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RESEARCH

Assessing the quality of raw GNSS observations and 3D positioning performance using the Xiaomi Mi 8 dual-frequency smartphone in Northwest Mexico

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Abstract

GNSS observations from smartphones have gained popularity in recent years due to the high precision achieved in various applications. While most studies have focused on signal quality evaluation, few have explored static and kinematic positioning. Furthermore, the majority of these studies have primarily concentrated on European and Asian countries. Therefore, we present the first study conducted in Northwest Mexico, which evaluates the performance of static and kinematic positioning using code and phase observations obtained from the Xiaomi Mi 8 smartphone. In addition, we assess the signal quality of ~ 100 available GNSS satellites. This study proposes an alternative method for analyzing the observed Carrier-to-Noise Density Ratio (C/N_0) of GNSS observations in relation to theoretical reference values. The results reveal that the average C/N_0 value of the GNSS satellites is approximately 18% lower than the reference values. Furthermore, the pseudorange observations indicate a significant multipath error, with magnitudes close to 200 cm for L1/E1 and less than 86 cm for L5/E5a, highlighting the susceptibility of the smartphones GNSS antenna to this type of error. The static experiment demonstrates RMS positioning errors of 0.7 cm, 1.2 cm, and 4.2 cm for the E, N, and U components, respectively. Moreover, the kinematic experiment exhibits discrepancies of 1.4 cm due to the circular trajectory of the smartphone. Finally, the results suggest that dual-frequency smartphones offer promising positioning capabilities, presenting opportunities for engineering applications, including structural health monitoring, among others.

Keywords Smartphone Xiaomi Mi 8 · Kinematic and static positioning · Quality analysis · Multipath · Carrier-to-noise density ratio · GNSS

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