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LARGE SCALE LEO CONSTELLATION DEPLOYMENT OPTIMIZATION METHOD BASED ON NSGA II

Abstract

The traditional one-shot deployment method is no longer suitable for large-scale low-orbit constellation deployment due to the continuous expansion of the scale of low-orbit constellation. Constellation deployment optimization is a complex and multidisciplinary engineering problem. A phased deployment optimization method based on NSGA-II is proposed to reduce the cost of large-scale low-orbit constellation deployment. First, low-orbit large-scale constellation deployment needs to meet regional service performance and gradually expand to the world. In the first stage, satellite climbing is applied using tangential thrust in plane. In the second stage, earth perturbation is used to reduce fuel consumption on RAAN satellites in berthed orbit; In the third stage, out-of-plane yaw thrust is applied to satellite phase adjustment in target orbit. Second, mathematical models of orbital altitude, inclination, RAAN, and ion thrusters are established for each stage. Finally, the optimal berthing orbit is given to achieve the deployment purpose of multiple satellites and multiple orbits, using the total deployment time and fuel consumption of the same batch of satellites as the objective function. The simulation results show that compared with the traditional deployment method, the optimized deployment method can reduce the satellite fuel consumption and give consideration to the overall performance of the phased deployment constellation. To demonstrate the effectiveness of the proposed method, a large scale navigation satellite constellation in low orbit is used.