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SCHEDULE OPTIMIZATION FOR A HETEROGENEOUS EARTH OBSERVATION SATELLITE CONSTELLATION

Abstract

Spacecraft operations require finding the right compromise between utilizing and preserving their available resources in the pursuit of contributing as efficiently as possible to their declared mission goals. To achieve this balance, key resources such as data storage and downlink, power, thermal range, payload, and stakeholder interests need to be carefully managed. Managing the schedule of a single spacecraft is already a complex task, but the challenges increase significantly when multiple assets are involved in a constellation, leading to new use cases and requirements. The goal of this paper is to define and implement an optimization approach to the scheduling of a heterogeneous earth observation satellite constellation accounting for both mission success criteria as well as cost effectiveness of the operations, while also taking into account all other relevant resource constraints. This approach was developed and implemented while preparing for the integration of the FOREST-2 satellite mission developed by OroraTech into an expanding constellation of satellites used for detecting wildfires. The algorithmic approach is based on the strategy used during the operational phase of the FOREST-1 mission, which served as a predecessor to FOREST-2. Special consideration has been given to how changes in the number of satellites within the constellation impact overall performance, specifically in relation to factors such as latency and revisit times. However, the concept is transferable to the operations of any Low-Earth-Orbit Earth observation satellite constellation. The state of the art of commonly used approaches for the scheduling of constellations of Earth observation satellites is presented and evaluated with respect to their suitability to the task at hand, and compared to our proposed approach. The model description and implementation into the scheduling workflow are introduced and the results of a parameter analysis used for adjusting and validating the optimization of its results are presented.