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PERFORMANCE OF ELECTRODYNAMIC TETHER SYSTEM FOR DEBRIS DEORBITING: RE-EVALUATION BASED ON THE RESULTS OF KITE EXPERIMENTS

Abstract

JAXA has been investigating a small satellite for active debris removal. Electrodynamic tether (EDT) is one of the most promising deorbiting technologies for cost effective debris removal. Precise numerical simulations have been performed for some aspects of mission analysis, such as available electric currents, orbital changes and tether stabilities. A tether is modeled as a lumped mass to take into account tether flexibility, and precise environmental models such as the geomagnetic field and plasma are considered. JAXA conducted demonstration flight of EDT using the HTV, a Japanese cargo ship to the ISS. HTV6 was launched on December 2016 and tether experiments named KITE was conducted on January 2017. Unfortunately, the tether could not be deployed but field emission cathodes worked very well and some results regarding electron emission capability to the ambient plasma were obtained. Numerical simulations were conducted using the new model based on the results of KITE experiments. We also updated some parameters of the tether, reel and so on obtained throughout the development phase of KITE. Performance of EDT to deorbit large debris was investigated in order to design the debris removal satellite. Some questions about the applicability of EDT for debris removal, and the solutions for them are described in the paper such as the efficiency in high inclined orbit, collision avoidance maneuver, etc. A new flight demonstration using a small satellite to demonstrate EDT, or a future plan to remove a Japanese rocket upper stage are also investigated.