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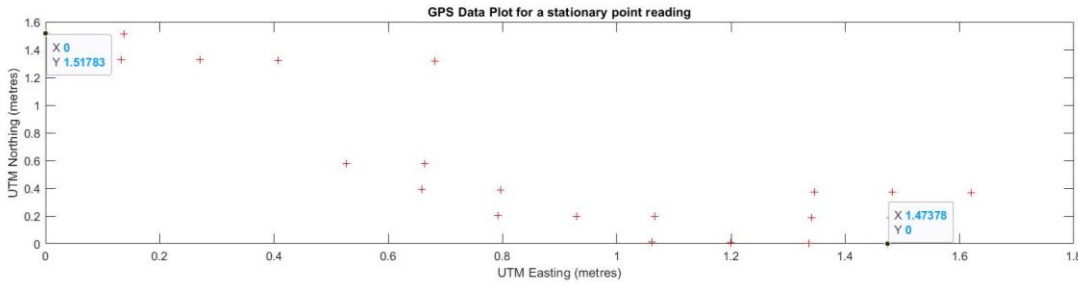
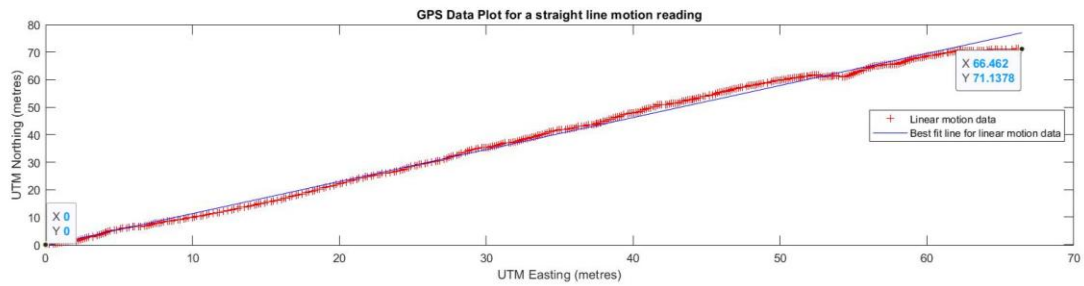
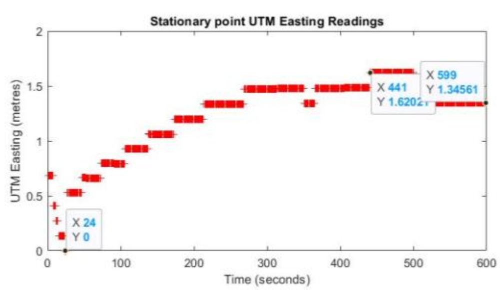
LAB-1 REPORT

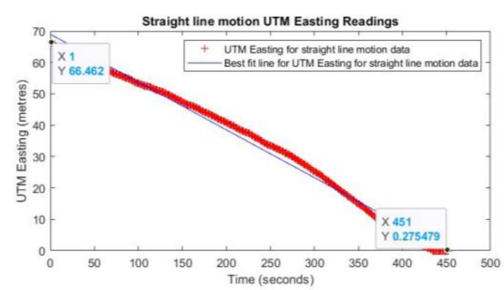


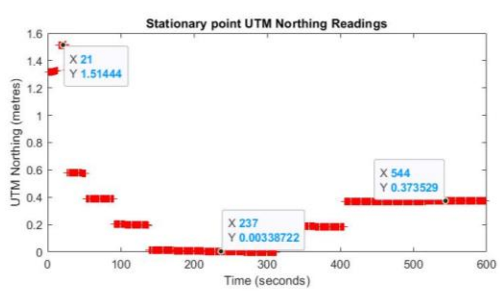


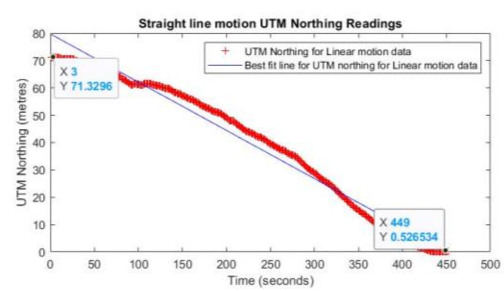
The GPS Data plot gives the UTM Northing vs UTM Easting value as shown in the above plot. The data plot for stationary point reading shows readings that much more spread out and non-linear than the plot for the straight line motion. There are several reasons for this:

1) In a straight line motion, the sensor passes through multiple satellite configurations, thereby giving better and accurate location co-ordinates.
2) The Kaalman filter in the GPS sensor presents better tracking while in motion than uncorrelated readings in the stationary data.
3) When the stationary data is collected and the satellite configurations from which information is retrieved changes, the data first collected and the next data in the sequence might be a treated as a completely different point.



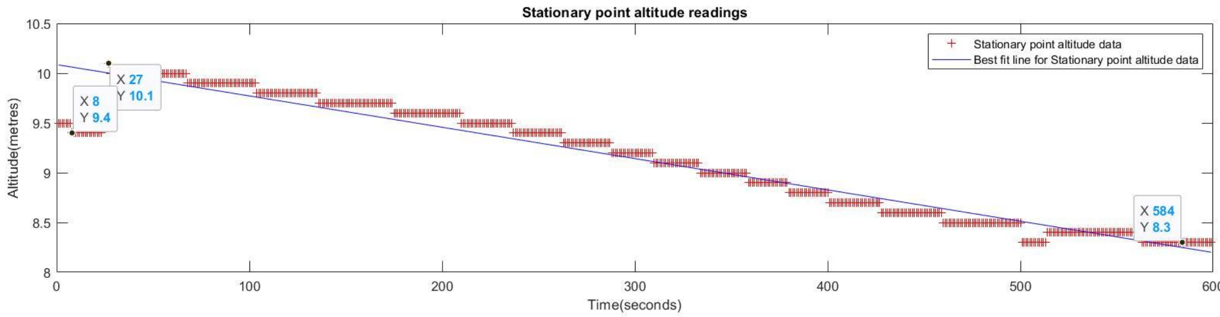


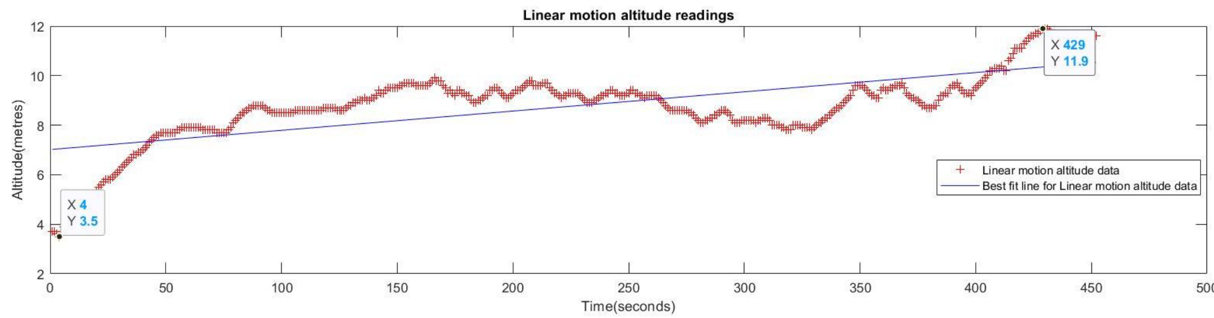




The above plots are fitted with a best fit straight line to see the deviation from an ideal case of

GPS accurate tracking. The below plot shows the altitude readings in the staionary point and linear motion cases.



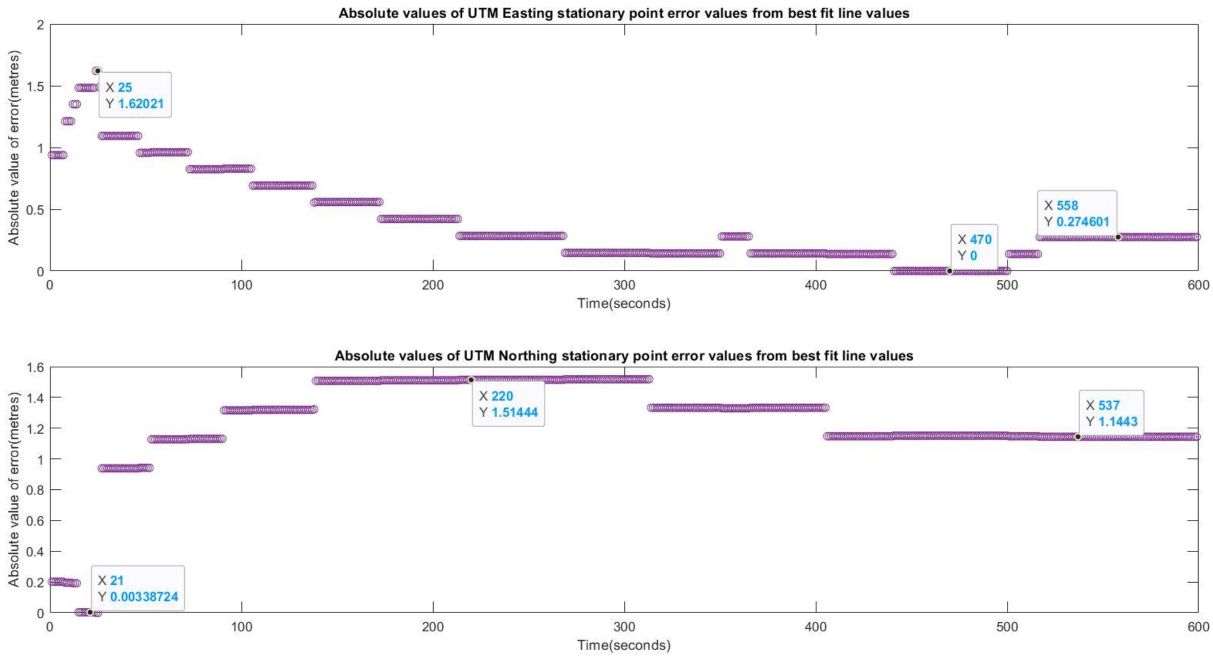


The changes in altitude could be due to the following reasons:

1) The ellipsoidal shape of the earth does account for some of the variations in altitude. So the data does not turn out to be a constant but a varying curve. This, in addition to the error gives rise to the plot as shown above
2) The GPS puck was not held perfectly level or still while on the straight line motion. This could also have contributed to the plot as shown above.

Further, some of the common factors that affect the GPS sensor readings are error in clock timings, prevalent atmospheric and environmental condition, the geometry of arrangement of the satellites in space etc. The statistical analysis of the data is as shown in the below table:

Parameter	UTM Easting(metres)	UTM Northing(metres)	Altitude(metres)
Mean(Stationary Point)	327199.2187	4689685.687	9.14207
Standard deviation(Stationary point)	0.349	0.294230529	0.5652
Mean(Linear motion)	327237.8693	4689729.171	8.775221
Standard deviation(Linear motion)	20.0041	23.33586573	1.4597
Minimum value(Stationary Point)	327197.9886	4689685.411	8.3
Maximum value(Stationary Point)	327199.6088	4689686.928	10.1
Minimum value(Linear motion)	327203.4072	4689689.387	3.5
Maximum value(Linear motion)	327269.8692	4689689.387	11.9
Range(Linear motion)	66.462	71.33301398	1.8
Range(Stationary Point)	1.6202	1.517826059	8.4



The above plot gives the absolute values of the errors in UTM Easting and Northing values in the stationary point from the best fit line for the respective parameters.

The key inference from the above plot are:

- Since the error plots do not resemble any standard distribution patterns (Gaussian distribution, Normal distribution etc.), a viable bound cannot be set to the given errors. This can be attributed to any of the occurrences and conditions at the location and time where the readings were recorded.
- Even in linear motion, the error plot follows an erratic distribution such that viable bound cannot be set

References:

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- https://www.scribbr.com/methodology/random-vs-systematic-error/
- https://www.webassign.net/question_assets/unccolphysmechl1/measurements/manual.html