Quality Assessment of GNSS Observations from Recent Low-Cost Receivers

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SUMMARY

Consequences of technology development and market expectations are cost-reduced versions of instruments designed to track Global Navigation Satellite System (GNSS) signals. GNSS mass-market receivers can be distinguished into the chipsets embedded in smartphone devices and the low-cost modules integrated with application boards. The first group aims at providing an approximate position primarily for personal navigation and applications. The positioning accuracy of smartphone chipsets is limited by factors such as quality of integrated antenna, high suppression to multipath, or duty-cycling effect. The low-cost receivers are, in turn, not constrained by the above limitations and thus can be used in precise applications by industry users. However, a prerequisite of precise positioning with such receivers is a high quality of code and phase GNSS measurements and a correct definition of the stochastic model.

This study aims to assess the noise of GNSS observations collected by the most recent multi-frequency GNSS low-cost receivers. The experiment is based on zero-baseline set-ups built of pairs of the receivers provided by u-blox, Skytraq, and Septentrio. The analysis investigates the stochastic properties of multi-system code and phase data transmitted on all available frequency bands. The code pseudoranges are assessed using a multipath combination, which provides information on the coupled impact of pseudorange noise and multipath effect. We use double-differenced data derived from a zero-baseline set-up built of homogenous pair of receivers to analyze phase observations. In the study, we take advantage of two kinds of GNSS antennas, namely a patch one dedicated for low-cost receivers and a geodetic one used as a benchmark to contrast the results. The results are also compared with the corresponding dataset recorded with a high-grade geodetic receiver - Trimble Alloy. The experimental results reveal a competing to high-grade receivers quality of the low-cost receiver observations and, thus, the applicability of such receivers to precise positioning.