EECE 5554 LAB 2 ANALYSIS REPORT

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(DATA BORROWED FROM GROUP 6)

1. INTRODUCTION TO RTK GNSS

Real-Time Kinematic (RTK) Global Navigation Satellite Systems (GNSS) is a high-precision positioning technique used for various applications such as surveying, construction, agriculture, and navigation. RTK GNSS uses signals from multiple satellites to determine the precise location of a receiver in real-time. This report will discuss the differences between RTN GNSS and GNSS and sources of error in RTK GNSS.

2.RTN GNSS vs. GNSS

GNSS is a term used to describe any satellite navigation system that provides positioning, navigation, and timing services. Examples of GNSS systems include the US Global Positioning System (GPS), the Russian Global Navigation Satellite System (GLONASS), the European Galileo system, and the Chinese Beidou Navigation Satellite System. GNSS systems provide a global coverage, allowing users to determine their position anywhere in the world.

RTN GNSS, on the other hand, stands for Real-Time Network GNSS. It is a technique that uses a network of fixed reference stations to provide high-precision positioning information to a mobile receiver in real-time. The reference stations are set up at known locations, and their positions are precisely determined using GNSS techniques. The mobile receiver uses signals from multiple reference stations to determine its precise location.

3. ERROR DIFFERENCE BETWEEN GNSS AND RTK GNSS

The error difference between RTK GNSS and traditional GNSS can be significant. While traditional GNSS can provide positioning accuracy of around 5-10 meters, RTK GNSS can provide sub-centimetre accuracy with proper setup and operation. This is because RTK GNSS uses a network of reference stations to correct for errors in the GNSS signal, which can be affected by various factors such as atmospheric conditions and signal interference. These errors can introduce significant inaccuracies into the positioning information provided by traditional GNSS, while RTK GNSS can provide highly precise and accurate positioning information. However, it is important to note that even with RTK GNSS, there can still be sources of error that can affect the accuracy of the positioning information

4.SOURCES OF ERROR IN RTK GNSS

Despite the high-precision capabilities of RTK GNSS, there are still sources of error that can affect the accuracy of the positioning information. Some of the sources of error include:

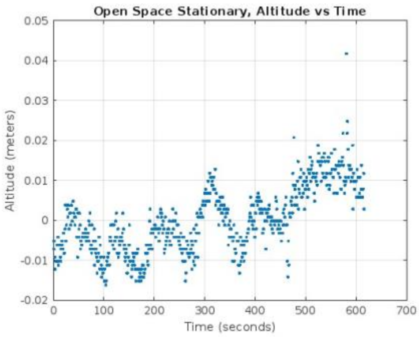
- Atmospheric conditions: The GNSS signal can be affected by atmospheric conditions such as ionospheric and tropospheric delays, which can cause errors in the positioning information.
- Multipath interference: Multipath interference occurs when the GNSS signal reflects off surfaces such as buildings, trees, and other structures before reaching the receiver. This can cause errors in the positioning information.
- Signal interference: Signal interference can occur when other electronic devices emit signals that interfere with the GNSS signal.
- Receiver error: The receiver itself can introduce errors into the positioning information due to factors such as clock drift and noise

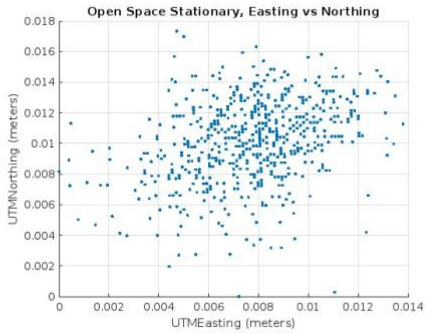
TYPES OF DATA SET

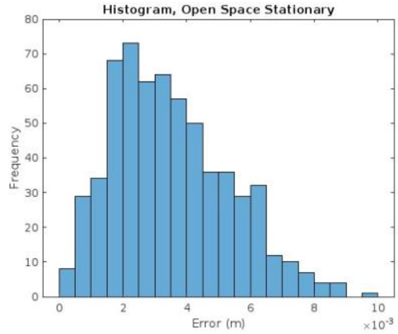
1. OPEN SPACE DATA SET – At Columbus garage.
2. OCCLUDED SPACE DATA SET – Infront of ISEC building.

5. OPEN SPACE DATA SET [COLUMBUS GARAGE]

A. STATIONARY DATA SET





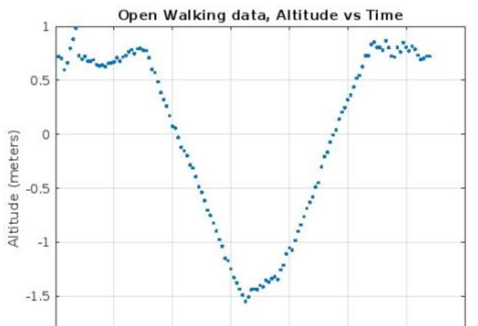


By analysing scatter plot of stationary data from RTK GNSS, we can observe a tight cluster of points around the true position indicating a high level of accuracy and precision in the measurement, which is critical for providing accurate correction data to the rover station. We can also assess the level of accuracy and stability of the rover station, which can help identify any issues with the receiver or antenna.

The error value for open space stationary data is negligible i.e., **0.0040 m.** Fix quality is **4** which means the position solution was calculated using signals from at least four satellites. Ideally, the fix quality should have been 5 since it is in open space. But there might be several reasons we got fix quality as 4 i.e., Atmospheric conditions, Multipath interference, Signal interference. Since the data was provided by the TA to us it is had to provide the accurate reasoning for this fix quality.

Moreover, the stationary data is also providing information about the environment and the sources of interference that may be affecting the accuracy of the position measurements. Overall, stationary data from RTK GNSS can provide valuable information for calibrating and optimizing the system for high-precision positioning, and it can also help identify any sources of error or interference that may be affecting the accuracy of the measurements.

B. MOVING DATA SET

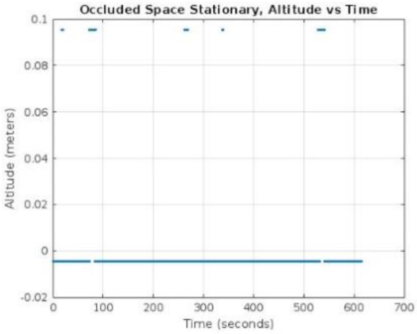


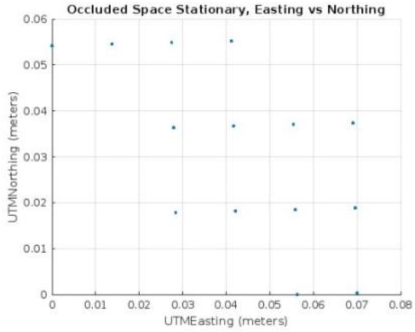
A temporary negative value in the altitude versus time graph in RTK GNSS may be due to a loss of GPS signal or a sudden change in altitude. However, these values are typically corrected by the RTK GNSS system once the GPS signal is restored or the altitude stabilizes. Therefore, it is important to analyse the data and identify any significant trends or patterns in the altitude versus time graph to ensure accurate and reliable position measurement.

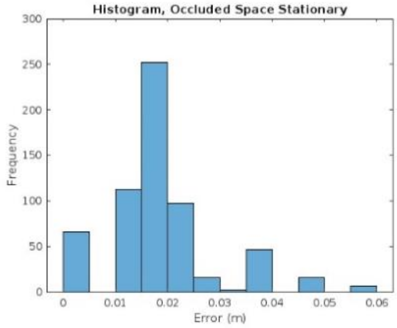
The error value for open space moving data is small i.e., **1.0105 m.** Fix quality is **5** which means the position solution was calculated using signals from at least five satellites.

6. OCCLUDED SPACE DATA SET [INFRONT OF ISEC BUILDING]

A. STATIONARY DATA SET





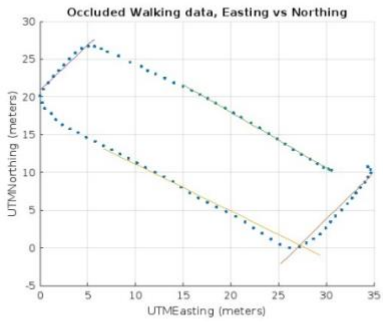


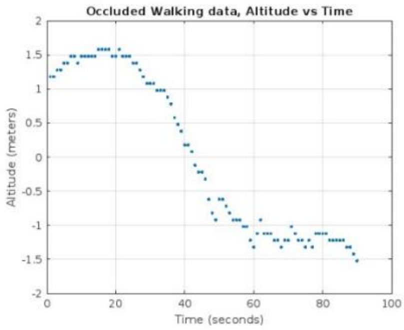
The error value for occluded stationary space stationary data is **0.0082 m.** Fix quality is **4** which means the position solution was calculated using signals from at least four satellites.

We can observe that as we moved to occluded area the error was slightly increased which is expected since the obstruction around such as ISEC building, and many other surrounding buildings reduces the number of satellites for position calculations. The presence of obstructions in the occluded case can significantly affect the quality and reliability of the position measurement in RTK GNSS, leading to differences in the stationary data compared to the open case.

Ideally, Fix quality can also play a role in the differences between open and occluded stationary data. In the occluded case, the fix quality may be lower due to the reduced number of satellite signals available for position calculation. This lower fix quality can lead to greater variability in the stationary data and reduced accuracy and precision in the position measurement. In the open case, where there is a clear line of sight to the GNSS satellites, the stationary data is likely to be more consistent and accurate. The fix quality is likely to be high, and the position measurement is likely to be reliable.

B. MOVING DATA SET





The error value for open space moving data is small i.e., **0.5697 m.** Fix quality is **5** which means the position solution was calculated using signals from at least five satellites. The error value is lower than the open space station data which is not expected, ideally the error should be more as compared to open space. And even the fix quality should be lower compared to the open space moving data.

But the since data collection process was done by other group it is difficult to give the proper reasoning behind it.

But considering the ideal conditions, the presence or absence of obstructions in the open and occluded cases can significantly affect the quality and reliability of the position measurement in RTK GNSS, leading to differences in the moving data. The GNSS fix quality can also play a role in these differences, with lower fix quality in the occluded case potentially leading to greater noise and irregularities in the moving data.

7. CONCLUSION

A lot could not be said about the data due to indirect sourcing from the third party. However, a couple of key observations were made with the available information. We can observe that the data collected from the open space was more accurate and precise than data collected from the occluded space at least in case of stationary data set. Since the fix quality was same for both was 4 it is difficult to give proper reasoning for it but ideally the fix quality should be less in case of occluded space as compared to open space.

In case of moving data, we could observe that the error of deviated position and true position was very low which indicated that the RTK GNSS sensor is very accurate and precise even in the case of moving rover. But again, the fix quality for moving data in both open and occluded area was same i.e., 5 it is difficult to give any reasoning for it.

It can be concluded that the RTK GNSS is more precise and accurate compared to the GNSS sensor used in LAB 1. Since the data is constantly being corrected by the base station which wasn't the case in GNSS sensor.