LAB1- Report

Collection of data -

1) The stationary free data was collected in carter ground. (42.33908599222849, -71.08467257292587)
2) The stationary occluded data was collected in front of the Snell Library. (42.33891545311627, -71.0883254201646)
3) The walking-free data was collected in the middle of carter ground from one end to the other. (42.33904245523604, -71.08457675904971 - 42.33946941829274, -71.08516854961233)
4) The walking-occluded data was collected in front of the Snell library till Richard's hall. (42.33875752262959, -71.0883022667916 - 42.339688966134, -71.08907273795563)

Question 1

Please state **three** major environmental/systemic sources that might increase errors in GPS. Which may have an effect on your wide open data sets? Which may have an effect on your occluded data sets?

Reasons for wide open data sets -

1)Atmosphere might have been refracting the signal.

2)Laptop might have been reflecting the signal.

3)Error in the sensor itself.

Reasons for occluded data sets -

1) Trees might have been reflecting the signal.

2) Buildings might have been reflecting the signal.

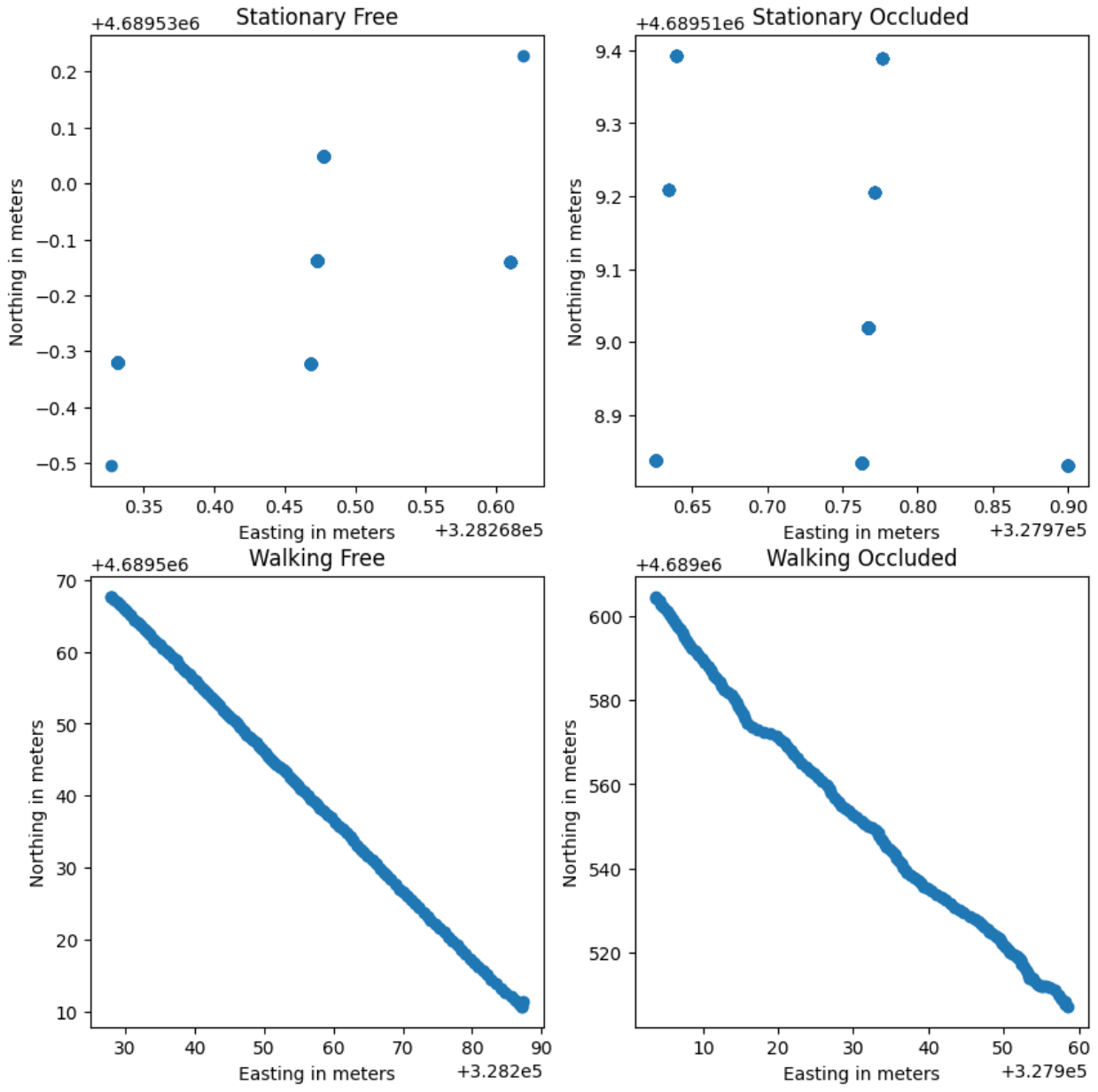
3) People might have been blocking the signal.

Question 2

Please upload your scatterplots (open area and occuluded) of northing vs. easting, with the 1st value subtracted from each dataset. As a reminder, a good plot should include:

- Axis labels
- Appropriate units

- Legible text

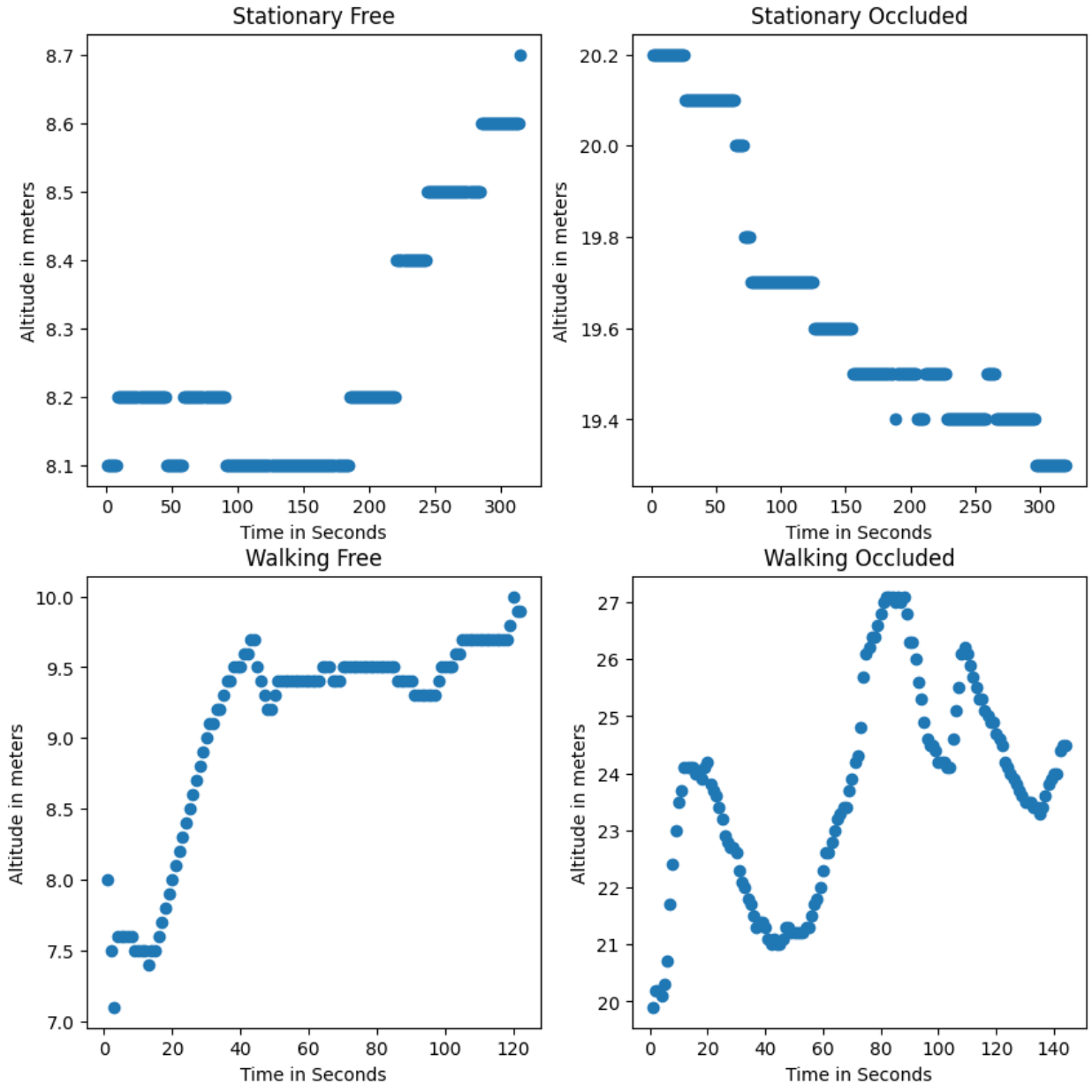


Question 3

Please upload your scatterplots (open area and occluded) of altitude vs. time. As a reminder, a good plot should include:

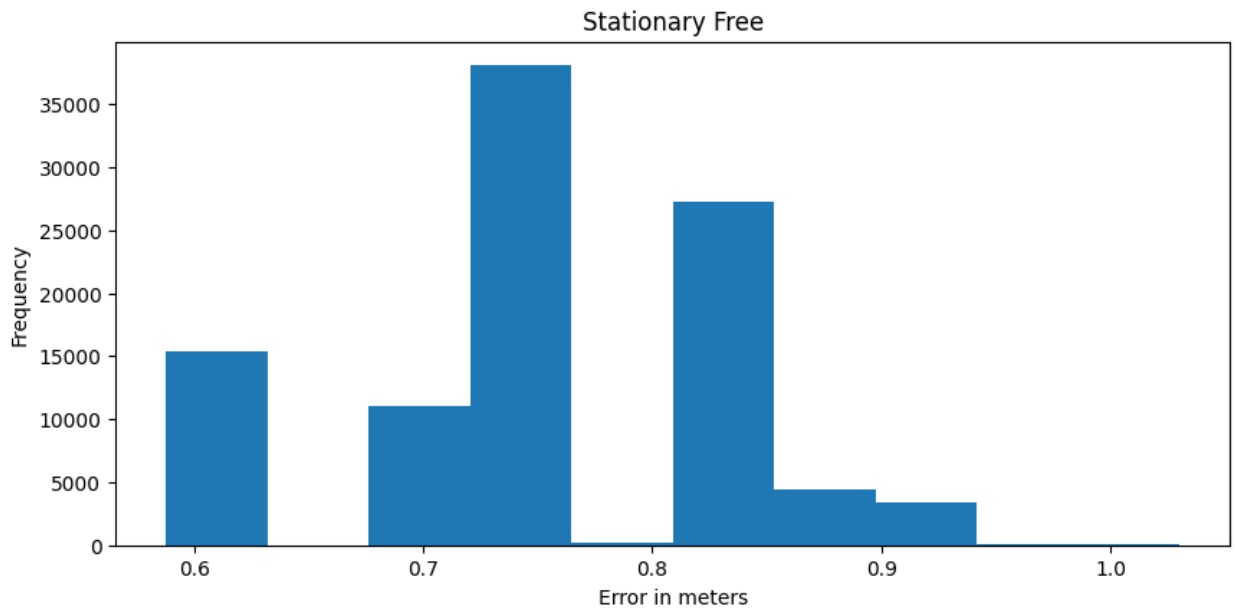
- Axis labels

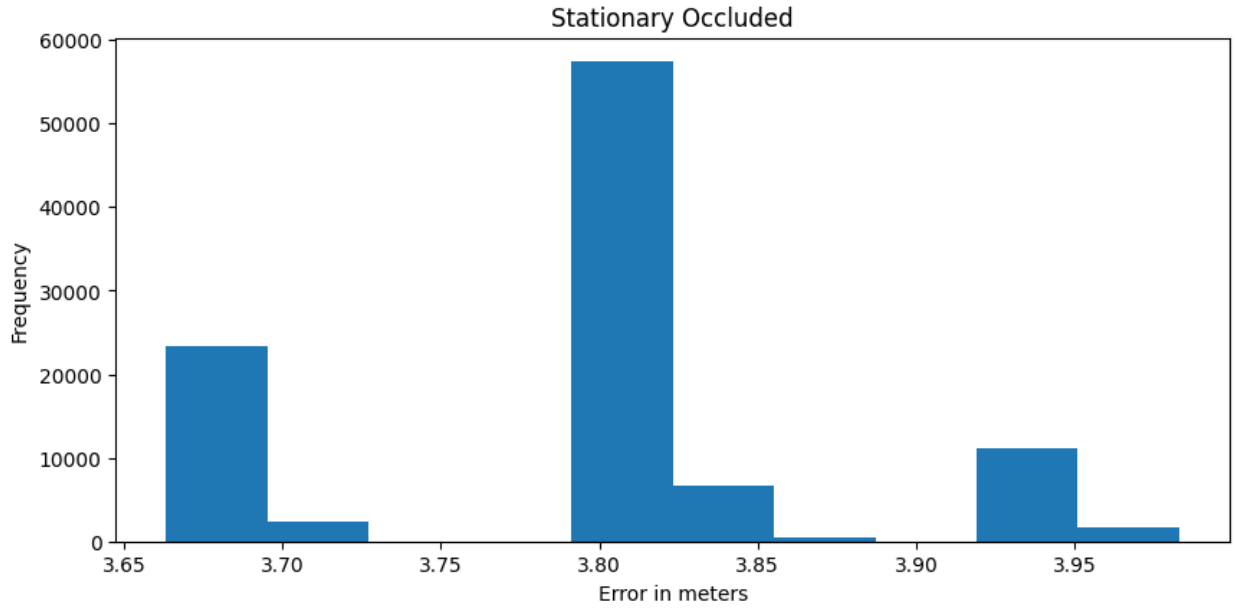
- Appropriate units
- Legible text



Question 4

Please upload your histogram plots (open area and occluded stationary data) of error from your "known" stationary position.





(stationary free)
RMSE is 0.7542783987671025
Mean is 0.7497483754405961
Median is 0.7528960749152498

(stationary occluded)
RMSE is 3.794299640831517
Mean is 3.793409207532582
Median is 3.805139915362912

Question 5

Using your northing vs. easting stationary data and your "known" location, what is the mean of your errors from your known positions? The median? Which makes more sense to use as your error from your "known" position, and why?

Please remember a completely correct answer will include a short calculation and appropriate units.

Mean is 0.7497483754405961

Median is 0.7528960749152498

The root mean square error is 0.7542783987671025

The Median makes more sense to use as my error from the known position because the data is skewed, which will lead to the mean being distorted by the outliners.

Assuming the error array to be [0.1,0.1,0.1,3] in meters then the mean is 0.825m and the median is 0.1m as we can see due to the outliner the mean is way off than the actual error, therefore, the median is a better choice.

Question 6

Do your values for error in northing vs. easting data and your altitude data make sense 1) given your hdop and vdop values, and 2) given general precision for GPS units? Why or why not? How did the measurements change from a wide open area to an occluded one?

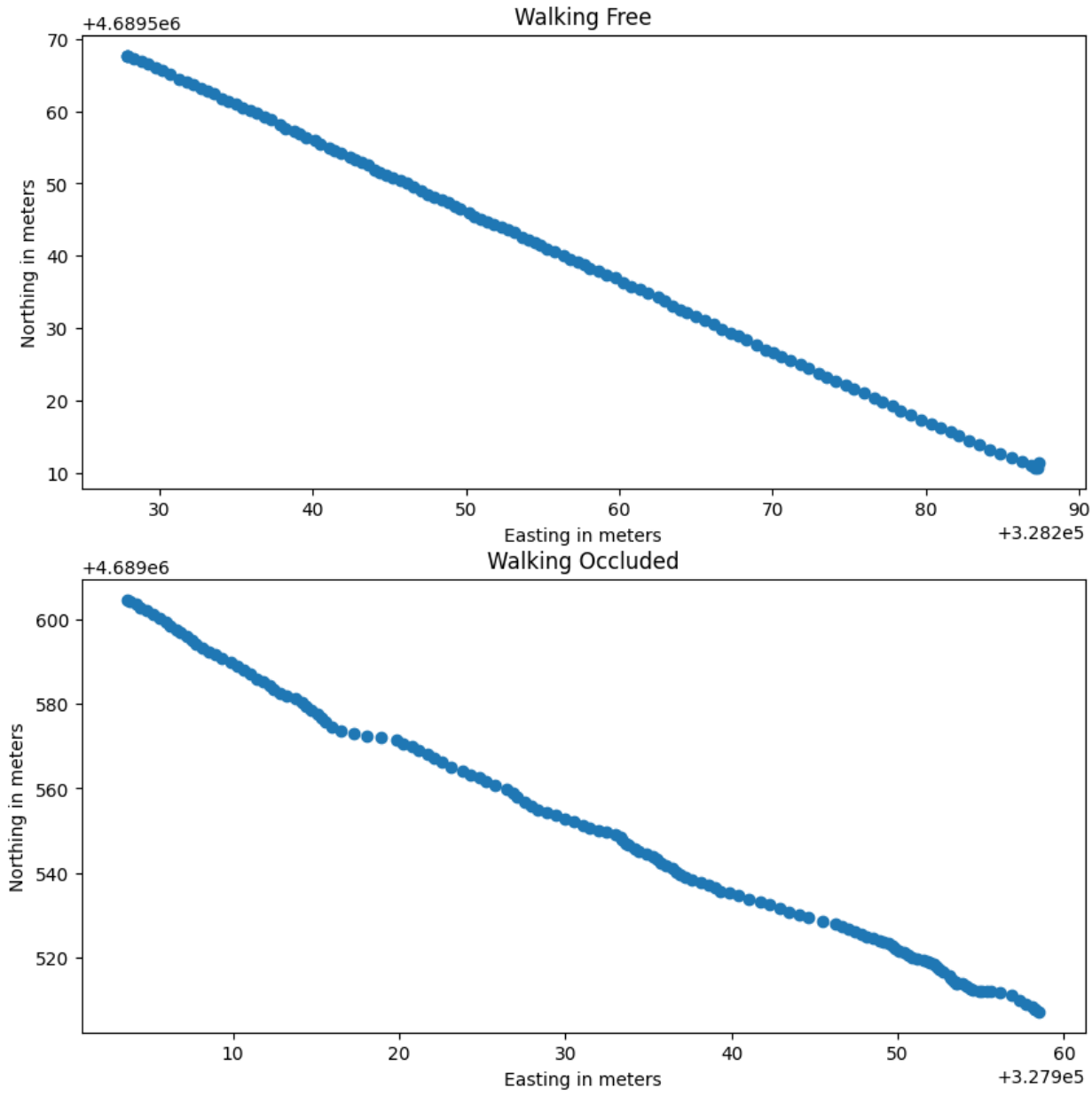
Yes the error in northing vs easting data and my altitude data make sense given the hdop, vdop values, and the precision for the GPS unit that we got as we can see that the errors in the free and occluded area are

0.7542783987671025m and 3.794299640831517m respectively. Which is quite accurate given the specifications and the conditions in both cases.

Also, for altitude data, the difference between the values for wide open data is 0.6m and 0.8m for the occluded case which is quite apt given the specifications and the conditions in both cases.

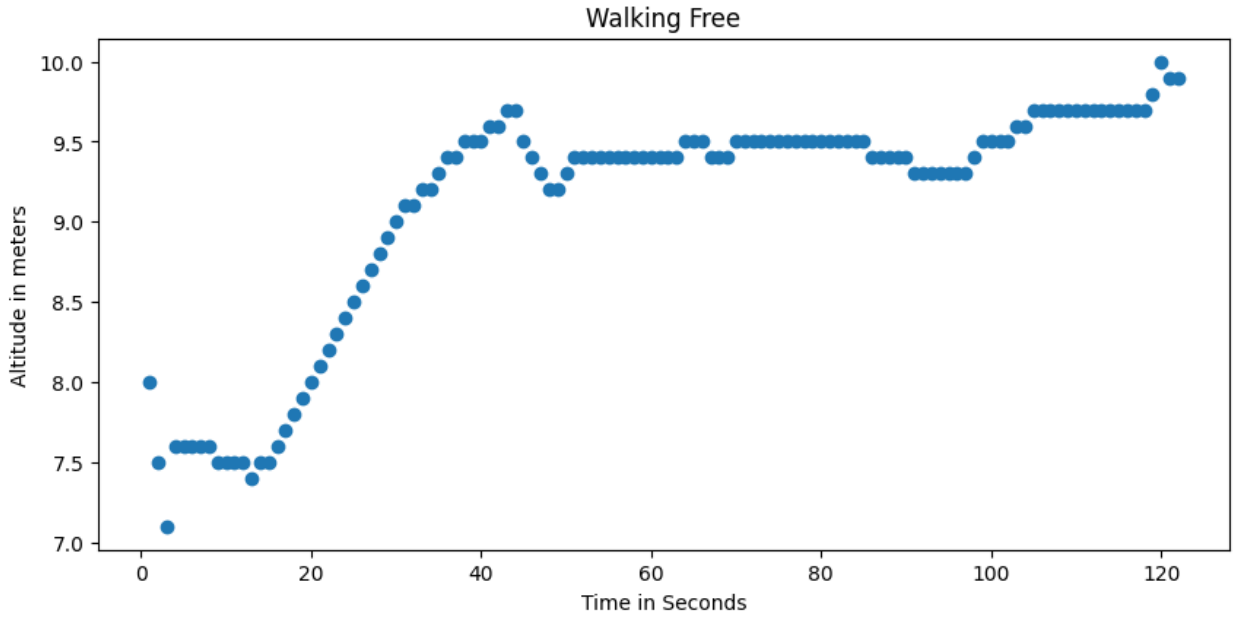
Question 7

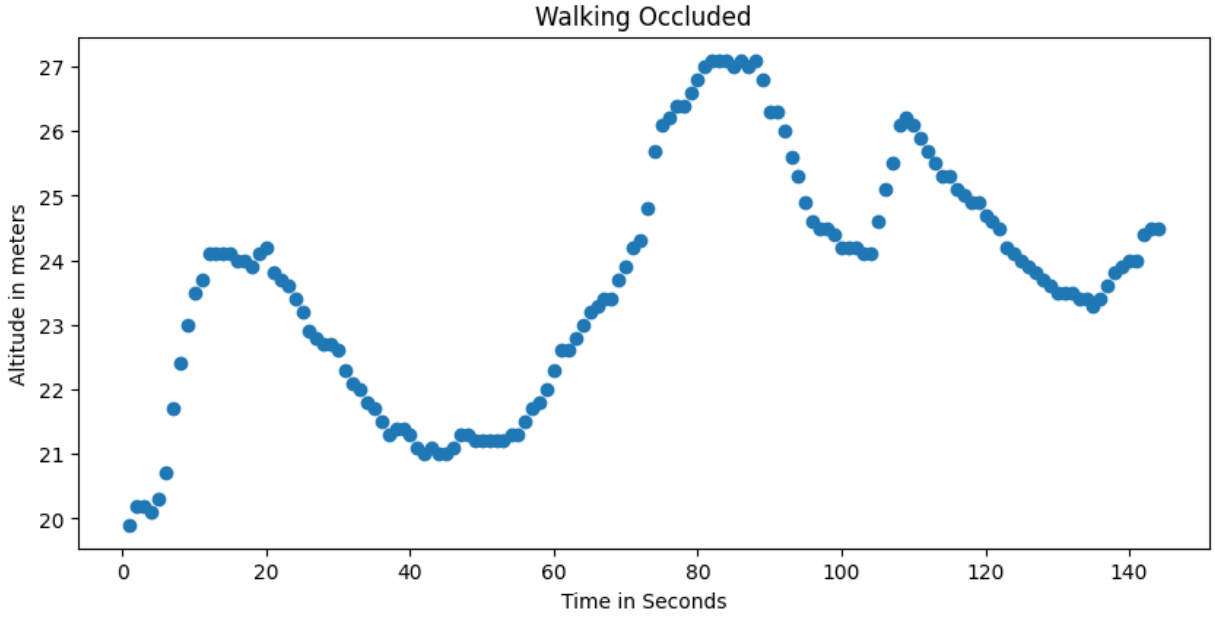
Please upload your scatterplot of northing vs. easting for walking data, with the 1st value subtracted from each dataset.



Question 8

Please upload your scatterplot of altitude vs. time for walking data.





Question 9

Assume you walk in a perfectly straight line (not a great assumption, but we'll roll with it!) What is the numerical error from a line of best fit to your walking northing vs. easting data? How did you calculate this error? Please remember a completely correct answer will include a short calculation and appropriate units.

The root mean square error for walking in free space is 4.41036502266303 and for walking in occluded space is 5.797703871342078. To calculate this error using linear regression I have made a line that will fit my given curve (since we assumed that we have walked in a Straight line so our graph should be straight). Then I got the line equation i.e y = -0.97007 * x + 5007971.95178(free) and y = -1.71161 * x + 5250842.78840(occluded). in this Easting (in meters) is x and we get y that is Northing(in meters). Then we calculate the error for all points by modulus(nothing from the line - nothing from data) and then we use this formula

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N} (Predicted_i - Actual_i)^2}{N}}$$

to calculate the root mean square error of the trajectory.

Question 10

How do your values for error in northing vs. easting walking data and your altitude data compare to 1) your hdop and vdop values, 2) general precision for GPS units, and 3) your stationary data sets? Can you explain any discrepancies?

Values for error in northing vs easting walking data and my altitude data are as aspected since while walking I was in no way walking perfectly in a straight line and thus the data has only error of 4 m and 5 m for free and occluded space respectively, is quite remarkable considering the general precision for the GPS unit that we have.

Also, the altitude is good enough as there is no possible way that I could have held the GPS puck at the same height also considering that since I was walking, the ground might have caused the change in altitude and considering the difference between the max and min values is just 3m and 7m for free and occluded space respectively, Thus the change in altitude can be observed in the plot due to the reasons mentioned above.