LAB 2

About RTK: RTK is short for real time kinematics. A GPS receiver capable of RTK takes in the normal signals from the Global Navigation Satellite Systems (GNSS) along with a correction stream to achieve 1cm positional accuracy. It is used in fields where high precision positioning is required.

Difference between RTN GNSS and GNSS: RTN GNSS refers to a network of permanently installed GNSS receivers that are maintained and monitored by a service provider, and are capable of providing high-precision real-time positioning data to users.

GNSS is a satellite-based positioning system that offers global coverage and does not rely on any ground based infrastructure. The fundamental difference between RTN GNSS and GNSS is that while RTN GNSS is based on a network of ground-based receivers, GNSS is solely reliant on satellite signals.

Sources of error: The sources of error are atmospheric conditions, number of GNSS satellites, receiver noise, multi-path interference and improper configuration.

a) Comparing the deviations in occluded stationary data collected using RTK GNSS and standalone GNSS (used in Lab 1) shows that RTK has very little deviation as compared to GNSS.
The RTK GNSS deviation, as shown in figure 1, is in centimeters whereas the standalone GNSS deviation from lab 1, as shown in figure 2, is in meters.
RTK GNSS is more precise and accurate in occluded spaces as compared to the GPS puck used in lab 1.

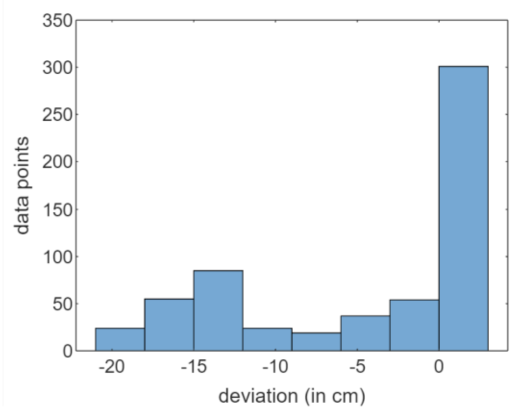

Figure 1 Deviation in occluded stationary data

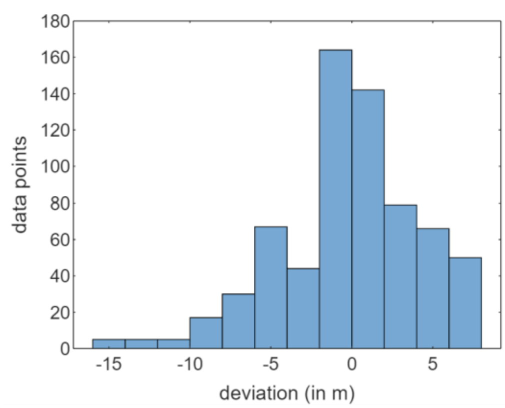

Figure 2 Deviation in stationary data

b) For this question, I've taken into consideration the stationary data in open space and the stationary data in occluded space.
For occluded space, the shape of the histogram is unimodal centered around 0 deviation. The deviation is in centimeters, which means more range.
For open space, the shape of the histogram seems to be bimodal since the points are concentrated in 2 positions, but the deviation is in millimeters, so it doesn't have much deviation. The range is less.

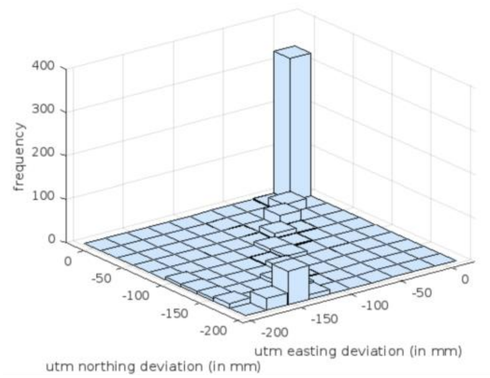

Figure 3 Stationary Data in occluded space

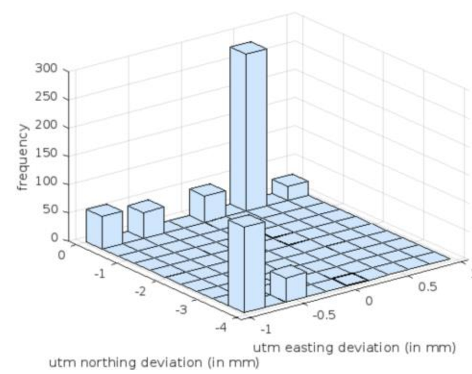

Figure 4 Stationary Data in open space

```
%easting histo
m=median(utm_easting,"all")
error=(utm_easting-m)*1000;
figure;
histogram(error)
xlabel('deviation (in mm)');
ylabel('data points');

%northing histo
w=median(utm_northing,"all")
err=(utm_northing-w)*1000;
figure;
histogram(err)
xlabel('deviation (in mm)');
ylabel('data points');
```

Figure 5 error calculation

c) The shape and range of the histogram is different from the dataset collected in Lab 1. The standard deviation in utm easting for the stationary data of Lab 1 was 4.25 meters and the standard deviation in utm easting for the stationary data of Lab 2 is 0.67 millimeters for open space and 69.8 millimeters for occluded space.
The range of histogram in Lab 1 was way more than that in lab 2. The shape of the histogram was multimodal.

d) RTK GNSS measurements are more accurate and precise in open spaces, while in occluded areas, the measurements tend to be less accurate and precise. The reason for this is that in open spaces, GNSS signals encounter fewer obstructions, leading to a higher number of satellites being tracked and a more accurate fix.
Occluded spaces are more likely to experience signal blockage or reflection, resulting in a less accurate fix. The GNSS fix quality for open space is constant at 5 and for occluded space is varying.
We can see that the data with most deviation is the occluded walking data because of continuous movement and simultaneous obstructions. This is not the case with open space walking data and the signal received is stronger, without a lot of interruptions resulting in lesser deviation.

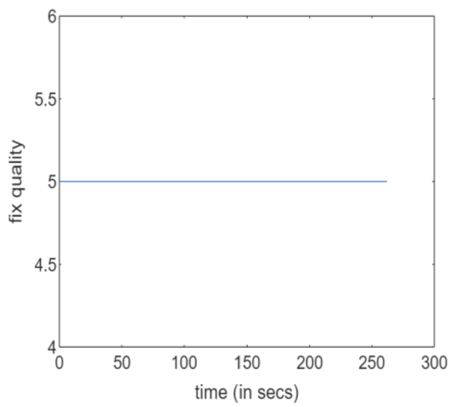

Figure 6 fix quality for open space

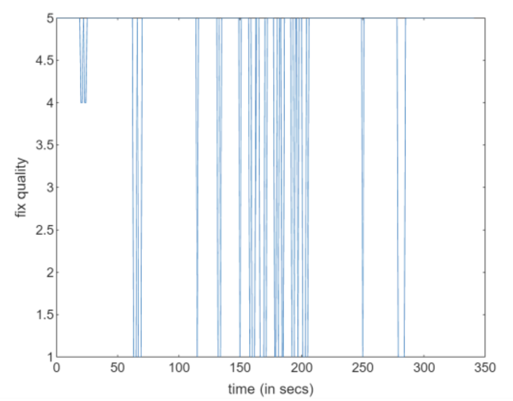

Figure 7 fix quality for occluded space

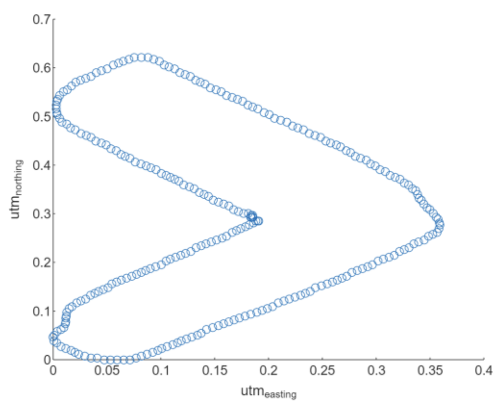

Figure 8 open space

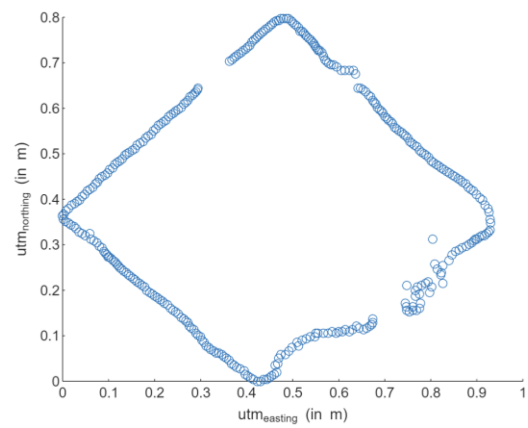

Figure 9 occluded space

e) The quality of the GNSS fix is a crucial factor that can significantly impact the accuracy of stationary RTK GPS measurements, regardless of whether the measurements are taken in open or occluded areas.

The standard deviation in utm easting for the stationary data is 0.67 millimeters for open space and 69.8 millimeters for occluded space.

Typically, in open spaces, the quality of the GNSS fix is higher, resulting in more precise and accurate measurements. On the other hand, in occluded areas, the quality of the GNSS fix tends to be lower due to signal blockage, leading to less precise measurements.

However, 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.