ECE 6310 – Introduction to Computer Vision – LAB 7 REPORT

MOTION TRACKING

TASKS

1. Data information
   a. 7 cols: time, x_acc, y_acc, z_acc, pitch, roll and yaw
   b. Unit for time = seconds
   c. Frequency = 20Hz
   d. Time period = 0.05 s
   e. Unit for accelerometer data = Gravities
   f. Unit for gyroscope data = radians/sec
2. Experiment
   a. Iphone moved along each axis independently for 2-3 seconds
   b. Between each motion, rest period is 2-3 seconds
3. Goal
   a. Automatically segment the data into periods of motion and periods of rest
   b. Calculate motion along and about each axis during periods of motion
4. What to do:
   a. To segment:
      i. Use window and calculate variance along all 6 axes
      ii. When all var < threshold, Iphone is at rest.
      iii. When any var > threshold, Iphone is in motion.
      iv. Note: units are different for the gyroscope and accelerometers, thresholds will be different.
      v. Consider smoothing data first
   b. To calculate motion
      i. Gyroscope data must be integrated
         1. Multiplying the data by time between samples
      ii. Accelerometer data must be double integrated
         1. Calculate three values:
            a. Velocity at the end of a sampling period
            b. Average velocity during a sampling period
            c. Distance traveled during the sampling period
            d. Initial velocity = 0.
            e. The velocity at the time of a data sample = velocity at the time of previous sample + acceleration reading*(time between samples)
               i. Assumes constant acceleration
5. Outputs:
   a. For each detected period of motion, report:
      i. Total linear distance along each axis
      ii. Total angular rotation about each axis
6. Report:
   a. Times and indices of detected periods of motion in a table, where each row is a period, and each column is a linear distance in a certain axis.

Introduction

Gyroscope and accelerometer data were presented in a text file. This file was loaded into the c program for use.

Outputs

The following table summarizes the parameters used in this program for optimal results.

Parameter	Value
Sample Time	0.05 s
Acceleration due to gravity	9.81 m/s^2
Smoothing Window	10
Variance Window	11

The following table summarizes the variance thresholds used for each of the six axes:

Axis	Threshold Value
X	0.045
Y	0.005
Z	0.040
Pitch	0.006
Roll	0.006
Yaw	0.006

The following table summarizes the distances travelled along each of the axes, for **a total of 12 movements:**

Start Index	End Index	Start Time	End Time	X	Y	Z	Pitch	Roll	Yaw
17	48	0.85	2.4	0.099438593	-0.160780452	-5.635467347	-0.018779856	-9.46466E-05	-0.046510458
109	142	5.45	7.1	0.029572142	0.269300296	-6.401128098	-0.00123032	-0.016415567	0.030361945
212	233	10.6	11.65	-0.110327497	0.025351281	-2.539777571	-0.003513296	-0.011279642	-0.011139074
290	310	14.5	15.5	0.117628769	-0.001823216	-2.298271037	-0.003556675	0.015820346	0.029335509
378	406	18.9	20.3	0.149266214	-0.013827304	-4.8107436	0.161202128	0.106483526	-0.057577111
449	490	22.45	24.5	1.615075487	-0.804234131	-9.531412108	-0.168439542	-0.152718986	0.056441938
619	667	30.95	33.35	-0.066283285	-0.062560326	-13.67470355	0.046706496	-0.004047478	1.56699312
740	775	37	38.75	-0.065991969	0.060221826	-7.250809473	-0.001522551	-0.011022114	-1.527251216
852	892	42.6	44.6	-0.405350671	-2.895779046	-7.711897799	1.618410726	-0.088468108	-0.069301226
953	994	47.65	49.7	-0.397053447	-8.774643907	-2.1589062	-1.572569482	0.043175725	0.054137939
1055	1090	52.75	54.5	1.76224993	-0.012532315	-6.296537055	0.002106537	1.68322618	-0.073594246
1155	1194	57.75	59.7	8.253965986	-0.010609736	-1.204186974	-0.038989502	-1.602711378	0.044246039

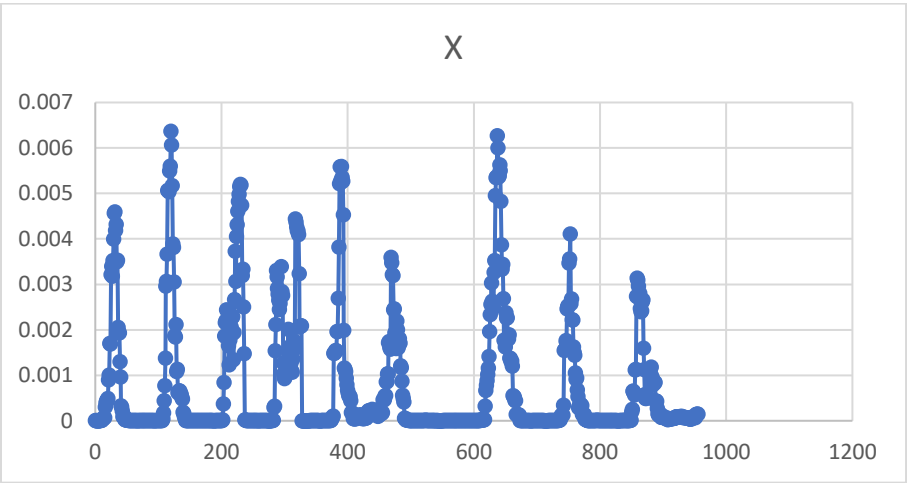The following table summarizes the total distance traveled along each axis:

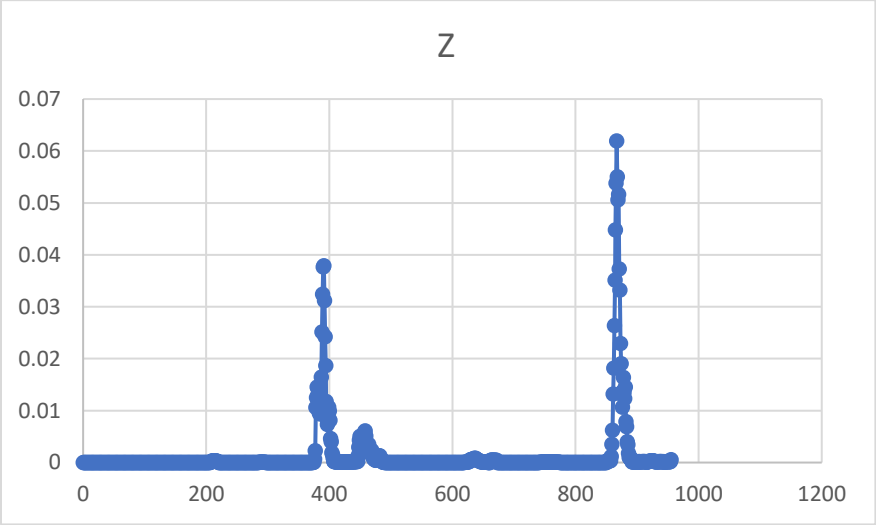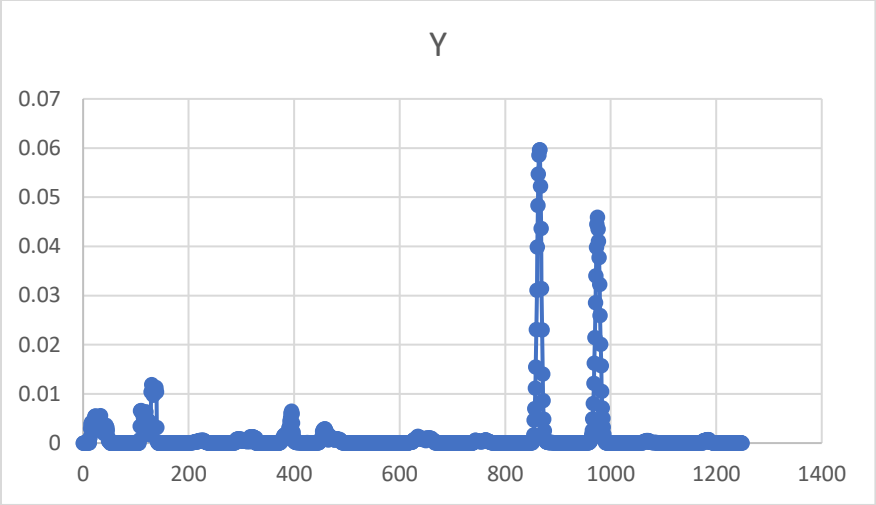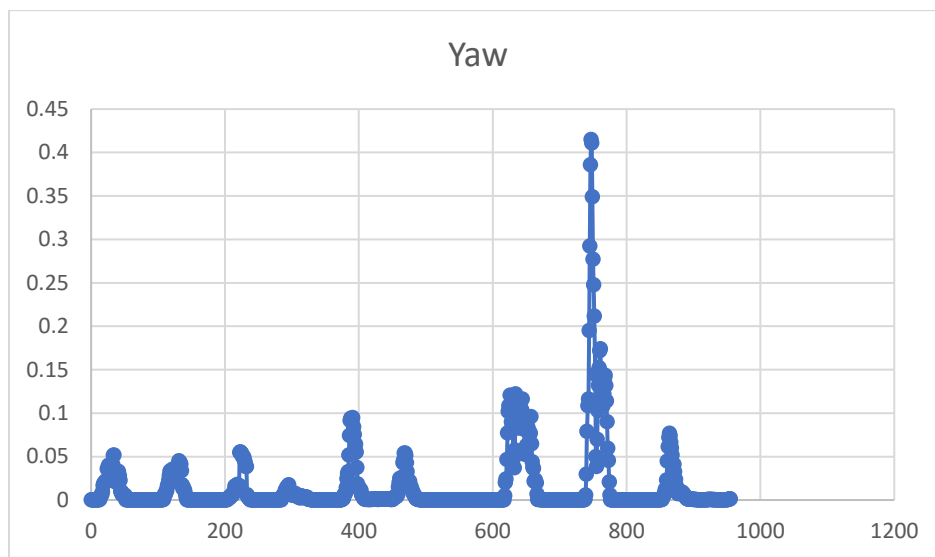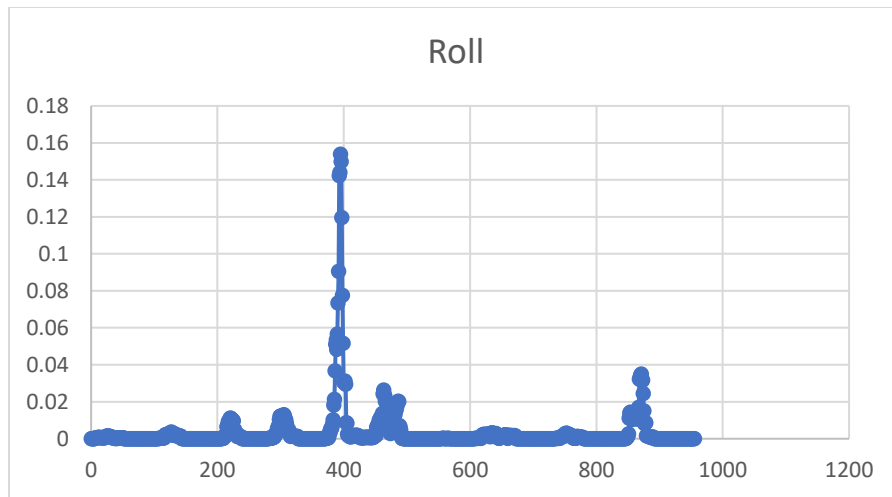| Axis	Distance Traveled
X	10.9821902527
Y	-12.3819170292
Z	-69.5138408081
Pitch	0.0198246638
Roll	-0.0380521410
Yaw	-0.0038568396

DISCUSSION

There is an indication of more motion along the Z direction because of the nature of the gyroscope, as well as because of the force of gravity.

The following are graphs from variances for each axis. The thresholds for the variances were determined based on trial and error.

The distances could be improved.

Y

Z

Pitch

Roll

Yaw

Output screenshot: