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MISSION PLANNING AND SIMULATION SYSTEM STUDY ON ACTIVE DEBRIS REMOVAL WITH SPACE-BASED LASER SYSTEM

Abstract

Simple debris shapes and orbital transfer models were used in most former removal procedures on Active debris removal with space-based laser system. A new mission planning was constructed and simulation system was researched and developmented, considering removal sequences, accurate removal procedures and de-orbiting access of debris, also taking the whole trackable debris t into consideration. This system includes four parts: (1) target debris selection module for determining the debris removal sequences, (2) high-accuracy orbital transfer module to simulate the changing orbit, (3) de-orbiting access module for estimating the removal result and (4) 3D view module to show the whole removal process and save the orbital elements along the removal process. Input of this system contains orbital elements, shapes and reflective coefficients of debris and performance parameters for acquisition, tracking and space-based laser system parameters. More than 23000 debris and more than 500 space-based laser system platforms were running on this system. Irregular shapes and reflective coefficients are reconstructed from the typical materials of satellites. The first step to removal debris is determining which one should be irradiated first. Reflecting lights received by acquisition system from irregular shaped debris are used to determine which debris can be found by the acquisition system. Relative acceleration between laser and debris are compared to the tracking system to estimate the tracking time interval. For trackable debris of the system, collision possibilities among debris, irradiating time interval are evaluated for planning the sequences of trackable debris. When the irregular-shaped debris irradiated by the space-based laser system, orbital changes are calculating step by step using an accurate dynamical model. In order to estimate the position and attitude change of debris, triangulation for the irregular-shaped debris are used to get the implied forces. After the irradiation, perigee changing and decreasing collision possibilities are used to access the removal. This new system can simulated different removal system performance parameters and different removal sequences, and it has 3D display functionality. Moreover, it can be used to estimate the efficiency of removal scheme and removal system.