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GNSS TO REACH THE MOON

Abstract

Reaching the Moon poses very strict requirements in terms of performance, flexibility and cost for all the spacecraft subsystems. These requirements become more stringent if this mission is designed to be accomplished using a small satellite. Navigation subsystem is without any doubts essential and nowadays, several systems offer different solutions to the navigation problem. Global Navigation Satellite Systems (GNSSs) such as GPS, GLONASS, or the future Galileo and BeiDou systems, introduce an easier way to provide an autonomous on-board orbit determination system; they only require the realization and installation of an on-board GNSS receiver, with low-cost, low-power consumption and limited mass and volume. While GNSSs have been already exploited with success for Low Earth Orbit (LEO), their use for very High Earth Orbit (HEO) up to the Moon altitude is still at the research stage. In this context, the purpose of this research is to determine the potential achievable accuracy of a code-based GNSS solution, during the whole trajectory to reach the Moon. GPS, Galileo, and GPS-Galileo combined (dual constellation) solutions are estimated, by considering constellations availability, pseudorange error factors and geometry factors. Unlike previous investigations, our study is making use of a very accurate multi-GNSS constellation simulator "Spirent GSS8000", which supports simultaneously the GPS and Galileo systems and the L1, L5, E1, E5 frequency bands. The contribution of this study, based on the achieved results, clearly demonstrates that GNSS signals can be tracked at the Moon's surface, but not with the current GNSS receiver's technology for terrestrial use. Therefore integration of a GPS-Galileo receiver with additional sensors and additional assistance are considered in order to improve the accuracy of the navigation solution and achieve the required sensitivity.