

IAF SPACE SYSTEMS SYMPOSIUM (D1)
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A MODEL-BASED APPROACH FOR THE PRELIMINARY DESIGN OF SMALL SATELLITES
CONSTELLATIONS BASED ON USER NEEDS ANALYSIS. THE IRIDE OPTICAL
SUB-CONSTELLATION CASE STUDY

Abstract

Users demand for services is a fundamental point for the end-to-end analysis of a space mission. In this work the importance of users' needs is highlighted thanks to the systematic model-based approach presented and used for obtaining optimal constellation in terms of services offered. The adopted methodology [1], that links users' need analysis and technical requirements of the considered constellation, includes 5 phases: formulation, in which, through an accurate analysis of user needs, it passes from user requirements to technical requirements and the former are traced thanks to a prioritization of the same, enumeration, in which the orbital parameters are selected of the constellation, then all possible constellation combinations are filtered with the parameters selected in the constellation design matrix, simulation, in which the obtained constellation combinations are simulated and the parameters and performances of interest are obtained, evaluation, in which the revenue metrics, down-selection, in which with the help of the Pareto optimality criterion it is possible to select optimal constellations in terms of satisfaction of user needs and amount of data downloaded to the ground. As a case study the preliminarily design of the optical sub-constellation of the Italian constellation for Earth Observation IRIDE, is considered. The considered case of study, based on the users' demand expressed through the Copernicus User Forum [2], permits to demonstrate the capability of the proposed approach for the preliminary designs of space architectures permitting to evaluate different optimal constellations and compare them considering their ability to reply to the needs raised by the end-users.

[1] Innovative methodology for the preliminary design approach for Low Earth Orbit constellations, Conti F., Marini L., Eugeni M., Pasquali M., Gaudenzi P., Proceedings of the 73rd International Astronautical Congress "IAC" 2022, Paris, France, 18th-22nd September 2022.

[2] E.Schiavon, A.Taramelli, A.Tornato, F.Pierangeli, Monitoring environmental and climate goals for European agriculture: User perspectives on the optimization of the Copernicus evolution offer, Journal of Environmental Management, 2021.