IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advances in Space-based Navigation Systems, Services, and Applications (7)

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AUTONOMOUS ORBIT DETERMINATION USING GNSS RECEIVER FOR ORBITAL RANDEZVOUS

Abstract

In recent years, GNSS systems have seen sufficient scientific and technological advancements to be deemed reliable for space applications. Given that certain space missions employ navigation technologies capable of collecting and processing GNSS information. The GNSS readings constitute a vast amount of data that will be utilized for Real-Time Orbit Determination. Orbit determination (OD) is the use of satellite data to determine the positions and relative movements of space objects. This is necessary for formation and rendezvous maneuvers, such as those required to assemble or restock a space station, as well as for navigation to a specified target orbit. Applications of relative orbit determination include determining the distance between spacecraft in formations, swarms, and rendezvous, as well as estimating their location and orientation using angle measurements. The GNSS system is currently considered a fundamental part of on-board relative navigation for a number of applications, ranging from precise baseline determination on the ground to coarse real-time estimation onboard. This Topical Collection contains flight results from missions such as the Space Shuttle, PRISMA, TanDEM-X, and Magnetospheric Multi-Scale to illustrate the precision and usability of GNSS for both real-time and offline space-based relative navigation.

Orbit determination is a difficult subject that requires meticulous modeling to ensure that the system runs within safe constraints. This is especially true for missions involving space rendezvous, which might result in misunderstandings or conflict with other space actors. These procedures may be necessary to the mission of a space station or spaceship, but they usually violate best practices and ethical standards

This article's objective is to examine the applicability and performance of autonomous GNSS Orbit Determination for a LEO-orbiting spacecraft planning to execute rendezvous and docking. The study has been performed considering the Orbit Determination loop, from the GNSS signal acquisition to the estimation of satellite orbital parameters. The entire OD chain should consider different arc of acquisition and prediction and noise for the GNSS measurements. The analysis must take into account the mission requirements in terms of final accuracy and time needed to provide a reliable solution.