LAB-2 Report

Aryaman Patel

Preamble

The following analysis was performed on data collected under the condition of (a) Data in a clear environment and (b) Data collected under the condition of occlusion.

The site for the first part of the data collection was the 'Carter Playground' and the latter part was chosen to be the 'Columbus Ave' next to the ISEC buildings.

The collected data have been analyzed to show the changes in the accuracy of the RTK based GPS connection

Analysis

A. Stationary Data with and without Occlusion:

Figure 1 and 2, shows the UTM Easting Vs UTM Northing viridis scatter plot for the stationary data collected in a non-occluded and an occluded environment. Each circle is of a distinct color, as depicted from the color bar represents the points in the data that are under one another.

From the plots the error on the GPS is at the 'cm' level as compared to the case with only GPS that showed irregularities in 'meter.'

Figure 2 shows the changes in the uncertainty of the RTK GPS data due to the "Multipath" error caused due to the high rising buildings in the environment.

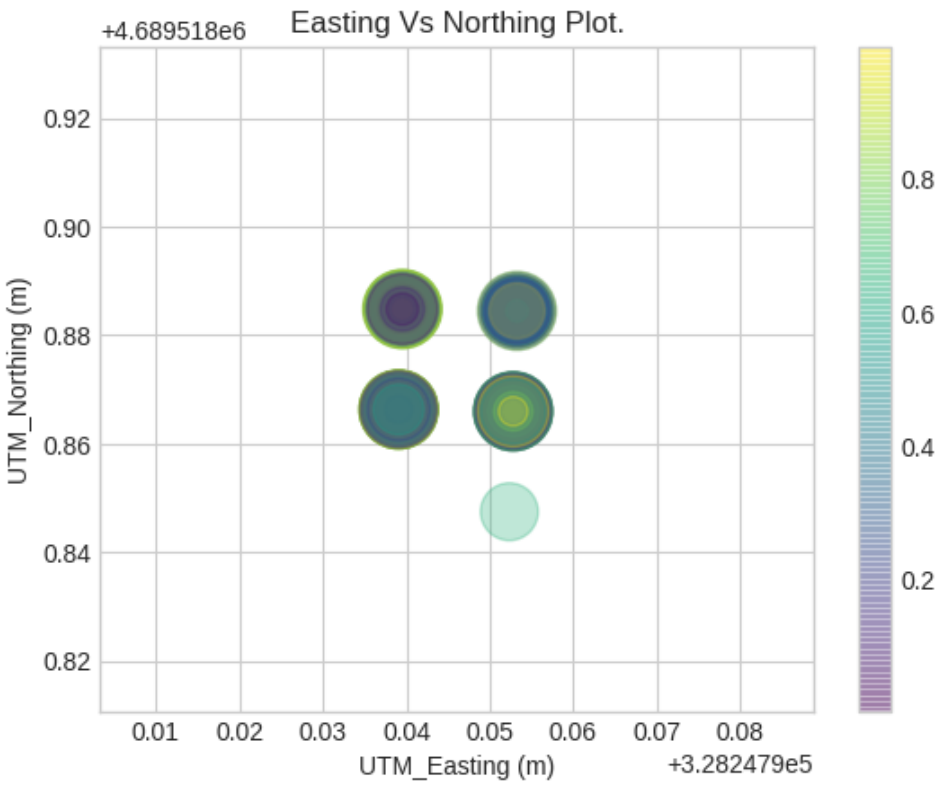

Figure 1. UTM_E vs UTM_N Stationary (non-occluded)

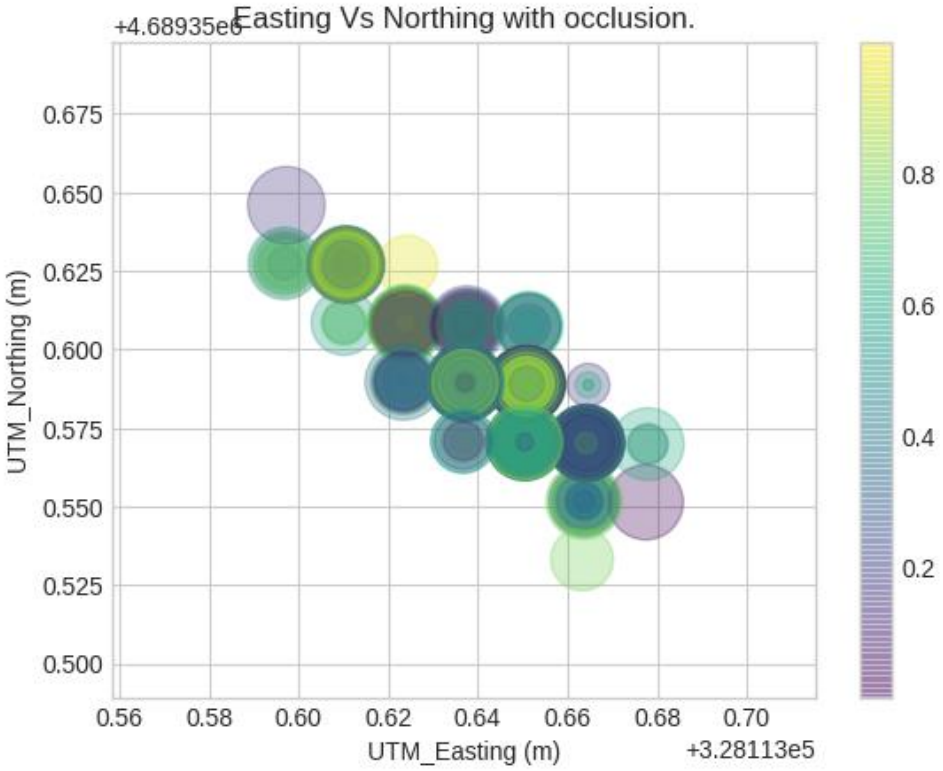

Figure 2. UTM_E vs UTM_N Stationary (occluded)

The following are the CEP (50%) and the 2DRMS (95%) plot analysis of the stationary data. CEP is Circular Error Probable that is a mean error radius that is a measure of the precision. The confidence region gives us the area under which the measurements and the estimates are likely to be in. The Distance Root Mean Square is a measure of the 2D accuracy of the data.

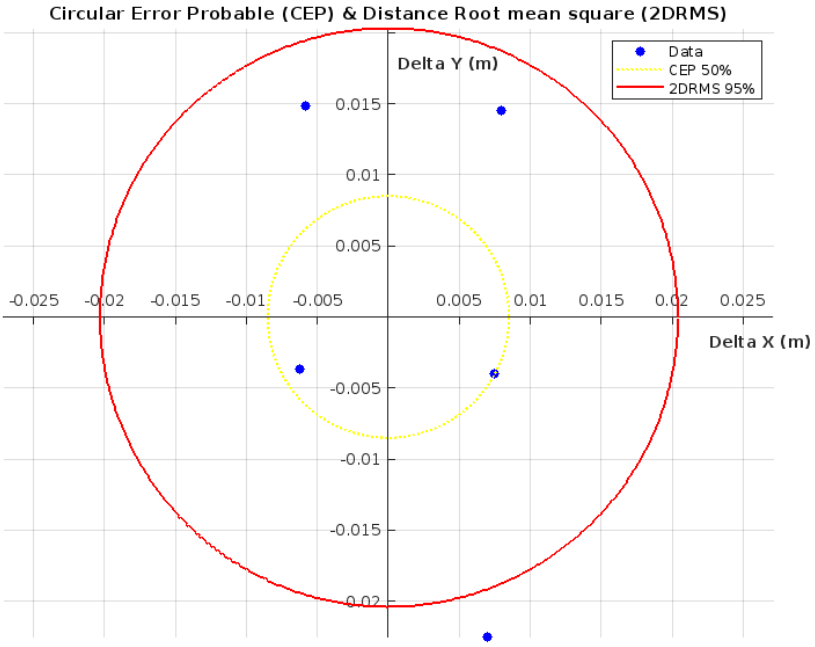

Figure 3. Delta X vs Delta Y with the CEP and DRMS analysis (non-occluded)

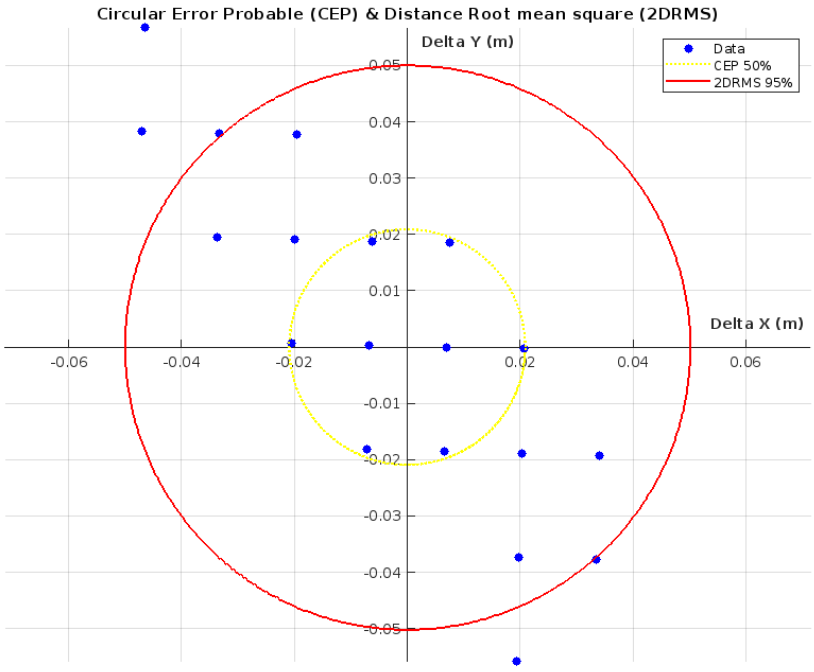

Figure 4. Delta X vs Delta Y with CEP and DRMS analysis (occluded)

Data	CEP (50%)	2 DRMS (95%)
Stationary occluded	*0.0209 m*	*0.0501 m*
Stationary non-occluded	*0.0085 m*	*0.0204 m*

The table above shows a comparison of the CEP and DRMS values for the different data. We can see that the data is distributed at a much larger circle for occluded data set as compared to the non-occluded one.

Figure 5, shows the liner line fitting and the 95% prediction interval of the data, which is the region where the future measurements are estimated to fall in. This modelling can be used as a tool to correct future errors in the region.

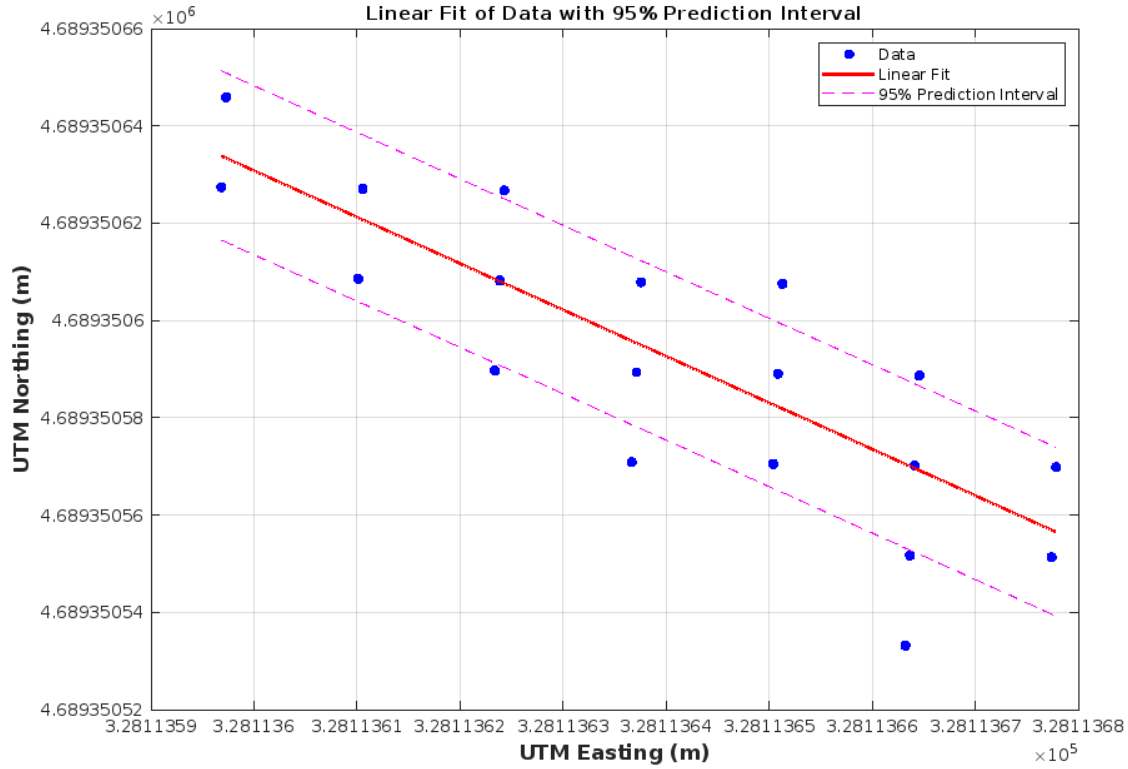

Figure 5. Linear Fit of the Data with 95% Prediction level.

B. Moving Data with and without occlusion.

The following Figures 6 and 7 are the UTM Easting and UTM Northing plots of the moving data collected. The plots also depict the 'best fit rectangle' plot which can be used to calculate the root mean square of the collected data.

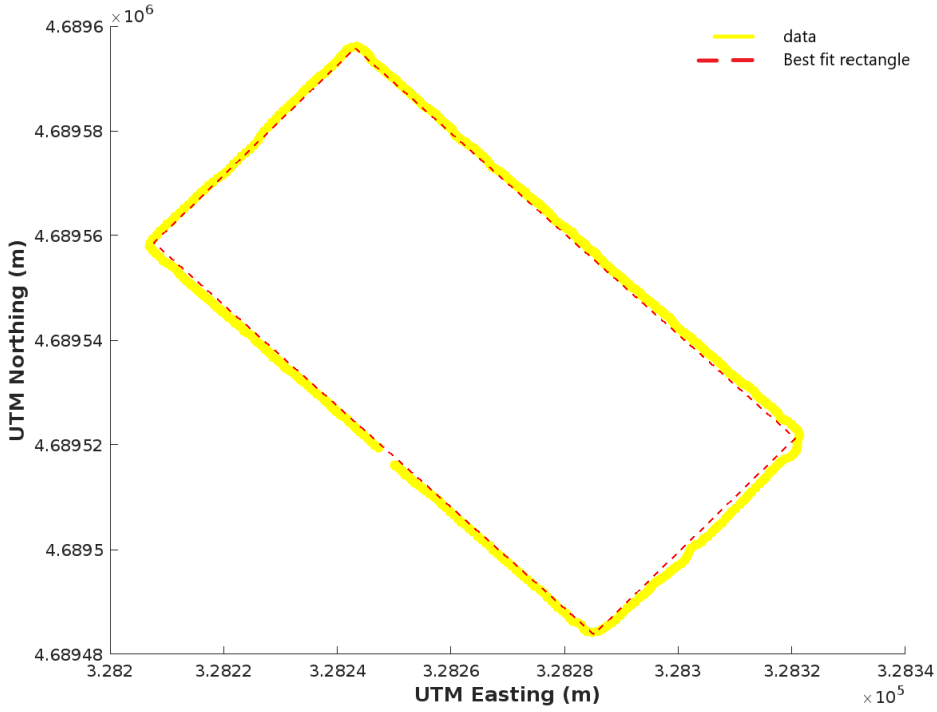

Figure 6. UTM_E vs UTM_N along with the Best fit rectangle (non-occluded)

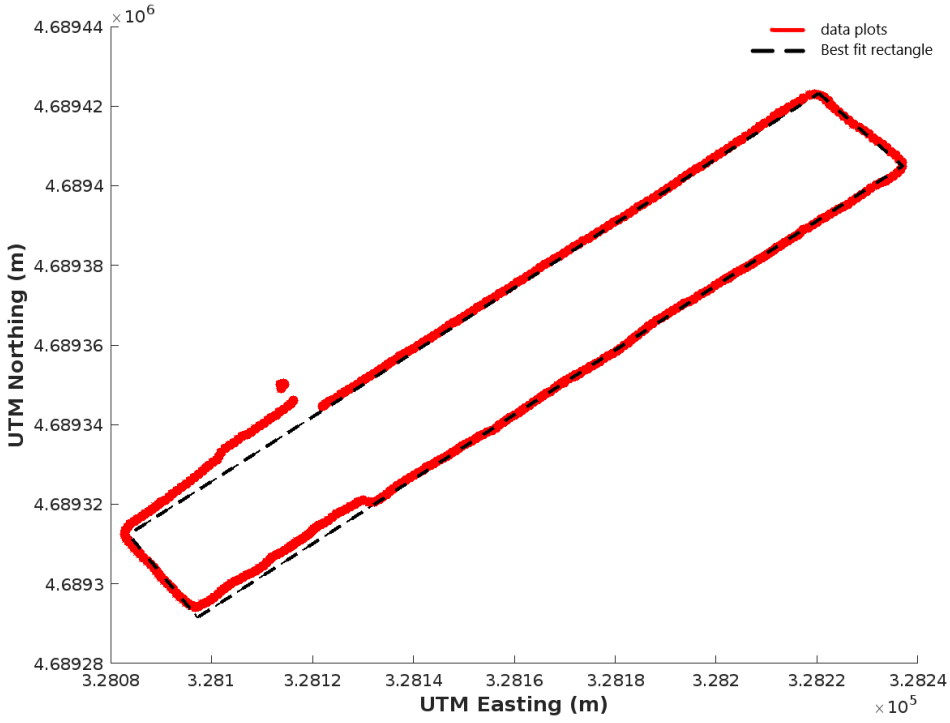

Figure 7. UTM_E vs UTM_N along with the Best fit rectangle plot (occluded)

An attempt at modelling the error in the **stationary occluded** data using the multi-variate gaussian distribution gives a non-normal distribution plot of the data. From the plot one can conclude that the error distribution is **non-Gaussian**. However, with multiple samples one can approximate the data to a Gaussian Distribution.

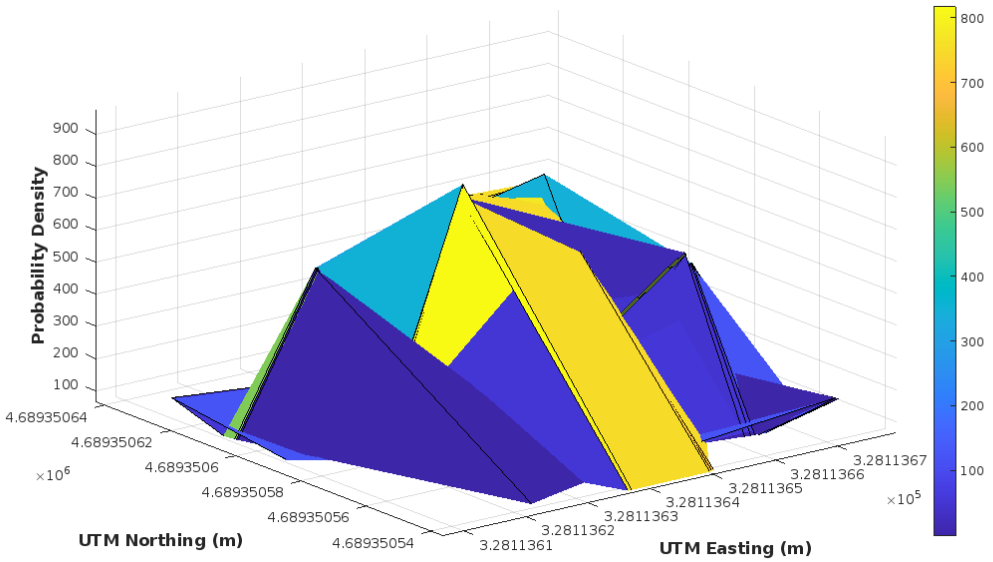

Figure 8. Error distribution modelling using Multivariate Gaussian formula (occluded)

Similarly, for the **stationary non-occluded** data shows a non-normal distribution, a figure of the contour plot is shown below. (A contour plot is provided for better visualization).

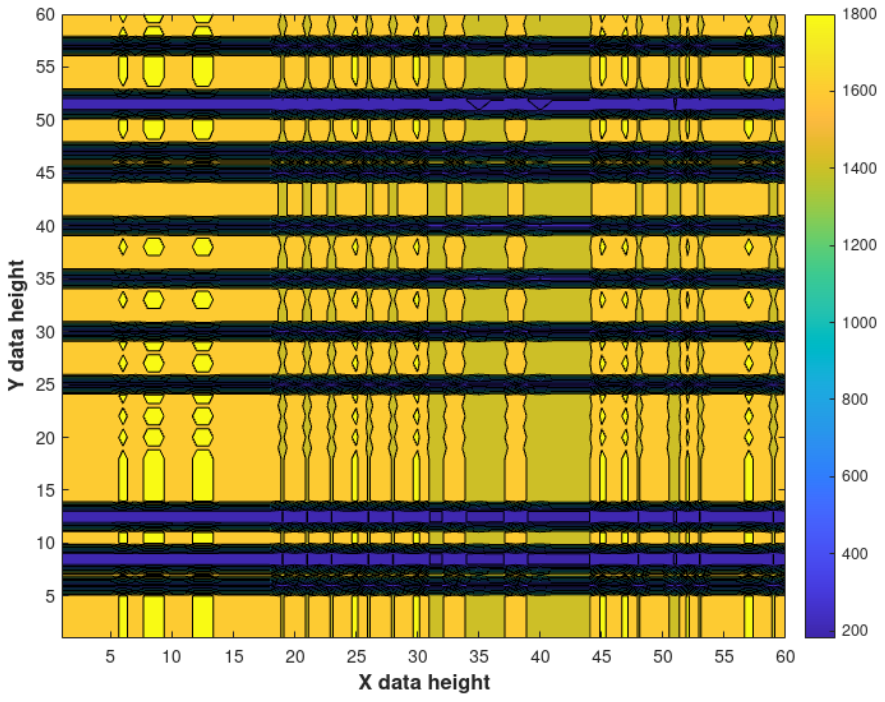

Figure 9. Contour plot of the error distribution for Stationary data (non-occluded)