18th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Virtual Presentations - 18th IAA SYMPOSIUM ON SPACE DEBRIS (VP)

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AN EFFICIENT STRATEGY FOR DEFUNCT SATELLITES DETUMBLING USING ELECTROMAGNETIC FIELD FORMED BY MULTI-SATELLITES CAGING

Abstract

Defunct satellites usually lose their orbit/attitude control and communication ability in space, and become tumbling due to the residual angular momentum and environment disturbance like solar pressure and the gravitational perturbation. In order to docking or capture defunct satellites, it should be despinned first to avoid collision risk, especially for the large size satellite with high angle velocity tumbling. This paper proposed an efficient despinning strategy for tumbling satellites using electromagnetic field formed by multi-satellites caging. The main idea is to use the electromagnetic torque generated by multi-satellites formation as the control torque to detumble target defunct satellite. First, considering the diversity of geometric structure and uncertainty of the motion parameters, the motion envelope of the target satellite can be obtained. Then, based on which, the berth positions of multiple satellites relative to the moving tumbling satellite are determined. There are two requirements for the berth positions of multiple satellites: 1) it should avoid collision between the servicing satellite and target satellite; 2) the envelope caging determined by the berth positions can minimized the despinning time. Thirdly, an optimization algorithm for the dynamic envelope caging design are proposed based on RRT* approach, considering multiple constraints including the collision between multiple satellite or servicing satellite and target satellite, the attitude constraints of multiple satellites and the energy equilibrium constraints for each servicing satellite. And, a complete analysis of the stability and convergence properties of the generated electromagnetic field are provided. Finally, the simulation results demonstrate the efficiency of the three-dimensional caging configurations optimization method and the proposed despinning strategy using electromagnetic field that generated by multi-satellites.