21st IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations - 21st IAA SYMPOSIUM ON SPACE DEBRIS (IP)

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TARGET SELECTION AND SEQUENCE OPTIMIZATION FOR ADR BY SPACE-BASED LASER BASED ON ANT COLONY ALGORITHM

Abstract

Space-based laser-driven debris active removal technology is the most effective method for centimeter-scale space debris, which can continuously remove or drive away a large number of targets that enters the range of laser in a single mission. However, for the centimeter-level space debris cannot be effectively tracked and catalogued, the space-based laser platform can only rely on its own equipment capability to detect and identify target in the removal task, and drive while detecting. This puts forward the following requirements for the capability of it: 1) be able to screen the driveable debris that will enter the range of laser from all the detected space debris; 2) be able to predict the consequences after laser driving of each debris (whether it can be lowered, removed and the lowest possible orbital height) and the optimal action time; 3) be able to formulate the driving sequence based on the action time and the consequences of each debris, with the goal of maximizing the total number of debris removed or the total orbit lowering, and guide the work of the laser platform. Based on the ant colony optimization algorithm, this paper studies the problem of target selection and sequence optimization for ADR by space-based laser,and compiles the calculation program. The algorithm takes the platform detection range, laser energy, repetition frequency and other parameters as well as the debris orbit as input,and realizes the screening of whether it enters the laser range or can be removed and the analysis and calculation of the optimal action time for single debris. It also implements the conflict resolution of the drive window and the calculation of the optimal drive sequence for multiple debris. For the same randomly generated debris group, compared with the mode of sequentially driving according to the order of entering the laser range, the optimization algorithm can significantly improve the overall working efficiency, that is, more debris can be removed or the sum of orbital perigee decreases of all targets is greater.