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Kinematic PPP Positioning Using Different Processing Platforms

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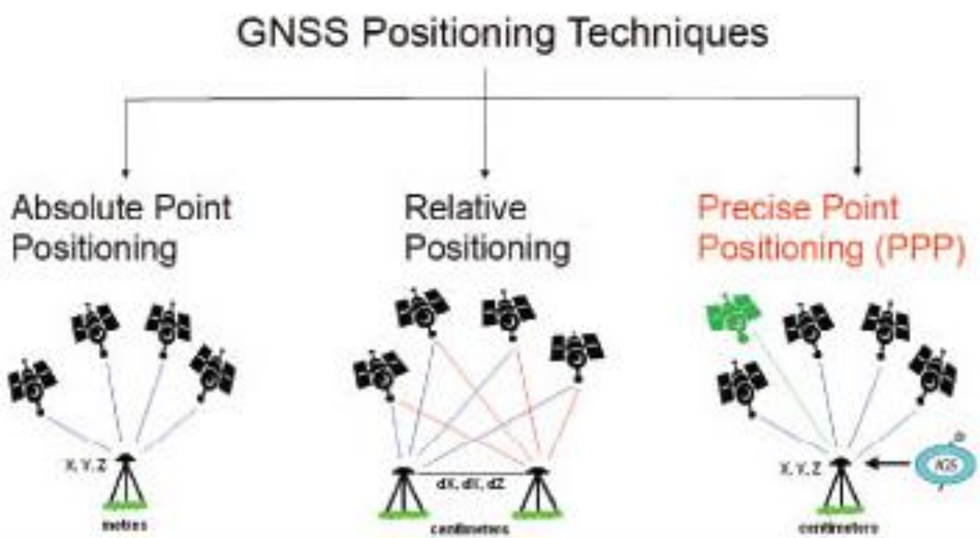
- ***Introduction***
- ***Aplication – Kinematic Test***
- ***Evaluation of the Measurements***
- ***Conclusion***

INTRODUCTION

Precise Point Positioning (PPP) that has attracted wide interest by academic and commercial community in the last decade.

This absolute positioning technique uses undifferenced carrier phase and pseudorange observations besides precise orbit and clock data for accurate positioning.

Using only single dual-frequency Global Navigation Satellite System (GNSS) receiver, PPP provides reliable and accurate global solution to the users in cm and decimeter level positioning accuracy for static and kinematic positioning techniques, respectively.



The PPP technique has become a strong alternative to the differential GNSS methods due to its;

- easy use,
- simple field operations,
- no base station requirement, and,
- provides cost effective high accuracy positioning.

The use of PPP has been increased, but it has some drawbacks including **necessity of long occupation time for converge** and **unavailability of PPP processing mode** in common commercial GPS processing software.

Especially long convergence time is limited its use in many situations where rapid GPS surveying is required and surveying efficiency is concerned.

There are various alternatives to be used in order to obtain PPP-derived coordinates and they can be categorized into different processing platforms like;

- Scientific (Academic) Software (e.g. BERNESE, GAMIT, GIPSY OASIS, RTKLIB, and gLAB),
- Commercial Software (e.g. GrafNav),
- Web-based Online Processing Services (e.g. CSRS, APPS, GAPS, and magicGNSS)
- In-house software

Recently, web-based online GNSS processing services have been developed by several institutions, research centres or organizations as an alternative to conventional GNSS data processing methods and served to users all over the world. The users of these services do not need a processing software and their complex processing strategies.

Within this study, two different PPP processing platforms;

- Scientific (academic) / commercial software
- online processing services

were used to estimate PPP-derived coordinates.

Used Scientific/Commercial PPP Post-Processing Software

RTKLIB: RTKLIB is an open source program package for multi-GNSS positioning software developed by Tomoji Takasu from the Tokyo University of Marine Science and Technology in Japan.

gLAB: gLAB GNSS analysis tool was developed by research group of Astronomy and Geomatics (gAGE) from the Universitat Politechnica de Catalunya (UPC) for European Space Agency (ESA).

GrafNav: GrafNav is a commercial GNSS post-processing software developed by Waypoint Products Group of Novatel.

Used Web-Based Online GNSS Processing Services

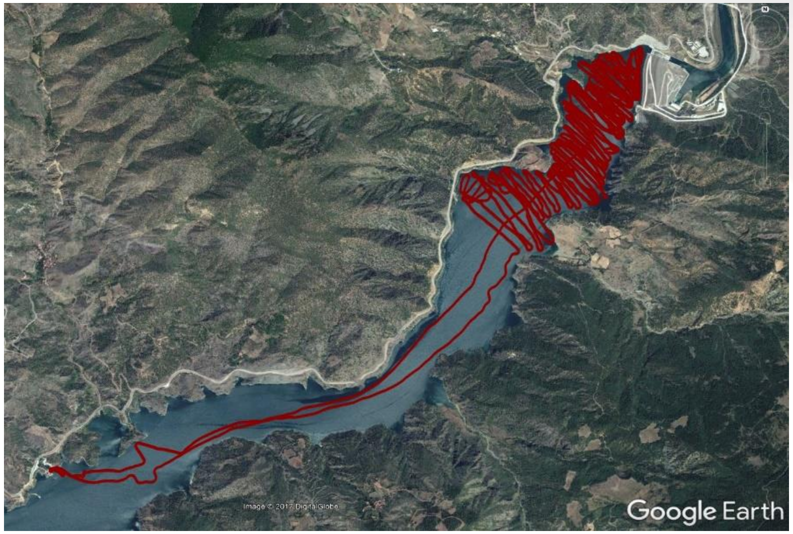
Canadian Spatial Reference System Precise Point Positioning (CSRS): In 2003, the CSRS-PPP service, operated by Geodetic Survey Division of Natural Resources Canada (NRCan), was developed.

magicGNSS: The magicGNSS online GNSS processing service, developed by GMV Aerospace and Defense Company in Spain, was launched in 2008.

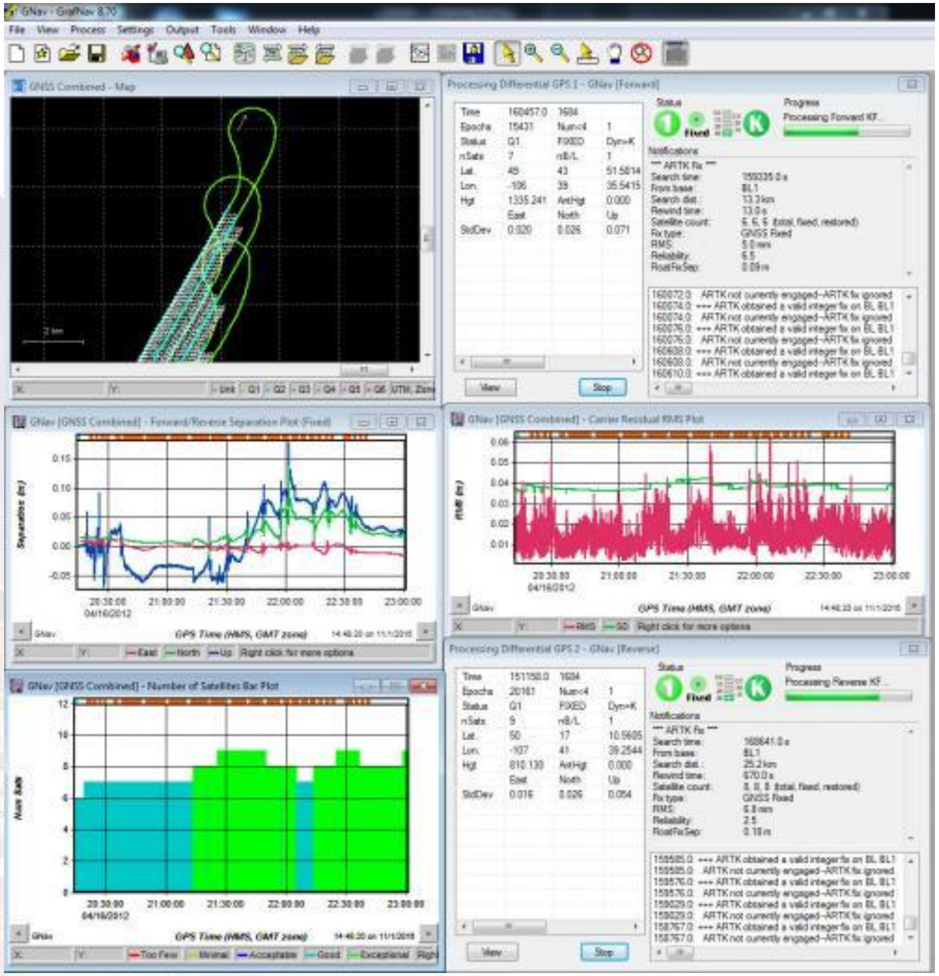
PERFORMANCE ANALYSIS OF KINEMATIC PPP

In order to compare the positioning performance of different PPP data processing platforms, a kinematic test was conducted at Obruk Dam Lake, in Çorum, Turkey in June of 2017.

Through the test, the data was collected for approximately 6 hours at 1-second data collection interval with an elevation mask of 10°. In this experiment, Trimble R10 multi-frequency/multi-constellation GNSS receivers were used.



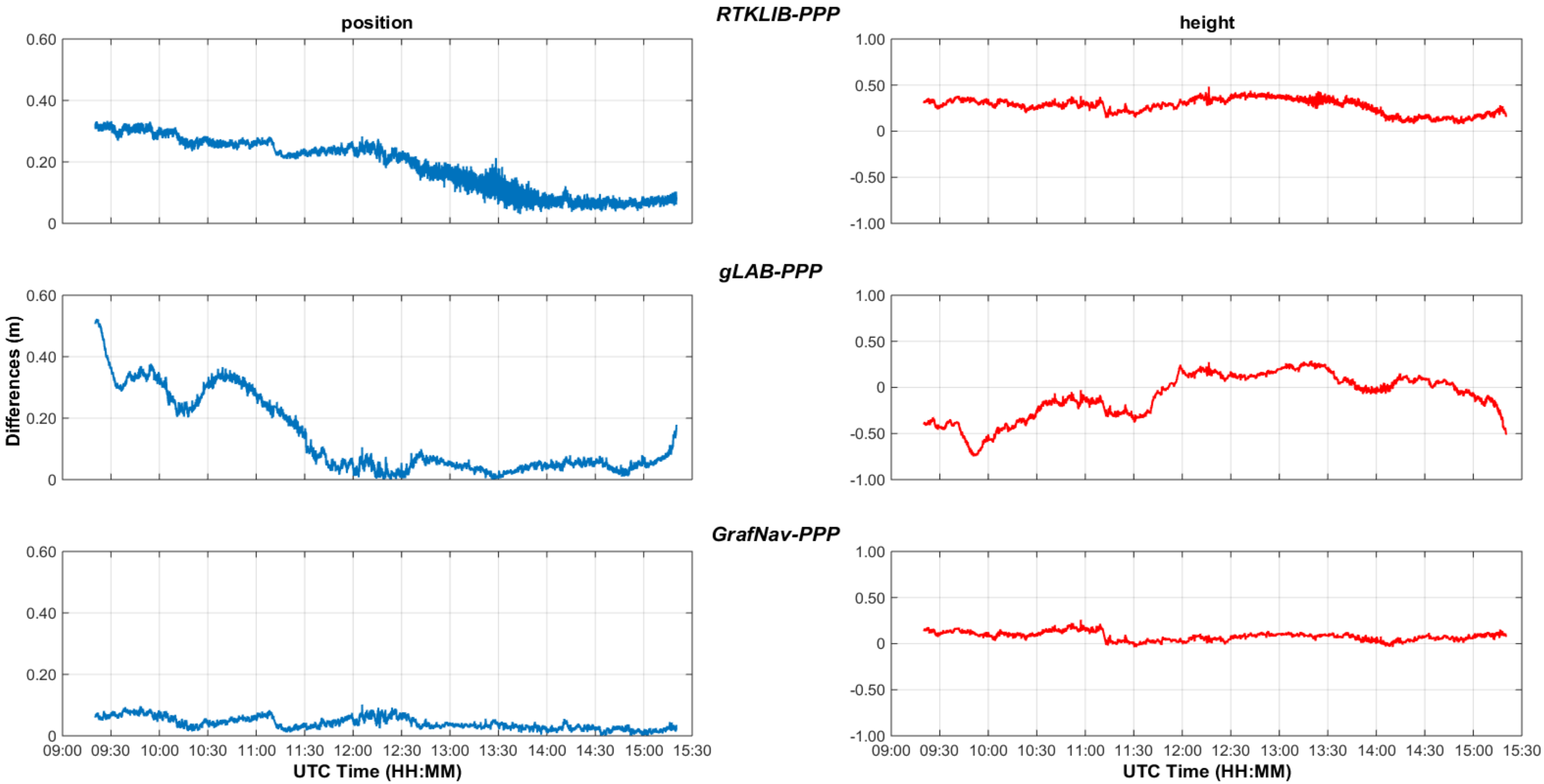
During the kinematic experiment, a second same type of GNSS receiver was occupied at a reference point on the shore and the GNSS data were collected through the measurement. The collected data at this station was used to calculate the precise known coordinates of vessel for each epoch (i.e. in order to obtain reference trajectory) with the carrier-phase-based differential method.



The known coordinates of the vessel (reference trajectory) with PPP technique were calculated with GrafNav GNSS Post-Processing Software.

The the PPP-derived coordinates of the vessel were calculated with GrafNav GNSS Post-Processing Software, gLAB and RTKLIB.

Additionally, the collected data on the vessel was sent to the magicGNSS service via e-mail, and to the CSRS-PPP online-PPP service using its interactive web page.


RTKLIB-PPP
position
height
gLAB-PPP
GrafNav-PPP
Differences (m)
0.60
0.40
0.20
0
1.00
0.50
-0.50
-1.00
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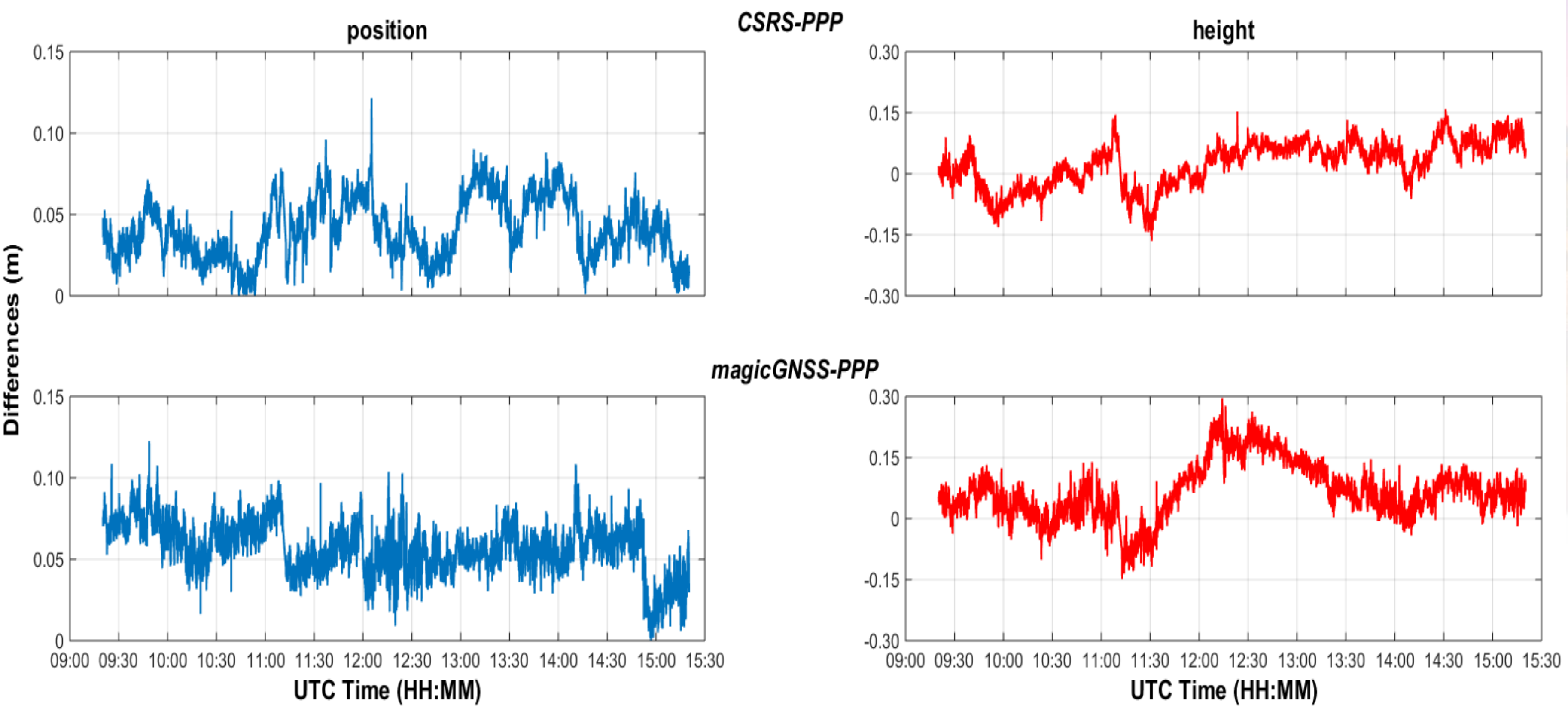
UTC Time (HH:MM)


CSRS-PPP
position
height
magicGNSS-PPP
Differences (m)
0.15
0.10
0.05
0
0.30
0.15
0
-0.15
-0.30
09:00 09:30 10:00 10:30 11:00 11:30 12:00 12:30 13:00 13:30 14:00 14:30 15:00 15:30
UTC Time (HH:MM)

When the results are examined, it is seen that the online services generally produce better accuracy than the scientific/commercial software. For scientific/commercial software group, the best result was obtained from GrafNav software, where the difference for 2D position reach to 10 cm as a maximum, while the difference for height component varies between -4 cm and 26 cm.

CONCLUSION

The results showed that under dm level of accuracy can be achieved with the PPP technique in a dynamic environment easily, quickly and cost-effectively. The obtained accuracy proves that the PPP technique can be used many marine surveying applications.

On the other hand, when the PPP is chosen as a positioning technique for engineering or similar projects, it is highly recommended that the results must be analysed and interpreted very carefully. It should be kept in mind that, using the results without any analysis may cause a big mistake in some cases. Therefore, the results could be checked for instance by evaluating the same data sets on different platforms.

Thank you very much for your interest and attention…

Contributions, Questions???

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