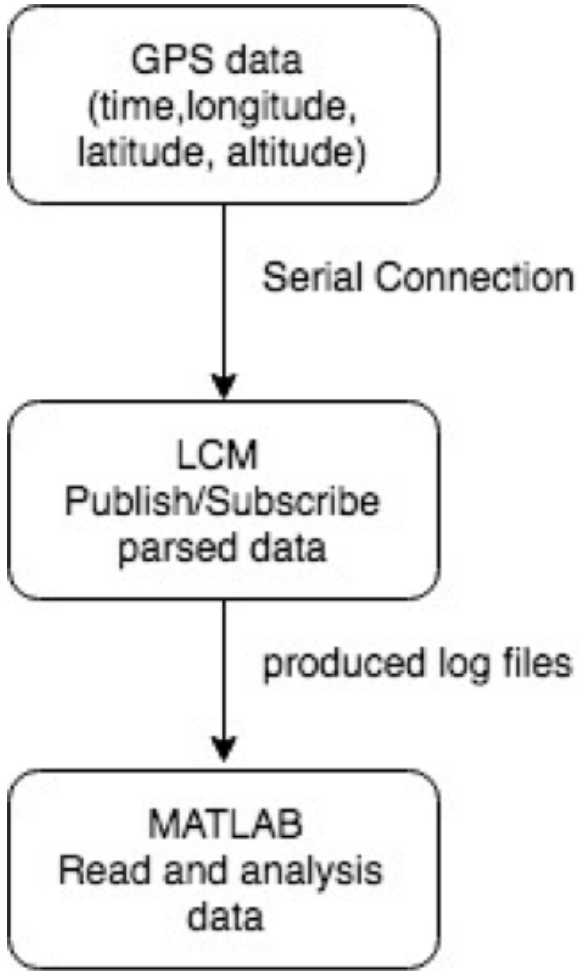
GPS Data Measurement Procedure



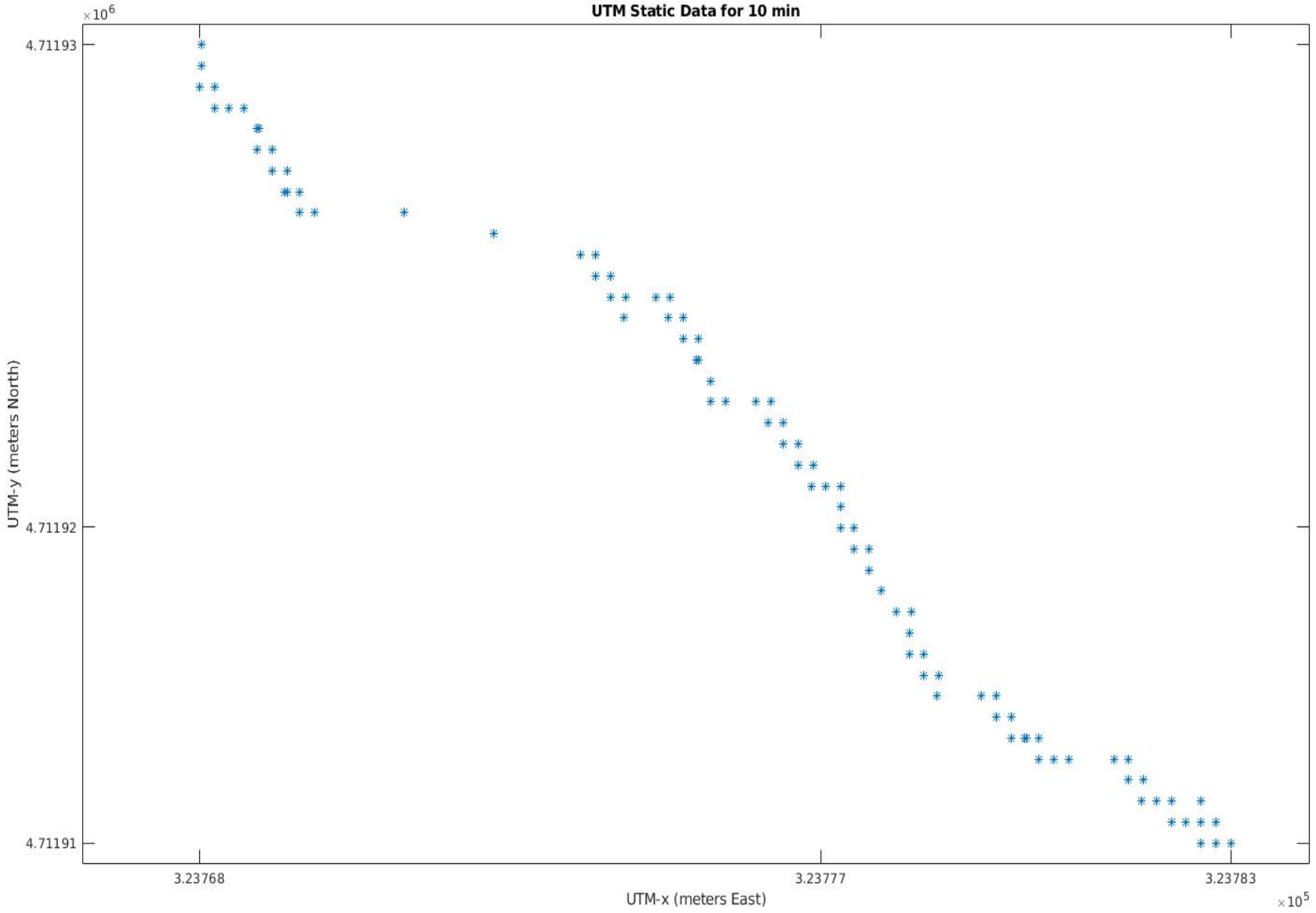
Contents of lab1 folder and how each contribute:

- GPS_struct.lcm: Includes package name that defines a namespace for the data structure, and a structure definition for GPS data.
- gen-types.sh: generates the python binding for the GPS_struct.lcm.
- read_gps.py: python scripts that parses gps data and publish to lcm.
- runspy.sh: Bash script that starts lcm-spy to view lcm messages
- buildjar.sh: Bash script to generate related java files.
- data and log folders: log files (`lcm-log-dynamic, lcm-log-static`) and data generated in ods format `(utm_data.ods)` are stored here.
- gps_lcm folder: folder to store struct files.
- gps_lcm_read.m: MATLAB script to read lcm log files and plot.

Bash script to set up and run the lcm for GPS:

```
#/usr/bin/env bash
sudo chmod 666 /dev/ttyUSB0     #give permission to GPS at /dev/ttyUSB0
lcm-logger -s ./log/lcm-log-%F-%T&      #start lcm-logger
./gen-types.sh                  #generate lcm file
./buildjar                      #build java files
./runspy                        #start lcm-spy
python read_gps.py
```

UTM Static Data Analysis



Experiment location:
46 Leon St, Boston, MA, 02115.
UTM: (x-ea: 327738, y-no: 4689355)
Experiment time: 656s

Averaged readings:
UTM: (x-ea: 323777, y-no: 4711918)

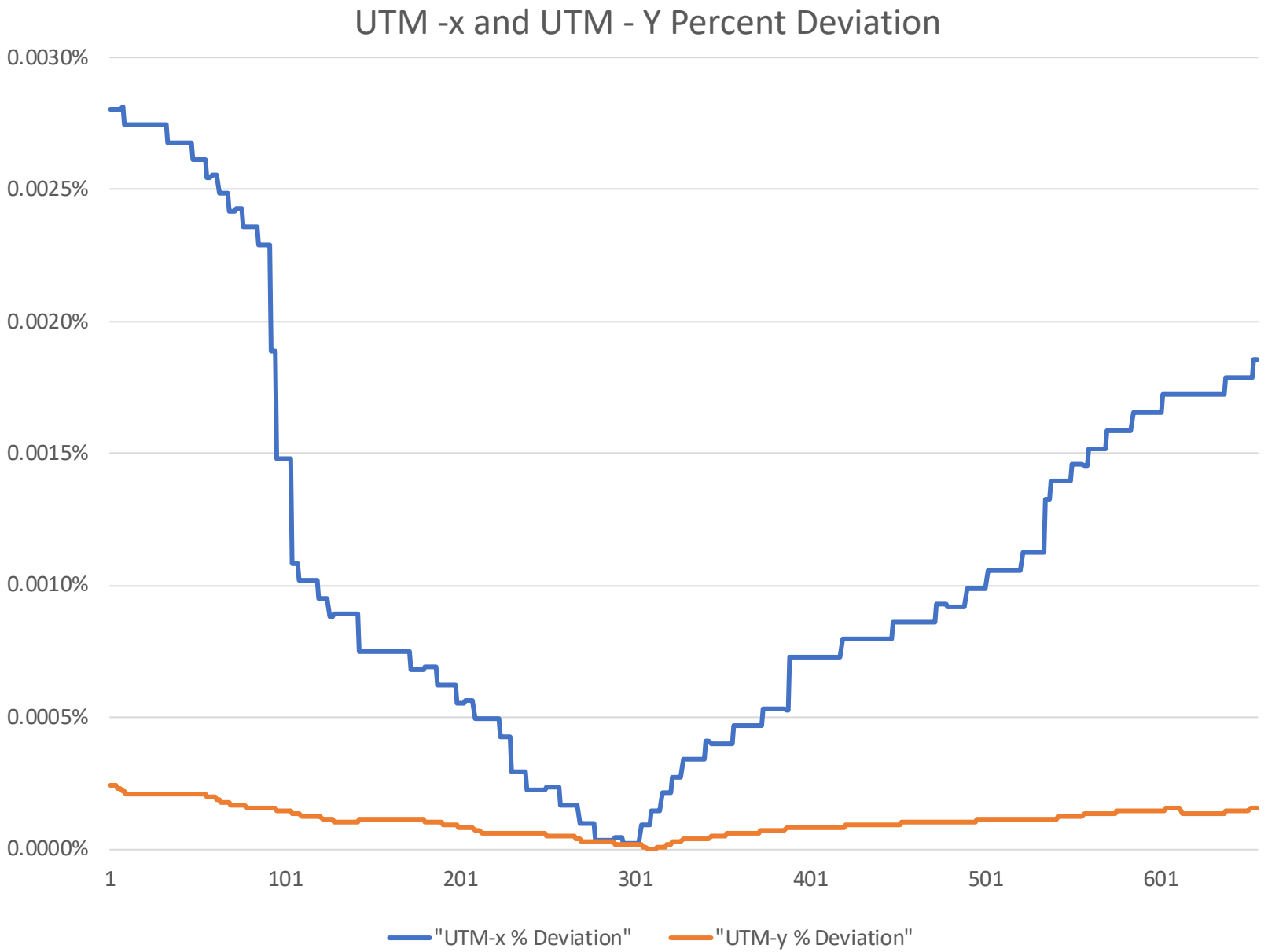
Error %: x-ea: 1.2%, y-no: 0.48%

Possible reasons for error:

- Environmental factors: humidity, atmosphere pressure and local temperature can cause signal delay.
- Multipath issues: radio signals reflect off surrounding terrain; buildings, canyon walls, hard ground, etc.

(source: https://en.wikipedia.org/wiki/Error_analysis_for_the_Global_Positioning_System)

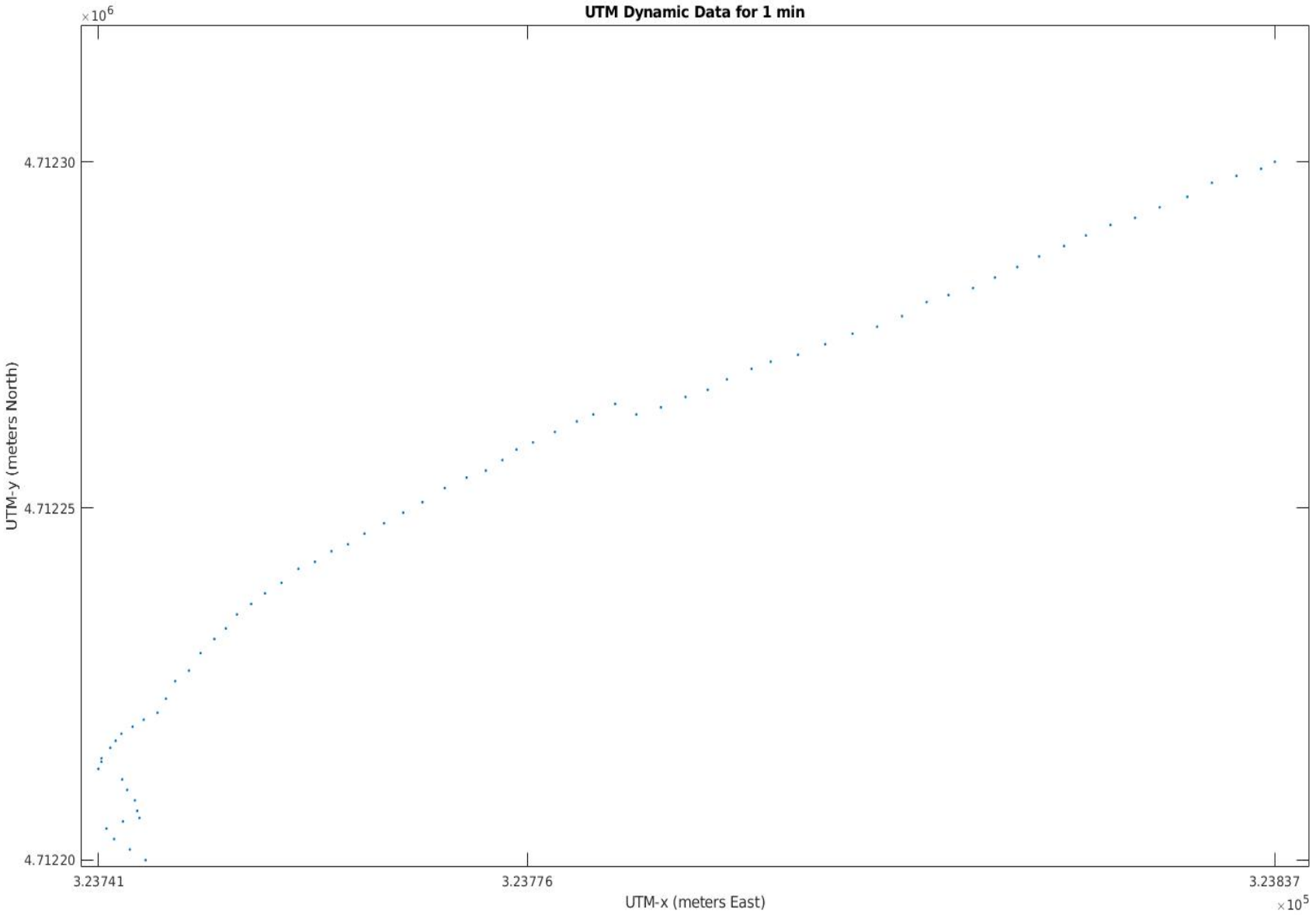
UTM Static Data Analysis



Observations:

- UTM-x signals tend to have a higher deviation percentage. (Reason: Data taken on a windy evening, GPS might be fluctuating left to right more.)
- Overall, UTM readings are stable.
- Both UTM-x and UTM-y are most stable at time 300 second.

UTM Dynamic Data Analysis



Distance walked in straight line (from Google maps): 160m.

Time walked in straight line: 75s.

Tested walking distance:

$$\sqrt{\Delta UTM_X^2 - \Delta UTM_Y^2} = 135\text{m}$$

Reasons for experimental error:

- Not walking in complete straight line.
- Environmental factors that cause delays to GPS data acquisition.
- Inaccurate distance measurements.