EECE 5554 - Robot Sensing and Navigation
Lab 2 Report

Introduction:

RTK GPS, or Real-Time Kinematic Global Positioning System, enhances GPS accuracy by using real-time corrections from base stations. It achieves centimeter-level precision, crucial in applications like surveying, construction, and autonomous vehicles, ensuring highly accurate and reliable positioning data for various professional and scientific purposes. The traditional GNSS provides meter-level accuracy, while RTK GNSS achieves exceptional precision by receiving real-time correction data from nearby reference stations. These correction signals compensate for satellite signal errors, atmospheric disturbances, and other factors, ensuring highly accurate and instantaneous positioning.

Further we could see that the source of errors in case of RTK-GPS are signal obstruction from buildings or trees, atmospheric changes, electromagnetic interference, and poor satellite geometry can introduce errors. Additionally, inaccuracies in base station positions, multipath reflections, receiver noise, and satellite clock errors couldimpact measurements.

Data Collection:

The first set of data was collected from the open and clear environment . The device was kept stationary while collecting the data. This was followed by a moving data collection where the device was moved in a square at the open location. The next set of data was collected at the occluded area which had a lot of trees, building and shadows. The stationary data was collected for about 10 minutes and the walking data was collected while walking in a square.

Data Analyses:

In this section the scatter plot of UTM_northing and UTM_easting data, scatter plot of Altitude and time data, histograms will be plotted for all the 3 data sets collected and error calculations will be made from the plotted graphs.

1.Stationary Data in Open Space:

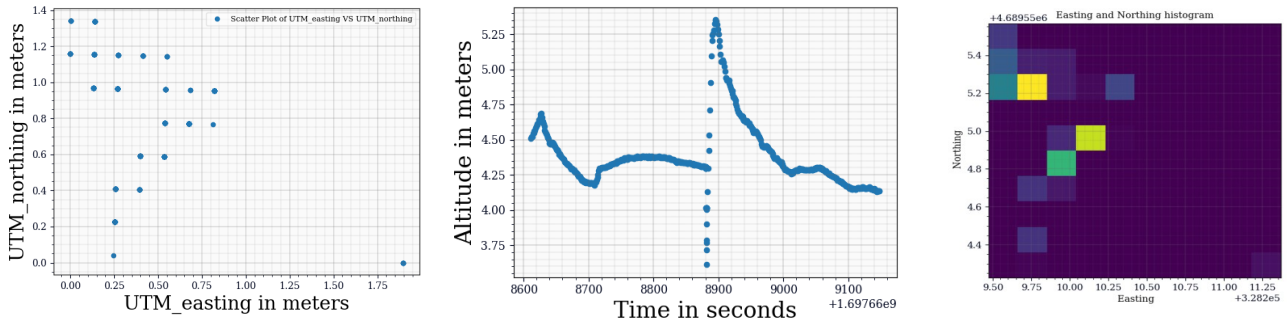

Fig1 : Plots of stationary open data

2.Stationary Data in Occluded Space:

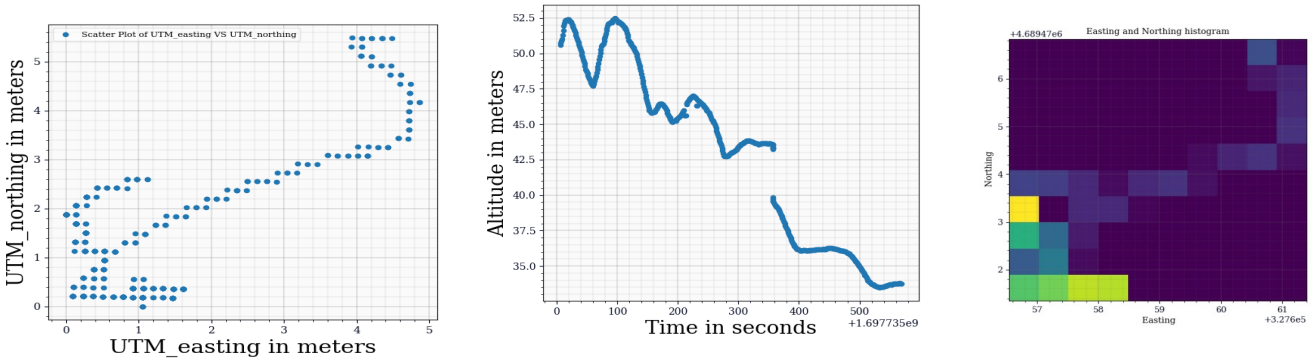

Fig2 : Plots of stationary occluded data

3.Walking Data in Open Space:

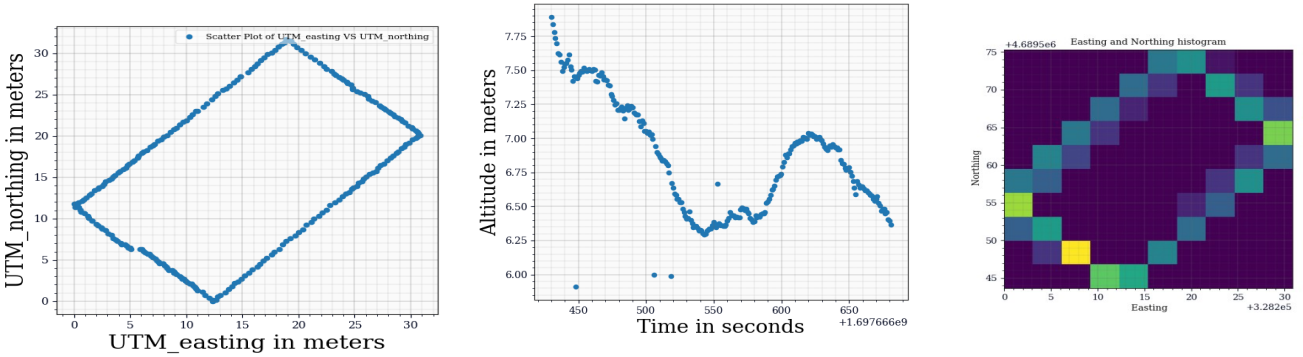

Fig3 : Plots of walking open data

4.Walking Data in Occluded Space:

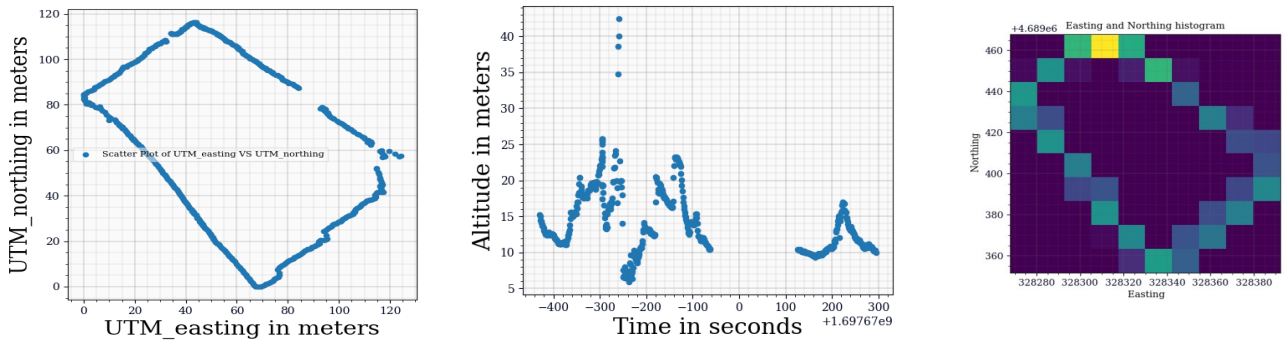

Fig3 : Plots of walking occluded data

Answers:

a. It was found that the RMSE error in terms of stationary data was found to be 0.3708 and 1.8226 for open and occluded respectively this was found to be lower than the normal GNSS as the RTK GNSS provides real time corrections which results in much lower error than the traditional GNSS which offers valuable information about the location. In terms of moving data the RMSE error was found to be larger than the stationary data but less than the traditional GNSS data. It was 13.31989 and 47.9402 for open and occluded walking data respectively.

b. We can also notice from the histogram that the range of the UTM easting and UTM northing data is very close and the values are more closely plotted which verifies with the fact that RTK data is more precise due to the real time corrections.
c. The plotted histogram is much closer and denser in terms of data points and the shape is random and according to the collected data. We could also see that the borders are densly populated compared to the center. The fix value of the RTK data was found to be 5 in majority of the case while it was 4 in few occasions.

d. We found that in terms of moving data the scatterplot was more precise in terms of open data and the histogram confirms a dense data in the start and the end of the square for the open data while in terms of occluded data the histogram had a denser data in the middle and the scatter plot was distorted due to the presence of trees/buildings which causes multipath and reflection errors.

e. The error in open area was found to be lower than the occluded this could be due to the fix quality which was found to be in the range of 4-5 for the data collected.