EECE 5554 Robotics Sensing and Navigation
Lab-1 Report

Introduction

The Lab focused mainly on writing a driver to obtain the Latitude and Longitude coordinates by parsing the raw data obtained from the GPS puck. Later, the obtained data was plotted and analyzed to understand the errors/noise in the scattered data.

The first part of the lab was to write a driver and then collect the raw data which would contain data in various formats so it was written to collect only the GPGGA format data and along with UTM values all the data was published on to the " /gps " rostopic. Once the driver was written, a launch file was also created for the gps driver.

Collecting the data

Once the driver and launch files are created, the data was collected in bag files using rosbag. Two types of data was collected, one by staying at a stationary location and the other by walking in a path. The stationary data was collected beside snell engineering center which was later verified by checking the gps coordinates of the location on internet. Thew moving/walking data was collected starting from snell library through the soccer ground till the curry student Centre. The collected data was stored in respective bag files.

Data analysis:

The collected bag file's data was converted to csv files and then using pyplot, graphs were plotted for that data. As shown in the below figures UTM_northing vs UTM_easting graphs were drawn for both stationary and walking data. Additionally latitude vs longitude graph was also plotted for both the cases. The altitude graphs weren't plotted since there is no inference being taken from it. We are only analyzing the error in scattered data while collecting the gps co-ordinates.

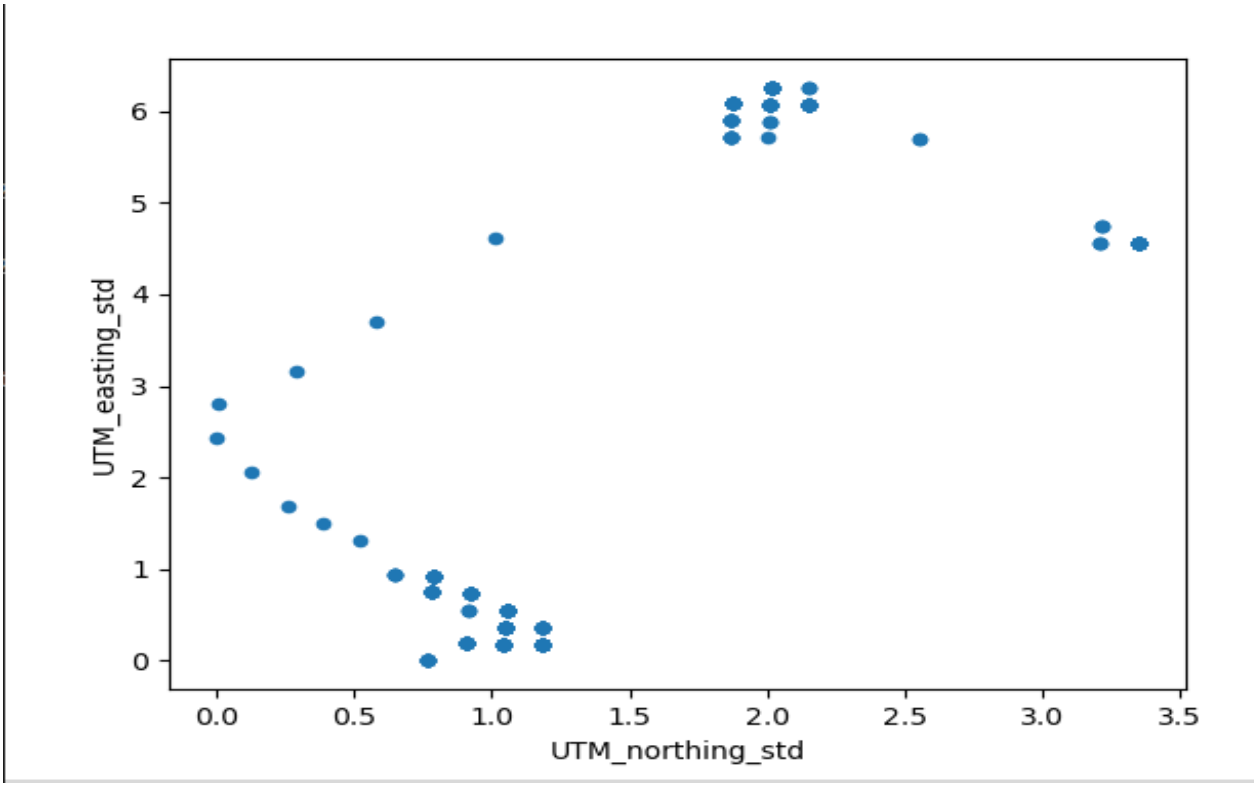


Figure-1: UTM nothing vs UTM easting for Stationary Data

In Fig-1 UTM northing vs UTM easting has been plotted for the data collected at a stationary point. The UTM northing defines the distance from the equator and the UTM easting defines the distance from the prime meridian. As observable from the plot, instead of showing a single stationary point the data seems to be scattered around a region which is because of various reasons which will be discussed in later sections. Also one inference made from the data is that the data would best fit in Gaussian error distribution.

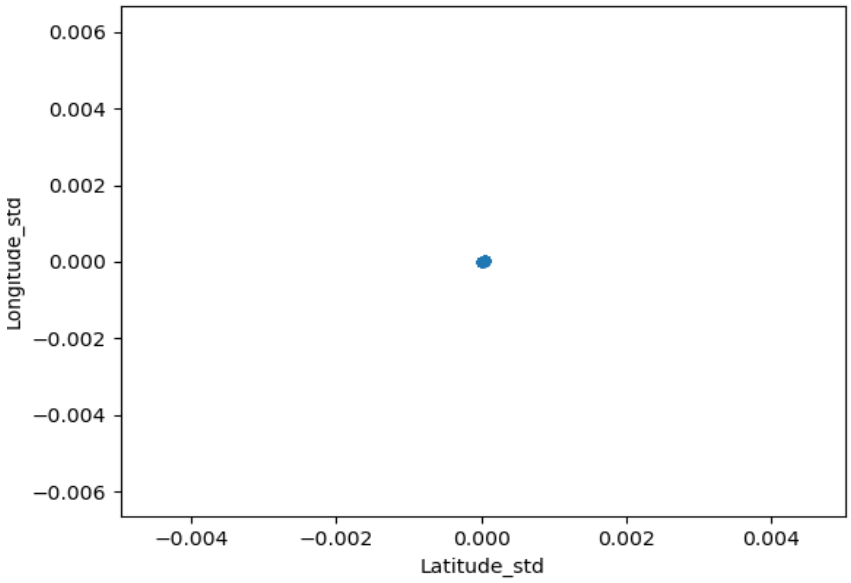


Figure-2: Latitude vs Longitude for Stationary Data

Figure-2 Latitude vs Longitude for the stationary data was plotted which seems to be a single point with a small error which makes the point blurry/multi-point overlap

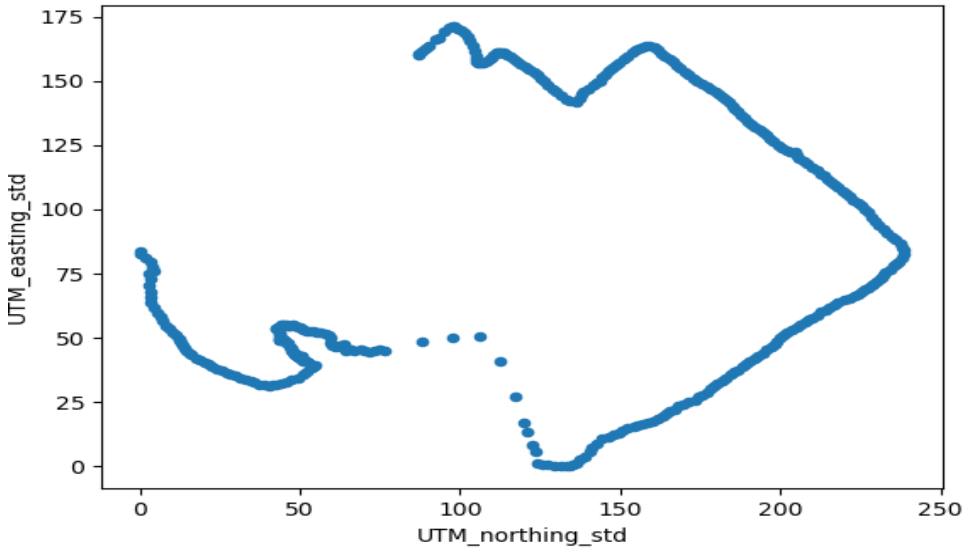


Figure 3: UTM easting vs UTM northing for moving data

In Figure-3 UTM northing vs UTM easting of the data collected while walking (from snell library through soccer ground to curry student center) was plotted. It had straight paths around the soccer ground, curvy paths from snell library to ISEC building and also indoor environment inside the ISEC building. The data which had lesser density and scattered data is collected inside the ISEC building which obviously shows the loss in gps signal due to various reasons which include obstructions, electromagnetic influence etc. The plot with solid points depicts the data collected in open areas which shows an important observation that the UTM data seems to be more scattered in case of stationary data but not while walking. The reasons of the same are discussed in further sections.

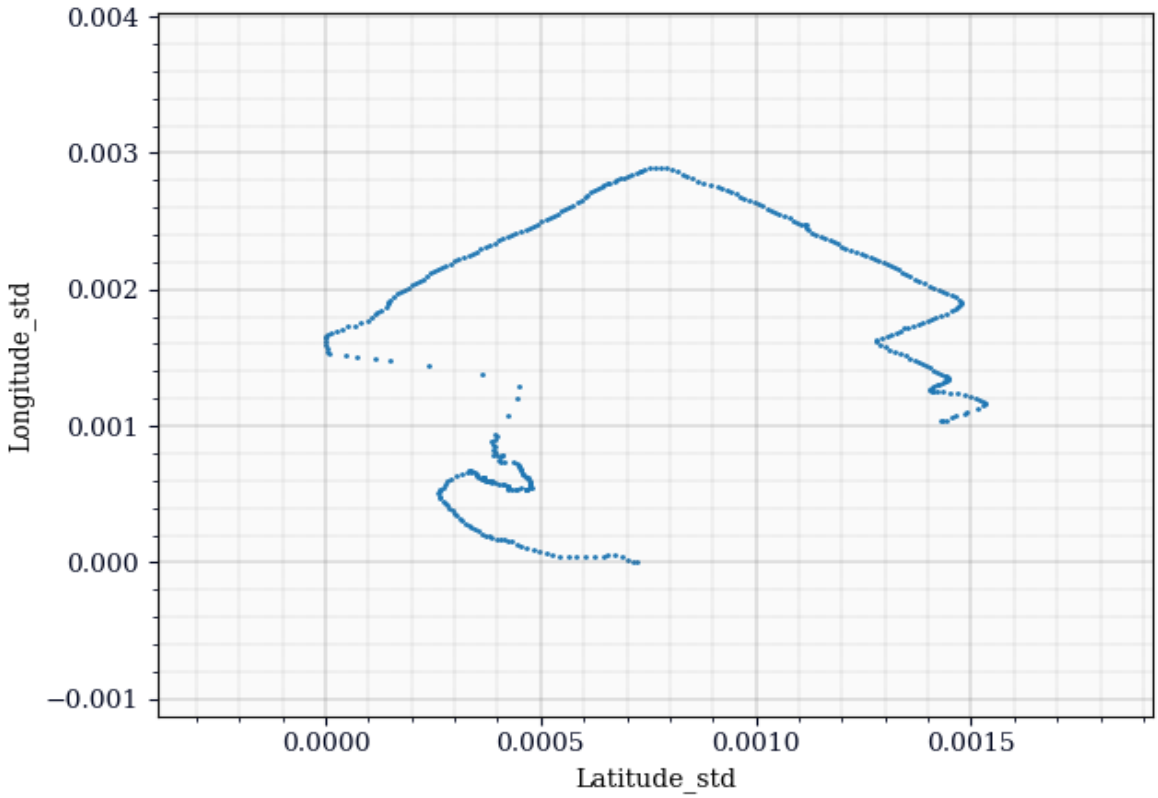


Figure 4: Latitude vs Longitude for moving data

The Firgure-4 shows the plot of Latitude vs Longitude of the data collected while walking in the path mentioned in previous sections which seems similar to the UTM graph and we can deduce similar points like the graph seems distorted in the indoor environments and the gps signal seemed pretty strong in open.

The main observations made from the data are:

- The gps data seems to be more scattered in case of statioanry data

- The gps data seems to be more accuarte in case of walking which could be observed through the straight line plots for the path surrunding the soccer ground with a miniaml deviation from the path

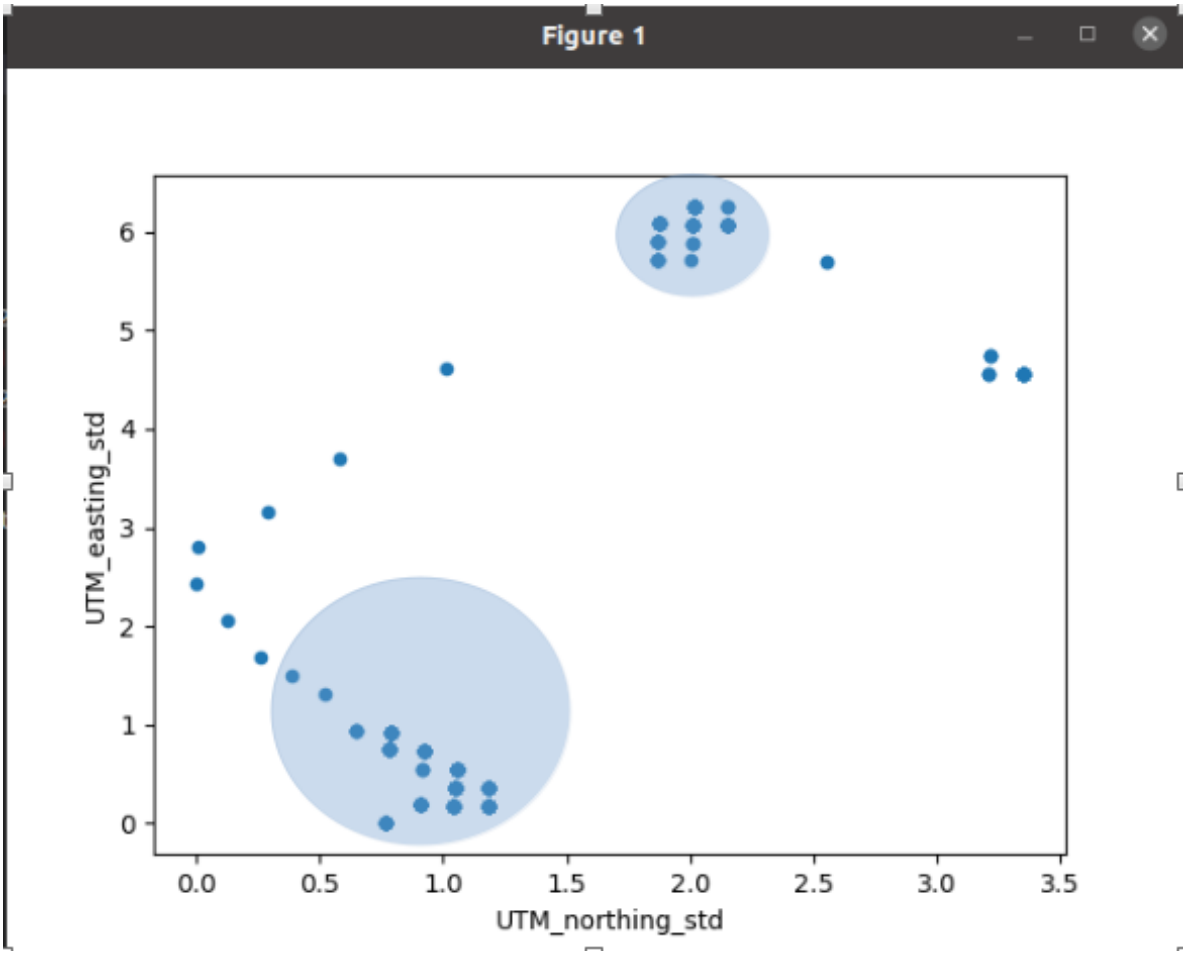
Possible reasons for the errors/scattered data:

- There are lot of reasons for the collected gps data to be inaccurate. The possible reasons for that in our case are as follows:
  - Satellite signal blockage due to buildings, bridges, trees, etc.
  - Indoor or underground used Signals reflected off buildings or walls ("multipath")
  - Cartoon of GPS signals being blocked and reflected by buildings
  - Radio interference or jamming
  - Major solar storms
  - Satellite maintenance/maneuvers creating temporary gaps in coverage
  - Improperly designed devices that do not comply with GPS Interface Specifications
  - -cited: gpssource (ctrl+click)

- Considering the above reasons we can relate it to our scenario which would make more sense for the data to be scattered in stationary data as the data was collected beside the snell engineering Centre, between three buildings, lot of scope to signal blockage because of trees, reflected signals because of buildings and radio

interference because of all the surrounding electronic equipment. This would answer the sources of the errors

- we can put bounds to these errors by considering the more dense regions in the graph to be the probable location which are the circled regions in the below graph.



- There is no specific reason that i was able to find to get such a random multiple clustered data but from the understanding of such clusters it is expected that our location is in any of the two clustered regions.

- As mentioned previously the gaussian error distribution best suits for the gps data from a resource on web **“Gaussian distributions have many convenient**

properties, so random variates with unknown distributions are often assumed to be Gaussian, especially in physics, astronomy and various aspects of engineering. Many common attributes such as test scores, height, etc., follow roughly Gaussian distributions, with few members at the high and low ends and many in the middle."

- No statistical analysis was made since it wasn't specifically mentioned but that would prove the error distribution.
- One important inference with the error in gps data while stationary is that even in android phone we don't get the exact precise location in closed areas if we just switch on the location and sometimes even the orientation is wrong but once we start walking by taking other parameters and accelerometer readings, imu data and also using some algorithms which take the previous data they make a probable location so that we get an accurate location.so this says about the navigation while walking and why we get better gps data while walking than while at stationary point. As we can observe the deviation from the straight path is minimum from the below graph in the presented region.

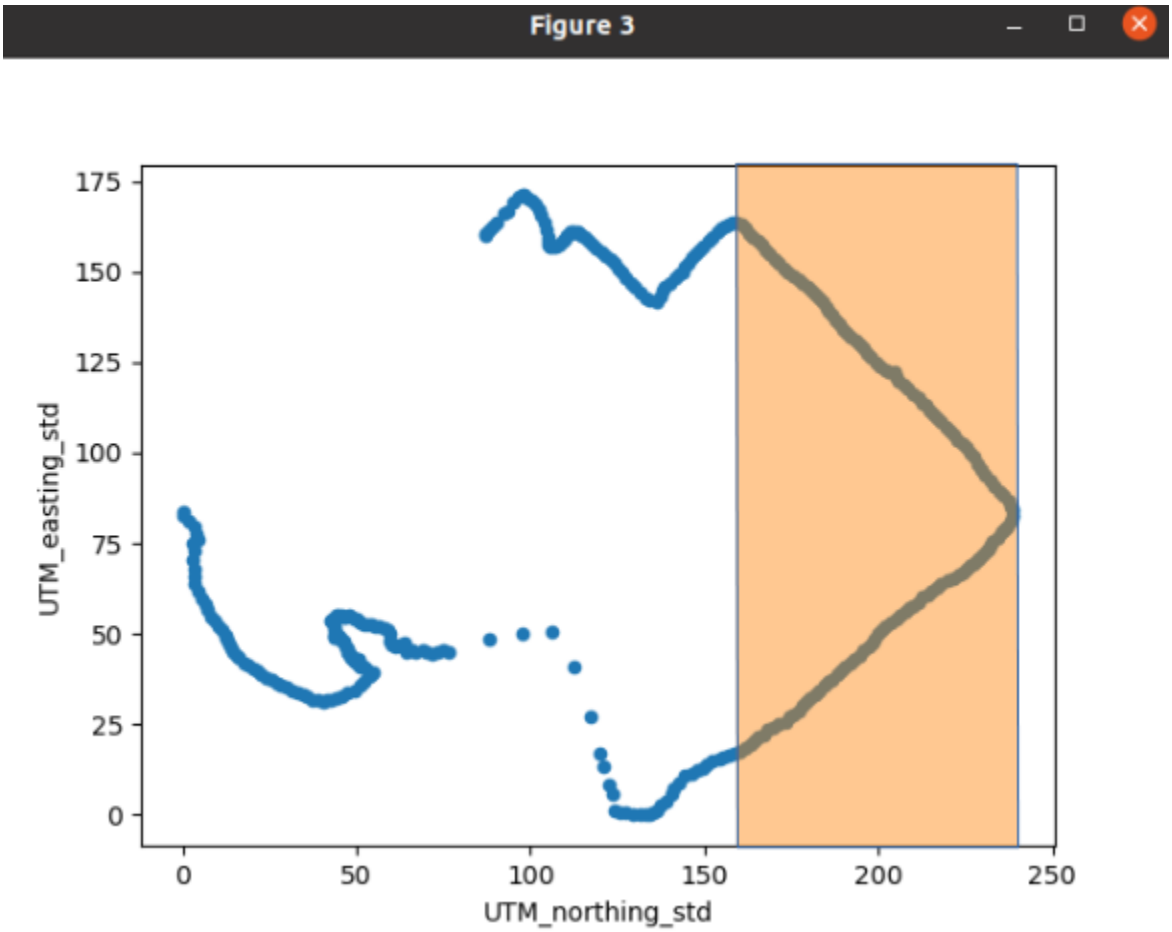


Figure 3
175
150
125
100
75
50
25
0
UTM_easting_std
0
50
100
150
200
250
UTM_northing_std