Improved GNSS Measurement Quality Estimation for Positioning Performance Validation

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Abstract From most daily tasks to complex operations, modern devices are very much dependent on Global Navigation Satellite System (GNSS) technology to provide location information. This technology is proverbial that it is almost expected to perform ideally when sufficient GNSS satellites are in view. Although GNSS positioning is generally reliable, such systems would occasionally provide unrealistic measurements and currently, there are no established means to independently validate the performance of such devices from a system level. Thereby, this research aims to develop algorithms to refine GNSS measurement quality estimation techniques which are to be used for positioning performance validation.

Introduction

Contrary to many standalone electronic devices, the performance of a GNSS device is not only dependent on its internal circuits and processors, but is greatly influenced by many external factors such as the atmospherics. In developing an effective methodology for GNSS device testing, this research has identified that quality indicators, through stochastic modelling, play a big role in determining the performance of positioning from an overall system level. The simplistic stochastic models used for most GNSS devices is one of the main causes of inaccurate quality indicators. As such, this research is divided into the theoretical and practical component, with the repeatability of the tests being a crucial aspect of the overall methodology.

Methodology

Theoretical Component

The ongoing issue with high precision stochastic modelling stems from the treatment of systematic residuals as residual noise, leading to the occasional unrealistic quality estimation. This research attempts to address these systematic residuals in order to provide more accurate and reliable quality estimation.

Practical Component

In its preliminary stage, a Record and Playback System (RPS) is used as a primary tool to generate a reliable test platform for different receivers. As the satellite signal itself is kept as a constraint, the positioning performance can be evaluated from the raw measurement generated by the receiver. It is from these raw measurements that stochastic models are used to calculate positioning quality estimations. Hence, receiver performance is validated based on the internal/onboard receiver quality estimations against the refined quality estimation algorithms developed.

Research Methodology Diagram