Report on GNSS Training

Course ID: T151-40

Team No: 11

Team Members:

Miss Thitimar Chongtaku

Mr. Siwat Kongwarakom

Mr. Warot Watahong

Mr. Thantham Khamyai

Training held at GIC/AIT, Thailand

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1. TEAM 11

1.1. EXECUTIVE SUMMARY

GNSS (Global navigation satellite system) is used to determine position for both dynamic and static methods. To know position, various navigation satellites which are from several nations such as USA (GPS), GLONASS (Russia), BeiDou (China), QZSS (Japan) and Galileo (Europe) provide the positioning service. Positioning methods that are mostly used are SPP (Single Point Positioning), DGPS (Differential Global Positioning System) and RTK (Real Time Kinematic). SPP is the positioning method which derives absolute position using only C/A code. DGPS comprises base station and rover. Base station is a fixed position with true location through a time while rover is collecting data. The collected position would be solved to enhance accuracy and precision for rover positioning. RTK is a positioning method to fix location real time while RTK base station is fixed. The RTK base station would send fix signal to RTK rover at the same time (real time).

In this study, there are 2 receivers which are high price (NetR9) and low price (M8T) receivers. Position collection were SPP, RTK and DGPS. First, we would compare SPP method between NetR9 and M8T. Second the DGPS which rover(M8T) was fixed signal by base station would be illustrated how they are different from SPP. Finally, RTK method which C/A code and L code were contributed to determine more precise positioning was operated by post processing, and it would be compared with SPP and DGPS on how precise and accurate of these three methods of positioning.

The project focuses on a comparison of different positioning methods provided by free and open source software (FOSS) package called RTKLIB, RTKDroid, and U-Center. In conclusion, three types of positioning mode including Single Point Positioning (SPP), Differential GPS (DGPS), and Real Time Kinematic (RTK) evaluate differently result for accuracy level. The errors in GPS Observation caused by several reasons, i.e., satellite orbit, satellite clock, ionosphere Error, troposphere Error, multipath, and receiver circuits. Thus, different positioning methods provide the error which is cut off 50 percent of data, SPP is 1.998106 m for rover and 2.275975 m for base respectively. Whereas DGPS is 1.210554 m and RTK is 0.00016 which is the most accurate and good precision among three methods.

For further study, it will be useful if we can integrate and apply all of the technique to survey and collect the data and use all the equipment together both low-cost and high-end receiver.

1.2. TEAM MEMBERS

No.	Member		Affiliation	E-mail
1	Miss Thitimar Chongtaku	Doctoral Student	Remote Sensing and Geographic Information System (RS&GIS), Department of Information & Communication Technologies (ICT), School of Engineering and Technology (SET), Asian Institute of Technology (AIT), Thailand	St119790@ait.asia
2	Mr. Siwat Kongwarakom	Master Degree Student		St120582@ait.asia
3	Mr. Warot Watahong	Master Degree Student		St120353@ait.asia
4	Mr. Thantham Khamyai	Master Degree Student		St120251@ait.asia

1.3. INTRODUCTION

GNSS (Global navigation satellite system) is used to determine position for both dynamic and static methods. To know position, various navigation satellites which are from several nations such as USA (GPS), GLONASS (Russia), BeiDou (China), QZSS (Japan) and Galileo (Europe) provide the positioning service to users by many types of signals and communication to determine more precise and accurate position.

Basically, positioning methods that are mostly used are SPP (Single Point Positioning), DGPS (Differential Global Positioning System) and RTK (Real Time Kinematic). Those have different principle and ways of processing to determine position. SPP is the positioning method which derives absolute position using C/A code from navigation satellites by solving time and distance of signal from 4 satellites to determine position. DGPS comprises base station and rover. Base station is a fixed position with true location through a time while rover is collecting data. The collected position would be solved to enhance accuracy and precision for rover positioning. RTK is a positioning method to fix location real time while RTK base station is fixed. The RTK base station would send fix signal to RTK rover at the same time (real time). However, if it is cannot be real time processing, it can do post processing also.

In this study, there are 2 receivers which are high-end (NetR9) and low-end (M8T) receivers. Position collection were SPP, RTK and DGPS. Two receivers collected position with the same antenna because we prefer to compare data between these two receivers.

Firstly, we would compare SPP method between NetR9 and M8T. Secondary, the DGPS which rover(M8T) was fixed signal by base station would be illustrated how they are different from SPP. Finally,

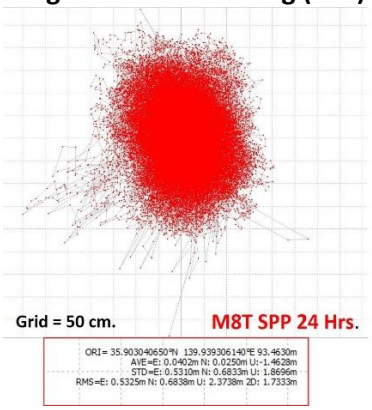
RTK method which C/A code and L code were contributed to determine more precise positioning was operated by post processing, and it would be compared with SPP and DGPS on how precise and accurate of these three methods of positioning.

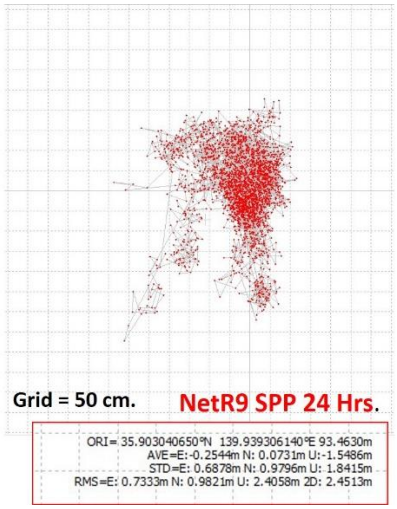
1.4. SUMMARY

The project focuses on a comparison of different positioning methods provided by free and open source software (FOSS) package called RTKLIB, RTKDroid, and U-Center. The RTKLIB supports real - time and post - processed positioning while U-Center play a key important role for configuration setting of receiver. The most important modes of operation tested by the team are Kinematic, Static, Fixed. The data for evaluation were obtained from low - high cost Global Navigation Satellite System (GNSS) receiver including M8T and NetR9.

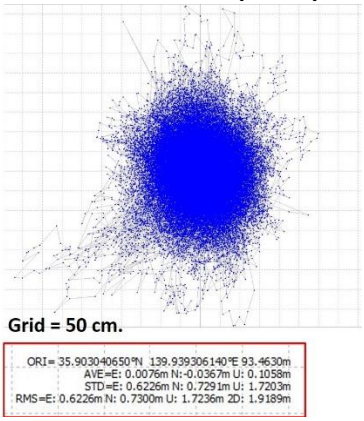
In conclusion, three types of positioning mode including Single Point Positioning (SPP), Differential GPS (DGPS), and Real Time Kinematic (RTK) evaluate differently result for accuracy level due to its attribute, for example, type of observation, required reference station, receiver, and surrounding environment.

Single Point Positioning (SPP)

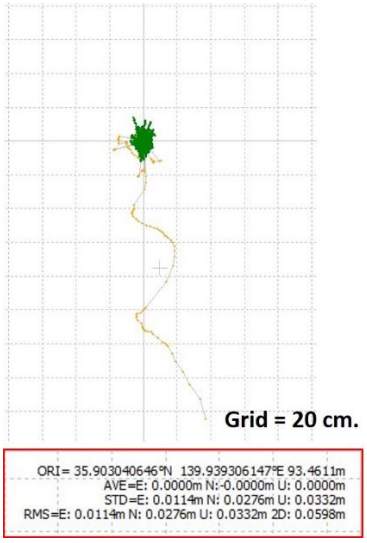




Differential GPS (DGPS)



Real Time Kinematic (RTK)



Moreover, errors in GPS Observation caused by several reasons, i.e., satellite orbit, satellite clock, ionosphere Error, troposphere Error, multipath, and receiver circuits. Thus, different positioning methods provide the error which is cut off 50 percent of data as given table

Single Point Positioning (SPP)	**Differential GPS (DGPS)**	**Real Time Kinematic (RTK)**
CEP of Rover: 1.998106 m CEP of Base : 2.275975 m	1.210554 m	0.00016 m

1.5. RECOMMENDATIONS

For the recommendation of this work, it would be better if we have a time for field survey and collecting the data by ourselves instead of using the sample data. Besides, if we can do it by ourselves it can help us to improve our skill and technique in GNSS work.

In addition, field data collection and data logging, if we had more time during the field work then we can log the data and get the better result for processing the data.

For further study, it will be useful if we can integrate and apply all of the technique to survey and collect the data and use all the equipment together both low-cost and high-end receiver as well as further interoperability purpose, it will be also better if we can share and exchange the data together to compare and discuss the result before and after processing.