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LAYOUT OPTIMIZATION AND UNLOADING STRATEGY FOR SOLAR SAILS USING REFLECTIVITY CONTROL DEVICE

Abstract

For near-Earth spacecraft, many environmental forces are utilized to unload reaction wheels. However, effects like magnetic force or atmospheric friction hardly exist in deep-space environments where solar sails operate. Thus, to conduct the unloading process of solar sails operating in deep space, an unloading method that uses reflectivity control devices to generate SRP torque is proposed in this paper. Firstly, the basic principles of reflectivity control devices (RCDs), satellite kinetic model, and torque calculation method are given. Secondly, parameters to evaluate the layout of RCD panels are established and a nonlinear programming method is used to find the optimal layout. Then, the torque envelope can be obtained by traversing the switch combination, and it is easy to realize the torque redundancy since the same torque can be achieved by multiple switching sets. Therefore, it is particularly important to design a reasonable switching scheme to achieve efficient unloading. In this paper, we propose a fast torque resolution strategy that can eliminate redundancy and reduce search space. Finally, the layout optimization process of the solar sail RCD is verified by numerical simulation, and the validity of the proposed torque selection scheme is also demonstrated.