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MICROSATELLITE CONSTELLATION DESIGN AND EFFECTIVENESS EVALUATION UNDER FAST RESPONSE CONDITIONS

Abstract

For the detection of the island-chain in an emergency situation, a fast-responding microsatellite constellation that meets the specific rules is designed. First of all, the purpose of the microsatellite constellation design is defined, which is to realize a detailed investigation of the island-chain in case of an emergency and a long-term regular return visit after the tension. On the basis of the above analysis, the constraint model for constellation design is established based on the island-chain distribution range, coverage rate, revisiting period, detecting resolution, satellite orbital altitude, satellite weight and satellite operating lifetime. Taking into account the earth curvature, satellite orbital altitude and the satellite equivalent viewing angle, the coverage model of the constellation is built by the Monte Carlo method. And the optimal deployment model is established by taking the function of minimizing the number of satellites and maximizing the coverage of the island-chain as the objective function. Combining the global search nature of GA with the local convergence of SQP, the GA-SQP combinatorial optimization algorithm is adopted to obtain the precise optimal solution that meets the constraints for constellation design. On the basis above, the coverage period of the constellation is taken as the time interval, and a fast-responding microsatellite constellation composed of sixteen stars is constructed by the time-splicing method. Finally, STK is used to test the constellation's coverage performance, shined condition and data transmission opportunities with TTC station, respectively. The test result verifies the effectiveness of the proposed method.

Key words: Fast-responding; Microsatellite; Constellation design; Performance evaluation