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DESIGN AND STUDY OF SATELLITE CONSTELLATIONS IN FROZEN LOW LUNAR ORBITS

Abstract

The ongoing study is devoted to the analysis of exploiting frozen low lunar orbits (LLOs) for global and zonal communication/navigation constellations. We introduce a novel approach to the robust frozen LLO design based on the combined use of two non-gradient techniques, the Bayesian optimization and the Nelder-Mead algorithm. The methodology developed allows the robust solution of the boundary value problem involving the one-year orbit propagation in the full dynamical model. The stability of obtained frozen orbits is quantified. Using the useful nomogram with basic visibility parameters and best global coverage curves, several candidate configurations for a LLO constellation are identified. The frozen condition effect on visibility and coverage characteristics (position dilution of precision, mean revisit time, n-fold coverage area percentage) is analyzed. The minimum numbers of orbital planes and satellites per plane in frozen LLO constellations are determined for the 1-fold or 4-fold coverage, globally and in polar regions.