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RELEASE AND DEPLOYMENT EXPERIMENTS OF ELECTRODYNAMIC TETHER SYSTEM

Abstract

Space debris is steadily on the increase. Space debris left in orbit is dangerous not only because they may pose hazards to an operational spacecraft but also a huge number of smaller bits of debris could be generated by mutual collisions between large objects. Therefore we have been studying an active debris removal system that uses an electrodynamic tether as a highly efficient propulsion system. Electrodynamic tether is a propulsion system that can transfer large objects without the need for the propellant by using interaction with the Earth's geo-magnetic field.

Deployment is critical for the tether system, and the deployment dynamics need to be investigated by both ground experiments and numerical simulations. Stable tether deployment is made difficult by the large friction of the conductive tether. So the tether is wound on a tapered spool reel in a criss-cross fashion, and is deployed from the inside. A spring-loaded mechanism is use in order to release an end-mass and to deploy the electrodynamic tether. And a brake is used to make them slow down tethered satellite by the friction.

Release experiments were done on an air table in order to investigate the characteristics of the release mechanism, brake system, and deployment dynamics. The position and attitude of an end-mass where the tether reel is on-board, is measured using stereo cameras. Vibration tests of a tether reel in a vacuum chamber were also conducted in order to investigate the effect of cold welding, and the results of release and deployment experiments were compared before and after the vibration tests. The result of the experiments shows that criss-cross, tapered reel are effective for smooth deployment, and brake system works well. The deployment friction is evaluated in order to use in the numerical simulations.