

Accepted Manuscript

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PII: S0273-1177(17)30296-X
DOI: <http://dx.doi.org/10.1016/j.asr.2017.04.016>
Reference: JASR 13195

To appear in: *Advances in Space Research*

Received Date: 29 August 2016
Revised Date: 17 April 2017
Accepted Date: 18 April 2017



Please cite this article as: Paziewski, J., Sieradzki, R., Integrated GPS+BDS instantaneous medium baseline RTK positioning: signal analysis, methodology and performance assessment, *Advances in Space Research* (2017), doi: <http://dx.doi.org/10.1016/j.asr.2017.04.016>

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Integrated GPS+BDS instantaneous medium baseline RTK positioning: signal analysis, methodology and performance assessment

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Keywords: RTK positioning, GNSS, GPS, BDS, relative kinematic positioning

Abstract

BDS system has become regionally operational and it is expected that it will reach its full operational status in the next few years. Therefore application of fully operational GPS system together with dynamically developing BDS is of interest for scientific, navigation and land surveying communities. This study demonstrates an analysis of measurement noise for both aforementioned systems at the beginning. In the second part the mathematical and stochastic models of combined multi-GNSS medium range RTK positioning were presented. Furthermore, the performance assessment of single-epoch multi-baseline positioning was analyzed. The analysis of dispersion of undifferenced pseudorange observations caused by noise and multipath effect has confirmed slightly higher precision of code observations on the first in respect to second frequency for both systems. Moreover, the more detailed analysis suggests that in the case of strong ionospheric disturbances the internal smoothing of code measurements can be a source of their strong discrepancies. Due to the medium length of baselines (~40 km) the investigation of phase measurement noise was executed using triple differenced data. Generally it has shown the similar level of discrepancies for both systems. Only for geostationary BDS satellites one can observe measurable increase of noise. The quality assessment of instantaneous multi-baseline RTK (Real Time Kinematic) positioning based on single GPS or BDS systems, as well as on combined multi-GNSS observations, was evaluated simulating different observing conditions with terrain obstacles. The performance assessment of combined GPS and BDS precise relative positioning has proved the advantage of multi-GNSS positioning especially in harsh observing conditions. The usage of observational data from both systems allowed instantaneous positioning even with high elevation mask.

Keywords: GNSS positioning, RTK, instantaneous positioning, multi constellation positioning, signal noise

1. Introduction

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