LAB 2-RTK GPS REPORT

Robotics Sensing and Navigation

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Aim:

Implement RTK GPS by setting up the system, then analyze the data that was recorded while the operation was being done and compare the results to GNSS GPS Puck.

RTK GPS:

Real Time Kinematics, as well as RTK, is an abbreviation. The use of surveying to correct uncertainty arises in current satellite navigation in the GNSS system, where it measures the phase of the signal's carrier wave in addition to the information content of the signal and relies on a signal base station to provide the correction signal in real time with centimeter-level accuracy.

Hardware and Sensors:

2	**GNSS/RTK processing boards**
2	**GNSS antennas**
2	**915 MHz telemetry radios**

GNSS/RTK processing boards:

Using GPS/GNSS RTK boards based on the u-blox ZED-F9, it is possible to achieve centimeter-level accuracy in a matter of seconds. These boards are also compatible with Arduino, STM32 Nucleo, Raspberry Pi, and Pixhawk as an external GNSS. with the choice of RTK-SSR correction service. It can be used in a variety of modes. For example, it can be used in Standalone mode, which is the simplest way to achieve 1 meter position accuracy without experiencing any range restrictions. In this mode, the standalone GNSS application board is connected in its most basic form. where we can connect it to an Arduino, a computer, or a smartphone and get a position in a matter of seconds. With a maximum range of 35 km from the base station, it can be used as a base-rover configuration with accuracy of less than 1 centimeter. There is also a possible where different configuration of base-rover can be create to use as different mode of operation for example: Base-Multiple rovers configuration, RTK moving base configuration, standalone with RTK/SSR corrections are possible. For this analysis single stationary base with single rover configuration is being used.

GNSS antennas:

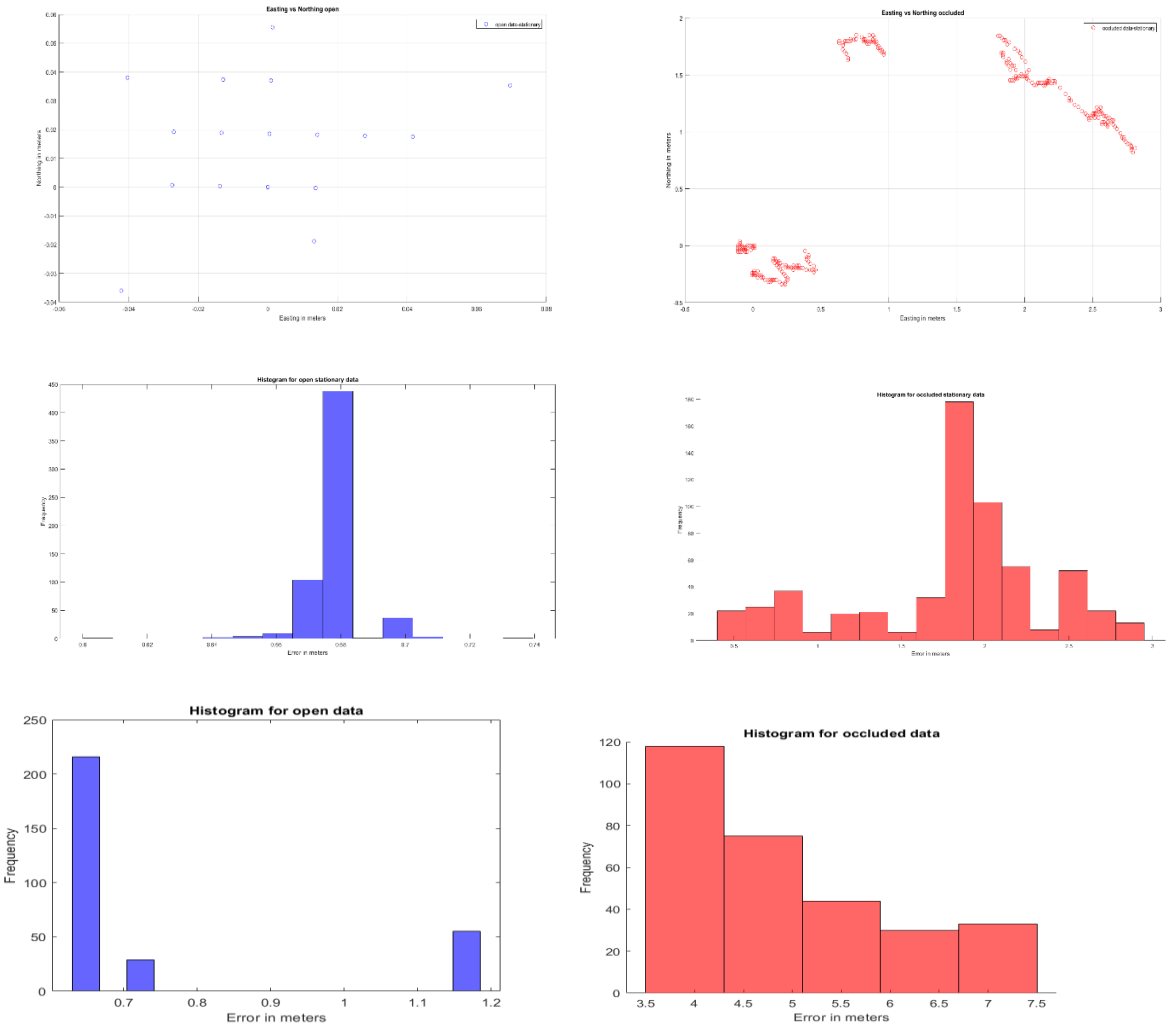
The output of GNSS antennas is fed to a processing board to calculate the position. A GNSS antenna is a device designed to receive, amplify, and convert radio signals transmitted on specific frequencies by GNSS satellites.

915 MHz telemetry radios:

The Digi XBee SX series' through-hole formatted, SMA-configured long range radio module. utilizing a setup that is most effective for airborne RTK correction transmission. In order for this module to operate effectively, the radio module must be able to send RTK corrections up to 10 km in both point-to-point configurations. RTK technology only behaves when the base and rover are within 20 km of one another.

Data analysis:

A) Comparing the deviation in values of Easting vs Northing of Open and Occluded stationary dataset:



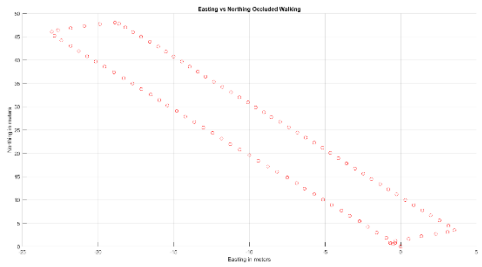
Histogram from LAB1 for stationary data

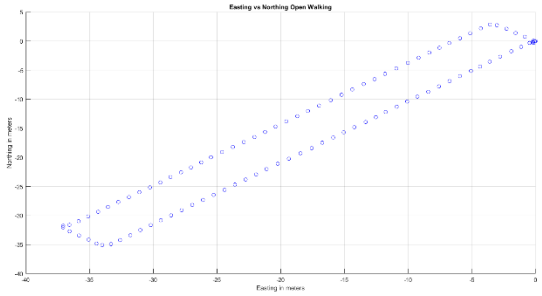
Histogram from LAB1 for stationary data

The above figures represent the error in both dataset for stationary category which are open and occluded where it is noticeable that the open dataset is being registered the error in range of 0.5 to 0.75 meters where it can be presume that error could be occurred due to Ionospheric delay and tropospheric delay since reading were taken in open area.

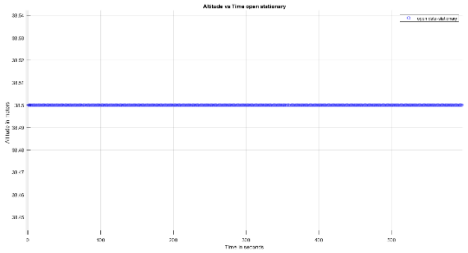
While we can notice uncertainty of 0.5 to 2.7 meters with higher frequency in occluded stationary dataset in which postulate that Multipath error could be the reason of this error since the data recorded near populated building area where the Multipath error could contribute the most as error due to reflection of windows pane which could deviate the GPS signals, In the Analysis of GPS puck (LAB 1) the error which was registered was in range of 1.2 meters in open dataset and 3.5 to 7.5 meters in occluded stationary dataset, where it is perceptible that RTK signal correction eventuated and due to that the better level of accuracy has abled to obtained in this experiment (LAB 2)

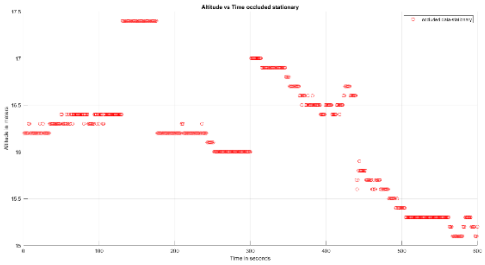
Easting vs Northing Open and Occluded Moving dataset:

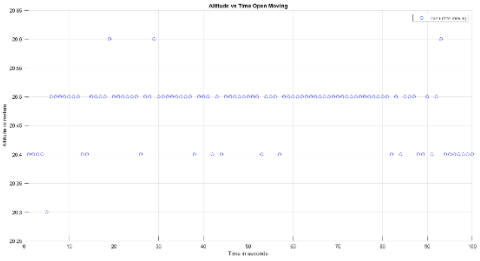


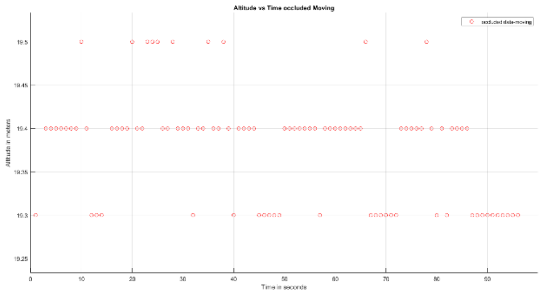


Altitude vs Time:







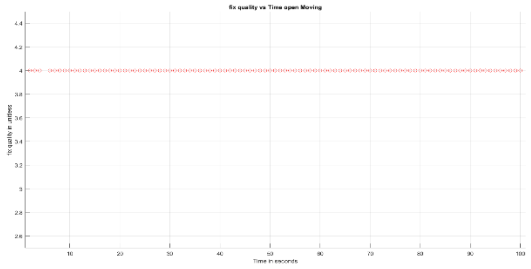


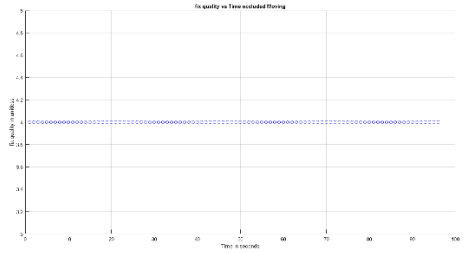
The above 4 figures show the analysis of Altitude vs Time where the similar results noticed in LAB 1, but the result consist of fewer error since there is RTK correction is being conducted in this case.

B) Histogram for open and occluded dataset created from known location we can notice that the error in the signal is following gaussian distribution due to that we can conclude that the noise in signal is following gaussian distribution (Histogram of both open and occluded having similar trend is being included above hence to concise the report please refer above)

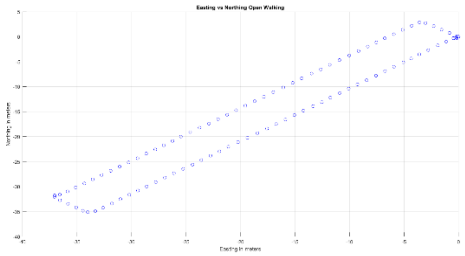
C) From LAB1 Histograms(Mentioned above) we can notice that the error has been reduced if we compare the GPS puck data and RTK GPS since in RTK Correction signal is being added to signal which leads to reduce the error in the system. RTK Base precise location is recorded which then compares the rover location with phase difference between them in signal allows the RTK Rover to get its location precise with compare to Base with this correction signal being added to system allow the system to achieve better data which consist of lesser error.

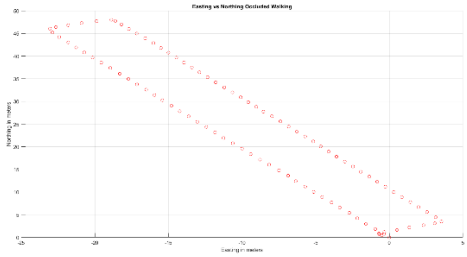
D) Moving dataset





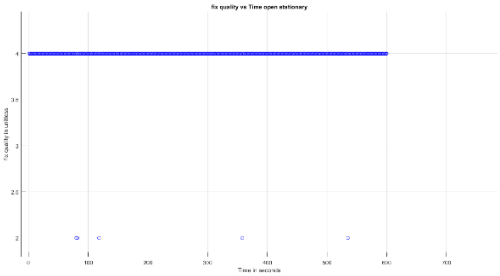
From the following plots of fix quality vs time for open and occluded moving It can be concluded that for majority of time the RTK is fixed since its value is at 4 hence there is no impact of fix Quality on data in the consideration of error

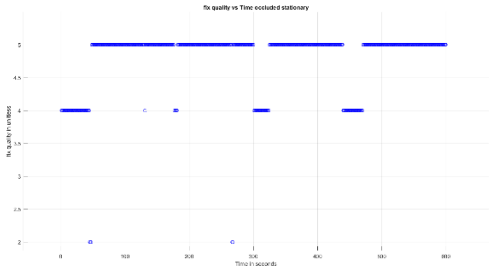




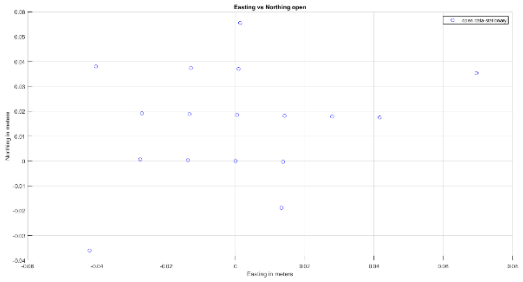
Following Moving data shows that there is no majority of any error apart from what we noticed in LAB1 has been added here since RTK was already Fix on most of time being. Hence due to that reason we can assume that what data received in this case is fairly acceptable.

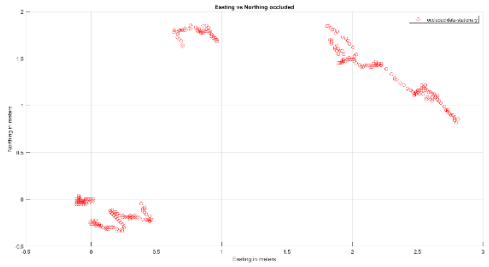
E) Stationary dataset:





We can notice in open stationary dataset that fix quality is being mostly set at 4 but there are couple of instances where the value is at 2 that shows the trend of error which introduced in open stationary dataset. For occluded stationary case the Fix quality is shifted to RTK fix to float where we can see the values deviate from 4 and 5 hence that the reason there is drift of error is being noticed in occluded stationary dataset apart from multipath error on system.





As mention above we can notice the change in fix quality in occluded stationary dataset raised the error in the system where we can observe the spread result in stationary dataset case.