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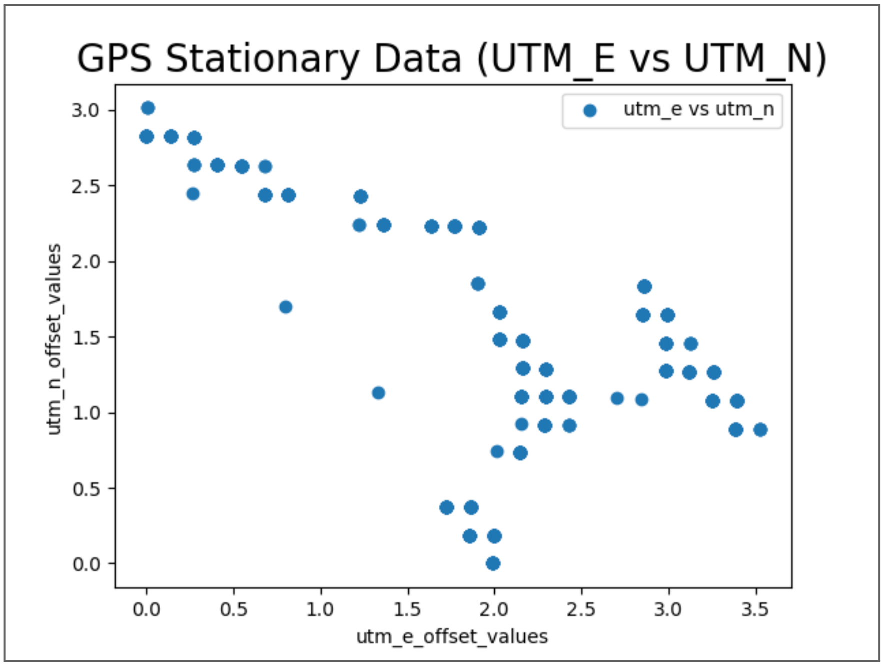
RSN LAB 1 – GPS

Analysis of Stationary GPS Data

Below is a plot of UTM Easting vs UTM Northing of the recorded data. It is clear from the plot that a drift in the GPS data is observed when the GPS puck is stationary.



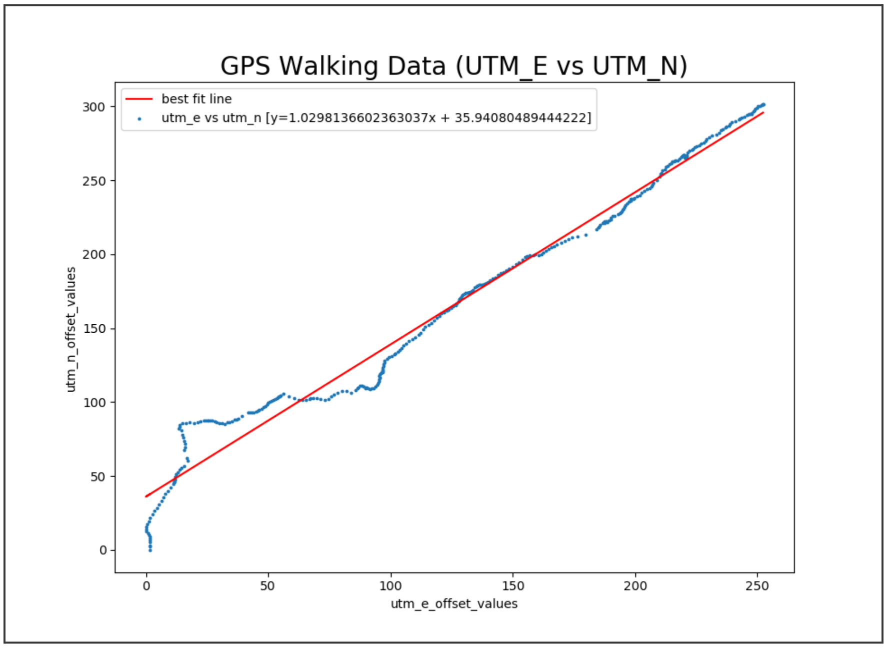
The nature of the drift is that the UTM_E values are increasing, whereas that UTM_N values are decreasing, meaning that the puck is experiencing drift in a certain direction. This error may be introduced due to a number of factors such as changes in the environment, urban canyon, etc.

To put bounds to this error, the GPS should have another source of measurement to determine whether the GPS is moving or not. For example, if with the help of an accelerometer, the GPS would be able to determine if it is moving or stationary.

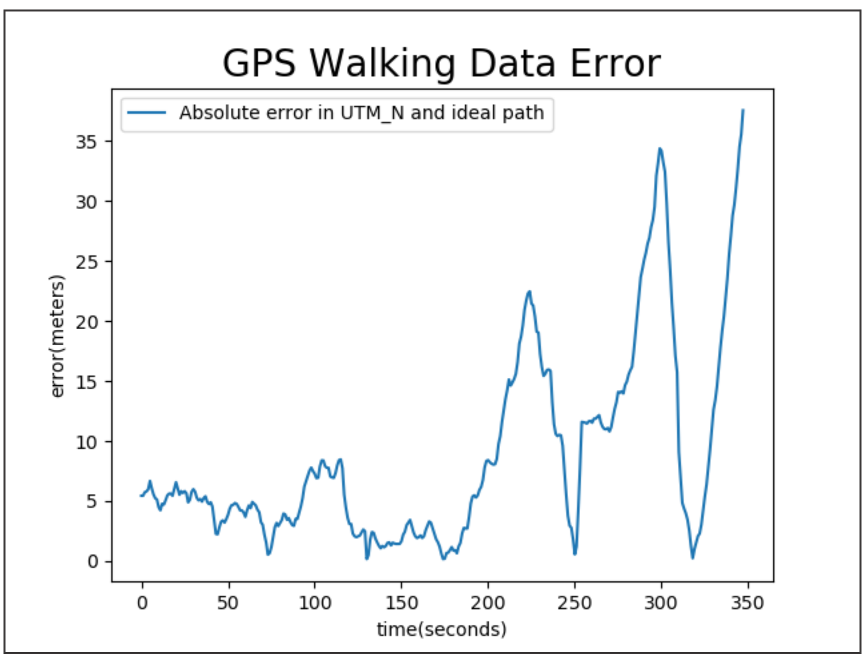
Even if a kalman filter is present on the GPS puck, it would be difficult for the filter alone to determine whether the GPS puck is moving or stationary. Hence when the GPS is recording data in stationary condition, it would be prone to drift.

Analysis of Dynamic GPS Data (Walking in a straight line)

Below is a plot of UTM easting vs UTM northing values. In an ideal scenario, this plot should be a straight line. Hence to evaluate the performance of the GPS, this recorded data is plotted against the best fit line which we may assume as the perfect path traversed by me while recording the data.



It is evident from the graph that the recorded data closely follows a straight line, with a coefficient of determination (R^2) = 0.9786. To quantify the error, I have considered that the actual path traversed by me is the red line, and for each value of UTM_E, I have calculated the error between the observed UTM_N, and the ideal UTM_N (obtained by plugging value of UTM_E in the equation)



It is observed that the error is about 5 meters when I start walking. This error can almost entirely be classified as a GPS error (and not as error introduced by walking in a non-straight path). I believe that the large error observed at the end of the walk is introduced due to the urban canyon effect due to a tall building present at the end of my walk.

However, it can be seen that there is a rough pattern observed in the error plot. At several points, the error is increasing at a high rate, and then almost drops to zero at a similar or faster rate. I think that this phenomenon could be due to the presence of the Kalman filter present in the GPS puck. While moving, the kalman filter can predict the expected output with respect to previous inputs. This would allow the filter to correct for abrupt errors produced by the GPS. This probably explains why walking data is more accurate than stationary data.