SPACE OPERATIONS SYMPOSIUM (B6)
New Operations Concepts, Advanced Systems and Commercial Space Operations (2)

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AUTONOMOUS GEOSTATIONARY STATION KEEPING USING ELECTRIC PROPULSION

Abstract

To date, the computations required for effective geostationary station keeping are executed on the ground by an expert team which uses specialized software for acquiring ranging and tracking data and the generation of the actual position and deviations of the satellite from its nominal position. A correcting maneuver is calculated and uploaded via telecommand. Once the maneuver is executed, the propellant consumption is calculated, and a new ranging campaign is performed to check the correct realization of the maneuver. Such operations represent an important workload for operators and scale with the number of satellites in their fleet.

Currently, electric propulsion is starting to become a baseline on GEO platforms for orbit raising and station keeping. Because of its low thrust capacity (limited to milli-Newtons), the overall thrusting time (several hours) is more important, while the maneuvers are more frequent, increasing the load on on-ground operations and planning. It would clearly be beneficial if the station keeping strategy could be modified and optimized for such system.

In the context of new operations concepts and cost reduction, on-board autonomy has been constantly increased to decrease the burden of procedures preparation. This paper highlights key parameters and methods to implement an autonomous station keeping system in GEO with low thrust propulsion for satellite operators. The method is based on the high precision orbit propagation of the state vectors and their integration using Cowell's method and a Runge-Kutta solver, regularly updated by GNSS data (fully autonomous) or by a TC from ground (semi autonomous). The system is able to detect the deviations in terms of COE and Radial In-track and Cross-track vector regarding its nominal position in the window. Different station keeping strategies using electric propulsion are discussed based on the frequency, the duration and the combination of the maneuvers. The results in terms of orbital control and propellant consumption associated with each scenario are then discussed. The operational aspects are also considered for each strategy.

In this way, the role of station keeping autonomy as an effective way of reducing operation cost, operators workload is demonstrated, as is the possibility for the provision of better orbital window control derived from reducing limitations in ground operations, an important factor for collocated satellites.