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ECE 6310

### Lab #7 Motion Tracking

In this lab, we are tracking the movement in any of the given axis with respect to the variance, in this code we have specified a window size in which we will calculate the variance and check whether it is above the threshold or not. If the variance is greater than threshold, then we calculate the motion of gyroscope along its three defined axis by multiplying the reading with the specified sampling rate. For accelerometer, I have calculated the velocity at the end of sampling period, average velocity during the sampling period and the distance travelled during the sampling period. After this, to find velocity of each axis we multiply it by gravity and then take the average.

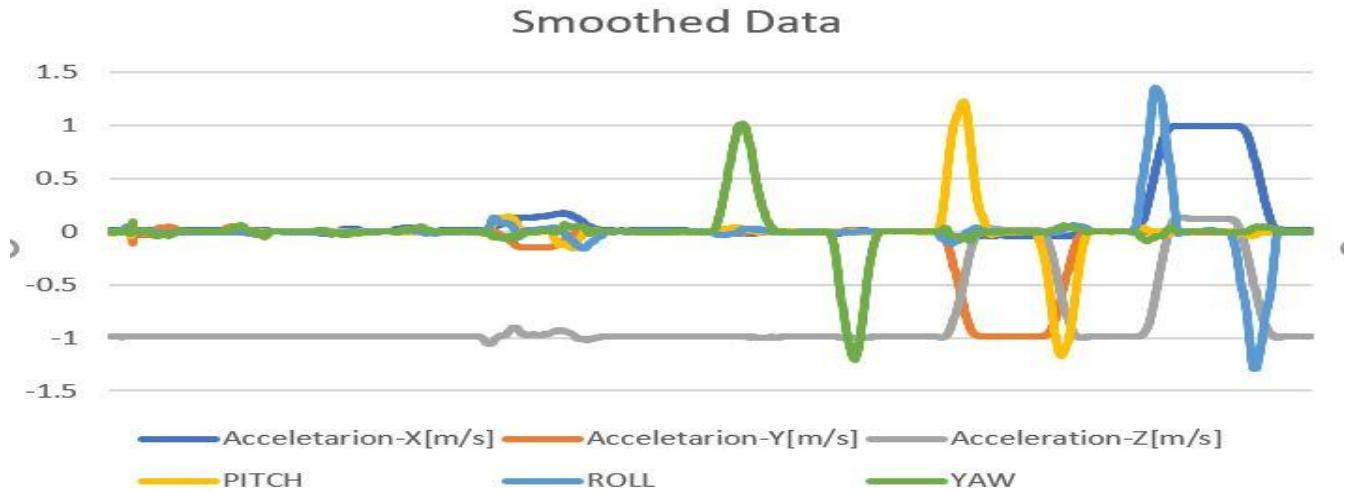
This lab was implemented using the following steps:

- 1.) Read the “data.txt” text file
- 2.) Smooth the given raw data - In this step we performed smoothing on the given raw data i.e. we filtered out the existing noise from the given raw data for proper visualization of the data along the given axis.
- 3.) Determining the movement - In order to determine if the iPhone was in movement, we have calculated the variance along the axis of Accelerometer and Gyroscope. This variance was then used to determine if it was greater than a set threshold for Accelerometer and Gyroscope axes (thresholds for both Accelerometer and Gyroscope were different). After determining if the iPhone was moving, the data for Gyroscope was to be integrated once and Accelerometer data to be integrated twice. Gyroscope data was integrated by multiplying the data by the time between samples, in this case 0.05. For the Accelerometer, three values were calculated: velocity at end of sampling period, average velocity during the sampling period, and distance traveled during sampling period. Velocity was calculated by velocity at the time of previous sample plus acceleration reading multiplied by the time between samples (initial velocity is 0, and constant acceleration is assumed). Average velocity was calculated by using average of the initial and final velocities of sampling period. The distance traveled was calculated by using the average velocity multiplied by the time between samples during that sampling period.

#### Raw Data:



**Smooth Data:**



**Movement Segments:**

**Accelerometer Threshold: 0.0009 | Gyroscope Threshold: 0.03 | Variance Window Size: 11**

Start Index	Stop Index	Start Time	End Time	X [m]	Y [m]	Z [m]
14	49	0.65	2.4	0.256064	-0.316698	-14.850183
109	142	5.4	7.05	0.067466	0.536124	-13.201827
206	238	10.25	11.85	-0.217162	0.081988	-12.399938
286	329	14.25	16.4	0.620282	-0.025468	-22.390909
378	407	18.85	20.3	0.325531	-0.030281	-10.653658
448	487	22.35	24.3	3.054094	-1.728742	-17.662994
622	663	31.05	33.1	-0.106901	-0.110559	-20.372381
742	775	37.05	38.7	-0.13283	0.117453	-13.269423
854	889	42.65	44.4	-0.655107	-4.136676	-12.600515
956	991	47.75	49.5	-0.598791	-13.440938	-2.957079
1059	1088	52.9	54.35	2.599228	-0.019205	-9.004156
1158	1195	57.85	59.7	14.997234	-0.016012	-2.800284
Total Distance:				20.209107	-19.089014	-152.163346

Start Index	Stop Index	Start Time	End Time	Pitch [radians]	Roll [radians]	Yaw [radians]
14	49	0.65	2.4	-0.017767	0.001065	-0.046859
109	142	5.4	7.05	0.00121	-0.015365	0.041551
206	238	10.25	11.85	-0.001187	-0.00968	-0.021367
286	329	14.25	16.4	-0.004582	0.002037	0.042248
378	407	18.85	20.3	0.160875	0.106606	-0.057485
448	487	22.35	24.3	-0.181188	-0.113467	0.050882
622	663	31.05	33.1	0.046811	-0.002195	1.506832
742	775	37.05	38.7	-0.001093	-0.00997	-1.505605
854	889	42.65	44.4	1.57538	-0.09729	-0.08077
956	991	47.75	49.5	-1.520516	0.008876	0.052772
1059	1088	52.9	54.35	-0.005122	1.702601	-0.073388
1158	1195	57.85	59.7	-0.038776	-1.604323	0.044563
Total Angular Rotation:				0.014047	-0.031105	-0.046625

**Accelerometer Threshold: 0.0009 / Gyroscope Threshold: 0.03 / Variance Window Size: 20**

Start Index	Stop Index	Start Time	End Time	X [m]	Y [m]	Z [m]
6	48	0.25	2.35	0.352533	-0.309568	-21.381299
100	142	4.95	7.05	0.191492	0.578579	-21.376094
197	237	9.8	11.8	-0.150589	0.105197	-19.386427
277	329	13.8	16.4	0.68473	0.018411	-32.78159
369	407	18.4	20.3	0.434299	-0.003757	-17.976666
440	485	21.95	24.2	3.981427	-2.823389	-23.638944
613	661	30.6	33	-0.00152	-0.075387	-27.943726
733	774	36.6	38.65	-0.139125	0.087022	-20.451682
845	889	42.2	44.4	-0.641987	-4.129016	-21.225546
947	991	47.3	49.5	-0.909985	-22.070812	-2.855779
1050	1088	52.45	54.35	2.612688	-0.019962	-16.336424
1150	1195	57.45	59.7	23.021133	-0.03924	-1.887527
Total Distance:				29.435096	-28.681921	-227.241702

Start Index	Stop Index	Start Time	End Time	Pitch [radians]	Roll [radians]	Yaw [radians]
6	48	0.25	2.35	-0.017175	0.000298	-0.044526
100	142	4.95	7.05	0.001452	-0.01667	0.040136
197	237	9.8	11.8	-0.000551	-0.012135	-0.013817
277	329	13.8	16.4	-0.005372	0.001318	0.041893
369	407	18.4	20.3	0.16069	0.105549	-0.059015
440	485	21.95	24.2	-0.192021	-0.093844	0.049514
613	661	30.6	33	0.047987	-0.0047	1.4599
733	774	36.6	38.65	-0.001611	-0.010253	-1.4764
845	889	42.2	44.4	1.575496	-0.097429	-0.080252
947	991	47.3	49.5	-1.513114	0.00934	0.051571
1050	1088	52.45	54.35	-0.005032	1.702818	-0.073442
1150	1195	57.45	59.7	-0.040427	-1.616448	0.043937
Total Angular Rotation:				0.010323	-0.032157	-0.060501