LAB2 – Report
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Real Time Kinematics is used to improve the performance of the GNSS receiver, RTK is capable of accuracy in terms of centimeters.
A single GNSS receiver receiving signals from the satellites might not be accurate. The received signals might have some error introduced by the atmospheric conditions, multipath error, obstacles etc. This makes it difficult for the stand-alone receiver to note down the precise signal data. Using RTK resolves this issue.
We are using GPS-RTK chip with new ZED-F9P from u-blox. One of them used as a base and the other one as a receiver(rover) and pair of telemetry radios for this experiment.

CASE 1: RTK base was static and the RTK rover was also static – open space

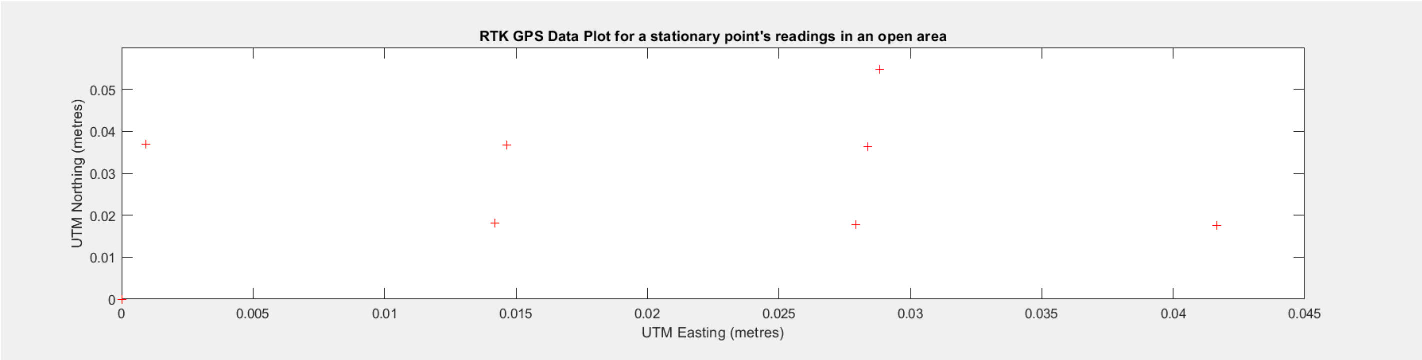

Figure 1

Data was collected on an open field with a clear sky. Data reading for about 10 mins was recorded as soon as the RTK float switched to RTK fixed. It was observed that it remained in the RTK fixed mode for the duration of the data recorded. With reference to the UTM Easting and Northing graph we can observe the points are scattered but the error observed is varying in centimeters.

CASE 2: RTK base static and RTK rover moving – open space

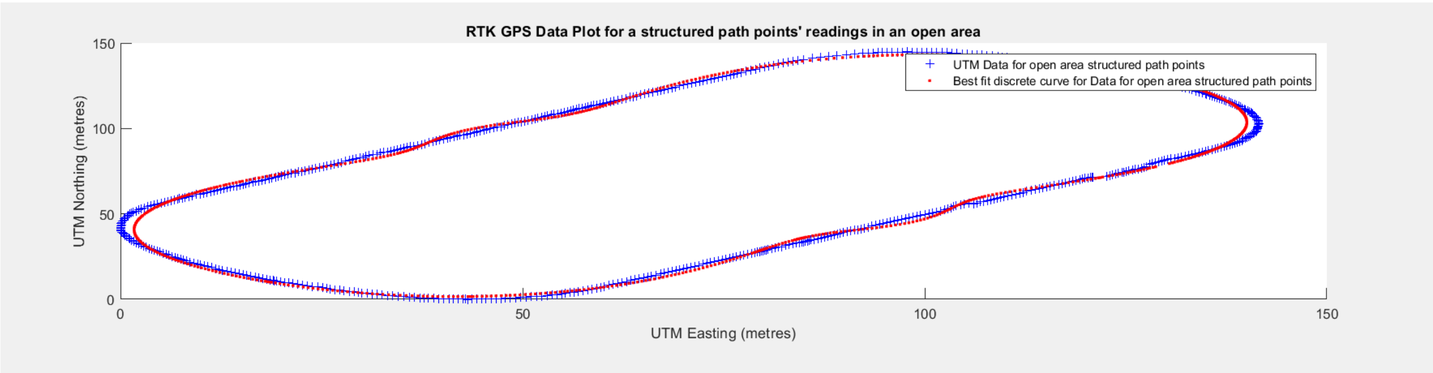

Figure 2

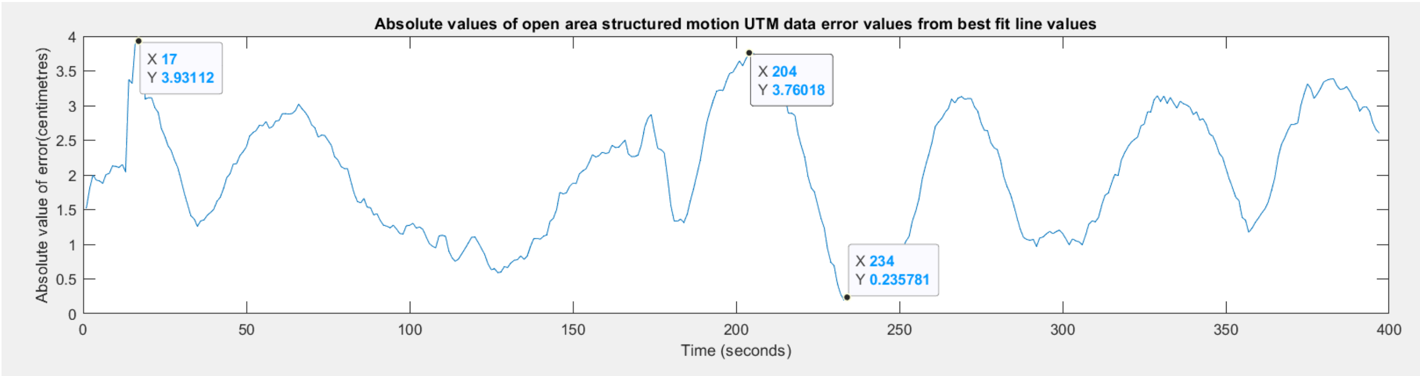

Figure 3

With reference to the graph plotted, we observe data set collected for the distance walked. A best fit line is plotted using polyfit function in MATLAB There is a little deviation observed when the best fit line and the data collected are compared. This is due to the obstruction on the open field, and possible the changing weather. This reading was taken a few hours before it snowed.

The graph of Time vs absolute values of error is plotted**, the error observed is in centimeters and is varying in the range of 0.2 centimeters to 3.9 centimeters**. The RTK base has proven to be doing a good job with the error correction, accuracy and low error range.

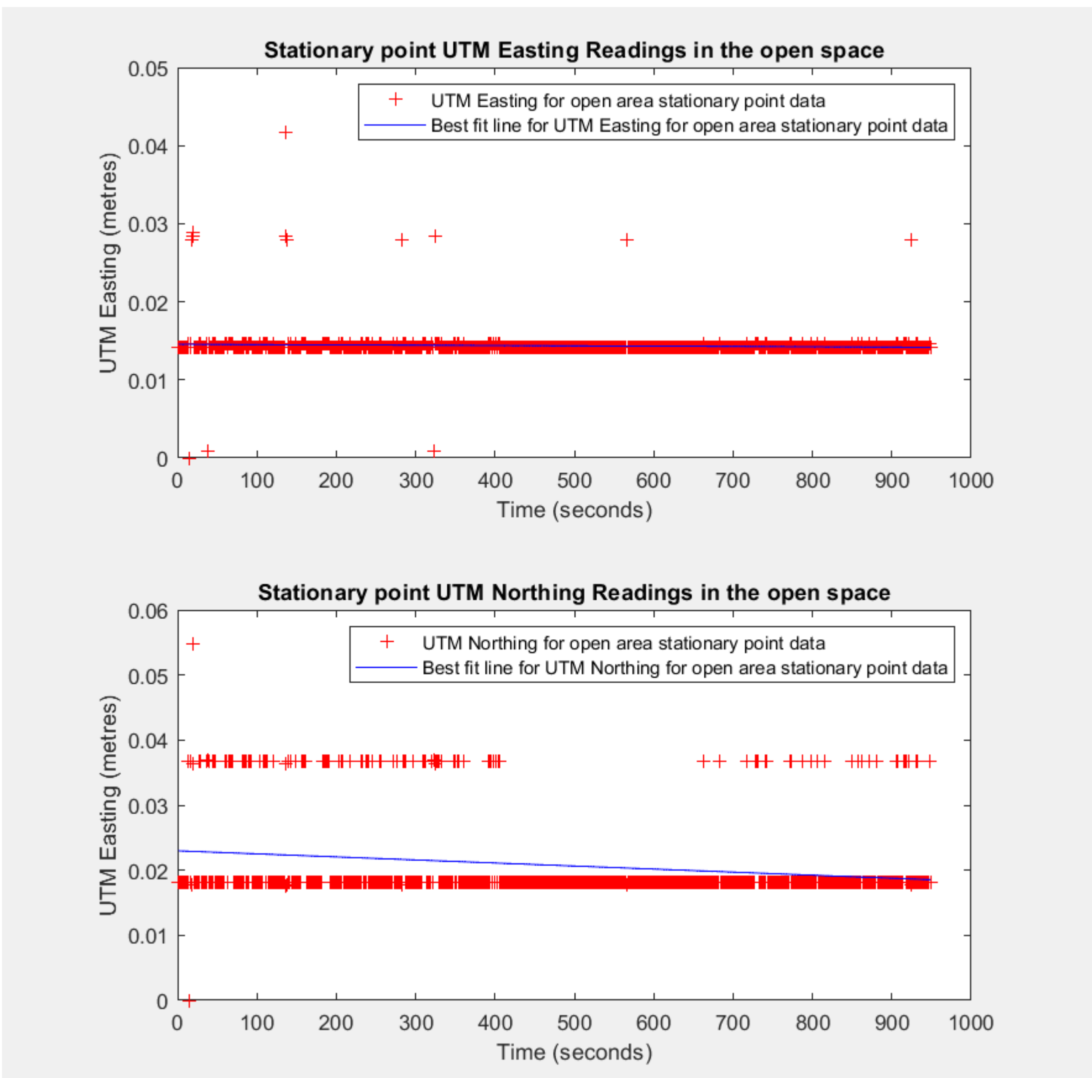

Figure 4

The above graph is plotting Time vs UTMEasting UTMNorthing individually compared to the best fit line. UTM easting data collected is very close the ideal readings, over a duration of time.
Some deviation is observed in the Time vs URTNorthing graph, but the errors are centimeters. Centimeter accuracy is expected from the RTK GPS.

CASE 3: RTK base static and RTK rover static – occluded space

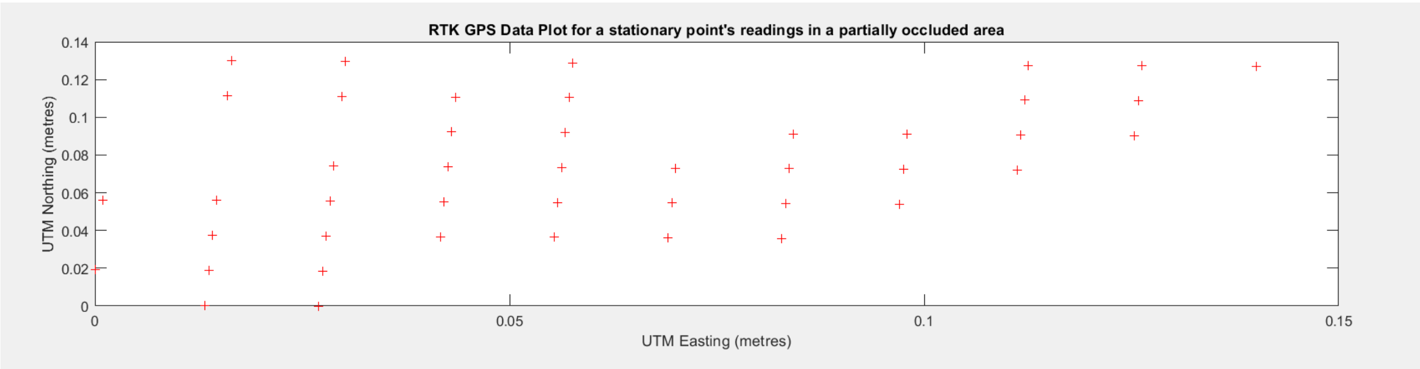

Figure 5

This data was collected in an occluded space with building, trees, on a cloudy snowy day. We can observe that the data collected, plotted on the graph looks more scattered as compared to the static data collected on an open field. This because of the multipath error received by the base and rover, even the corrected data send by the base to rover has errors in the data which is adding up to the overall error observed, resulting a scattered graph.

CASE 4 : RTK base static and RTK rover moving – occluded space

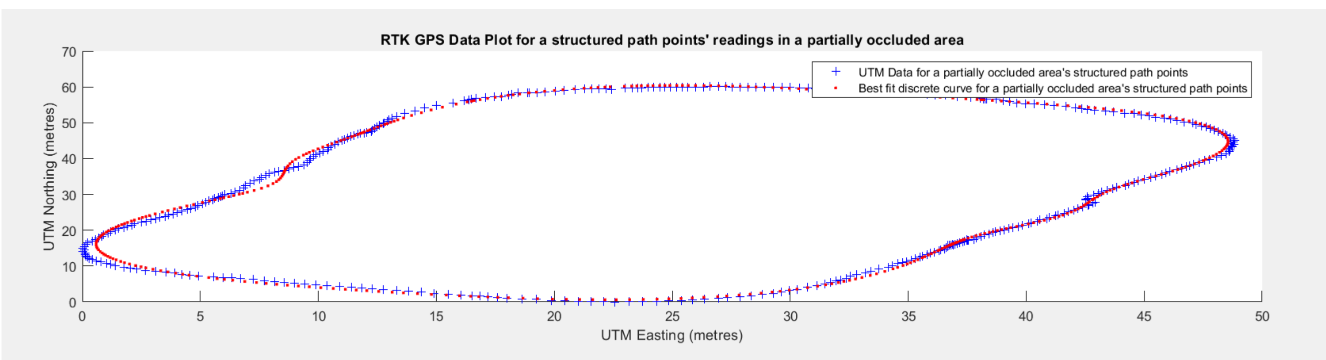

Figure 6

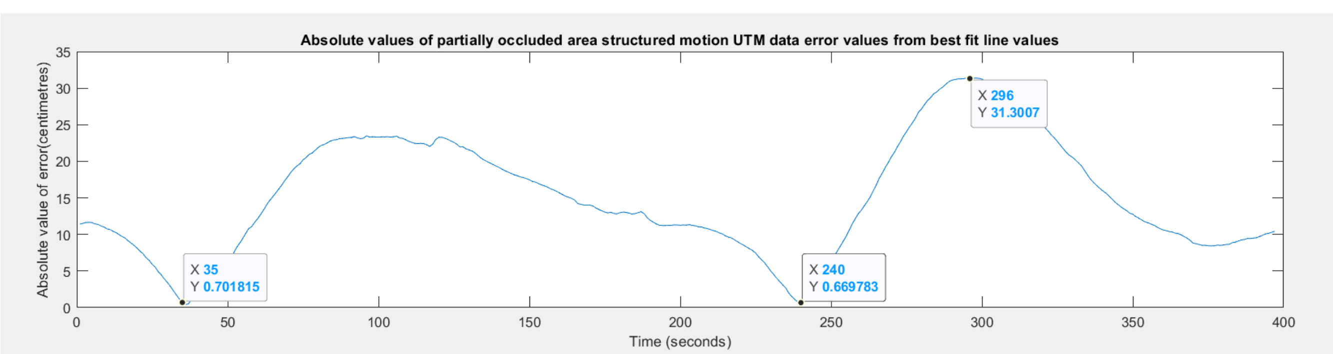

Figure 7

The data was collected at the same location as above with the same atmospheric conditions. The UTM Easting and UTM Northing graphs was plotted walking around in an occluded space. Collected data is compared with the best fit line. **The error is in the range of 0.66 to 31.3 centimeters,** which is far more than the errors occurring in the data collected in the open space

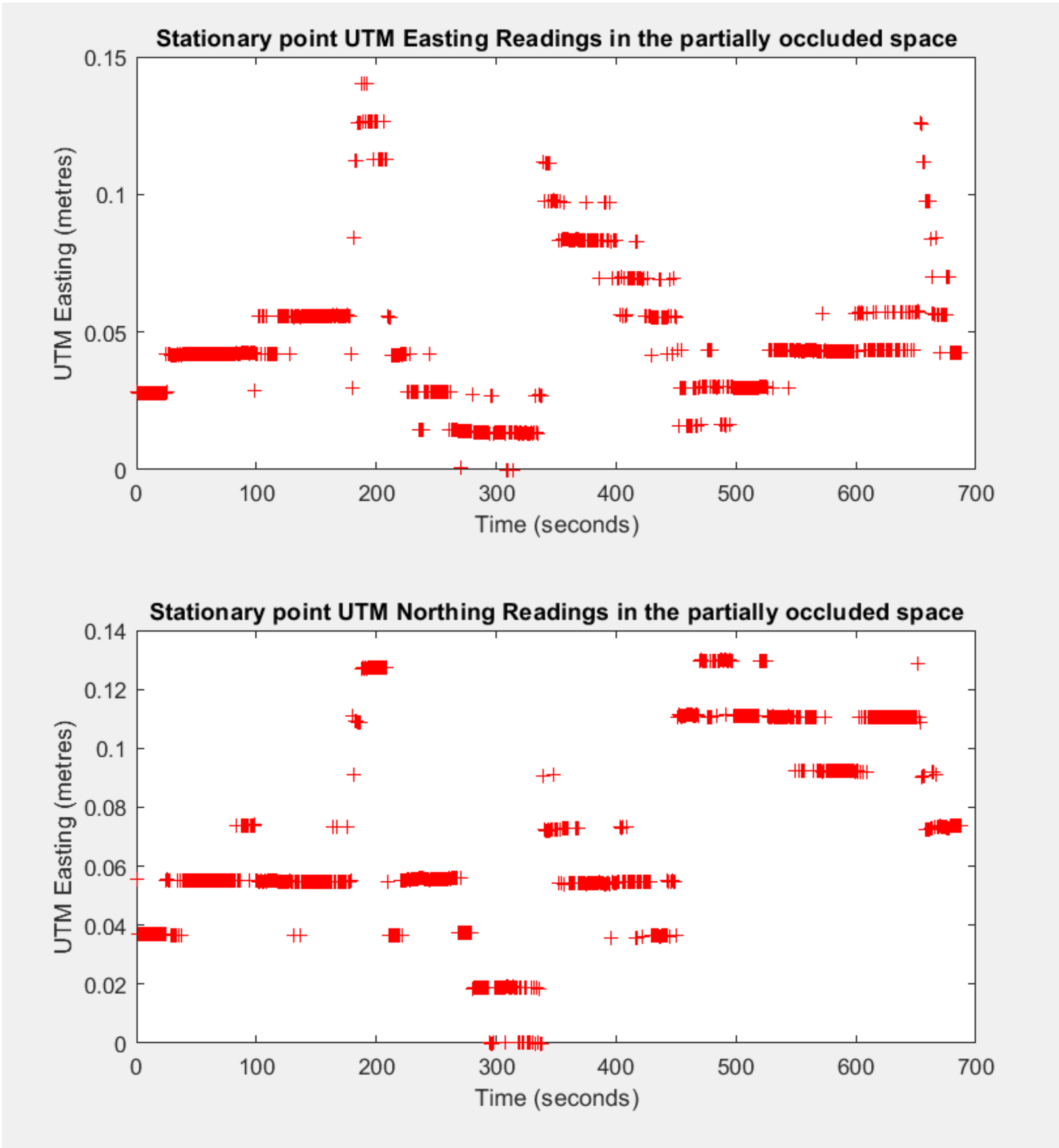

Figure 8

The Time vs UTM Easting/Northing graph is show erratically plotted data. This is clearly evident that occluded spaces give erroneous data. Even though the error is in centimeters we can see that we get better data when the experiment is conducted in an open area in clear atmospheric conditions.

GNSS accuracy depends on the below, is what we can understand from the collected data.

1. Ionospheric errors
2. Tropospheric errors
3. Signal obstructions and multipath
4. Geometric configuration of satellite
   Look at the error estimates.

Looking at the UTM data, it can be observed that the error is in centimeters and is close to the ideal readings.
Both the RTK base and the RTK receiver, receive signals from multiple satellites, the RTK base sends the correction data to RTK rover through radio modems, RTK rover uses this data to compare it with its own computed data reducing the error rate and thus achieving centimeter precision is what can be concluded from this experiment.
The distribution of noise in the signal is non-uniform and non-gaussian. Different kinds of noise are introduced in the system. The GPS antenna picks up electromagnetic radiations emitted by the sun, other discrete cosmic objects and ground environment of the GPS. The internal receiver noise also adds up the system noise.