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MULTI-ASSET SYSTEM DESIGN METHODOLOGY FOR EARTH OBSERVATION

Abstract

To better understand the Earth environment and climate change, to mitigate its effects and to provide emergency services, ensuring civil security, future European Earth observation (EO) infrastructures will heavily rely on operational satellite missions. To ensure continuous and timely provision of spaceborne Earth-observation data, these missions will be characterized by high temporal resolution, high availability, low latency and enhanced synergies between different observation products. These goals will likely be achieved by deploying multi-asset satellite systems, such as constellations and/or multiple modular payloads embarked on each spacecraft. In order to robustly design the EO system architecture, given a certain set of observational requirements, OHB has developed a parametric methodology to minimize the revisit time and the number of assets within the space segment, taking into account physical, technical and programmatics constraints. In the paper, OHB's developed methodology and the associated tool for parametric analysis generation are presented. Their objective is to reduce the wide trade space to a set of feasible and performance-wise compliant candidate mission scenarios to be further detailed and traded against criteria other than performances, such as cost, risk and schedule. Integrated versus sequential constellation deployment methods, and their respective optimum orbital phasing, are also discussed, to highlight the benefits and drawbacks of both deployments plans. For optical instruments, in particular, the detector size, being limited by technological capabilities, and the required spatial resolution effectively define the feasible swath width. Given the swath and the required revisit time, the minimum number of assets in the constellation is found through orbit optimization by generating the optimum repeating-ground-track Sun-synchronous orbits for the given set of input parameters. Furthermore, some relative instrument characteristics, that can be used to compare the different solutions, are computed for these mission profiles. The telescope aperture diameter scale with orbit altitude and the relative mass of the opto-mechanical part of the instrument can then be computed, for the different solutions, using an empirical law based on historical data, drawn from OHB heritage. When increasing the altitude, the instrument mass penalty is counterbalanced by increased availability and contacts with ground stations, reduced station keeping manoeuvres and propellant mass. The output of the analysis is eventually the solution that better weighs these different contributors, given the set of requirements to be compliant with. This methodology will be described in the paper and its effectiveness will be supported by an application example.