Report on GNSS Training

Course ID: T151-40

Team No: 13

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Training held at GIC/AIT, Thailand

6 – 10 JAN 2020

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1.1. EXECUTIVE SUMMARY

This GNSS Training involved the information about different satellite constellations such as GPS, GLONASS, Galielo, QZSS, Beidou and other satellite augmentation service.This training made us fluent in u-center windows, RTKLIB, and RTKDroid.This training made us champ in collection of low-cost receivers of single frequency and dual frequency and high cost receivers as well.This training taught us various post-processing methods: SPP, Kinematic, DGPS, Static postprocessing methods.This training taught us various gnss survey methods: static gnss survey, kinematic gnss survey, real-time static gnss survey, real-time kinematic survey.This training made us familiar about various gnss data formats: NMEA, RTCM, RINEX.This training empower us to check the accuracy and precision statistics in RTK.Differential correction from Base station using NTRIP communication through internet to rover stations to get the cm level positional accuracy.

1.2. TEAM MEMBERS

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1.3. INTRODUCTION

We initiated with learning on basics of GNSS and got acquainted with several observation and processing techniques along with the accuracy assessments. The basic Signal structures and operating frequency, broadcasted from different GNSS service providers were explored. These signals have peculiar properties (unique PRN codes or Unique frequencies). Low cost receivers are designed to collect data signals from specific satellites and only limited frequencies. Here, we used M8T (single frequency L1) and F9P (dual frequency L1, L2) receivers to collect the field data with different observation technique PPK and RTK techniques (for both static and dynamic data collection). The data were processed, analyzed and visualized using RTKLib packages, including the plotting, processing, converting etc. functions. The post processing results were compared to the real time processed data.

During this period of GNSS Training – Course (T151-40), we get to know about several GNSS systems (GPS, GLONASS, BeiDOU,QZSS), use of gnss technology in various applications, installation of u-center windows, RTKLIB, RTKDroid android application, learned about various gnss data formats, accuracy, errors, coordinate systems, gnss survey methods, gnss data processing, QZSS-PPP service, MADOCA and CLAS, gnss field survey, and finally report preparation and presentation of learnings as well.

1.4. LEARNINGS:

1. Configuring single frequency and dual frequency low cost receiver using u-center windows applications.
2. Collecting field data in proper way using low cost receiver.
3. Checking data quality of field collected data in u-center windows and RTKLIB.
4. Getting feedback from training resource personnel at the field and during data processing session.
5. Theories/fieldworks/post-fieldworks regarding SPP, Kinematic, DGPS.
6. SPP, Kinematic, DGPS positioning/processing using RTKLIB.
7. Changing configuration parameters/pre-processing parameters/processing parameters and inspecting the results/statistics/quality flags/plots/reasoning/accuracy/precisions/solution type.
8. Processing sample data provided by training by RTKLIB.
9. Comparing data from low cost receivers and high end receivers in terms of data quality/accuracy and precision statistics.
10. Collection of field data using low cost receiver using RTKDroid android application in static mode and kinematic mode using NTRIP communication.
11. Professor Dr. Dinesh Manandhar explained how using the NTRIP settings the differential corrections are applied to rover data transmitted from AIT Base Station, fluctuate only in cm level.
12. Demonstration of real time solution and post processing solution.

1.5. RESULTS:

We post-processed field collected raw data and sample data using following positioning techniques.

1. Single Point Positioning (SPP):
2. Static
3. DGPS/DGNSS
4. Kinematic

The M8T Receiver data from UT was processed with respect to Base NetR9 data. The true coordinate of base data is as follows:

Coordinate	Value	σ
X	3958757.045 m	- 0.005 m
Y	3328944.101 m	0.004 m
Z	3719537.389 m	0.004 m
Latitude	35° 54' 10.94635" N	0.002 m
Longitude	139° 56' 21.50211" E	0.003 m
El. Height	93.463 m	0.006 m

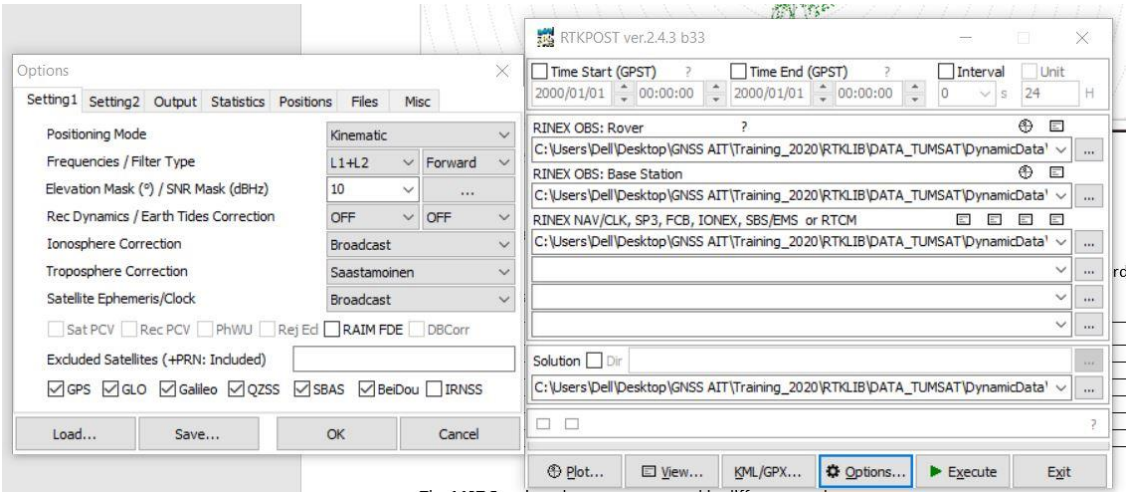

Figure 1: Parameter Setting for Static, DGPS and Kinematic modes in RtkLib

Single Point Positioning (SPP) Mode:
We collected data from low cost receiver and post-processed. We post-processed sample data provided by training both from low-cost receiver (M8T), and high-end receiver (NetR9). Following is the result.

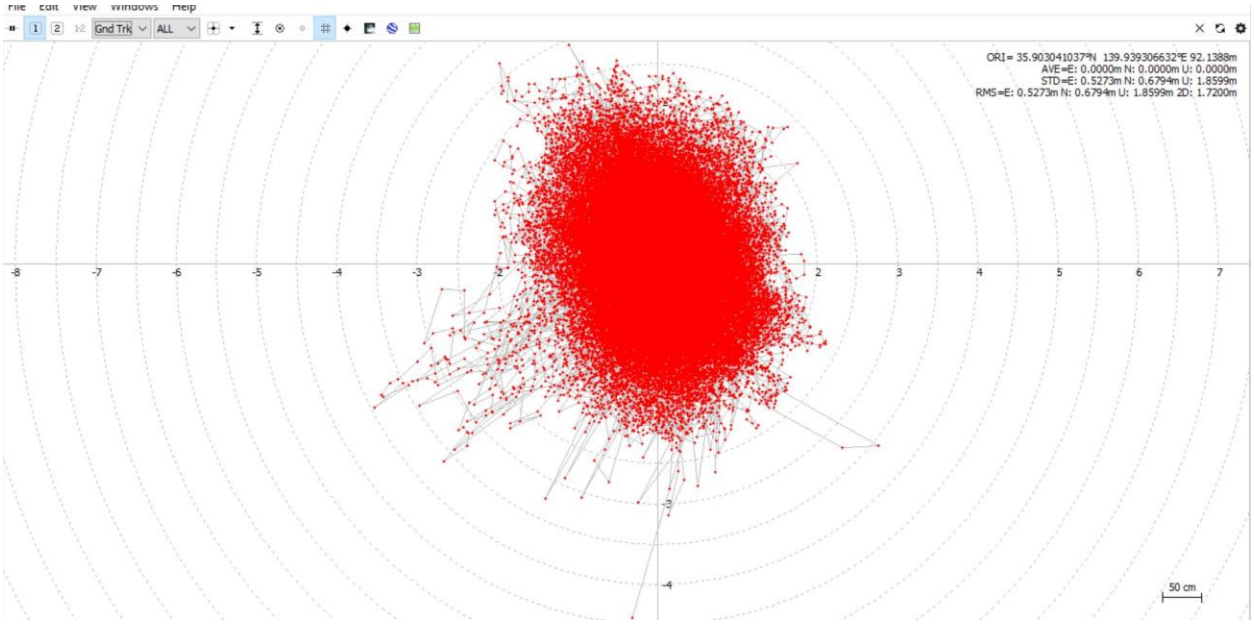

Figure 2: SPP of M8T receiver

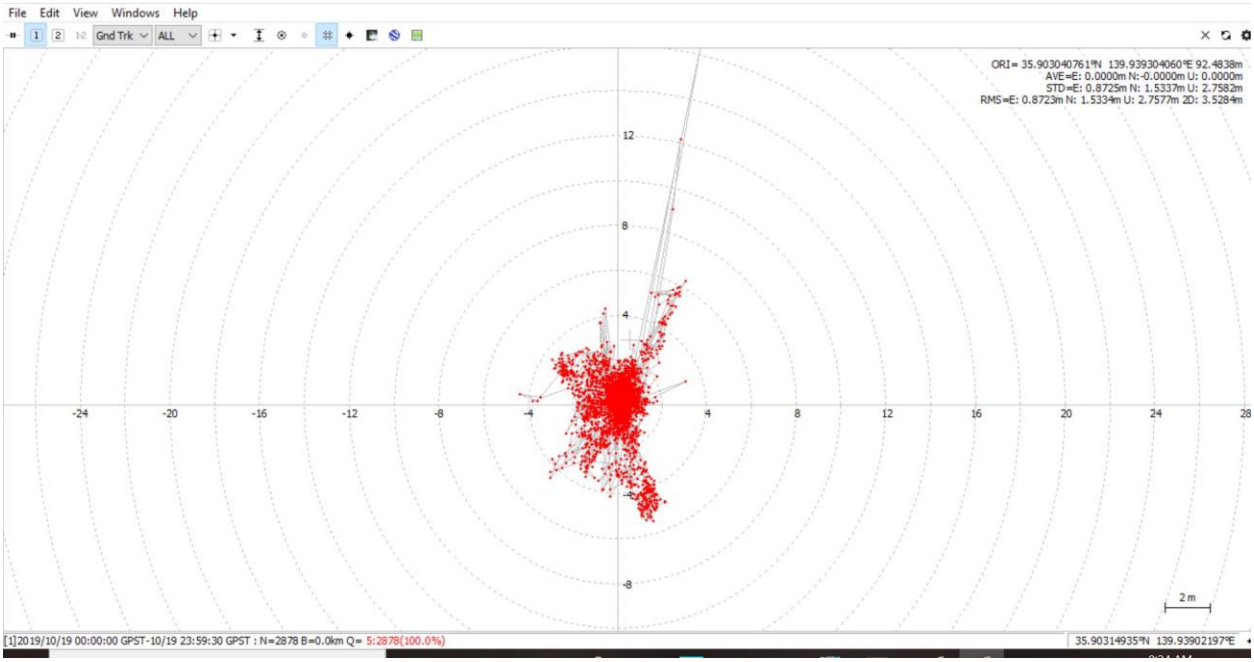

Figure 3: SPP of NetR9

Figure 4: Comparison of M8T and NetR9 in SPP mode

Static Mode:

We post-processed sample data in Static mode. The rover data is from low-cost receiver M8T and base data is from high-cost receiver NetR9. Results are as follows:

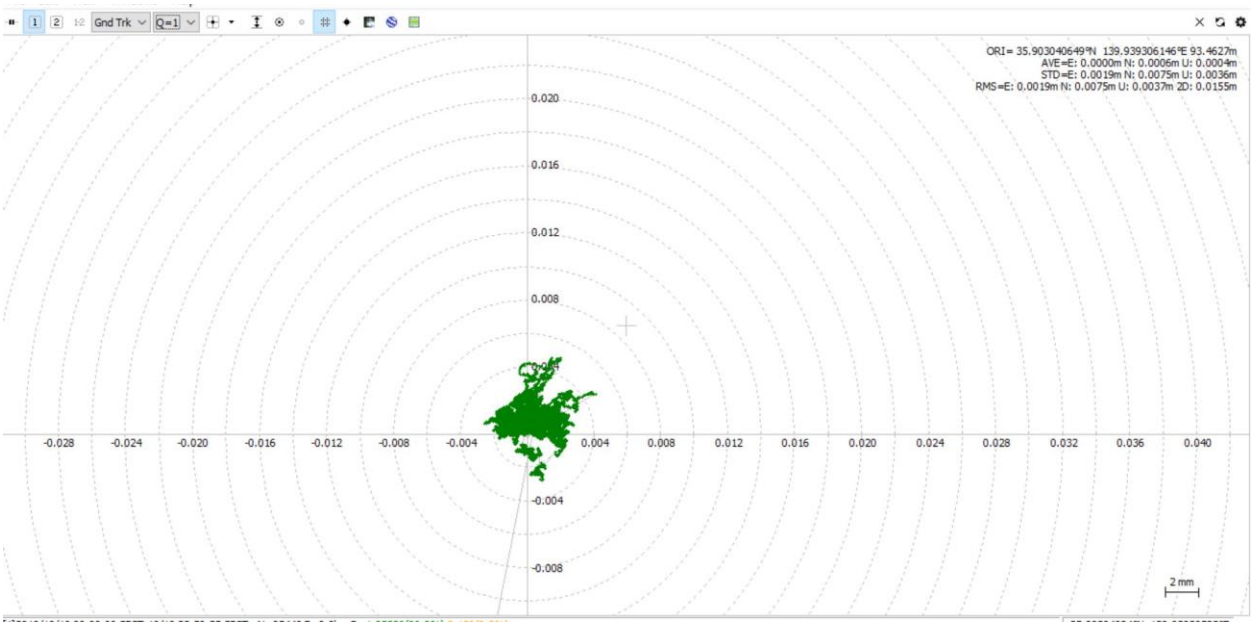

Figure 5: Ground track in Static Mode

Figure 6: Position plot in Static Mode

DGPS Mode:

The sample data was processed in DGPS mode in which the following results were obtained:

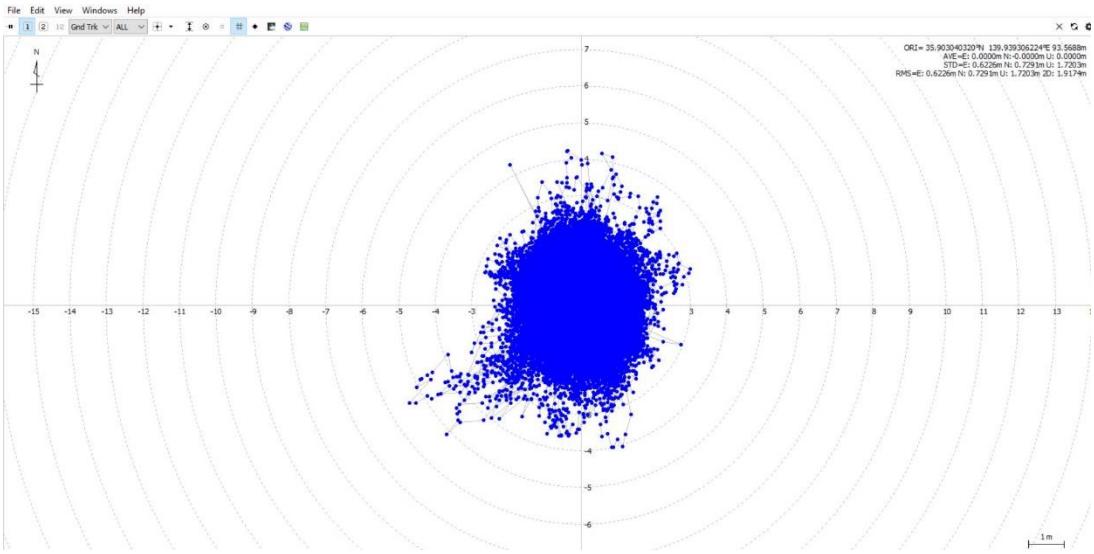

Figure 7: DGPS Mode of M8T Receiver from UT Data

Kinematic Mode:

We post-processed sample data in kinematic mode. We got following results:

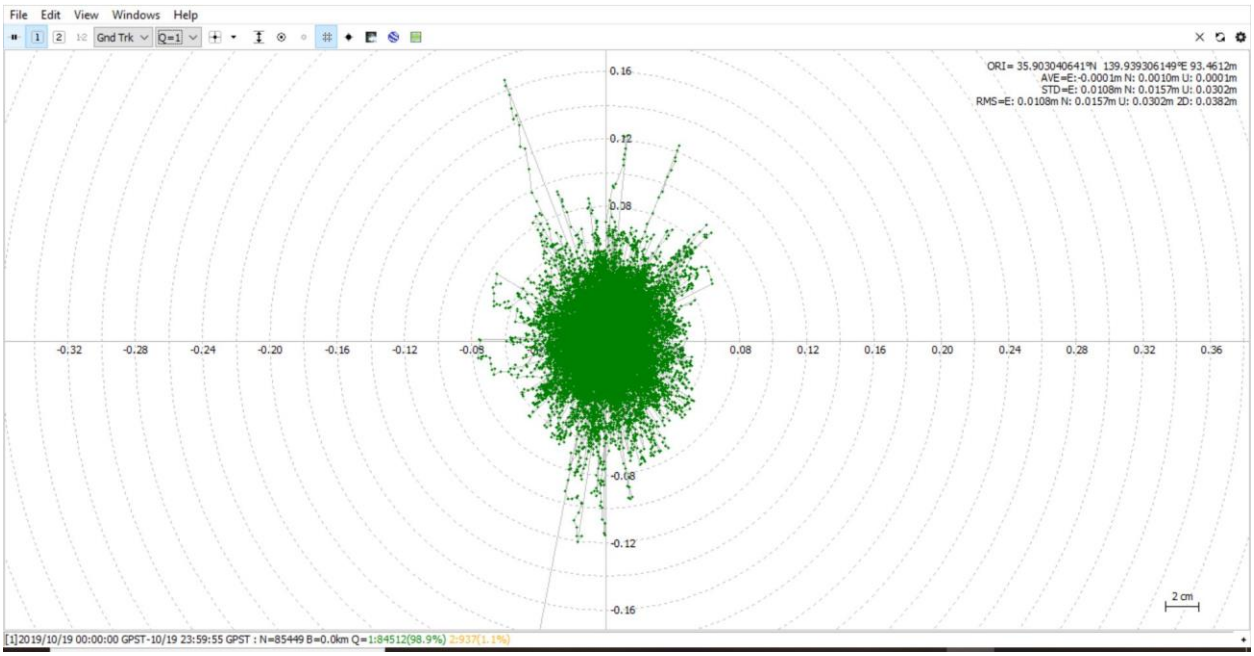

Figure 8:Ground track plot and statistics in Kinematic Positioning Mode

RtkDroid

First of all apk of rtkdroid was downloaded in our android mobiles and the receiver M8T was connected and the following parameters was adjusted:

Connection: USB

Device: u-box GNSS receiver

Format: ubx

Processsing Settings

Rover Mode: Kinematic

Elevation Mask: 15

Ambiguity Res: Continuous

NTRIP Settings

Address: 157.82.223.139 Port: 2101 Mount Port: AIT

User: training Password: training123

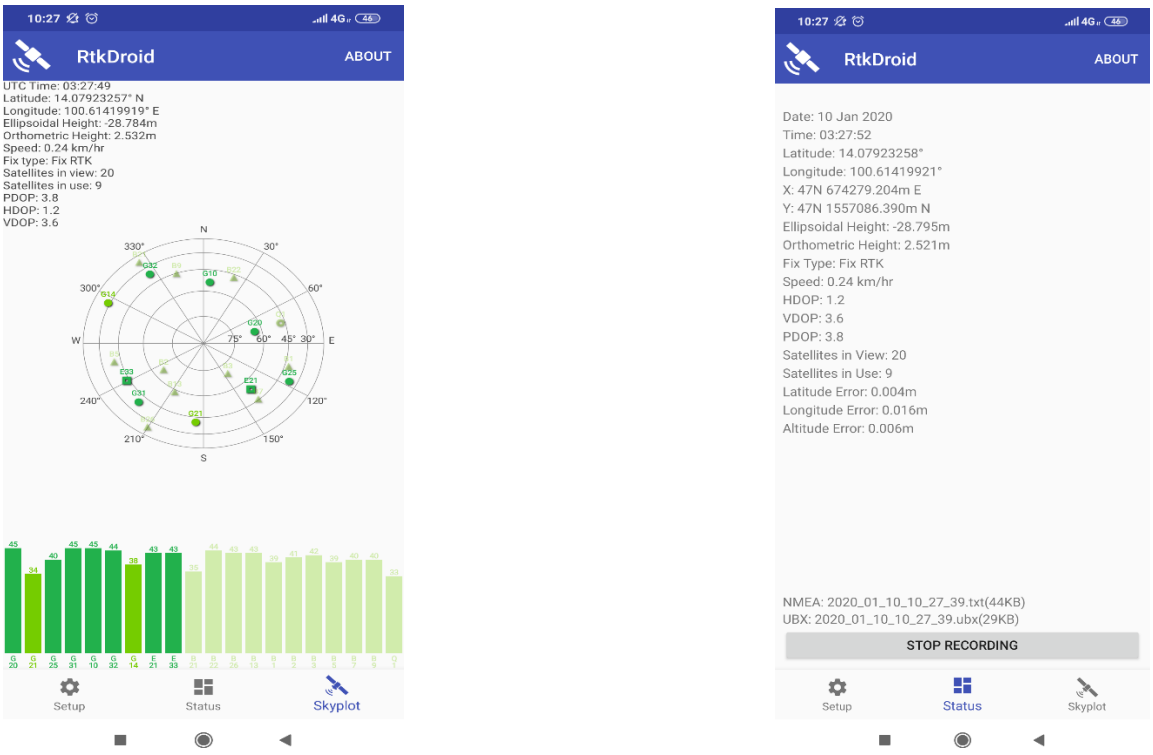

Figure 9: Satellite Information from M8T in RtkDroid

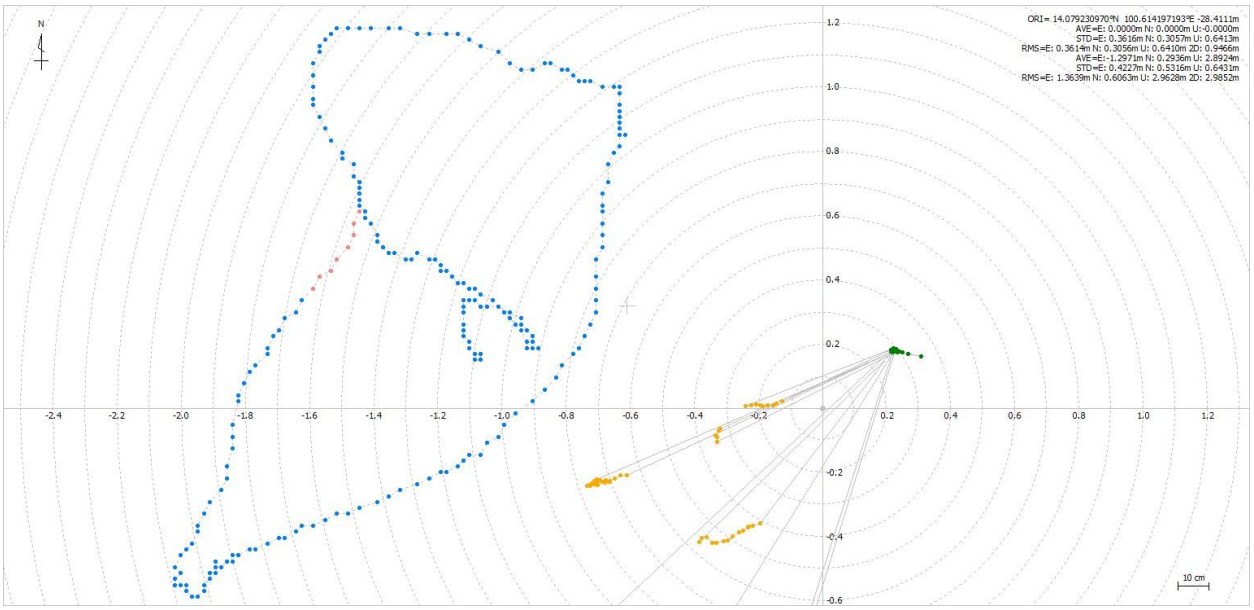

Figure 10: Data from M8T Receiver (Ubx vs NMEA)

The data collection was then started and thus collected data was in two different formats .UBX and .NMEA. The .UBX format is the unprocessed data and the .NMEA format is the processed data from the base station. The comparison was done and the processed data was found to have better accuracy than compared to the unprocessed one.

1.6. SUMMARY

This training empower us to collect data using low cost receiver, taught us various positioning methods, various gnss survey methods, various post processing methods and do the comparison, post-processed solution and real-time solution. We get to know about QZSS-PPP service such as CLAS and MADOCA-PPP.

1.7. RECOMMENDATIONS

We would recommend organizer to put one more lecture and workout regarding accuracy and precision statistics of gnss field collected data.