

SYMPOSIUM ON SPACE DEBRIS (A6)
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THE NONLINEARITY CHARACTER OF THE ELECTRODYNAMIC TETHER

Abstract

As a countermeasure for suppressing space debris growth, the Japan Aerospace Exploration Agency (JAXA) is investigating an active space debris removal system that employs highly efficient electrodynamic tether (EDT) technology as its orbital transfer system. In numerical simulation to evaluate the tether's dynamics, the tether has been modeled as point masses connected by linear springs and viscous dampers. However the actual tether shows non-linear behavior. In this paper, the non-linear springs model considering residual strain are developed based on the results of ordinary tensile test and dynamic tensile test of the tether. Then numerical simulations are conducted to investigate the effects of non-linearity. The target debris is H-IIA second stage at an altitude of 620 km and deploys EDT of 5000 m from the debris removal satellite (DRS) on the condition when the tether deployment is suddenly stopped of a few lengths, and considering the analysis such as a history of relative distance and in-place inclination angle between H-IIA and DRS, tether's tensile and stress-strain diagram. The result confirms that the non-linearity of the non-linear springs model in case of high tensile strength are different from the linear springs model so in numerical simulations with the tether, it is necessary to consider the non-linearity of the numerical tether model.