Paper ID: 29923
oral
student

SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Technologies (5)

Author: Mr. Minghe Shan
Delft University of Technology (TU Delft), The Netherlands

Dr. Jian Guo
Delft University of Technology (TU Delft), The Netherlands
Prof. Eberhard Gill
Delft University of Technology, The Netherlands

AN ANALYSIS OF CRITICAL DEPLOYMENT PARAMETERS FOR TETHERED-NET CAPTURING FOR SPACE DEBRIS REMOVAL

Abstract

Tethered-Net capturing has been identified as one of the most promising methods for space debris removal due to its flexibility and compatibility. The dynamic characteristics and deployment process of tethered-net have been investigated these years. Some ground-based experiments have been performed as well. In this paper, the critical deployment parameters for tethered-net capturing is analyzed. In the current design, the net is deployed by projecting four bullets on each corner. Its deploying dynamic behaviour is complicated because of its flexibility. Furthermore the capture ability of the net is insufficiently understood since both ground-based and space-based test cannot easily be performed. Even worse, as the contact between net and space debris is unavoidable during capturing, fragile parts of the space debris, such as antenna, might be damaged by the impact from net or bullet which conflicts with one of the most critical criteria: no new generation of space debris in SDR (space debris removal). The detailed objective of this paper is to investigate the optimum deploying parameters such as projecting angle and velocity in which the net is deployed in the most effective way such that the generation of new space debris is avoided. Based on that purpose, a dynamic model is established using a mass-spring model and a formulation of nodal parts in an absolute reference frame. The criteria to evaluate a net deploying can vary widely, such as effective traveling distance, effective deploying time and effective deployed area. All those aspects are analyzed in detail. To avoid generating new space debris, a contact effect formulation which determines the maximum stress on fragile part on space debris is derived based on deformation energy method. As a result, acceptable net-deploying parameters, e.g. projecting velocity and bullet mass, are obtained. Following such an analysis, we conclude that the mass of the bullet, projecting velocity, stiffness and damping coefficient are key parameters influencing the net deploying, while the projecting angle influences the effective deploying time and area.