The GPS data that we get from the satellites has various fields, some of which are GPGSA,GPGGA and GPVTG. We are particularly interested in the GPGGA data which has the following format:

$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx

where:

hhmmss.ss = UTC of position
llll.ll = latitude of position
a = N or S
yyyyy.yy = Longitude of position
a = E or W
x = GPS Quality indicator (0=no fix, 1=GPS fix, 2=Dif. GPS fix)
xx = number of satellites in use
x.x = horizontal dilution of precision
x.x = Antenna altitude above mean-sea-level
M = units of antenna altitude, meters
x.x = Geoidal separation
M = units of geoidal separation, meters
x.x = Age of Differential GPS data (seconds)
xxxx = Differential reference station ID

We are interested in the lattitude, longitude and the altitude data. Hence, when we use the serial port to read the data, coming in from the GPS we parse the data according to the format given above and convert it into utm format using the utm package in python.We log the data using lcm-logger and read the log-files using MATLAB.We plot the results as shown below in the graphs.
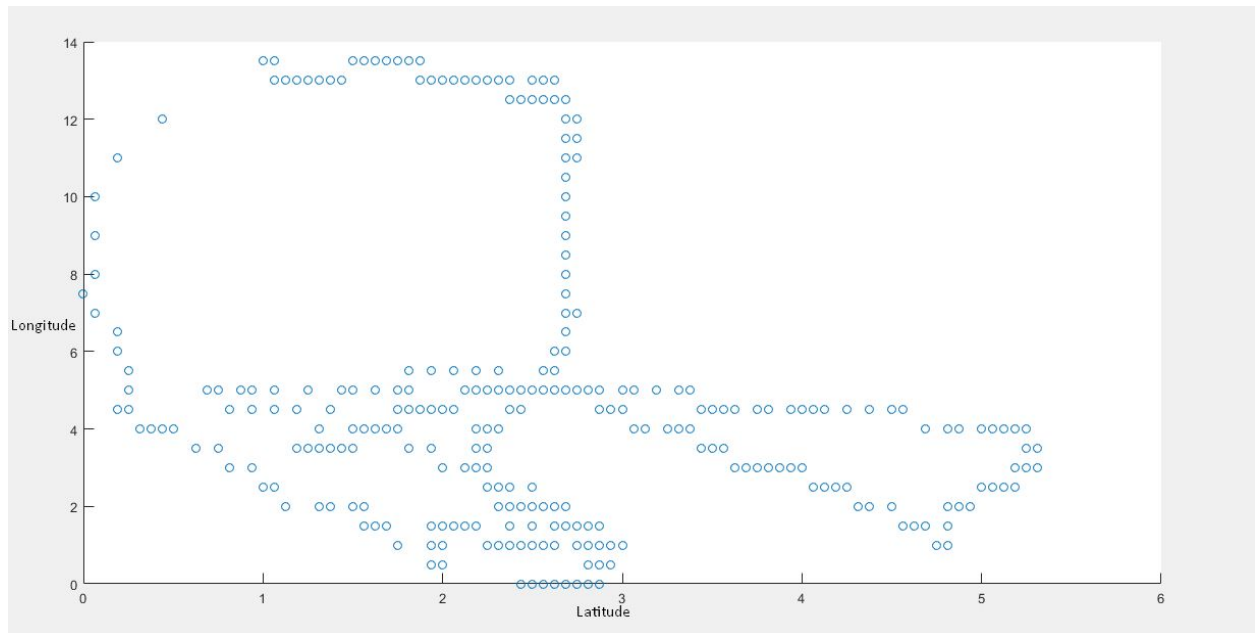
We plot the histogram of the values to display the probability distribution function of the values so that we can visualize the mean of our position estimate and the range of the GPS error.
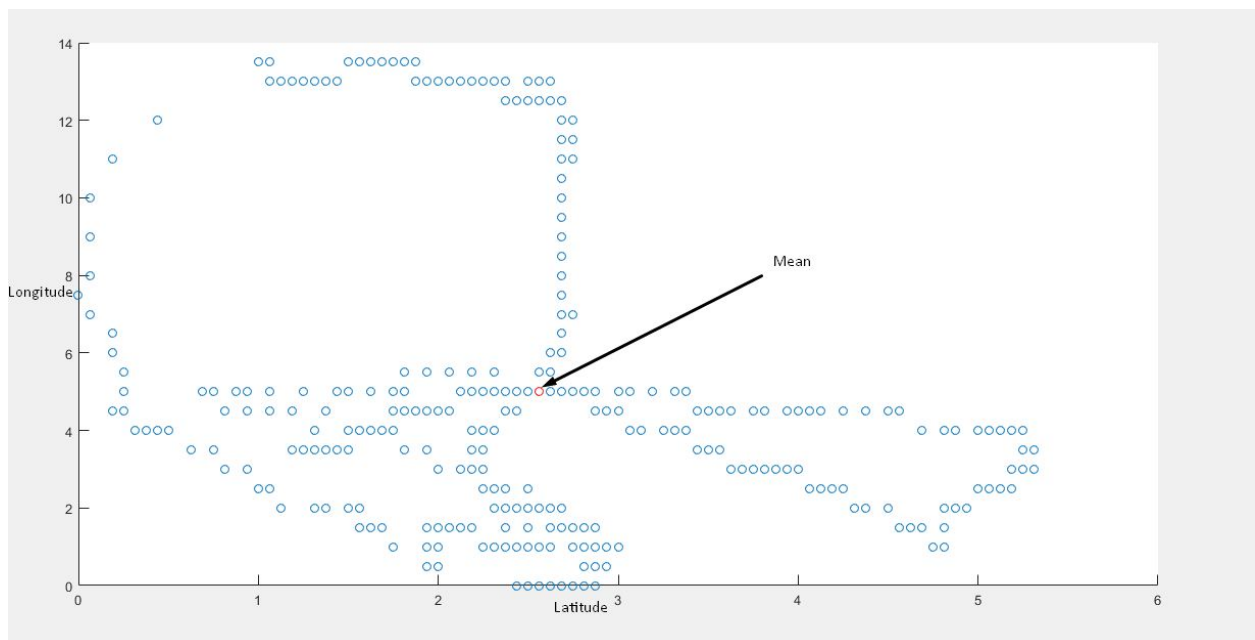

Even though the mean is not the correct way to estimate the position, we use it as a temporary means to convey the result of our experiments.

To increase the reliability of our data we need to employ techniques like sensor fusion.
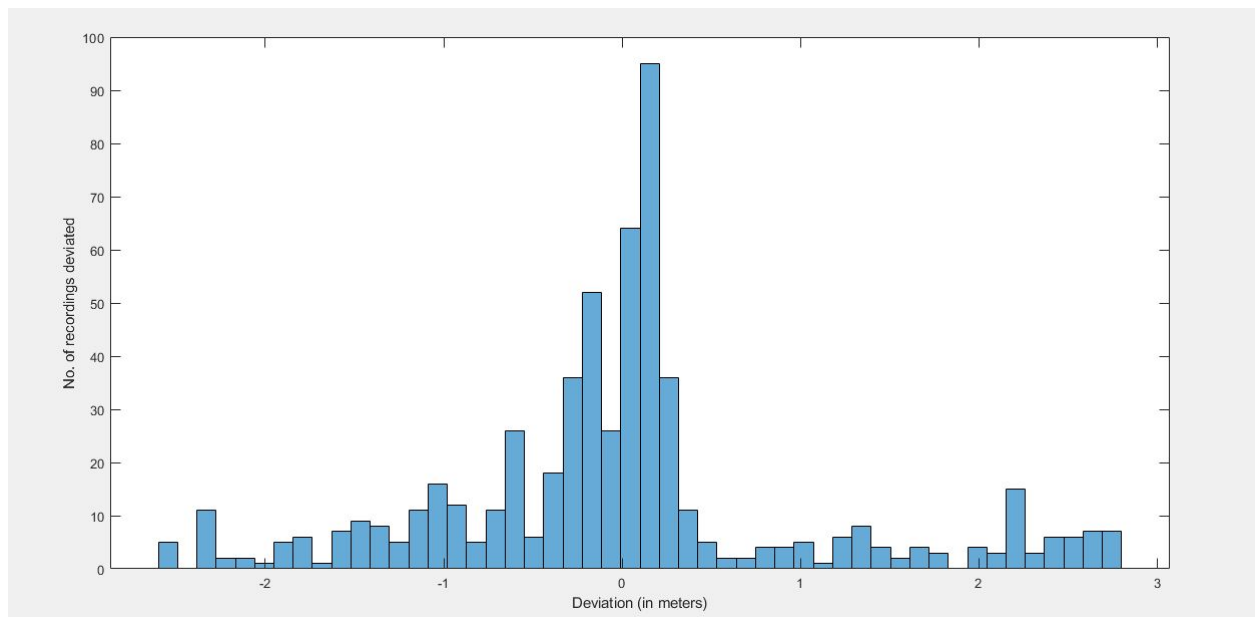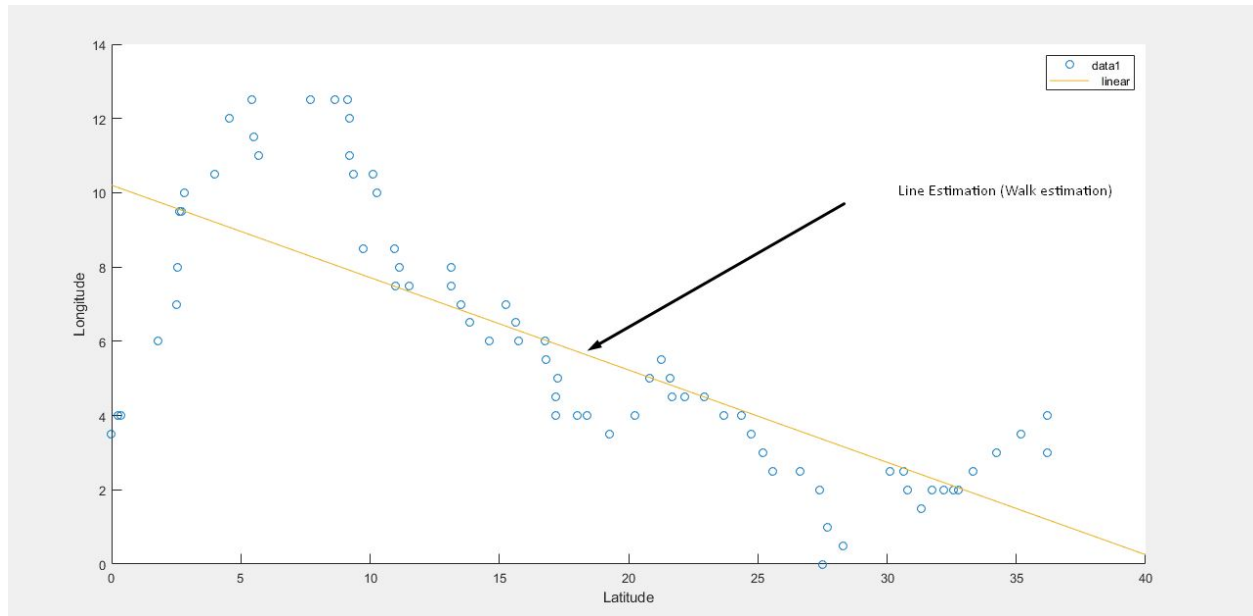
Error estimation for latitude

The error profile looks more or less like a gaussian curve in this case, though in the case below the error profile seems to be following a combination of two or more Rayleigh distributions.
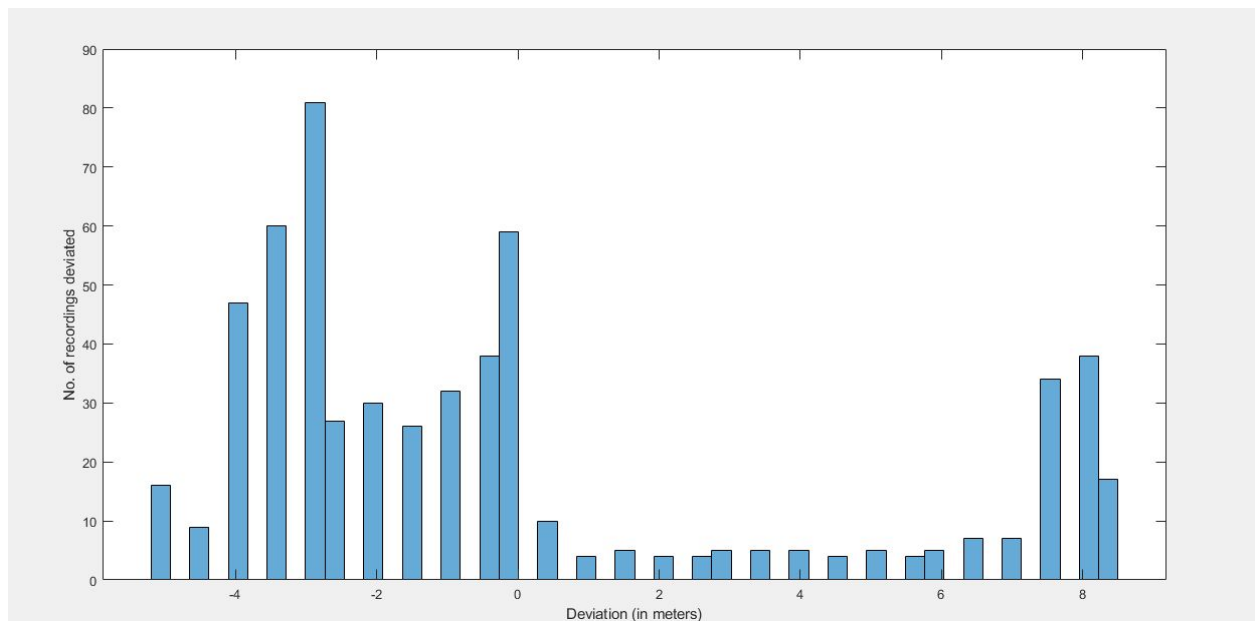

Error estimation for longitude

We then walk in a straight line for 10 minutes and the data collected is plotted below:

Shown in the plots we also add a linear line assuming we walked in a straight line to see the deviations from the straight line. We incorporate the line using basic curve fitting toolbox and the residuals(deviations) are the error estimates that are plotted in the graph below:
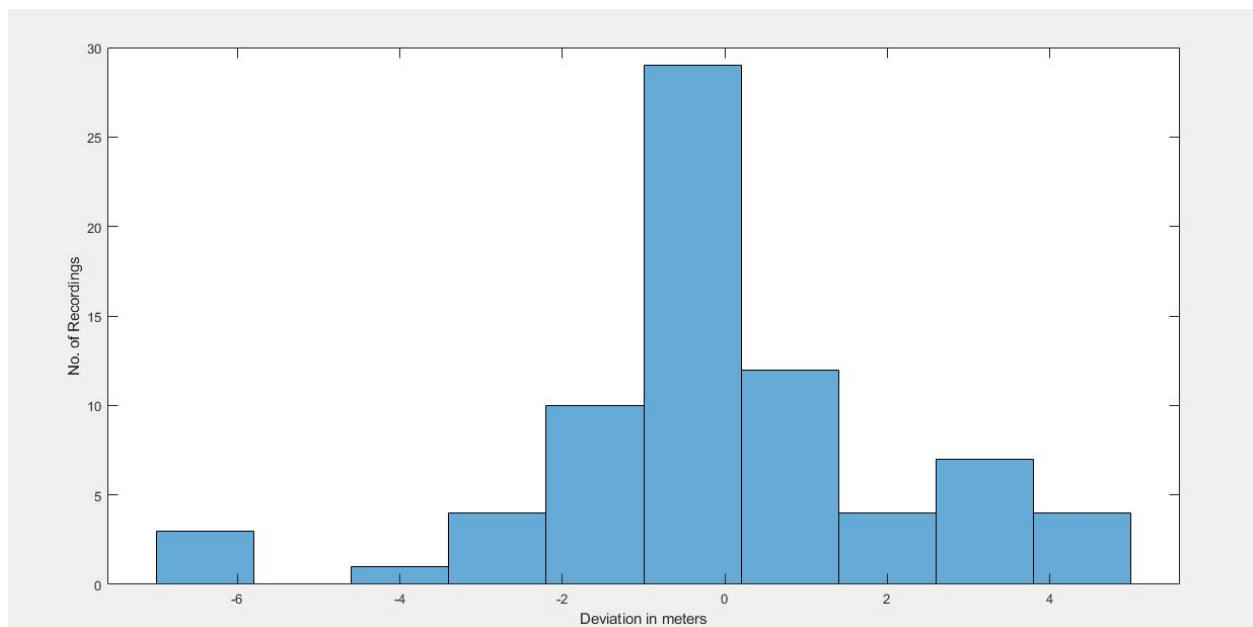
The residual error (deviations) that result seem to be forming a gaussian distribution.

References

1. [GPGA Format](#)

2. [Rayleigh Distribution](#)