Lab_2 Report
EECE 5554 Robotics Sensing and Navigation ----Professor Singh

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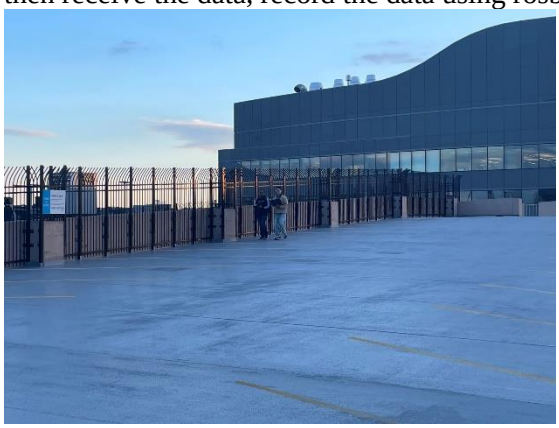
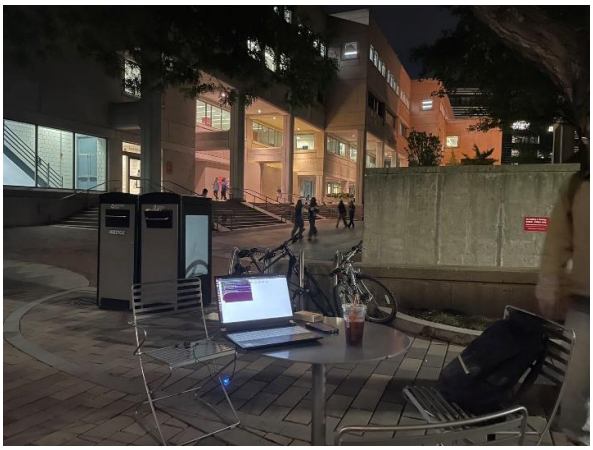
1. Short description on the project

In Lab 2, we are given a RTK procession board and an antennas. We first registered the mobile app and edit the settings both on the mobile app and the receiver(connected to the computer). Then the receiver start to give out the data in GNGGA format. We changed our driver in Lab1 then receive the data, record the data using rosbag.





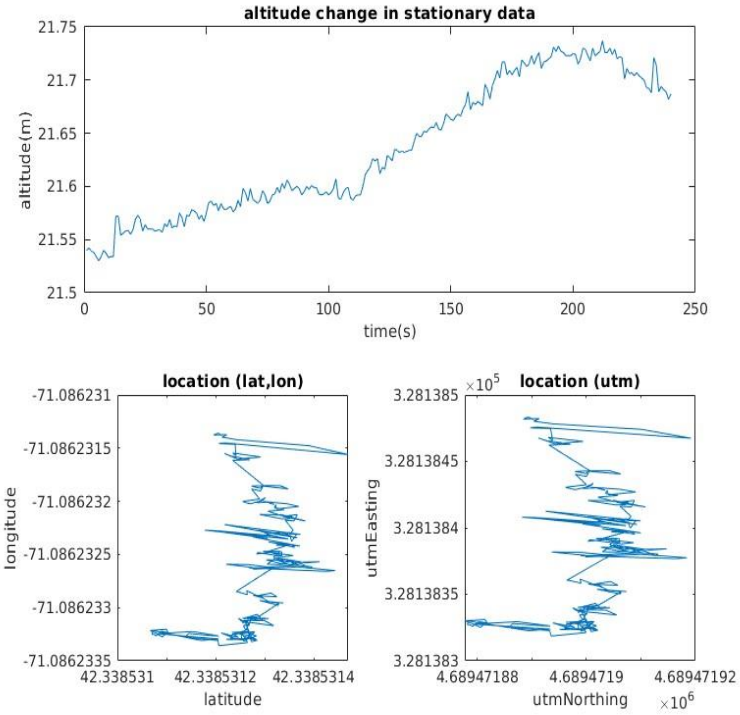
We collected 4 groups of data, two of them are stationary data and two of them are moving data. The two types of data are measured in two different areas: the open area and the area that with occlusion and reflections. The open area we choose is the top floor of garage near the ISEC and the occlusion area we choose is the garden area next to snell library and engineering college. When we are collecting the data, the RTK gives float data.

2. The data analysis

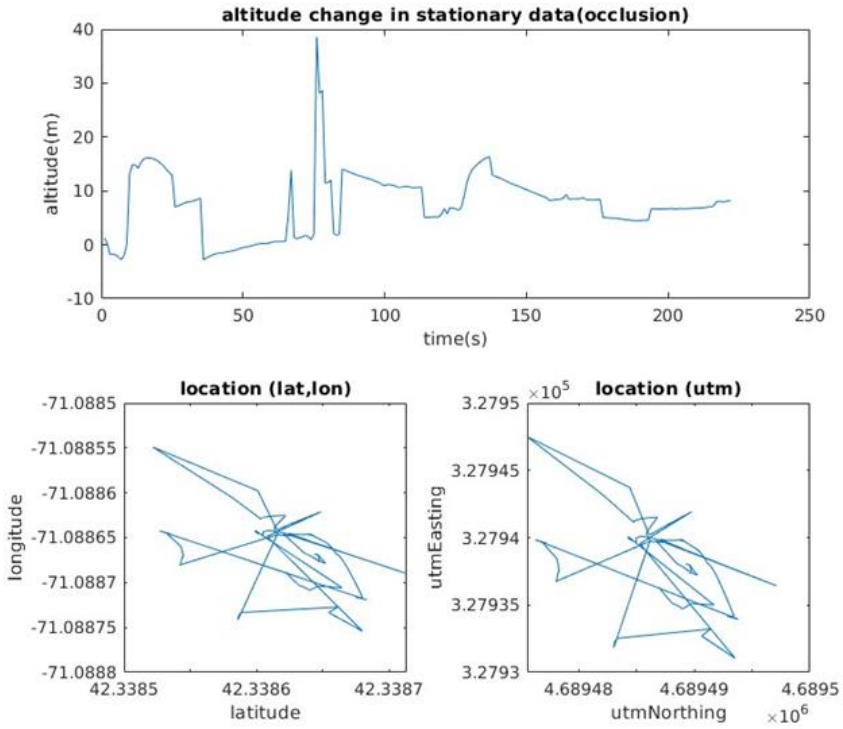
For the analysis script, I choose the same method in Lab1, using the Matlab to read the rosbag data and then plot the data to show Altitude-time change and 2D trajectory in utm easting and northing, longitude and latitude.

The plot of the rosbag data is below:

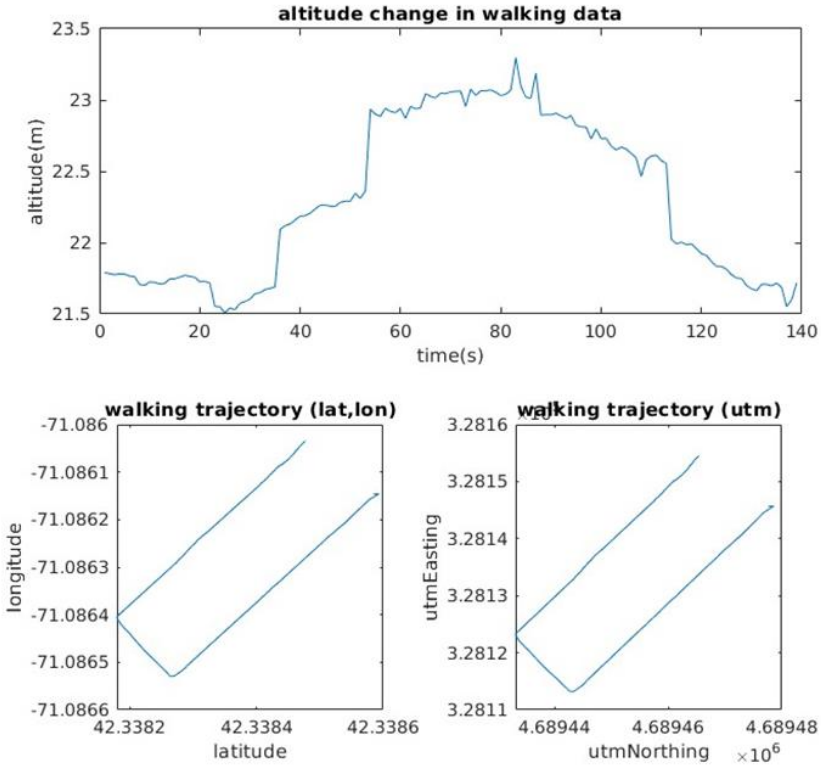
a. stationary data



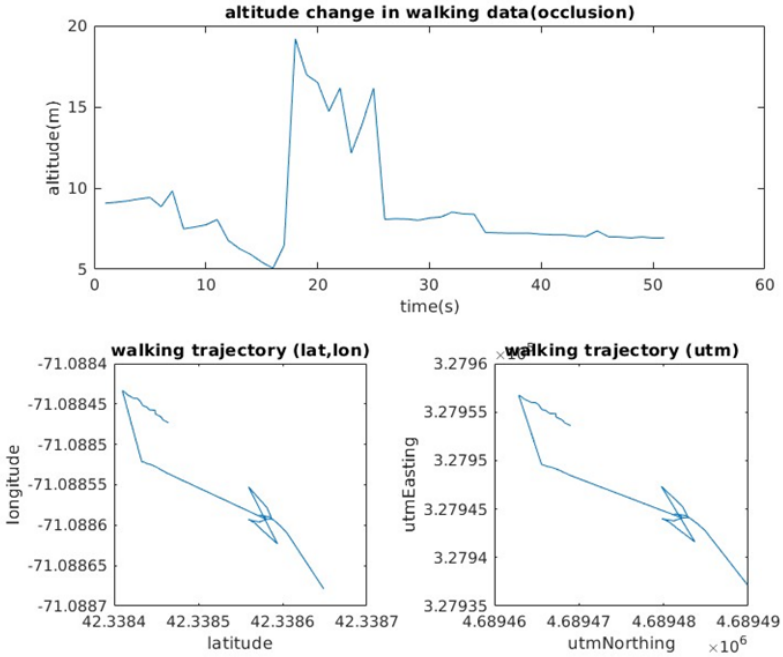
b. stationary data with occlusion



c. moving data

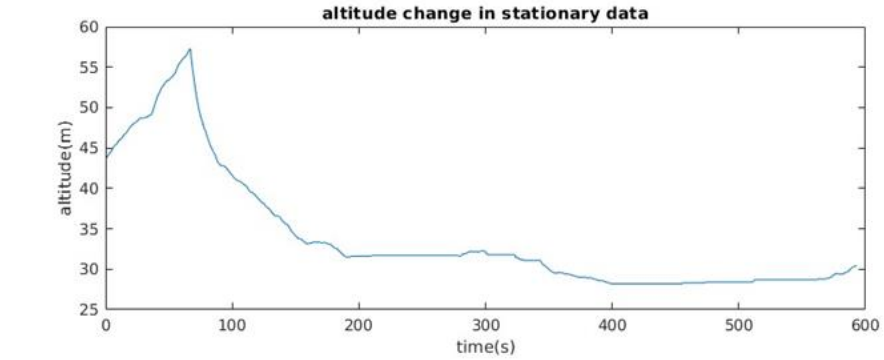


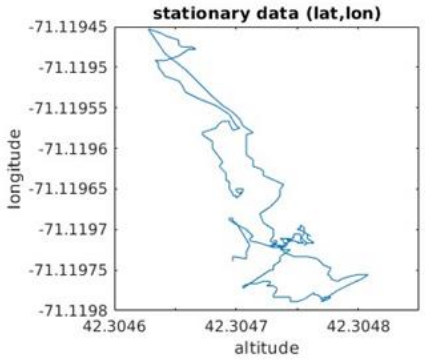
d. moving data with occlution

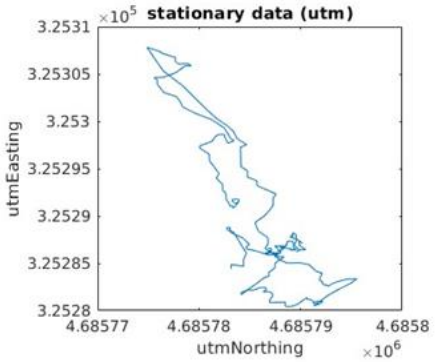


Lab1 data:

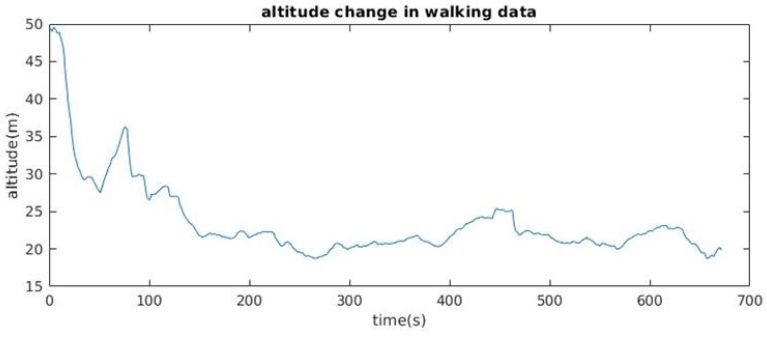
stationary:

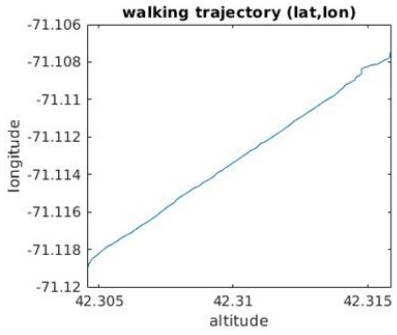


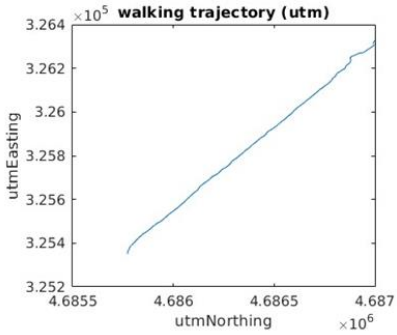




moving:







Analysis:

I): Comparing the RTK stationary and walking data to the data in Lab 1:

The RTK plot is more precise than the gps plot in Lab 1, the moving data scale is 0.0001 in RTK and 0.001 in gps (longitude and latitude) and the stationary data scale is also 0.0000005 in RTK and 0.00005 in gps (longitude and latitude), both in the open area. (in longitude and latitude, the utm data is almost the same because it is transferred from the longitude and latitude data in the driver).

II): Comparing the stationary data with and without the occlusion:

The stationary data in the open area has high accuracy, with the influence of occlusion, the number of data collected in the same period of time has decreased. There is also noticeable that the altitude of the stationary data with occlusion is not trustworthy, while the altitude of the stationary data is stable and rise a little bit, that may because the RTK GPS may take some time to start and get the accurate location.

III): Comparing walking data with and without the occlusion:

The walking data in open area seems accurate but lost one part, that may because of cloud in the sky blocked the data from the satellite. The number of walking data is not too much so if a series of data in a short constant time is lost, it may totally lost a whole line in the plot. The altitude data is good because the garage we walk has a small slope.

The walking data with occlusion is also not trustworthy, that may because of the buildings surrounded by when collecting the data, they reflect the gps signal and cause error. The small triangle on the plot may because we turn around when walking. The appearance of the plot may depend on the environment. In addition, the altitude is also wrong.

IV): Other observations:

The occlusion may cause inaccuracy in altitude and the turning angle. It can get the straight line but the angle changes significantly due to occlusion.

3. The answer to questions on instruction

a. What do the error (if you used a "true" position) or deviation (if you didn't) tell you about the accuracy of RTK GNSS navigation, as compared to standalone GNSS without RTK?

The RTK gps puck is more accurate, the detail can be seen in Analysis part I). The plot of RTK has smaller scale and more stable shape.

b. What can you say about the ranges and shapes of your position in Easting and Northing from RTK GPS? (Make a 2D histogram, state the deviations of Easting and Northing, and draw additional conclusions about these data).

For stationary data, the shapes of position varies randomly. For walking data, the trajectory in open area is perfect except losing a line, that may because of the cloud. The more details are discussed in Analysis above. The walking data with occlusion can measure the straight line but can't get the right angle due to the buildings surrounded by.

c. Is the shape or range of your histogram different than your dataset collected in Lab 1?

In Lab1 and 2, the stationary data is varied randomly so the shape is not important. The straight line in Lab 1 and 2 are good but the angle in Lab2 with occlusion is not accurate. All the data is more accurate in Lab2.

d. Give quantitative comparisons for how your moving data differ in the open and occluded cases, including error/deviation estimates? Does this have anything to do with GNSS fix quality?

The moving data in open cases has a tiny larger scale (that may because we walk a longer distance in open cases). As mentioned above, the straight line in both plots are good but in occlude cases, the error of angle is significant. It should be the same 90 degree as it in open case.

In addition, when we collecting the data, the RTK solution is always float, so the accuracy is not so good comparing to the fix quality. But the straight line in the plot shows that the GNSS fix quality works wo make the line straight. When signal is not so good, the line is not so straight, it can be seen in top part of the trajectory in occluded case.

e. How are your stationary data different in the open and occluded cases, including numerical error/deviation estimates? Does this have anything to do with GNSS fix quality?

The stationary data in open area has more accurate data, smaller scale. The shape of it may not so good because the scale is small enough. If it is put into a larger scale, it will be smaller as a center point. The plot in occlude case obviously has a center point. When collecting the data, it is losing signals for some period of time, so the data may not so accurate and has a larger error. But the center point exists with the help of the GNSS fix quality(float).

4. Conclusion

In Lab2, I learned the difference between the RTK gps and the simple gps puck. Also, I learned how to make my driver in Lab1 to suit for other environment, both in new kind of gps puck and in simulation. Gps is an essential part when building the mobile robot, especially for SLAM.