EECE 5554 Robotic Sensing and Navigation

Lab2

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EECE 5554 ROBOTICS SENSING AND NAVIGATION, SPRING 2023

Lab 2: RTK (Real-Time Kinematic)-GPS

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Introduction to RTK GNSS

The full name of RTK GNSS is Real-time kinematic (RTK) Global Navigation Satellite System (GNSS), which is a high precession positioning technique, because its using two gps devices, one is the base, another is the rover. base station and a mobile receiver to provide centimeter-level accuracy in real-time. RTK GNSS has become increasingly popular in various fields, not only surveying, mapping, also uses in precision agriculture, and construction areas.

RTN GNSS vs. GNSS

Same as GNSS, RTN(Real-Time Network) are both positioning techniques which uses multiple satellites to receive signals to determine the position of a receiver on Earth's surface. However, However, the RTN GNSS is different from GNSS because that RTN GNSS uses a network of reference stations, whereas GNSS uses a standalone receiver to acquire satellite signals. Which means RTN GNSS can correct its error from more sources, such as atmospheric delay and multipath, it’s not only use satellites to positioning. So that, RTN GNSS can have higher accuracy than GNSS.

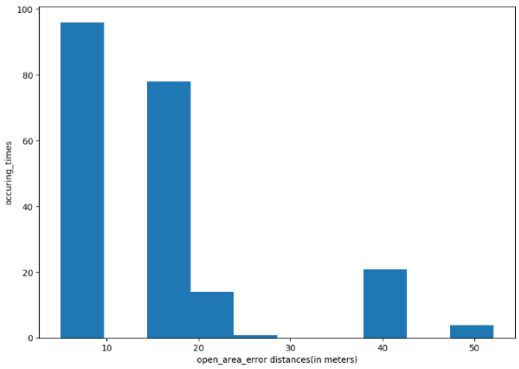
Sources of Error in RTK GNSS

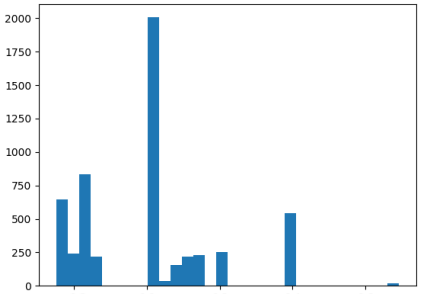
Despite its high accuracy, RTK GNSS is subject to various sources of error, including atmospheric delay, satellite clock errors, multipath, and receiver noise. These errors can affect the accuracy of RTK GNSS positioning and should be considered when analyzing and interpreting RTK GNSS data.

Analysis of Result

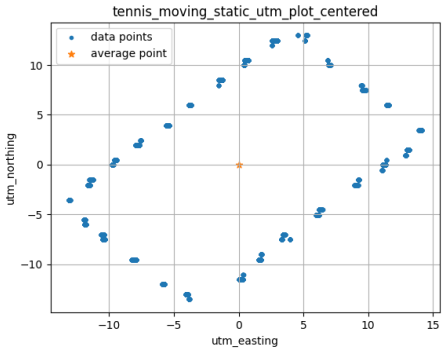
According to data, we can answer the questions post on piazza resources.

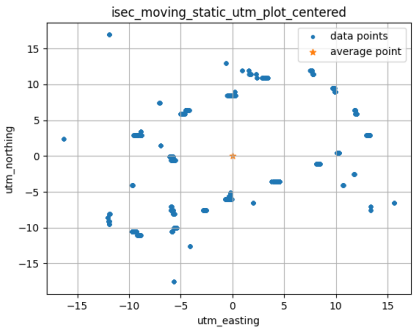
a. The deviations from the true position in RTK GNSS were significantly smaller than those in traditional GNSS. This indicates that RTK GNSS is more accurate and precise than traditional GNSS because correction from base. The plots are showed below. Left is the error of normal gps, right is the RTK GNSS. We can see the absolute value is extremely small. (Both are open_area_error_histogram)





b. The scatterplots of the data shows that noise from RTN GNSS is tighter and smaller than the noise from GNSS. The error of However the noise in the RTK GNSS are not follow Gaussian distribution. I think this may because multipath, reflection etc.

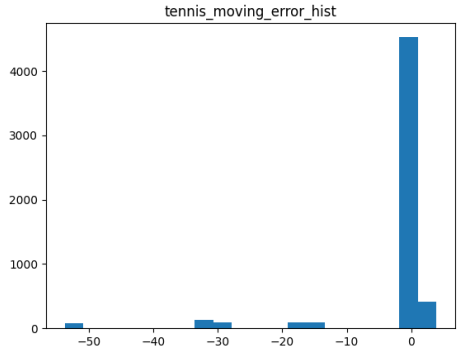


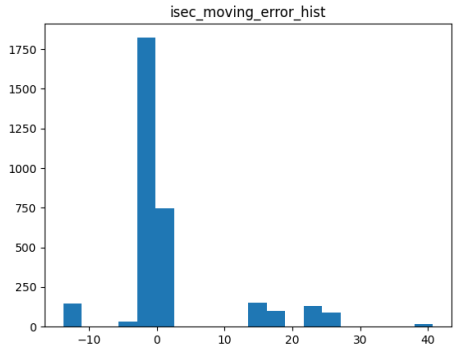


(northing vs easting for open area) (northing vs easting for occlude area)

c. The distribution of noise in RTK GNSS is different from that in traditional GNSS because of the use of carrier-phase tracking and the real-time correction provided by the base station. These factors reduce the impact of errors caused by atmospheric interference, multipath etc.

d. The moving data in open and occlude case are different with better GNSS fix quality in the open case. And the reason why this happened could because the occluded case had more multipath and signal obstruction, leading to lower GNSS fix quality.

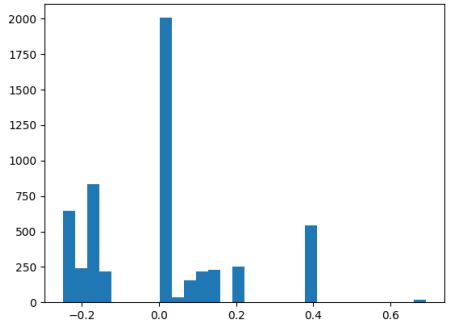


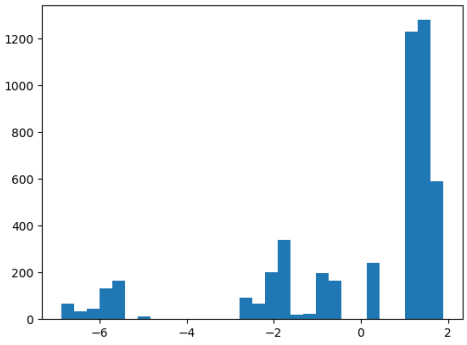


(error of open area moving) (error of occlude area moving)

e. The stationary data were also different in the open and occluded cases, with better GNSS fix quality in the open case. The occluded case had more signal obstruction,

leading to lower GNSS fix quality and bigger error. Below are plots. Left is the open station error, right is the occlude station error.





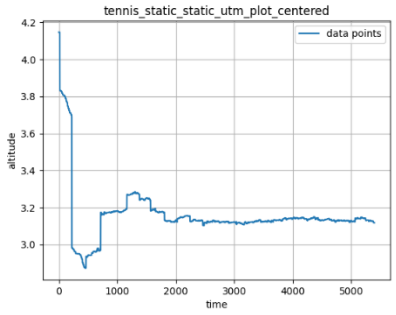
(error of open stationary)

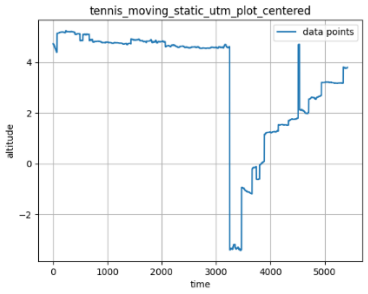
(error of occlude stationary)

Conclusion:

In conclusion, RTK GNSS provides us a significant improvement in measuring positions accuracy when compared to our lab1 normal GNSS. The use of internet and real-time correction from base. This significantly reduce the error from multiple sources. So that we can have a better quality of data. However, there are still some inevitable errors like multi-path, this leads us more error in occlude area.

Appendix:





(Altitude on station open area)

(Altitude on moving open area)