EECE 5554 Lab3 report

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1. UTM easting and northing requires float64 in ROS message to record

When I log northing and easting data with float32, I find the plot looks like this:

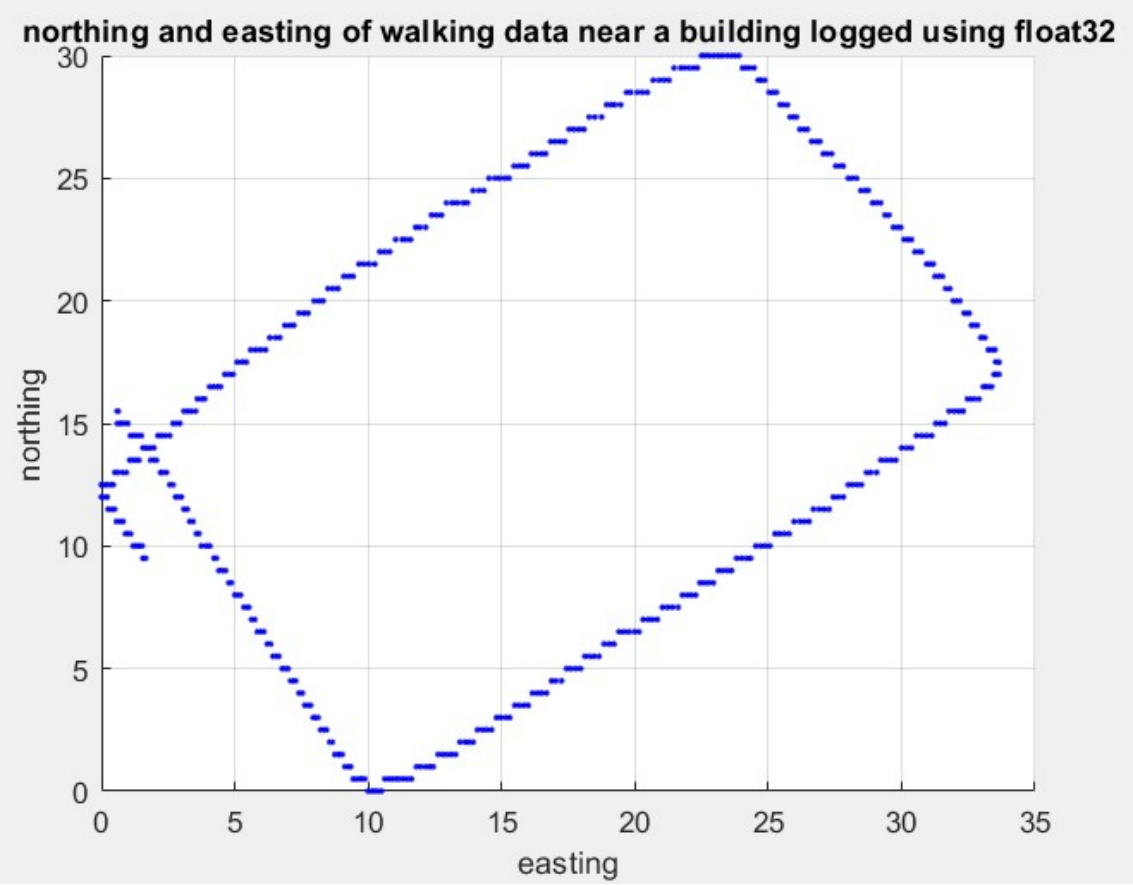

Figure 1. Northing and Easting of walking data near ISEC logged using float32

We can see that the resolution of easting is much smaller than that of northing. I thought it was because of the underlying mechanism of GPS, but after discussion with my teammate Sam, I find that the data of northing is has 1 more digit of integer compared with easting, as is shown below:

H	I
field.utm_easting	field.utm_northing
328077.6563	4689335
328077.625	4689335
328077.625	4689334.5
328077.625	4689334.5
328077.6563	4689334.5
328077.6563	4689335
328077.6563	4689334.5
328077.6563	4689334.5
328077.6875	4689334.5
328077.6875	4689334.5
328077.7188	4689334.5
328077.7813	4689334.5
328077.875	4689334.5
328077.9375	4689334.5
328078.0313	4689334.5

Figure 2. Northing and Easting of walking data near ISEC logged using float32

So I think the reason for different resolution is each data points can only occupy 32 binary bits, and as northing has 1 more digit in integer, so the precision of decimal will be reduced.

After I change it to float64, easting and northing has the same resolution.

2. rospy.sleep(), and buffer size

The first set of data we collected is consecutive in term of ROS time, while is not consecutive in term of space, as is shown below:

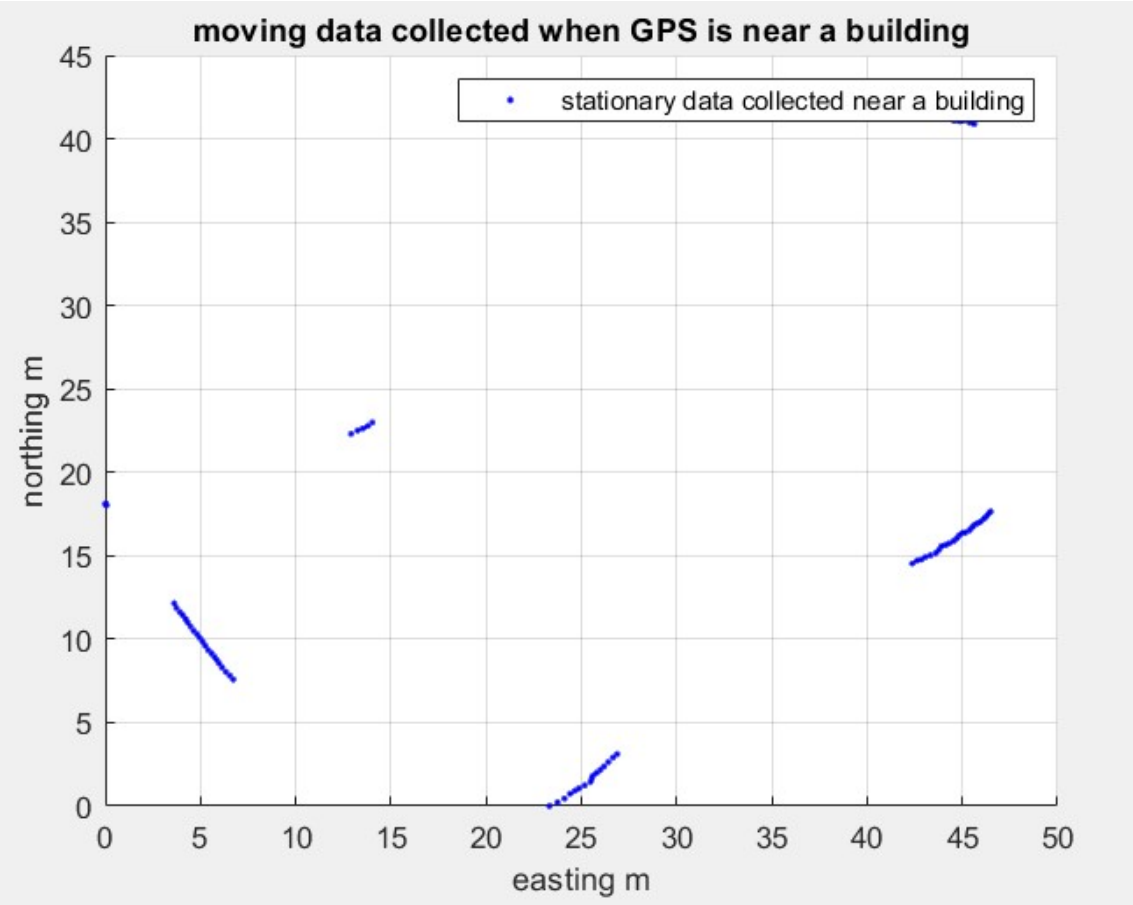

Figure 3. Non-consecutive moving data collected near ISEC

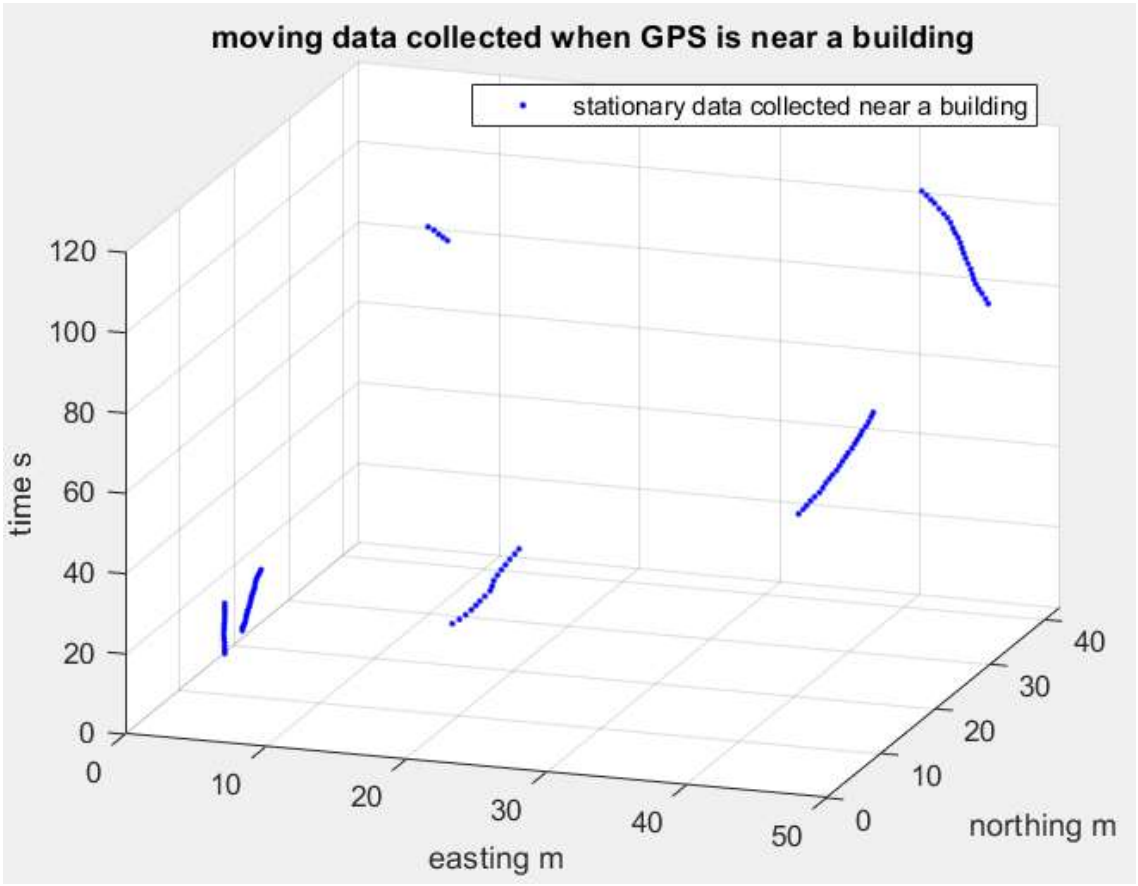

Figure 4. Non-consecutive moving data collected near ISEC

I think it may because the buffer size is small and the logging frequency is lower than frequency of receiving GPS data, so I increased the buffer size and decrease the ROS sleep time in my driver, but it still doesn't work. Then I deleted the rospy.sleep(), so the driver logs data as fast as it can, and the data become consecutive in term of time and space.

3. Data analysis

Stationary data near ISEC:

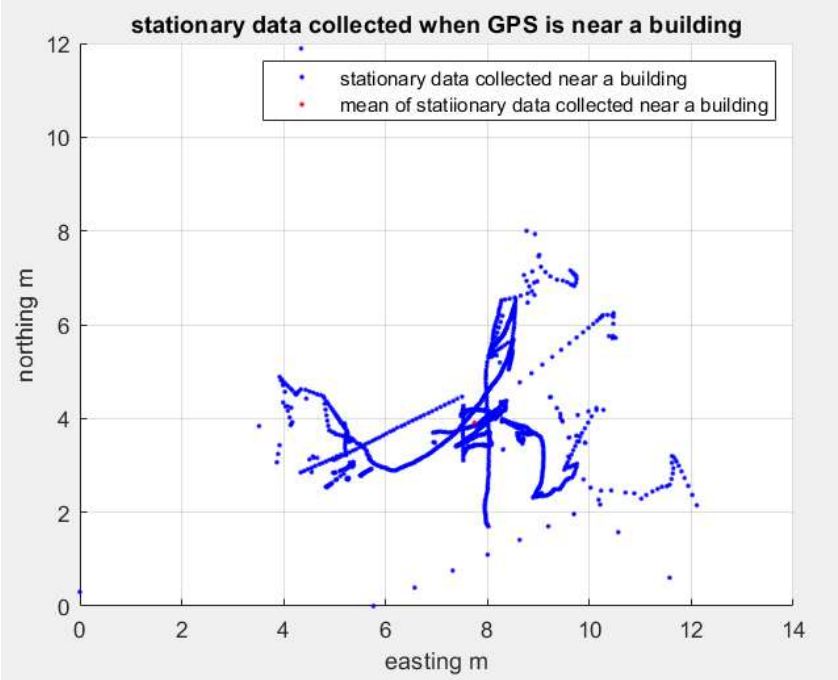

Figure 5. Stationary data collected near ISEC

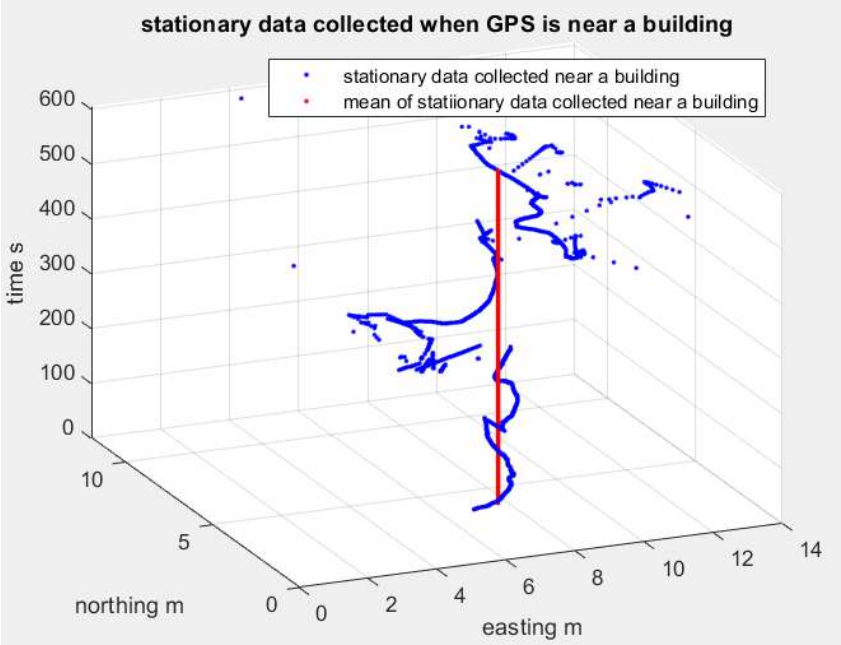

Figure 6. Stationary data collected near ISEC

Both northing and easting is changing with in an 8-meter range, which is much smaller than that of GPS which is tens of meters, and the covariance matrix is shown as follows:

```
cov_stationary_isec =

    1.5337    0.3347
    0.3347    0.8933
```

Figure 7. Covariance of data sitting near ISEC

During the time we logged the data, we also found that fix drops occasionally, so I plotted data logged when we sat near ISEC with fix = 5:

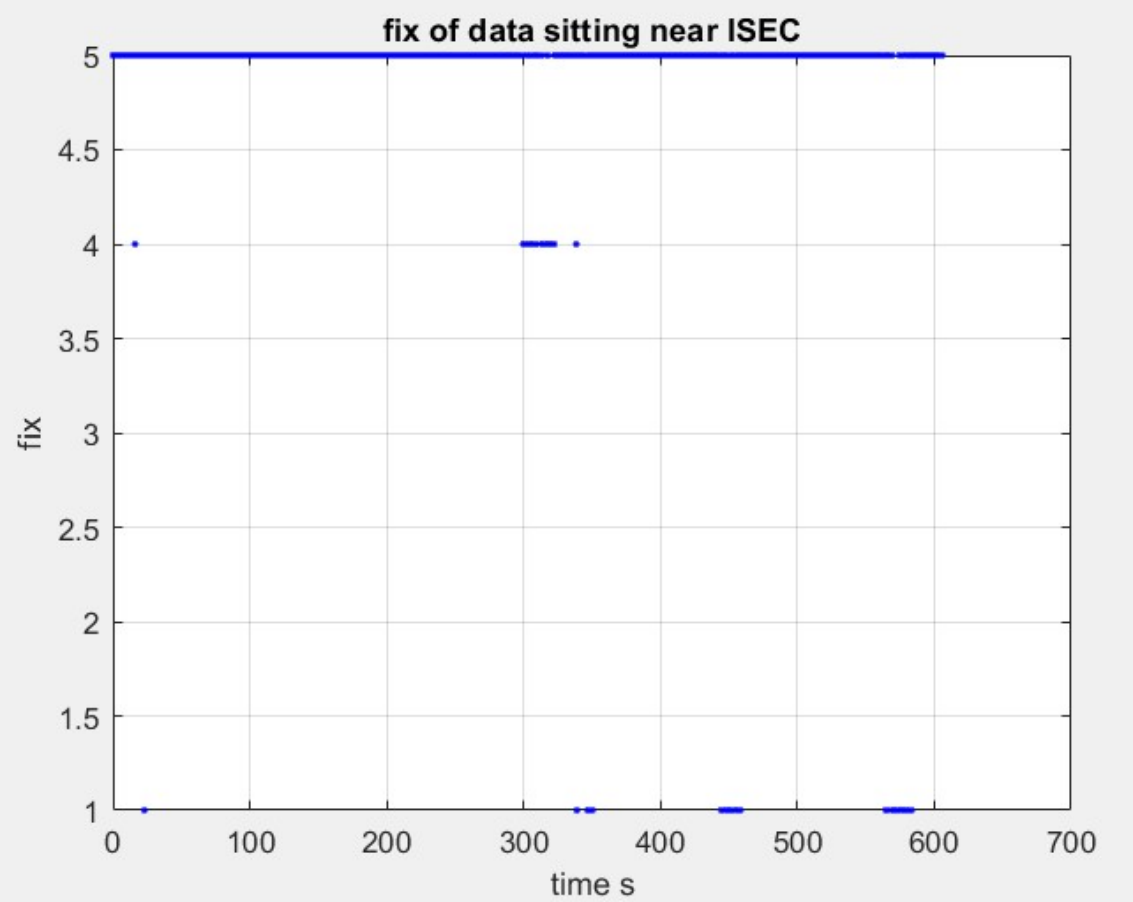

Figure 8. Plot of fix of stationary data collected near ISEC with respect to time

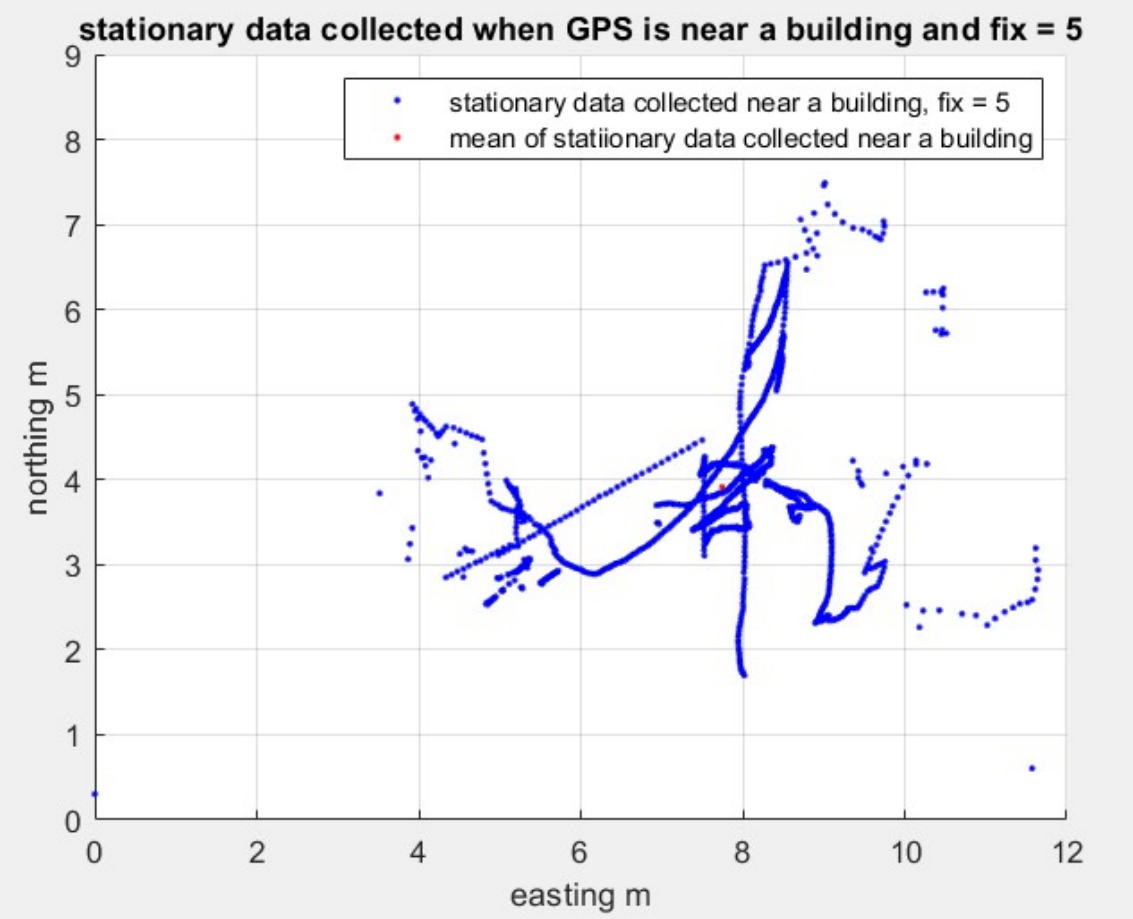

Figure 9. Stationary data with fix = 5, collected sitting near ISEC

Some data points at the outer range disappear and the variance get smaller

```
cov_stationary_isec_fix_5 =

    1.2906    0.2655
    0.2655    0.7943
```

Figure 10. Covariance of data with fix = 5, collected sitting near ISEC

Moving data near ISEC:

Figure 11. Data collected when walking outside ISEC

The error of moving data near ISEC is much smaller than that of stationary data near ISEC, and it's almost exactly the path we walk

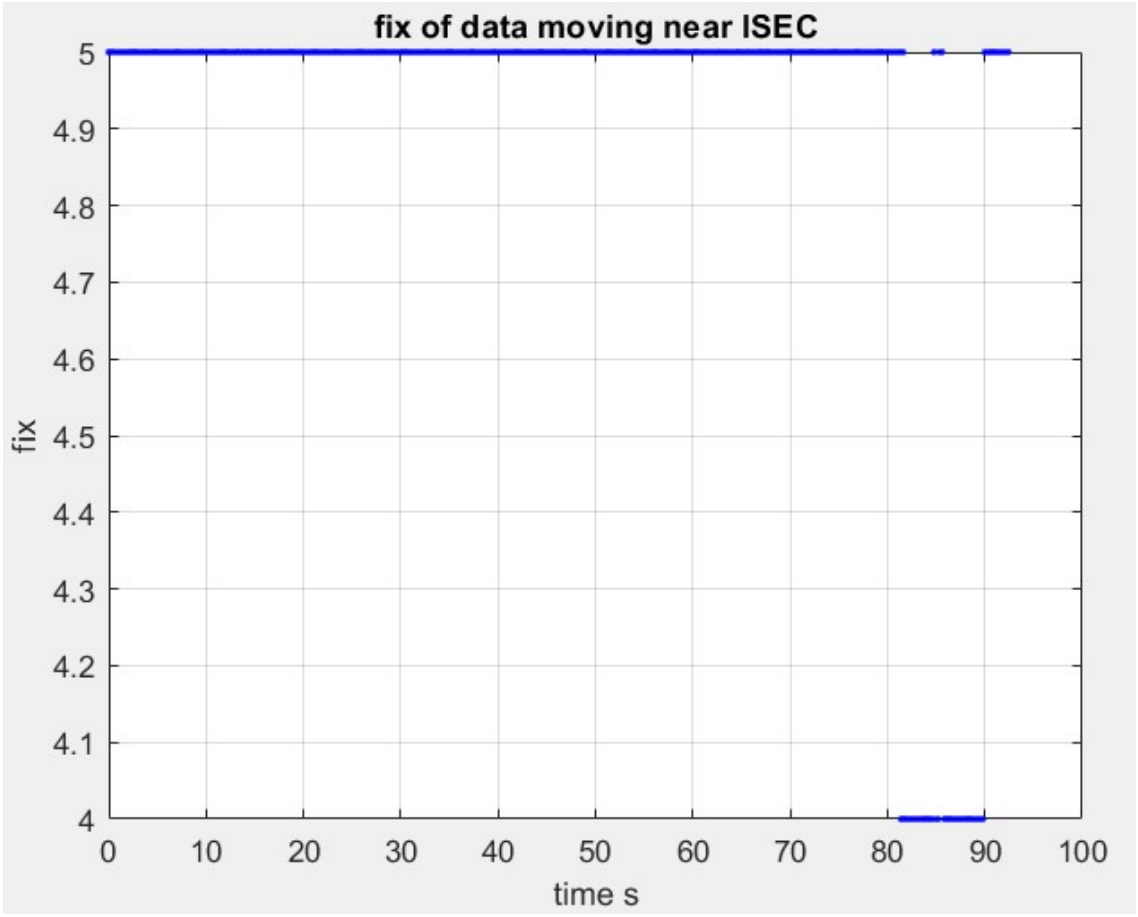

Figure 12. Plot of fix of moving data collected near ISEC with respect to time

Fix occasionally drops to 4, which is acceptable

Stationary data on open field:

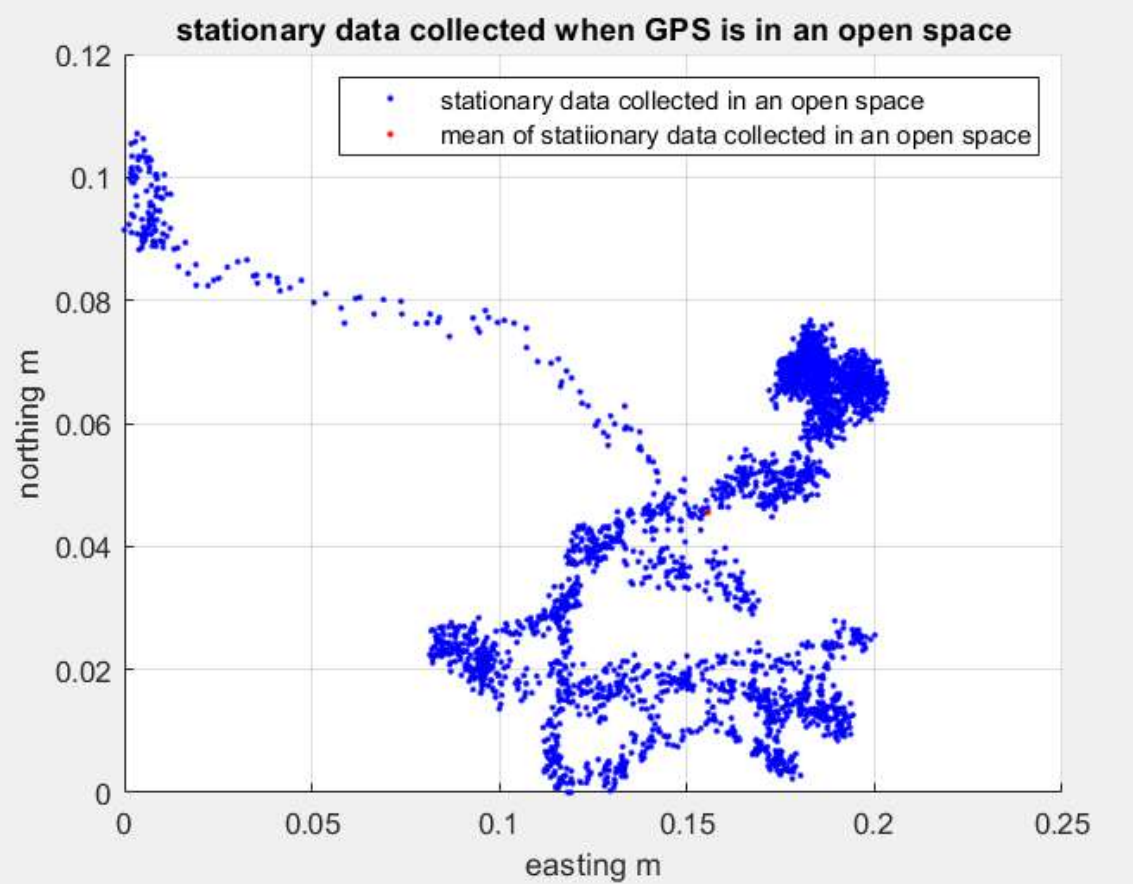

Figure 13. Stationary data collected on open field

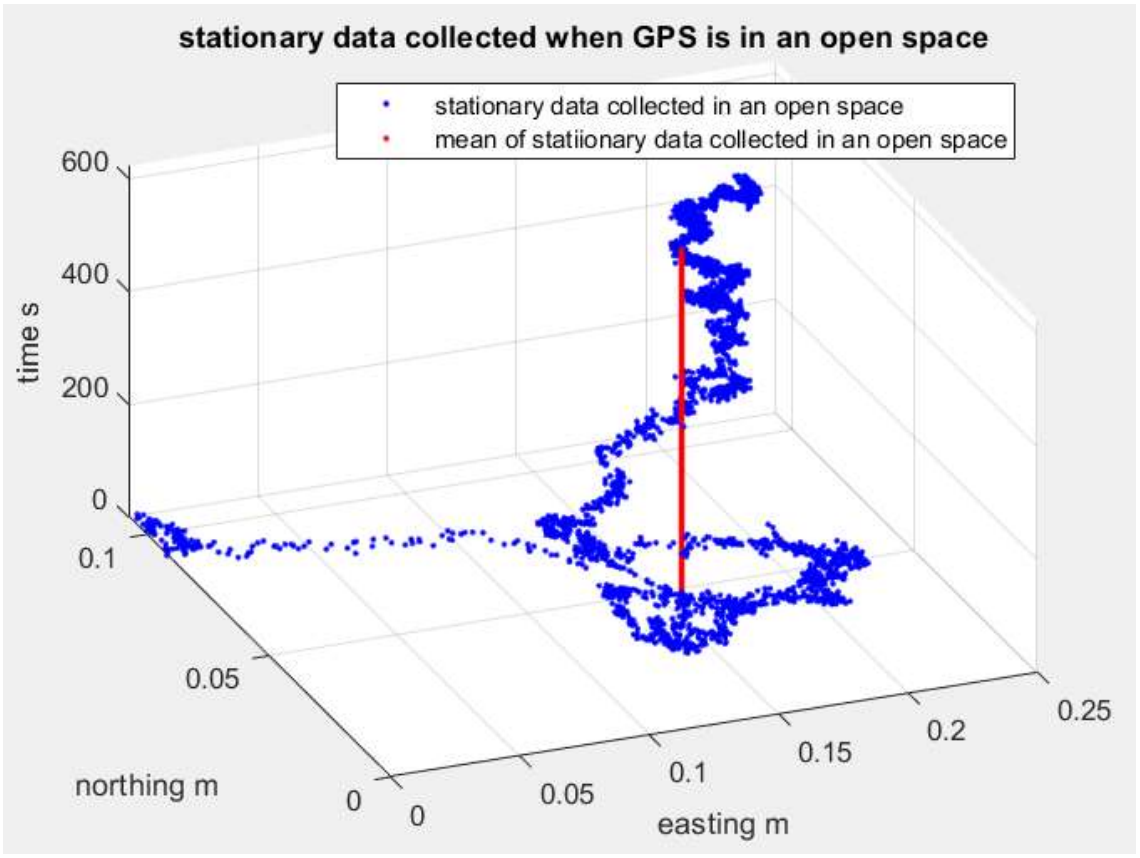

Figure 14. Stationary data collected on open field

As is shown, easting is changing with in an 0.25-meter range, and northing is changing in 0.12-meter range, which is much smaller than that of RTK GPS stationary data near a building quite precise, and the covariance matrix is shown as follows:

```
cov_stationary_field =

    0.0019    0.0001
    0.0001    0.0006
```

Figure 15. Covariance of data sitting on open field

The fix is 5 throughout the process

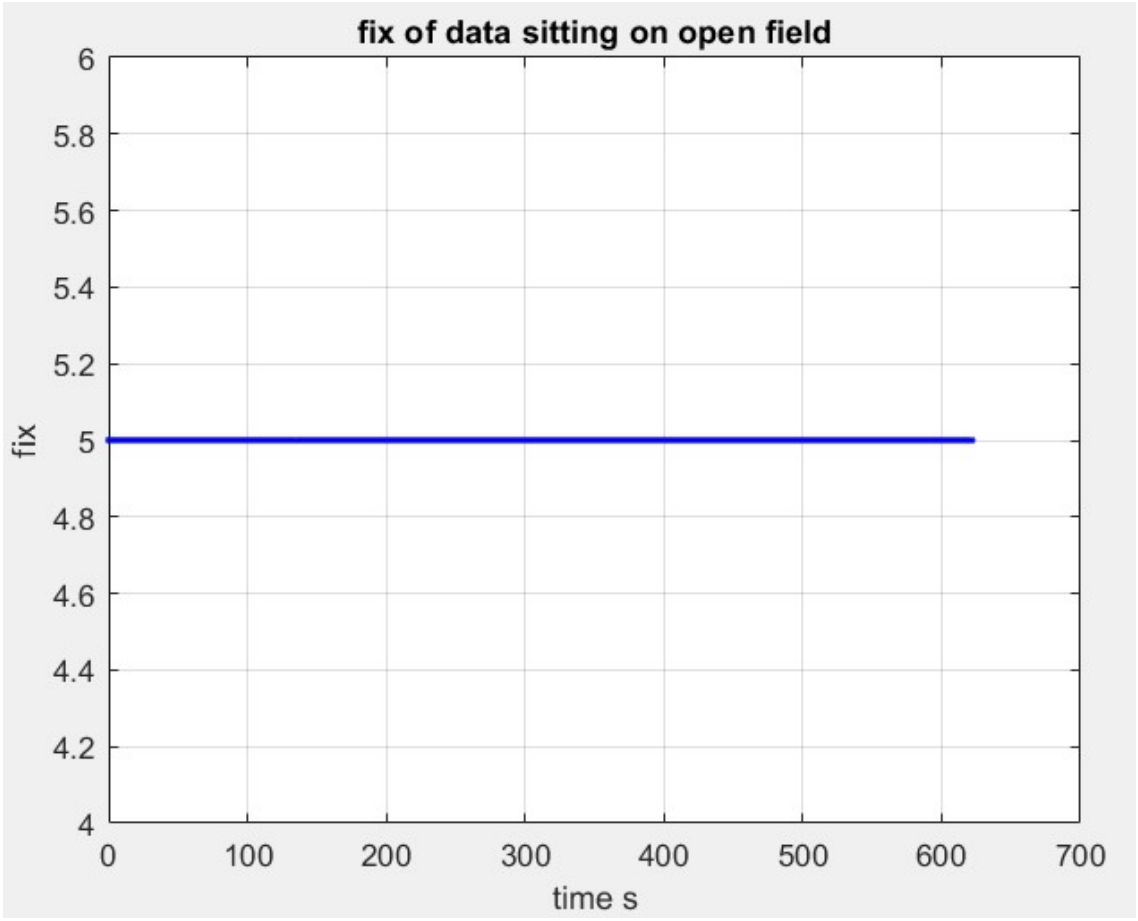

Figure 16. Plot of fix of stationary data collected on an open field with respect to time

Moving data on an open field:

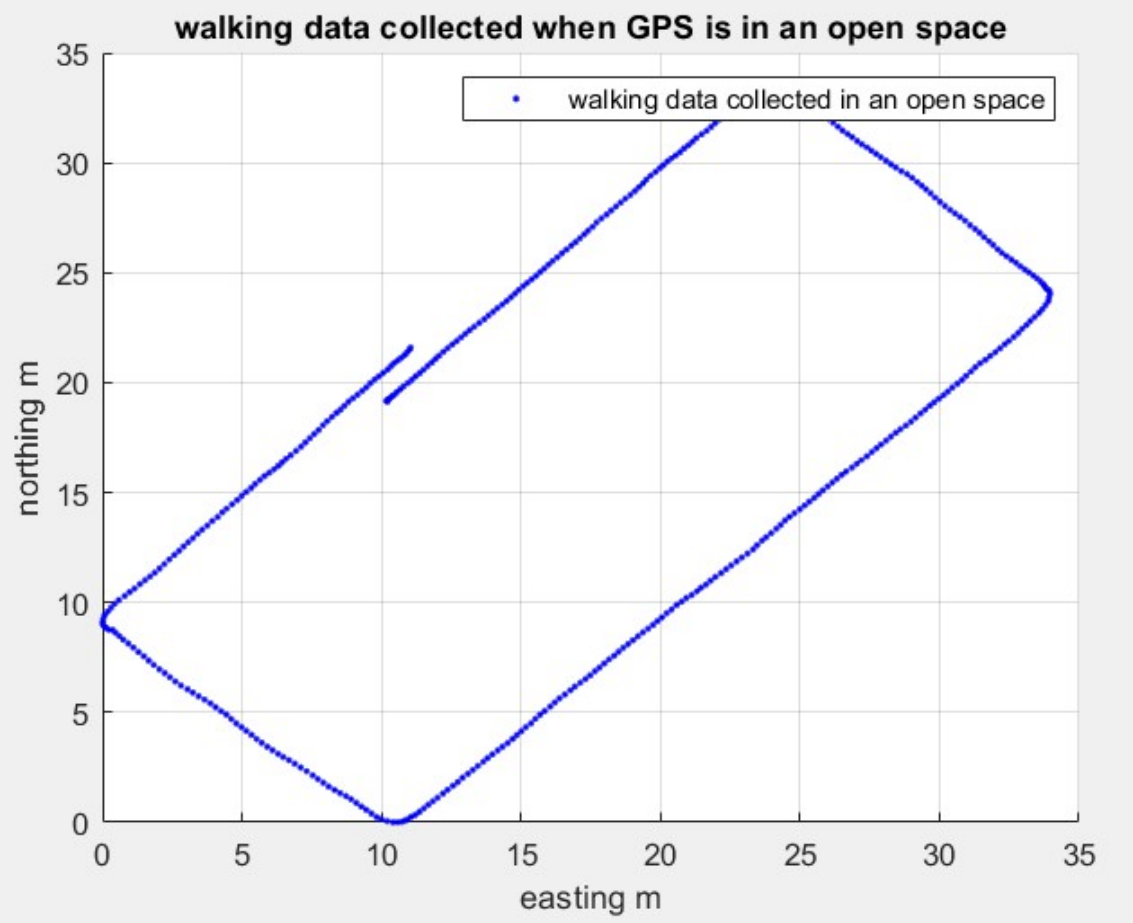

Figure 17. Moving data collected on open field

It's almost exactly the path we walk.

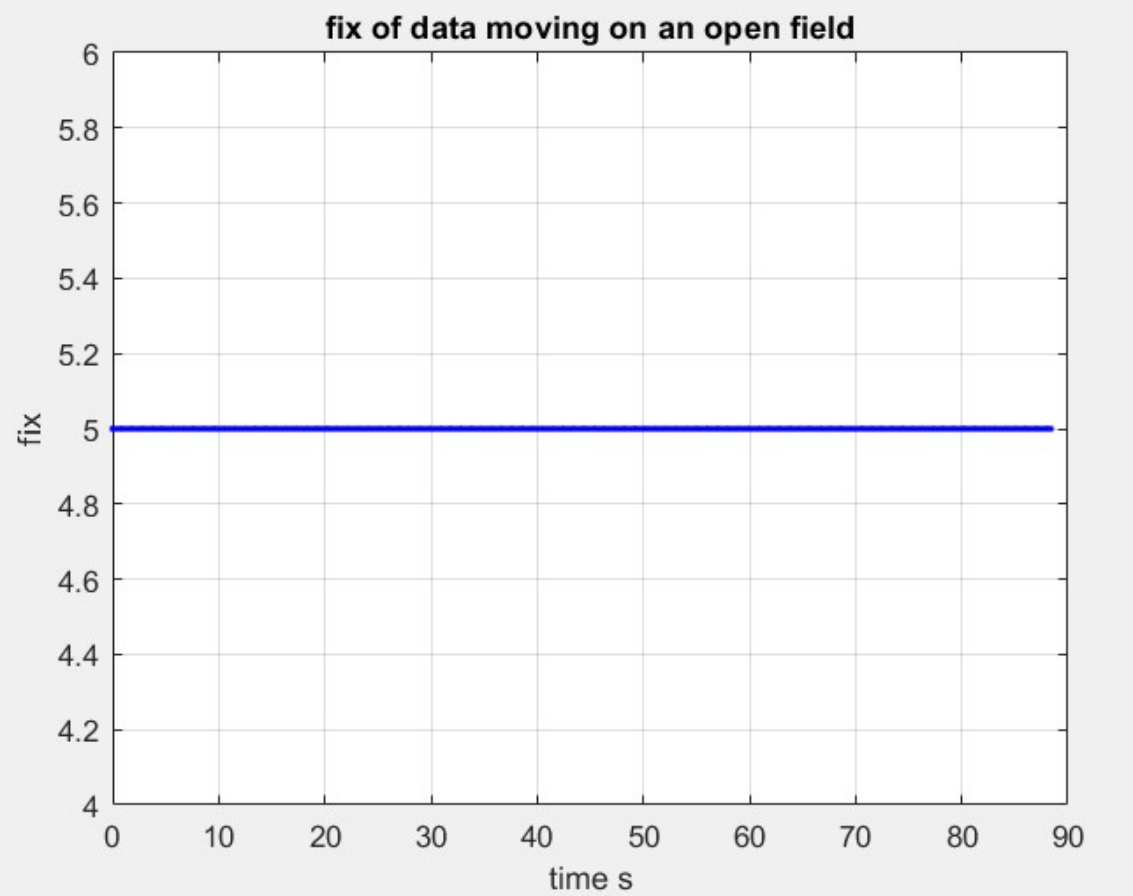

Figure 18. Plot of fix of moving data collected on an open field with respect to time

Fix is 5 throughout the process.

In conclusion:
RTK GPS is a more precise way to get location information compared with GPS. When RTK GPS is near a building, the stationary data has an error of 10 meters approximately and the fix drops to 1 occasionally, while error of moving data is much smaller, which almost reflects the path precisely. When RTK GPS is on a open field, stationary data has an error of tens of centimeters, and error of moving data is also small, which almost reflects the path precisely, and fix is 5 throughout both processes.