Key Technologies (7)
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Author: Prof. Valeriy Trushlyakov
Omsk State Technical University, Russian Federation

Dr. Vadim Yudintsev
Omsk State Technical University, Russian Federation

CONTROL OF THE ROTATING TETHERED SYSTEM FOR ORBITAL DEBRIS REMOVAL

Abstract

This study aims at investigating the motion and control of the tethered tug-debris system during the gripping and orbital transfer of space debris object to a disposal orbit using a rotating tethered tug-debris system. The rotation of the system occurs due to the difference in the orbital velocities of the space tug and the space debris object at the capture point [1]. An autonomous docking module (ADM) is used to capture the debris object (target). ADM is a small spacecraft equipped with a gripping device, a propulsion system, a control system, and the necessary set of sensors and video cameras for the attitude motion analysis of the target. ADM is installed on the space tug and separates from the space tug by the tether [2, 3] in the vicinity of the space debris object. A rotating tethered system is formed after the docking of the ADM with the space debris object. The rotation of the system provides the necessary tether tension, allowing to use of a pushing towing scheme, which makes it possible to adapt the available upper stages for active debris removal missions.

The problem of control of the tethered tug-debris system is considered for all stages of the mission. These stages include the gripping stage, after the separation of the ADM from the space tug, tether stabilization stage after the gripping the debris object, orbital transfer stage for deorbiting debris object, and the stage after the separation of debris object from the tethered tug-debris system when the ADM returns to the space tug for the next mission. Algorithms for controlling the tug-debris system for all these stages of the motions are proposed, which minimize the disturbance to the space tug. Requirements for the tether control system are formulated.

References

[1] V. I. Trushlyakov, V. V. Yudintsev "Rotary Space Tether System for Active Debris Removal," Journal of Guidance, Control, and Dynamics. Vol. 43, No. 2, February 2020.

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