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AUTOMATING SATELLITE MANEUVER PLANNING AND EXECUTION

Abstract

During the last decades, automation in satellite operations yielded many advantages like cost reductions and process improvements. Nevertheless, some areas still require a lot of manual intervention, such as maneuver planning. Up until today, most maneuvers are planned manually by operators and commanded afterwards with little automation. To address this issue, the paper at hand elaborates on how to implement a highly automated maneuver planning and execution concept for the operational phase of *Low* (LEO) and *Medium Earth Orbit* (MEO) satellite missions.

In a mission context maneuvers can basically be divided into two disjoint categories: nominal and off-nominal ones. While the first category comprises orbit keeping and collision avoidance maneuvers, the latter one covers all exceptional cases, including orbit transfer and de-orbiting maneuvers. Since nominal maneuvers constitute the vast part of the operational phase of a satellite mission, the discussed concept focuses on the automation of orbit keeping maneuvers and gives an outlook on how to automate collision avoidance.

Generally, maneuvers are optimized such that the required Δv is minimal. This also holds for the considered planning strategy which can be further constrained by mission requirements so that maneuvers shall only be executed during predefined time slots. As payload operations are likely to be interfered by maneuvers, the aim is to minimize maintenance periods while still fulfilling all mission requirements. Depending on the mission profile, the orbital region and other environmental conditions, a planning strategy might need to be adjusted over time (manually or automatically) to account for changing circumstances.

Given the above mentioned constraints, a maneuver is calculated in line with the planning strategy. The whole chain is automated here: orbit determination, maneuver planning, orbit propagation (including the planned maneuvers) and finally the conversion to a telecommand sent to the satellite. This automation is generic and independent of a specific project, meaning that the proposed concept can cope with various satellite types and different propulsion systems. The flight dynamics algorithms, however, are strictly separated by means of an interface as they are only generic to the extent of a certain mission profile and orbital region. With this modularization, the flight dynamics algorithms can be exchanged without any need to modify the rest of the operations software. Thereby, costly and complex software adaptions for a new satellite system or mission can be tremendously reduced.