SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Space-Based Navigation Systems and Services (6)

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GNSS RELIABILITY TESTING IN SIGNAL-DEGRADED SCENARIO

Abstract

Satellite navigation is critical in signal degraded environments where GNSS signals are strongly degraded and navigation solution can be inaccurate or unavailable. In this case the use of a single GNSS system do not guarantee an accurate and continuous positioning, a possible approach to solve the problem is the use of a multi constellation GNSS; in this work a GPS/GLONASS integration is considered. This approach provides enhancement of the positioning in terms of accuracy, integrity and availability. Monitoring the reliability and the quality of the obtained user navigation solution is essential for all considered GNSS configurations such as GPS standalone or integrated GPS/GLONASS. Reliability testing in GNSS context are usually referred to as RAIM (Receiver Autonomous Integrity Monitoring) and FDE (Fault Detection and Exclusion) and traditionally rely on statistical tests in order to detect and exclude erroneous measurements. RAIM techniques were developed, for the aviation application, to assess the integrity of GNSS signals and to guarantee the RNP; these techniques are fundamental in safety-critical GNSS applications. Air navigation are characterized by open sky scenario and only one measurement is supposed to be a gross error (or blunder), In this work the environment considered is critical for GNSS application and more blunders are supposed to be present in a measurements set. The FDE schemes analyzed in this research are obtained by combining different basic statistical tests. Specifically a so-called Global Test is adopted to verify, through an analysis of the self-consistency of the measure set, the presence of a blunder among the observations. A Local Test can be adopted to identify and reject a blunder into a data set declared not-consistent by the Global Test. The RAIM techniques investigated are Observation Subset Testing, Forward-Backward Method and Danish Method. Observation Subset Testing is carried out to find a self-consistent measurement subset iterating global test. Forward-Backward Method involves the use of the global test to identify an inconsistent set ,and the local test to identify and reject the suspected measurement, using global tests also to find the measurements to re-include into the solution computation. The Danish Method, similarly to the previous technique, combines global and local tests, iteratively reweighting suspected measurements in a least squares algorithm.