LAB1 REPORT

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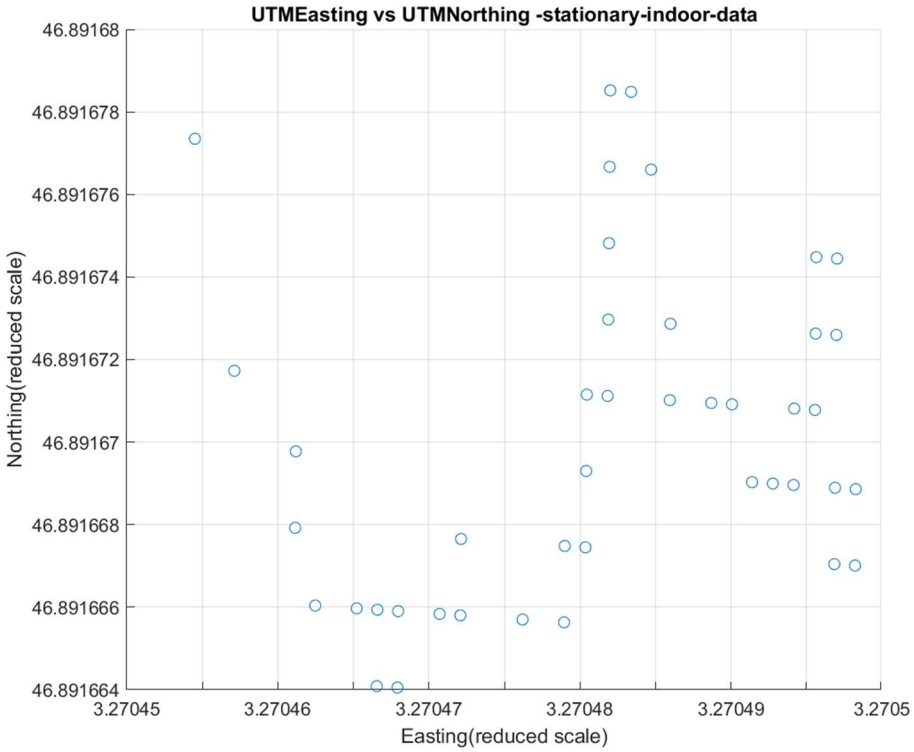
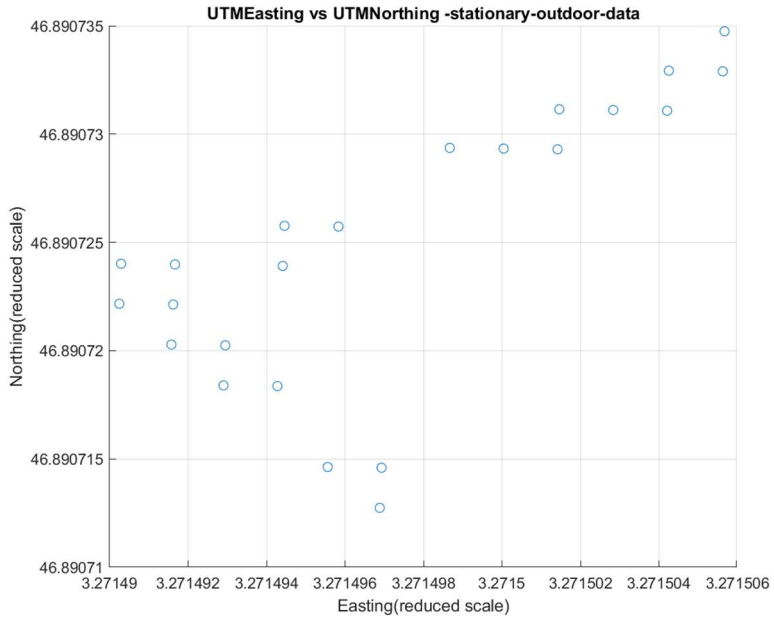
1)Make scatterplots of the Northing (y) vs. Easting (x) data (subtract the 1st value to scale) with your stationary data sets.

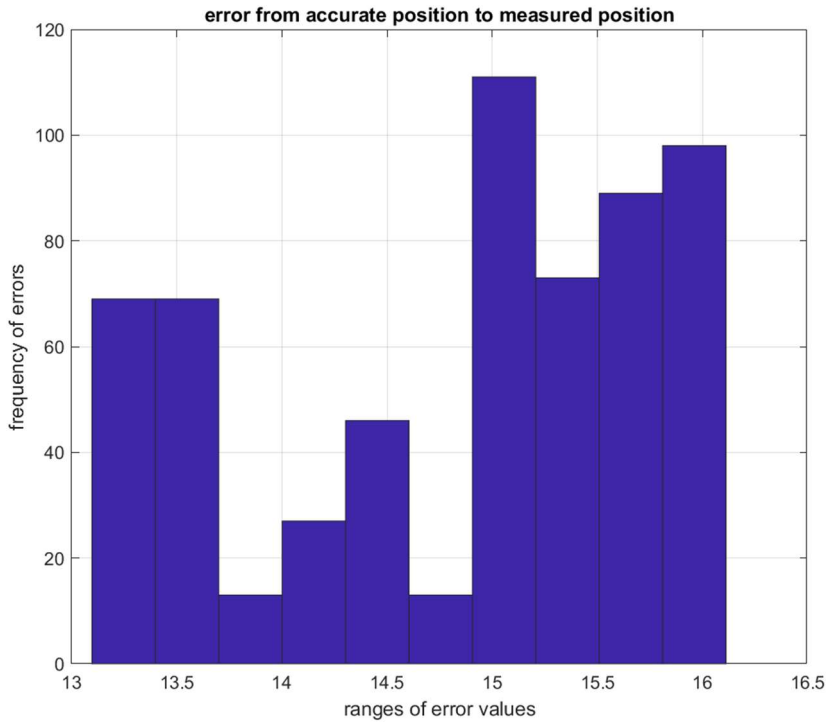


The above plot shows the UTMEasting vs UTMNorthing – stationary-indoor-data. The values of the easting and northing are of reduced scale (divided by 10^5). The data was taken from inside of a building using the GPS puck. Here the points are clumped together in certain areas, it could indicate a lower degree of accuracy in those areas.



The above scatter plot shows the UTMeasting vs UTMnorthing data. The data is collected using the GPS puck in the outdoor area where there are no buildings or trees in the immediate vicinity of the GPS puck. The UTM easting and UTM northing values are The above scatter plot contains points that are far away from the main group of points, it could indicate that these points are outliers. We can also observe a linear trend with points distributed randomly which indicates a high degree of spatial accuracy.

2)Make histograms of your error from your known position to your measured position.
What is your quantitative error estimate from your "known" position?
How do we get to a single error value?) ▪ Does this error value make sense given your hdop value and GPS error in general?

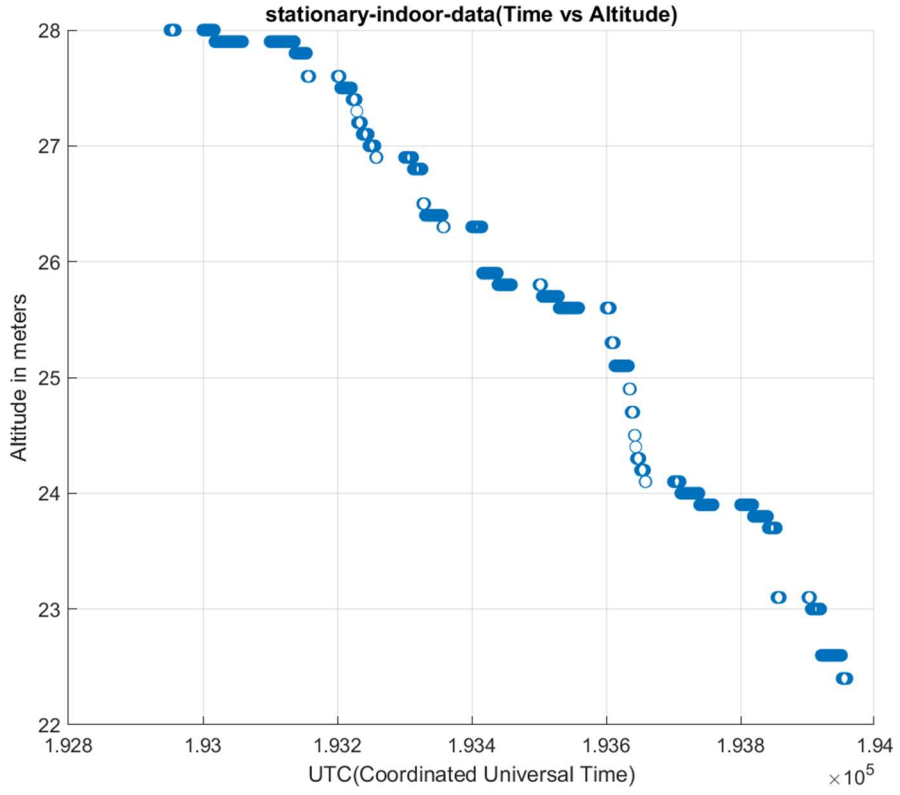


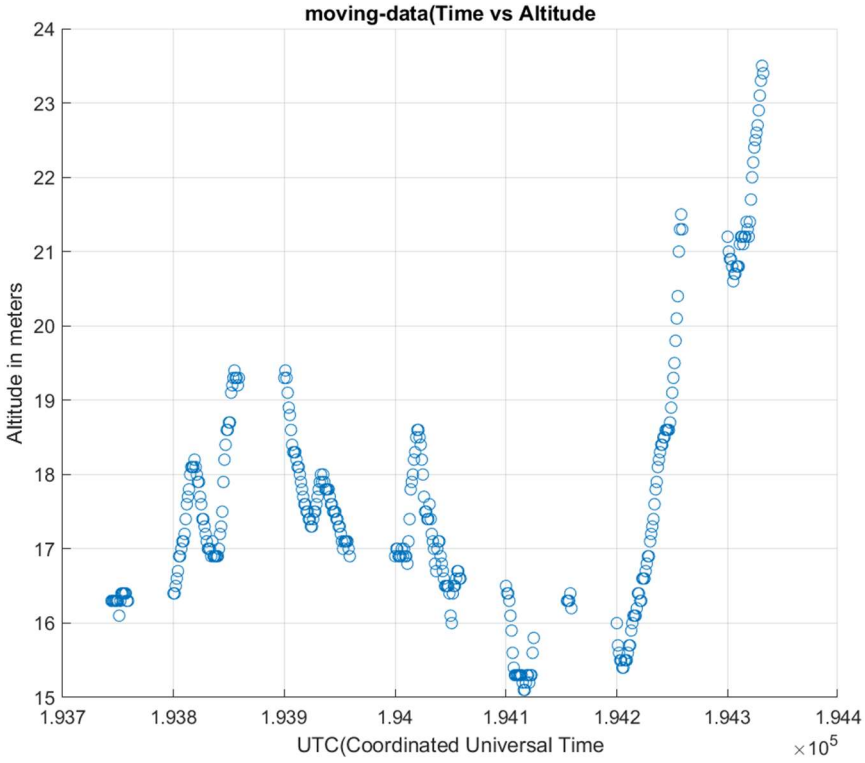
The HDOP value of 0.9000 is a measure of the horizontal dilution of precision, which is a value that represents the geometric quality of the GPS signal. Generally, lower HDOP values indicate quality GPS signal, while higher HDOP values indicate a lower quality GPS signal.

After calculating the mean error data from the accurate position (UTMEASTING:327037.76 / UTMNORTHING: 4689156.63 / UTM ZONE 19T) to the measured position form the histogram **I got mean error as 14.8316 meters and median error as 15.0531 meters.** On the x-axis we could see the ranges of error values and the y-axis shows the frequency of error within each of these ranges.

Also other factors like type of GPS receiver, indoor or outdoor environment, and the presence of obstructions can also lead to the effect of the accuracy of the measurements. I got the single error values which are mean and median errors using the Pythagorean theorem to find the distance between the two points in MATLAB.

3. Make scatterplots of altitude vs. time (ideally using pyplot, but matlab is ok too)

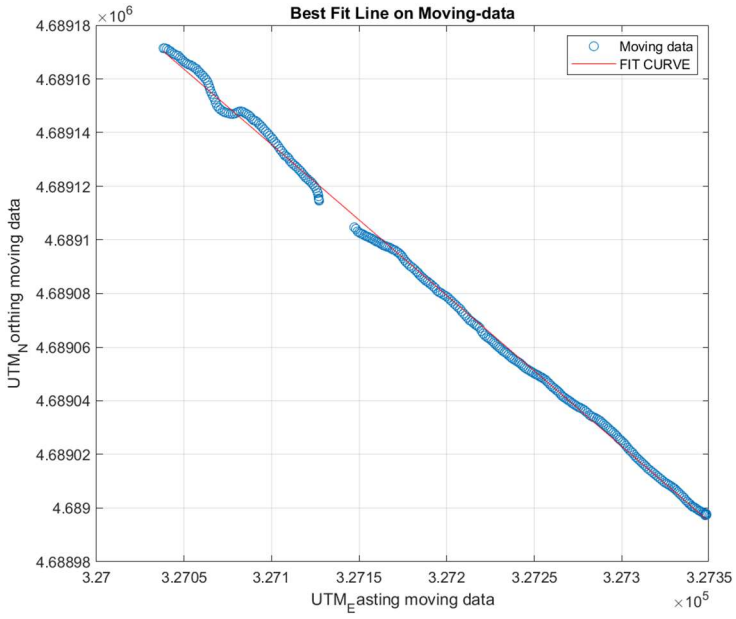




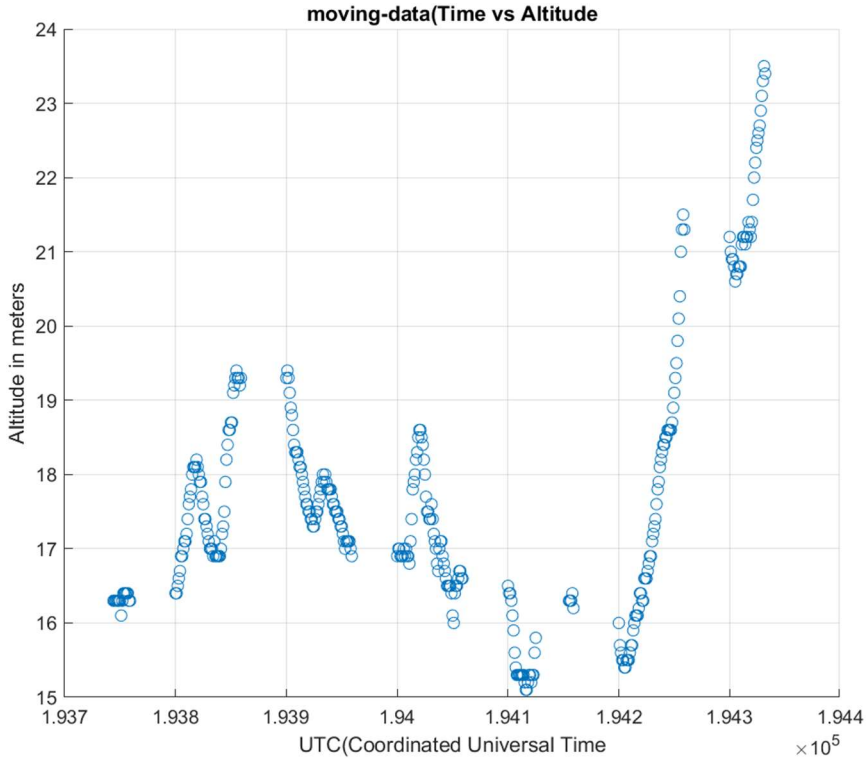
4)Let's assume that you walked in a perfectly straight line for your moving data.

Make another scatterplot of northing vs. easting. What's the error from a line of best fit to your data?

Plot your altitude vs time.



The Data is collected while walking, the above plot shows the moving data UTM easting and UTM northing values with the best fit curve. The fit curve is inserted using the polyfit function. The error from a line of best fit curve is calculated using the residuals which are the difference between the actual data points and the corresponding values predicted by the best fit line. I obtained a Mean Squared error(MSE) of 4.1702 meters and the Root Mean Square Error(RMSE) of 2.0421 meters. These measures can help to determine the accuracy of the line of best fit.



5)How do your estimated error values change for stationary vs. moving data?

The stationary-indoor-data or stationary-outdoor-data does not change with respect to time and the moving -data changes over time and also has a time-varying mean and variance.

Can you explain why this result is the case? What does this say about GPS navigation when moving for our receiver?

The receiver is moving so the relationships between the variables are changing over time. This behavior can result in increased uncertainty and large estimated error values for a line of best fit compared to stationary data.

What are the physically likely sources of error in GPS data sets?

1) Gps signals can be disturbed by the physical obstacles like buildings, tress as well as sources like electromagnetic interference.
2) If the driver script is written wrongly there might be errors in the calculations.
3) Receiver error sometimes GPS receivers can have errors due to inaccuracies in the hardware.
4) Human errors can also occur in the data due to mistakes while collecting data.