

Assessment of the accuracy of low-cost multi-GNSS receivers in monitoring bridge response

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Key words: *low-cost GNSS receiver; multi-GNSS; bridge monitoring; accuracy; modal frequency*

ABSTRACT

The monitoring of bridges is a crucial operation for their maintenance and safe operation. Several methodologies have been developed the last decades, where different sensors are deployed to measure the bridge response (displacement, acceleration, tilt, strain, etc.). GNSS technology is one of the methods which are applied with the main advantage the direct measurement of the bridge displacement is carried out in an independent global coordinate system. However, the high cost of the GNSS stations, consisted of dual frequency receiver and geodetic GNSS antenna, is the main reason of the limited application of GNSS for bridge monitoring. In the current study, we assess the accuracy of low-cost multi-GNSS receivers in monitoring dynamic motion, similar to that of bridge response. The precision of low-cost GNSS receivers was assessed against high-performance dual frequency GNSS receivers, by executing controlled circular motion of predefined radius, of amplitude ranging between 5 to 50 cm, and frequency of 0.363 Hz. From the analysis of the GNSS measurements it was assessed the precision of GPS-only and the potential beneficial contribution of multi-GNSS constellation by enhancing the accuracy of GNSS solution. Then, a low-cost monitoring system formed by two closely-spaced low-cost GNSS receivers was applied in dynamic displacement monitoring of the Wilford pedestrian bridge. The analysis from low-cost GNSS data shows similar accuracy in monitoring the bridge dynamic response to that of the survey-grade GNSS receiver, with same main modal frequency of the bridge identified.

This contribution was selected by the Scientific Committee for publication as an extended paper in Applied Geomatics <https://www.springer.com/journal/12518>