RSN Lab 2 report

Bhanu Prasad Arjun Jyothieswar

Data provided by Yijiang Huang

October 2023

1 Introduction

RTK GPS stands for Real-Time Kinematic Global Positioning System. It is a precise satellite navigation technique used to enhance the accuracy of GPS positioning. **RTN GNSS** stands for Real-Time Network Global Navigation Satellite System. It is a high-precision satellite navigation technique that provides real-time, centimeter-level accuracy in determining the positions of GNSS.

RTN GNSS relies on a network of reference stations, which are usually placed within a few tens of kilometers from each other. This enables the RTN GNSS receiver to get real-time corrections which makes it much more accurate than the GNSS receiver.

2 The driver code

The driver used in this assignment is almost similar to the one used in the previous assignment. The driver still reads data from the serial port as a byte type message and decodes it to a string data variable before parsing the data. The parsed data is then published to *"/gps"* topic as a *"gps_msg"* message and later recorded in a rosbag file.

3 Analysis

The analysis is done with the help of python scripts. The analysis is performed on 4 sets of data in total are taken, two sets of stationary data(one in open area and one in occluded area) and two sets of moving data(one in open area and one in occluded area)

3.1 Moving Data

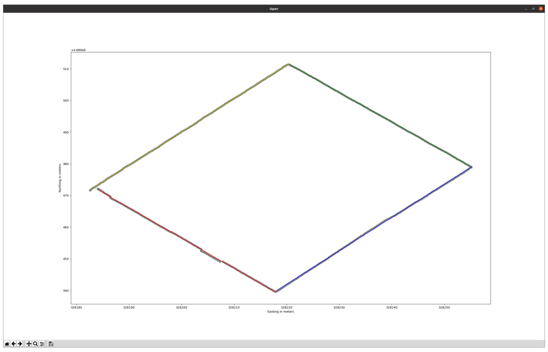
The analysis of moving data is done by estimating the average error of the points from the presumed rectangular path. This is done by first segmenting the data set into 4 separate segments. The segments are then individually used to generate a line using best-line fit method. To estimate the error of the data with respect to the derived line, the **Root Mean Squared**(RMS) error method was chosen.

3.2 Stationary Data

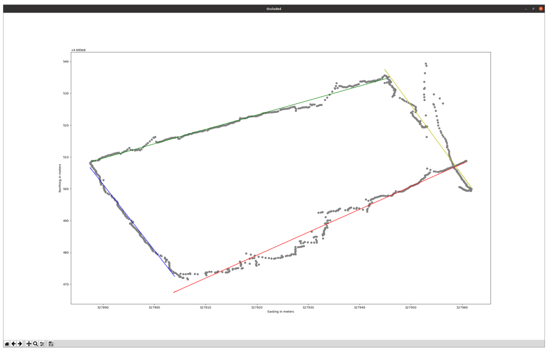
The analysis of stationary data is done by taking the mean of the error of each point collected. The data from Google Earth is taken as the ground truth. Where the error is the euclidean distance between the data and the ground truth.

4 Result

4.1 Moving Data



(a) Open data-set



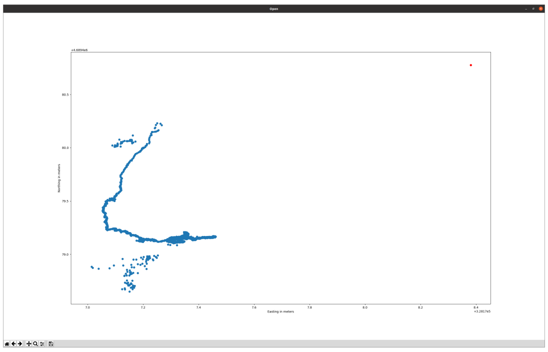
(b) Occluded data-set

Figure 1: Plot of Northing vs Easting co-ordinates

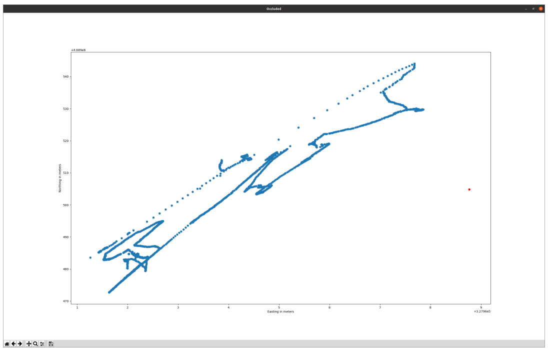
$$RMS\ Error\ of\ open\ data = 0.122\ meters$$

$$RMS\ Error\ of\ occluded\ data = 2.126\ meters$$

4.2 Stationary Data



(a) Open data-set

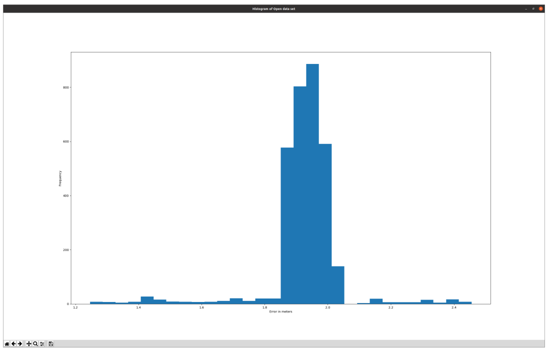


(b) Occluded data-set

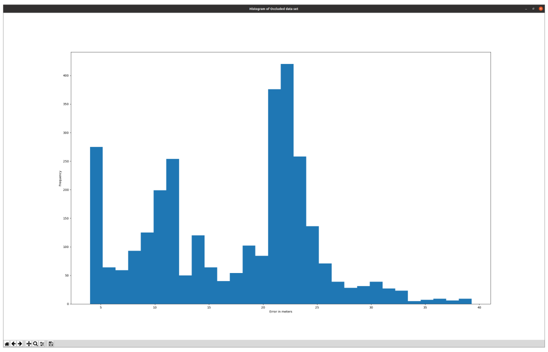
Figure 2: Plot of Northing vs Easting co-ordinates, The red point in the figures represents the absolute co-ordinates.

$$Mean\ error\ of\ open\ data\ set = 1.926\ meters$$

$$Mean\ error\ of\ occluded\ data\ set = 17.177\ meters$$

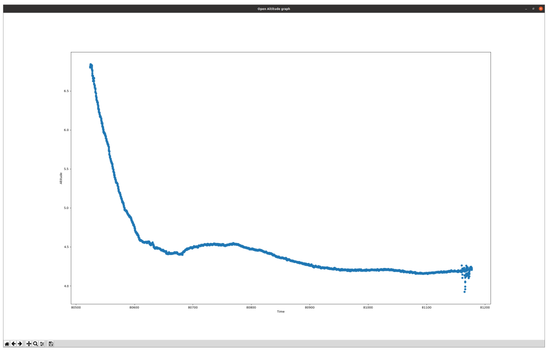


(a) Open data-set

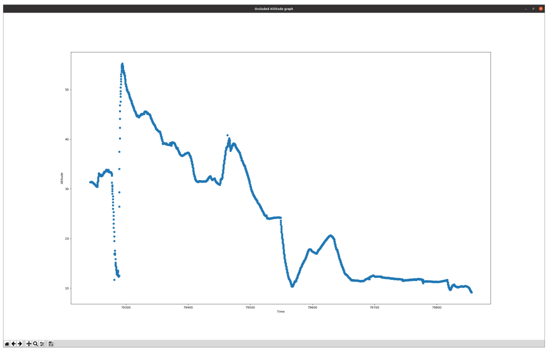


(b) Occluded data-set

Figure 3: Histogram of errors



(a) Open data-set



(b) Occluded data-set

Figure 4: Altitude graph

5 Conclusion

From the analysis of the data, the following conclusions can be drawn,

1. The accuracy of the RTK module is significantly higher than the standalone GPS module.

2. It can be observed from the histogram that the data is more concentrated when compared to the histogram generated in the previous lab. This conveys the superior precision of the RTK module.

3. It can also observed that the range of the histogram is smaller than that of the standalone module, meaning the RTK is more precise.

4. A significant difference can be noted in the accuracy of moving data depending on the environment, it can be seen from the RMS errors of the open environment being 0.122 meters increase to 2.126 meters in an occluded environment.

5. In an open environment, the corrections received were RTK FIX and the accuracy was significantly high. Meanwhile, in an occluded environment, the RTK switches to FLOAT and an increase in the error values can be noticed.