

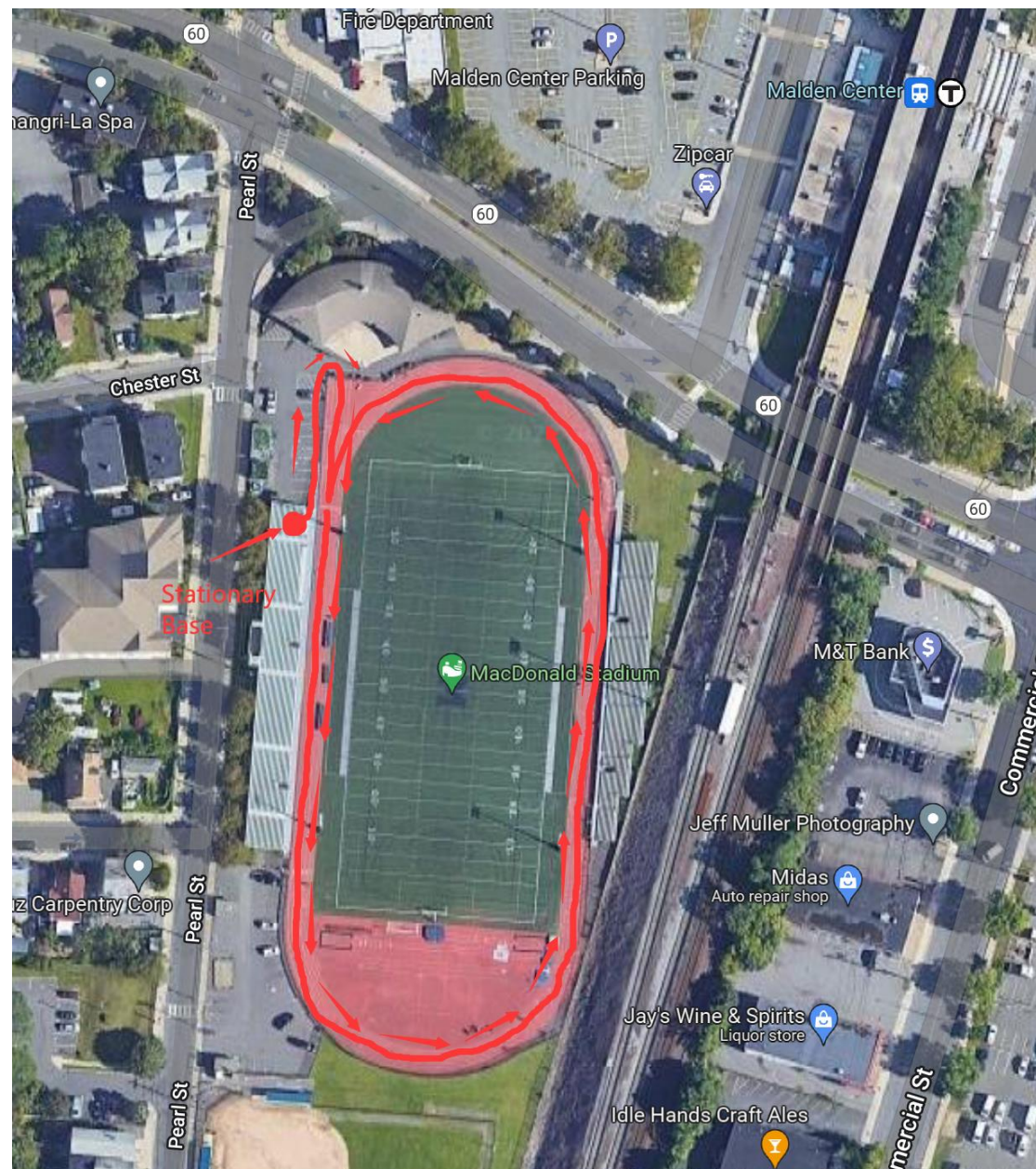
# EECE 5554 Robotics Sensing and Navigation

## Lab 2 Report

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### Introduction

GNSS/RTK processing boards, GNSS Antennas and Telemetry Radios are used to collect the data for this lab. The data has been collected in MacDonald Stadium next to the Malden Center MBTA Station. For a clear view, the google satellite figure is showed below.

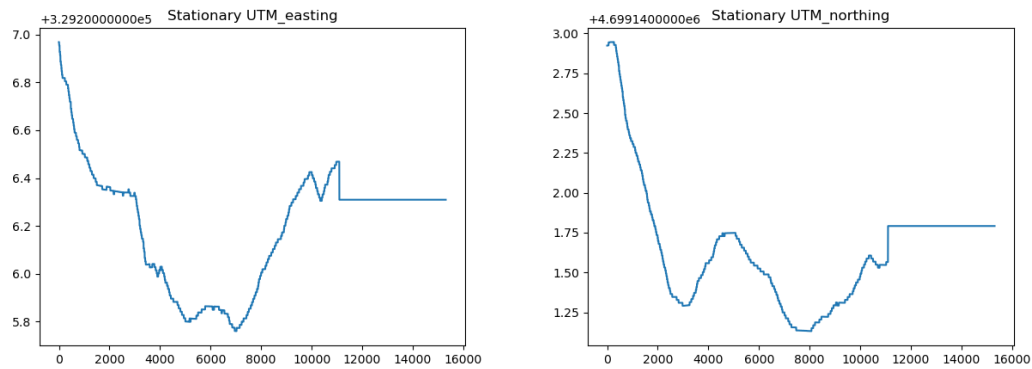


The GPS quality value in this area is constantly 5. Which indicates RTK float fix. And in the U-center, in the fix indicator, it says GNSS fix / 3D. The data measured in this area should be very precise and with good satellite signals.

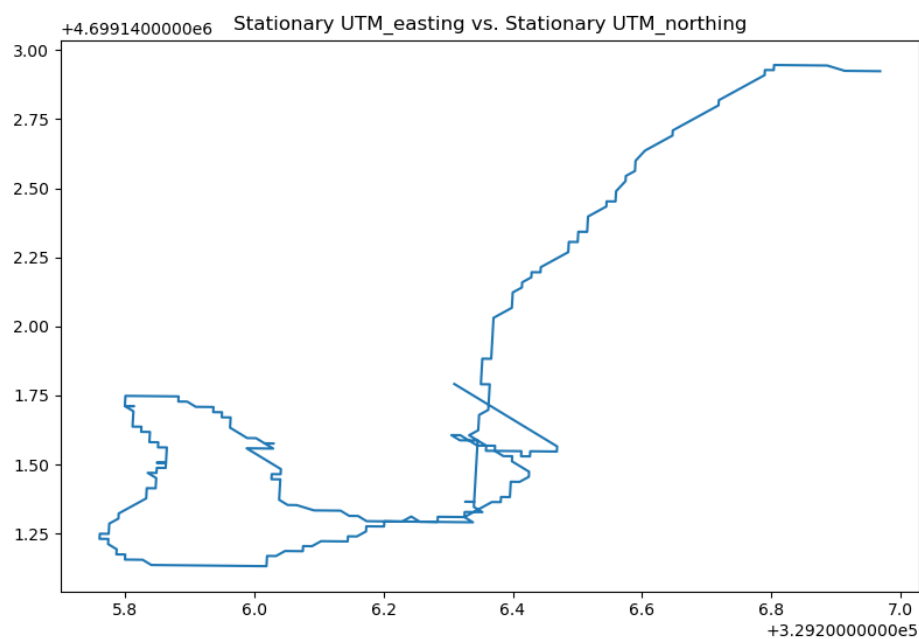
## Data Processing and Analysis

Similar to the lab1, the ROS bag feature has been used to record data. The bag file then be converted to yaml file. A Python analysis script has been used to read yaml file and use matplotlib to plot the file for this lab.

For 10 minutes stationary data, here are two plots for stationary UTM easting and UTM northing.

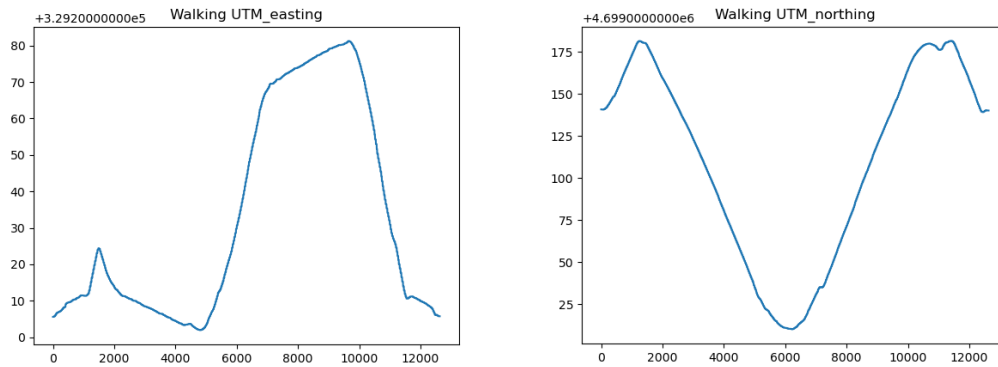


The next one is stationary utm\_easting verses stationary utm\_northing.

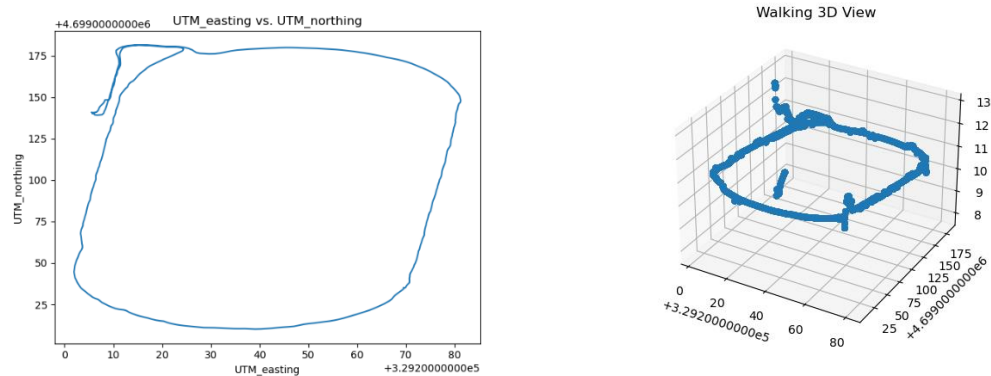


The stationary data has significant noise because during the 10-minute measurement, the antenna and RTK board placed on the bench next to the MacDonald Stadium had been blown down by the wind, and we must place it back to its start position. Therefore, the data is containing large error and oscillation.

Then we walked along the playground where the route has been indicated in the introduction. The UTM graphs are showed below.



And next plots are showing UTM easting verses UTM northing and also a 3 dimensional view of walking routes.

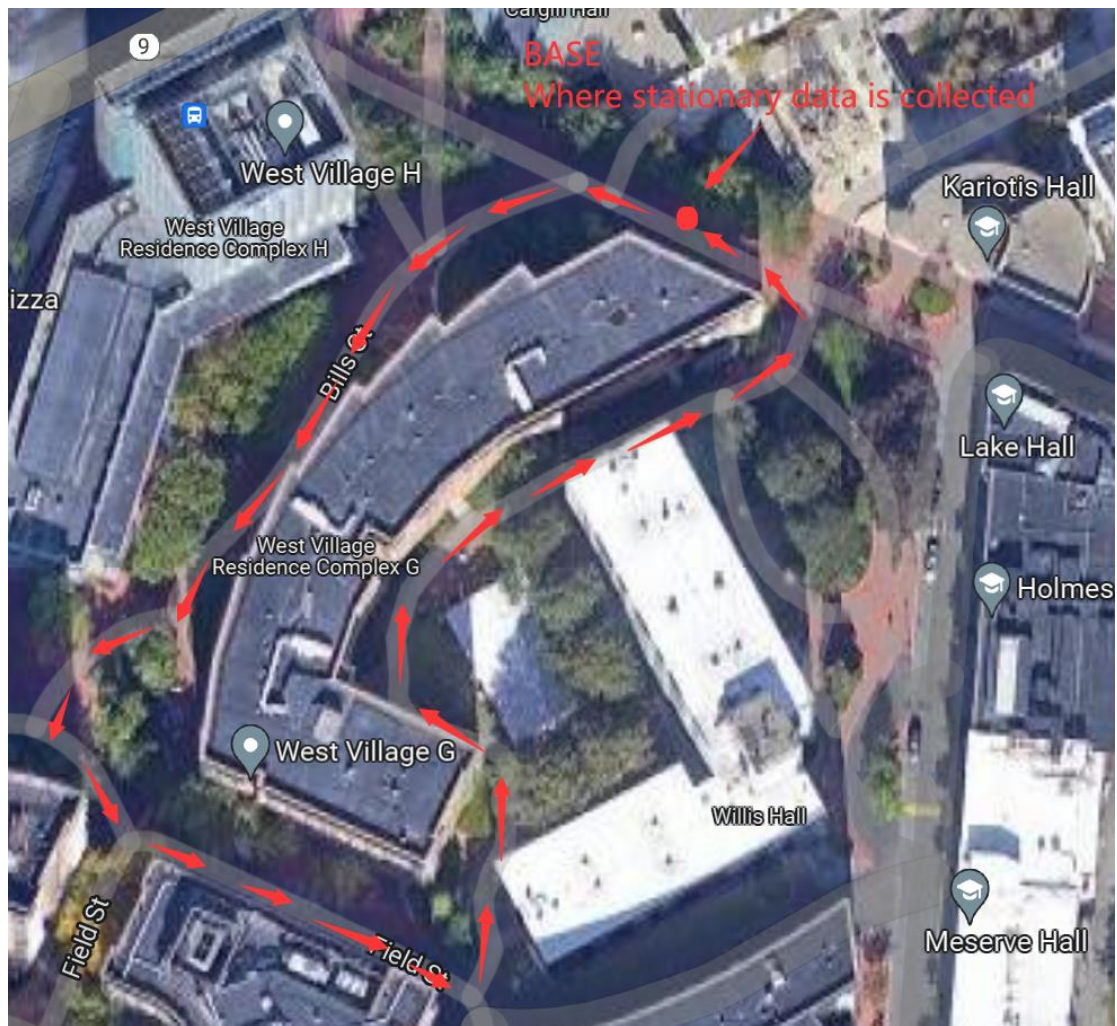


This plot is actually very close to the figure in the introduction. The route is we walking down from the left side bench and then walking along the playground then back to the bench. While we are walking along the route with the rover, the base is placed steady on the bench.

The error for this walking data is hard to see. Because the RTK board and antenna is carried with examiner. At some point, the data is very precise. Because there were someone running along the track. We need to switch left and right to avoid colliding with runner. Therefore, the route is not a perfect cycle or oval.

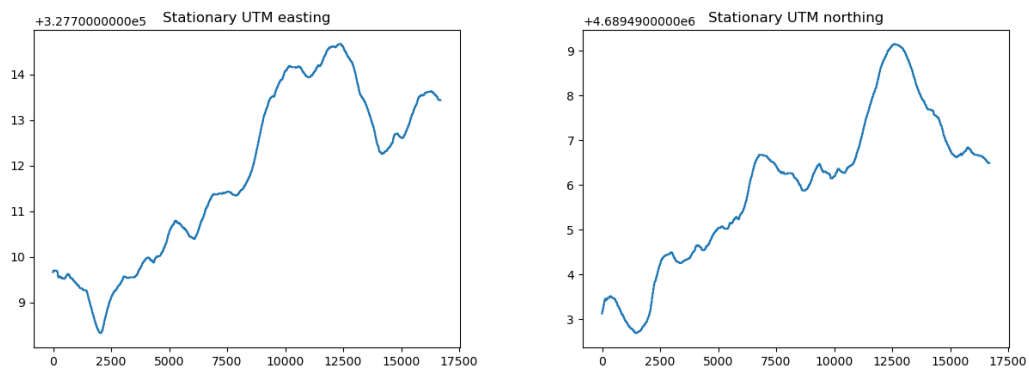


The other group of data which should measure from partial occlusion and reflections near by is recorded in the Northeastern University. The specific route is showed below.

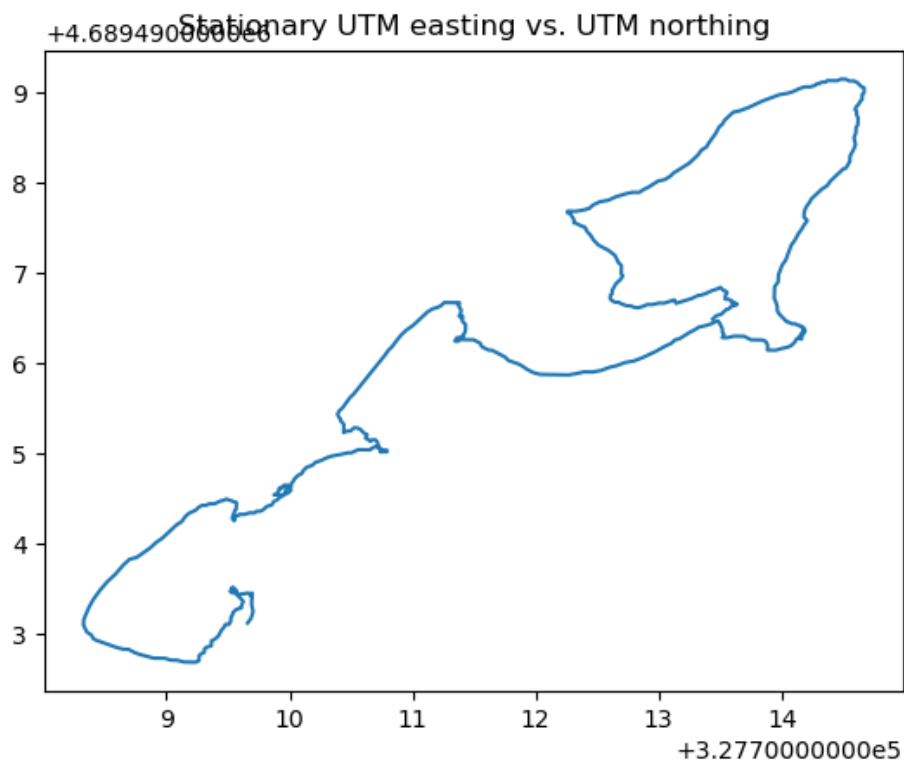


While collecting the data, we noticed that the GPS quality for this area is very low compared to the data collected from MacDonald Stadium next to the Malden Center MBTA station. The GPS quality value in this area is always 0 and 1. Which means the GNSS fix not available and GNSS fix valid. Since this data is collected from partial occlusion and reflections nearby. There are many trees planed in this area. Therefore, the GNSS maybe hard to fix in this area.

Here are the stationary data measured in the partial occlusion and reflection nearby environment.

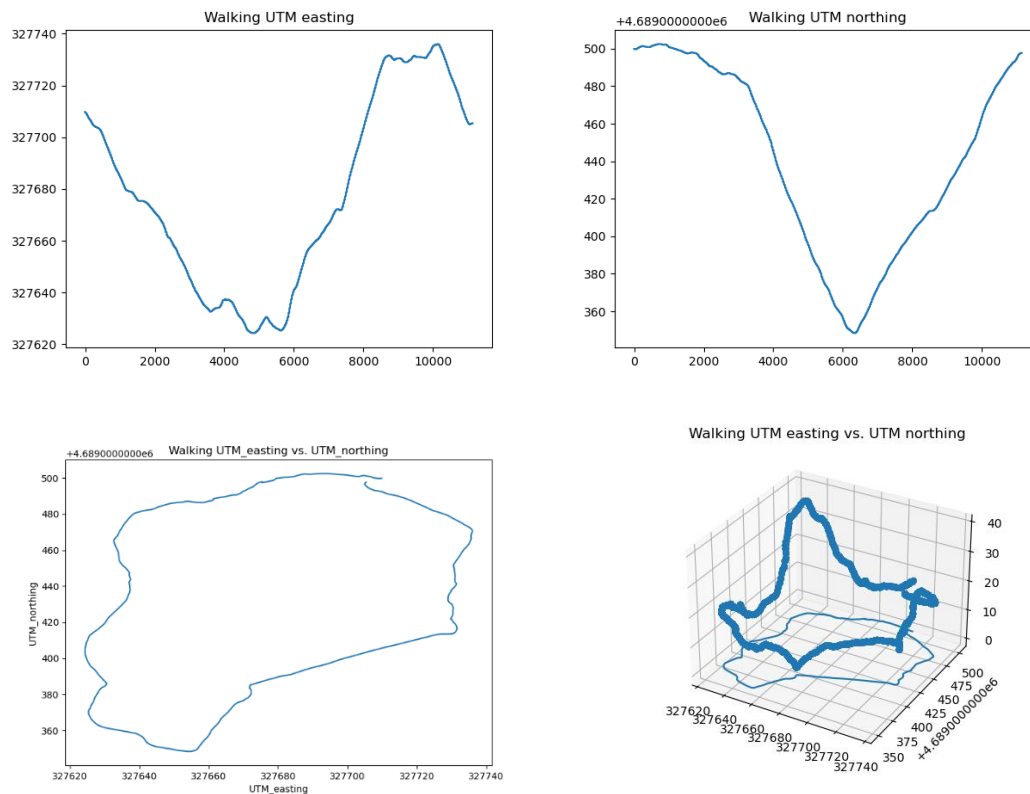


And here is the plot UTM easting versus UTM northing.



As the plots show, a stationary data should not look so noisy. The board and antenna are both placed on the bench on the map above. Therefore, there should be no human interaction to the data. The only explanation is the noise and low GPS quality. The GNSS is hard to find a fix.

Here is the walking data.



As showed in the plots. The UTM easting data and UTM northing data starts and ends at the same value which indicates the examiner walking in a close circle, starts and ends in the same location. The 2-dimensional plot of UTM easting verses UTM northing can see the walking route which is close the route indicated in the google map above. However, the 3-dimensional plot with altitude included shows there is a huge oscillation in altitude data. This may cause by low GPS quality and lose connection to base. While we are walking building by building, the Telemetry radio is flashing green, which indicates lose connection to other radio/finding paired radio. Because the building is affecting radio signal transmitting. And while we close to the base, the radio is able to reconnect again. Therefore, during the radio signal lose period, the data measurement could be unprecise.