Analysis of the GPS Data

In order to study the GPS navigation, two types of analysis is done. In first analysis, the GPS data is collected at a stationary location and second analysis is done while walking.

In the first analysis, three sets of trial is done. In first trial data is collected indoor, in second trial data is collected at partially open area surrounded by buildings and in third trial data is collected in a completely open area. Figure 1 shows the result of 3 trials.
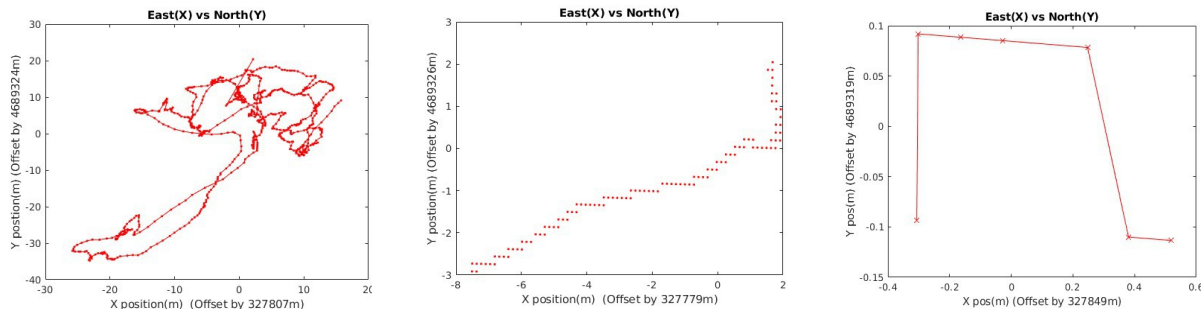

Figure 1. X and Y Position variation at Indoor, Partially open and completely open (left to right)

It is clearly visible that in indoor area, the accuracy is bad due to the Multipath effects and Signal attenuation which are the main cause of the position error. In partially open area the accuracy is better due to less effect of Multipath and in completely open area, the result is best and a precision within 1m is achieved. So Position error can be minimized by reducing the multipath effects which is due to the presence of trees and buildings near by.

But in real life, we are generally in partially open area and thus further stationary analysis is done for the second trial only.
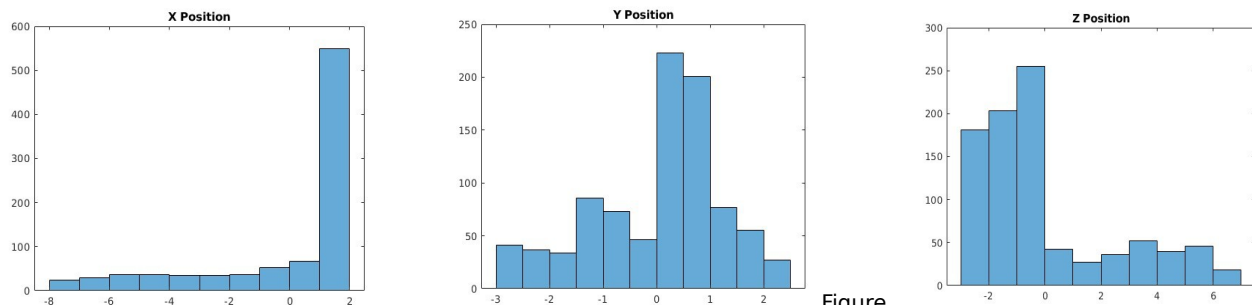
2. Histogram plot of X, Y and Z

On plotting the histogram for X and Y, it is observed that the position data is skewed and thus the error distribution is not normally distributed. The error estimation cannot be done by using mean. In order to understand the behavior of error, Median is more suitable as a statistical tool. The error is calculated using the median data and the actual data and below is the result:

-0.28m is error in X direction wrt Median
-0.9m is error in Y direction wrt Median
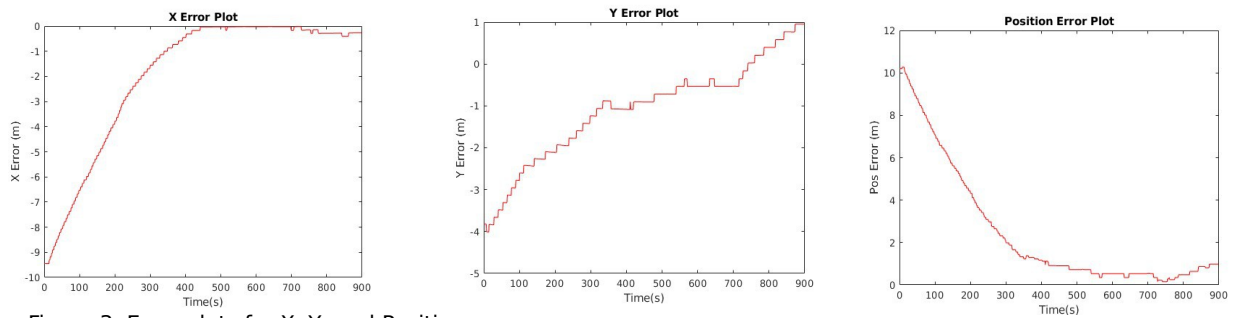This small error data confirms that Median is a good error estimate.

Figure 3. Error plots for X, Y and Position

At the start only, we have seen that the errors can be prevented by avoiding the multipath effetcs. But still some errors will be there such as Ionospheric delay, Tropospheric delay and clock errors and these can only be avoided by using RTK GPS which can sent the correction signal to receiver to compensate these errors.

In the second analysis, the data is collected while walking in straight line.
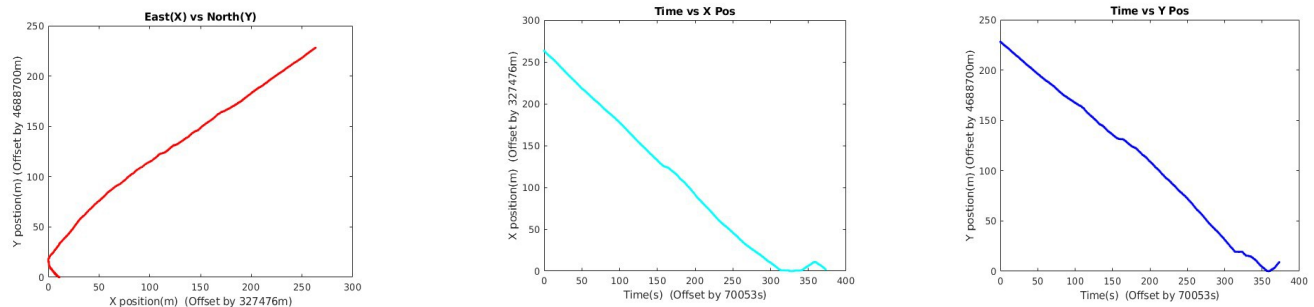

Figure 4. X and Y position plots

On plotting the X and Y position plot, it is visible that the GPS data is showing the change of coordinates in straight line and thus represents the walking on a straight path.
Since we are not staying at a point, then error estimation using median data is not possible as our actual position is continuously changing.

The 3D plots of X,Y wrt Time also confirms the straight line motion with change in the altitude. The Position scatter plot represents the change in altitude as the X and Y position changes. These plots can also be used to find the speed and direction of movement depending on the change of X and Y coordinates with time.

Since the walking data is recorded at completely open path and thus was able to prevent the multipath effects in the data. But some error still remains in the data which can be visible by slight deviation from the straight line that refer to the presence of noise error but the distribution is not clear.