Lab-2 RKT GNSS

Introduction

Real-Time Kinematic (RTK) is a satellite-based positioning system that offers centimeter-level accuracy for real-time applications. RTK relies on Global Navigation Satellite System (GNSS) technology to determine precise positioning information, and widely used fields where high-precision positioning is critical.

Differences between RTN GNSS and GNSS

RTN GNSS is a network of permanently installed GNSS receivers that are continuously monitored and maintained by a service provider. These receivers provide high-precision information that can be accessed by users in real-time. RTN GNSS is mainly useful in the occluded spaces which can interfere with the accuracy of traditional GNSS measurements.

GNSS, on the other hand, is a satellite-based positioning system that provides global coverage and is not dependent on any ground-based infrastructure.

The main difference between RTN GNSS and GNSS is that RTN GNSS relies on a network of ground-based receivers, while GNSS is based solely on satellite signals. As a result, RTN GNSS can provide higher accuracy in areas where the GNSS signal is obstructed or weak.

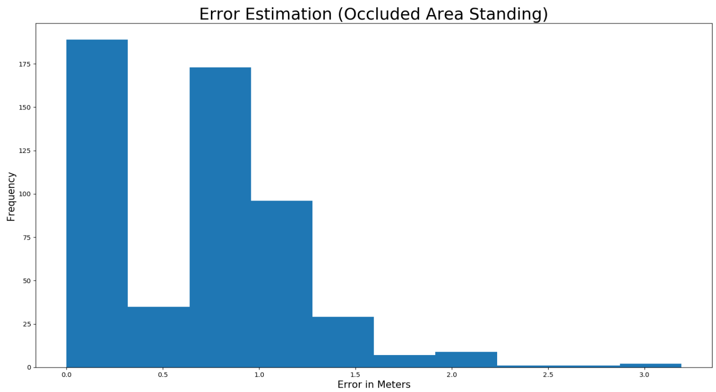
Sources of Error in RTK GNSS

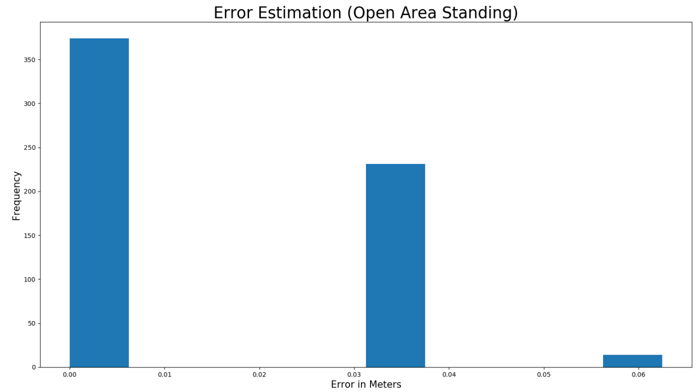
These are the few sources of errors while using RTK GNSS

1. Atmospheric conditions: The GNSS signal can be affected by atmospheric conditions such as ionospheric delays, which can introduce errors into the positioning information.
2. Multi-path interference: Multi-path interference occurs when the GNSS signal is reflected off surfaces such as buildings or trees, resulting in inaccurate positioning information.
3. Receiver noise: The quality of the GNSS receiver can impact the accuracy of the positioning information. Low-quality receivers may introduce noise into the signal, resulting in less accurate measurements.
4. Satellites in position: The number and position of GNSS satellites in view can impact the quality of the positioning information. In general, the more satellites that are in view, the more accurate the measurements will be.

Questions:

A) **What does the error (if you used a “true” position) or deviation (if you didn’t) tell you about RTK GNSS navigation, as compared to GNSS without RTK?**





Based on the above analysis, the error values obtained using RTK GNSS are significantly lower compared to those obtained using GNSS without RTK (Lab-1). This indicates that RTK GNSS provides higher accuracy and precision where the GNSS signal is obstructed or weak.

The low error values obtained using RTK GNSS as it relies on a network of ground-based receivers that provide continuous monitoring and correction of the GNSS signal. This correction helps to reduce the impact of sources of error, which are more likely to occur in urban and suburban environments.

In contrast, GNSS without RTK relies solely on satellite signals, which can be impacted by a variety of sources of error, resulting in higher deviation values. While GNSS can provide global coverage, it may not provide the same level of accuracy particularly in areas with obstructions or interference.

B) What can you say about the distribution of noise in the signal?

For Open area: Mean - 1.3 cms and Standard deviation - 1.68 cms.

For Occluded area: Mean - 0.647 mts and Standard deviation - 0.534 mts.

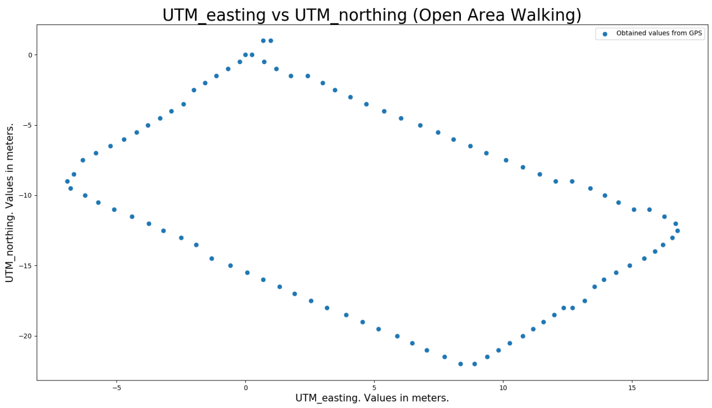
When using RTK GNSS, it is important to consider the mean and standard deviation as the errors in the measurements, because the accuracy and precision of the measurements can be impacted by a variety of sources of error, as I mentioned earlier, such as atmospheric conditions, signal blockage, and receiver errors.

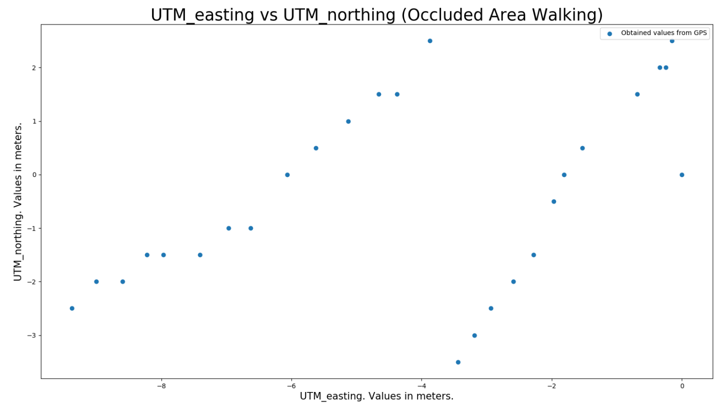
By considering the mean of the errors, we can estimate the bias in the measurements which are caused by the errors in the reference station. Whereas the standard deviation of the errors indicates the level of noise or random error in the measurements.

C) Why is this distribution different from GNSS data collected in Lab 1?

For GNSS data, the common approach to estimate the accuracy of the measurements is by taking the median value, rather than the mean value, because the errors in GNSS measurements often have a non-normal distribution. The median measures the central tendency of the data that is not affected by extreme values, making it a typical error for GNSS measurements.

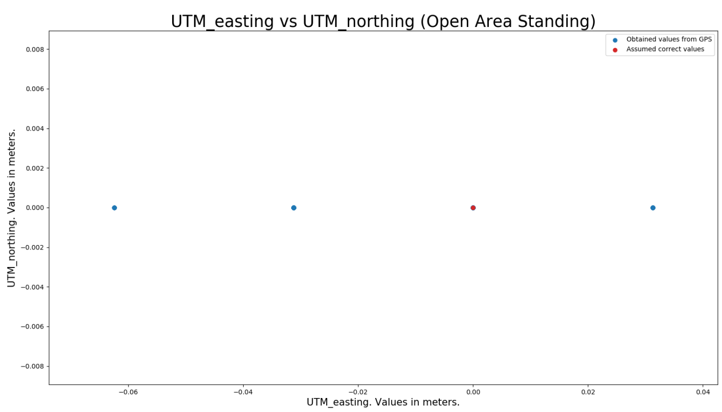
D) How are your moving data different in the open and occluded cases? Does this have anything to do with GNSS fix quality?

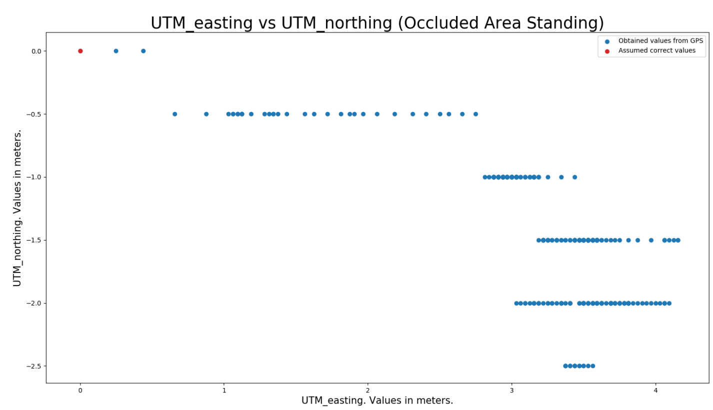




In open spaces, the RTK GPS measurements tend to be more accurate and precise, while in occluded areas, the measurements tend to be less accurate and precise. This is because in open spaces, there are fewer obstructions to GPS signals, which can lead to a higher number of satellites being tracked and a more accurate fix. Whereas in occluded areas, there is a higher likelihood of signal blockage or reflection, which can lead to less accurate fix. The GNSS fix quality, indicated as "RKT Fixed", is a measure of the quality of satellites being tracked, and it can play a role in the accuracy of the measurements. However, GNSS Fix Quality and other factors such as atmospheric conditions and receiver errors can also impact the quality of the measurements.

E) How are your stationary data different in the open and occluded cases? Does this have anything to do with GNSS fix quality?





In stationary RTK GPS measurements, the quality of the GNSS fix can have a significant impact on the accuracy of the data, regardless of whether the measurements are taken in open or occluded areas. In open spaces, the quality of the GNSS fix is often higher, resulting in more accurate and precise measurements. In contrast, in occluded areas, the quality of the GNSS fix tends to be lower due to signal blockage. The quality of the GNSS fix is not the only factor that affects the accuracy of stationary RTK GPS measurements. Other sources of error, such as multipath interference, receiver noise and atmospheric conditions, can also impact the accuracy of the data, even in open spaces with a high-quality GNSS fix.