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Author: Dr. Talini Pinto Jayawardena
Spirent Communications, United Kingdom

Dr. Ronald Wong
Spirent Communications, United Kingdom
Mr. Peter Aves
Analytical Graphics, Inc., United States
Ms. Karynna Tuan
Analytical Graphics, Inc., Singapore, Republic of
Dr. Robert Watson
University of Bath, United Kingdom
Prof. Cathryn Mitchell
University of Bath, United Kingdom

A COMPREHENSIVE TEST FRAMEWORK FOR THE PRE-LAUNCH EVALUATION OF GNSS RECEIVERS IN SATELLITES OPERATING IN THE SPACE SERVICE VOLUME (SSV)

Abstract

GNSS receivers are commonly used for precise orbit determination (POD) and on-board time stamping in satellites operating in geocentric orbits, particularly below GNSS altitudes such as the Low Earth Orbit (LEO). With the emergence of the commercial space industry, the use of GNSS within small satellites have become standard and considered an off-the-shelf plug-in system. This paper discusses the unique challenges that are encountered when integrating a GNSS system into a satellite and introduces a test framework that can enable system-level evaluation of spacecraft navigation and timing during ground testing before launch.

Given the lack of standardised test requirements for space borne GNSS systems, they are often subjected to only the basic pre-launch testing to confirm successful operation – most of which do not represent the environment in which the GNSS receiver operates in-orbit. Examples of such testing include simple go/no-go tests of the stand-alone receiver/antenna sub-system and testing with a live-sky signal received on the ground without replicating the in-orbit satellite motion. The problem becomes further exacerbated when considering more complex applications such as the planned future use of GNSS PNT in cis-lunar/lunar activities. The paper proposes the use of a test environment capable of realistically simulating the GNSS RF environment as seen by the satellite when operating in the SSV, which may be incorporated into hardware-in-the-loop (HIL) testing. The approach allows the realisation of the GNSS environment specific to a given spacecraft, which may be integrated into a comprehensive test framework where system-level testing can be performed on combined navigation/timing instrumentation.