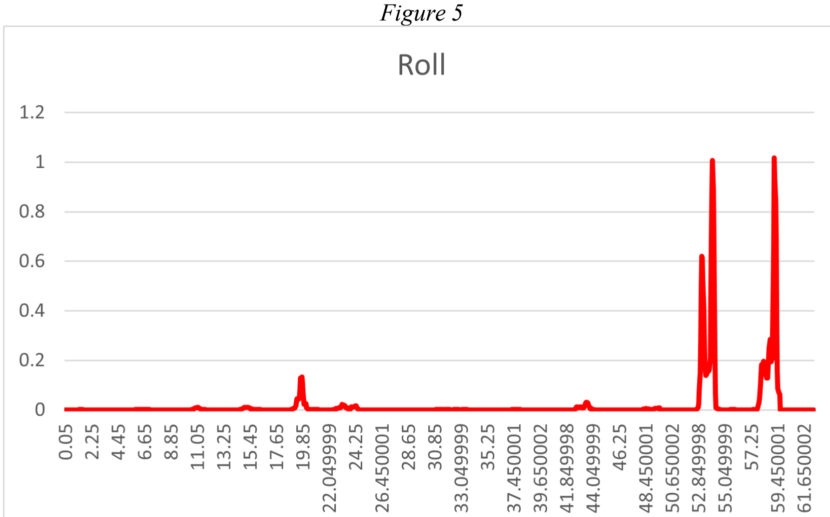

Figure 6

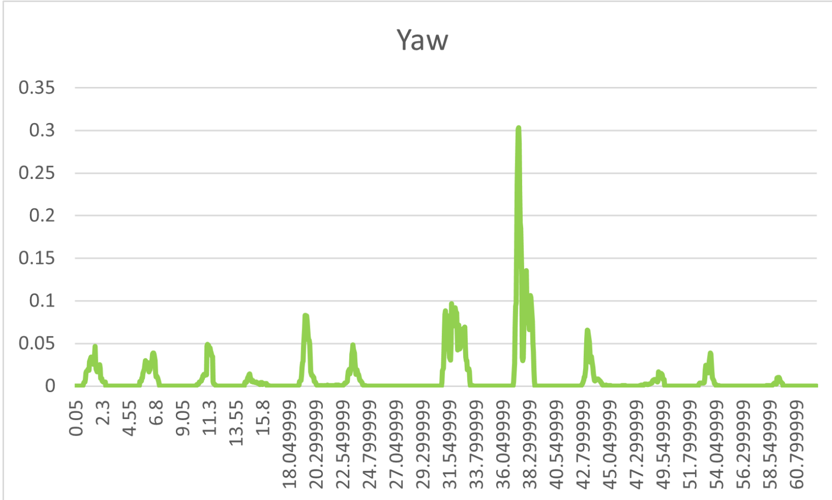

Figure 7

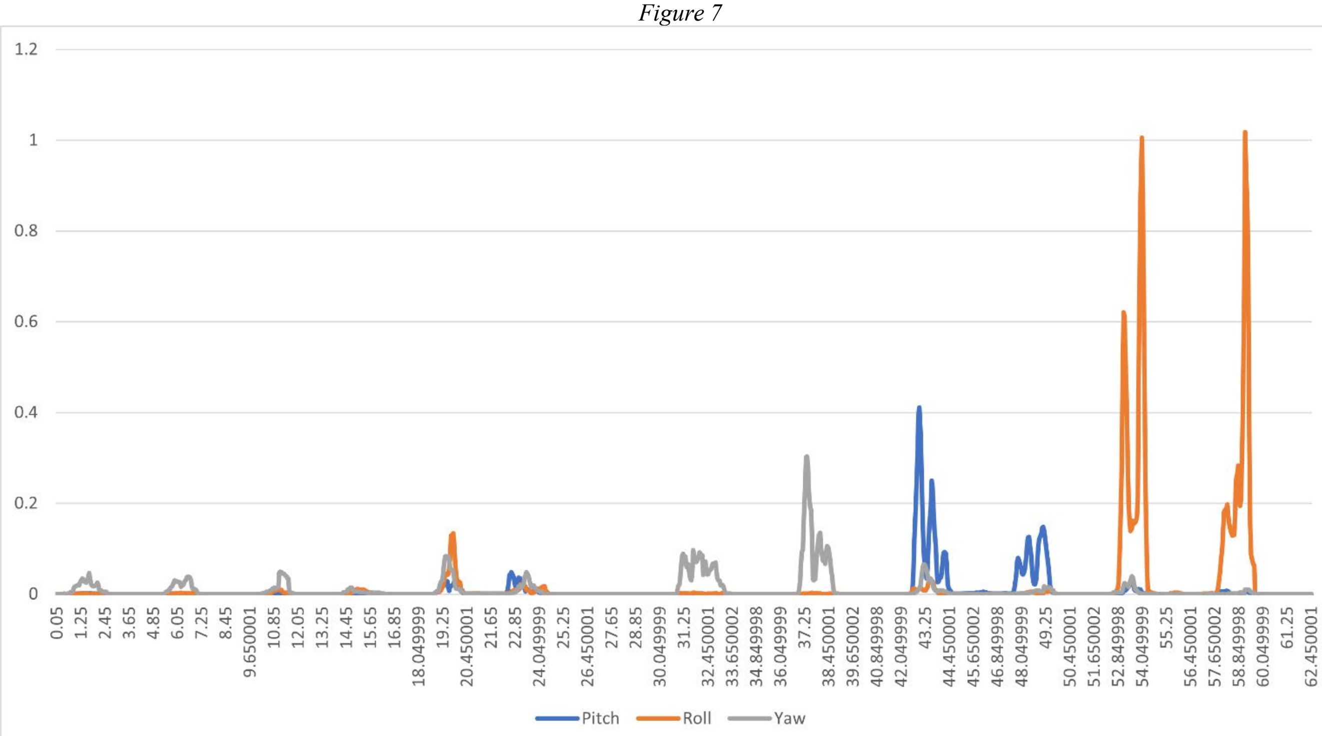

Figure 8 Gyroscope data variance

Start Time	End Time	Start Point	End Point	X-Linear distance	Y-Linear distance	Z-Linear distance	Pitch	Roll	Yaw
0.75	2.5	14	49	0.274389	-0.30152	0.185086	-0.01977	0.000707	-0.03883
5.45	7.2	108	143	0.082801	0.566376	0.181083	0.001822	-0.02401	0.022933
10.3	11.9	205	237	-0.21515	0.087594	0.166966	-0.00526	-0.00897	-0.0267
14.35	16.45	286	328	0.635353	-0.03291	0.28072	-0.00398	0.003155	0.04215
18.9	20.4	377	407	0.411988	-0.07055	-0.31734	0.162239	0.100728	-0.07124
22.45	24.5	448	489	3.469262	-1.78708	1.071226	-0.17118	-0.15155	0.053289
31.05	33.45	620	668	-0.17392	-0.13425	0.336171	0.045968	-0.00255	1.566456
37.1	38.9	741	777	-0.13662	0.142675	0.102977	-0.00283	-0.01086	-1.54062
42.7	44.65	853	892	-0.882	-6.59782	4.341036	1.611325	-0.089	-0.06852
47.75	49.8	954	995	-0.86375	-18.2047	16.07906	-1.57994	0.049474	0.05177
52.85	54.45	1056	1088	3.330576	-0.02238	1.847018	0.002214	1.690734	-0.07414
57.95	59.8	1158	1195	15.33773	-0.02145	14.00735	-0.03776	-1.60658	0.045568

As it can be observed in the table that the rotational data is not very good. These axes were easier to calculate than other and the reason for this can be observed in the plot of the acceleration variance of the Z-axis.

The big spike can be translated to movement in Z-axis, but the smaller spikes are also necessary for calculating motion in the rotational data. All the categories value must drop below the threshold to determine as iPhone has stopped moving and is at rest. The checking of all the threshold value makes it difficult for rotational components as when the phone is rotated or flipped the Z-axis is not feeling the gravity and the variance is varying greatly. It is not possible to keep a large threshold otherwise the smaller spikes will not be noticed if the threshold is large so after looking at all the variances and its value I have decided a threshold value for each axis.

The integral is performed on rotation in one direction and rotating back, as the end time is recorded only when the phone is rotated or flipped back. Based on the signal of rotation the area under the curve is almost zero. Respectively the accelerometer data varies greatly because the rotation and the flipping the accelerometers feel as gravity changes which creates a large spike and it carried over to second integral. This increases the error in the distance due to doing integration twice.

Conclusion:

From this lab it is concluded that it is very difficult to work with accelerometer and gyroscope, to achieve linear data from the data of these sensors are not very reliable. It is very difficult to extract the right answer from this data.