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RELIABILITY-BASED ORBITAL DESIGN OPTIMIZATION FOR A EARTH OBSERVATION SATELLITE

Abstract

In general, uncertainty is an inborn part of every system and thus, unavoidable. In order to have a real-life system with many interrelated components, taking uncertainties into consideration seems of upmost importance to have better performance, higher reliability, and robustness. In traditional methods of space mission design, the measurement to reflects goodness of an engineering design was only the system performance or a specific requirement such as revisit time, global coverage, mass or ground resolution, whereas more recently the focus on space systems has changed its tendency from mere performance to other aspects such as the economy, reliability, robustness of design, responsiveness as well as flexibility. This article aims to achieve the more robust and reliable orbit for an earth observation mission, in order to the satellite maintains its functionality when being exposed to orbital uncertainties. So, a mini-satellite platform is selected. In order to achieve the capability of “imaging everywhere and anytime”, the objective function is chosen as minimizing the number of orbital periods of the mission where the mean generated power of platform does not have to be less than the required power of satellite in that orbital period more than a definite limit (margin). Design variables are Altitude and inclination of orbit and right ascension of the ascending node. Several constraints are considered in the design. After a sensitivity analysis using Monte-Carlo simulations the most important uncertainties that have the most effect on objective function and the constraints such as orbital, structure and power parameters are determined. The particle swarm optimization algorithm and shifting constraint strategy are used respectively for optimization and reliability assessment. The results show a more reliable and robust point in comparison with deterministic optimization.