SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Concepts (7)

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A REORBITER FOR LARGE GEO DEBRIS OBJECTS USING ION BEAM IRRADIATION

Abstract

In recent years, space debris problems have become very serious. The worst case occurs in LEO region, where debris-to-debris collisions generate new debris. The situation in GEO region is not so bad. The debris problem there, however, should not be left because GEO is unique and has few debris-cleansing modes. Thus, we proposed a concept for a reorbiter to reorbit satellites and rocket upper stages left in orbit. The concept is based on the idea of thrusting a debris object by irradiating it with an ion beam. The reorbiter, equipped with two ion engines, approaches a debris object, and the ion beam exhausted from one of the ion engines irradiates and thrusts it to change its orbit. The other engine on the opposite side is operated so that the reorbiter follows it within a certain distance range. Their orbit is raised in a spiral to the disposal orbit about 300 km higher. Only the reorbiter returns to GEO to approach another debris object. This system can do without catching debris objects, and thus, can be applied to a wide range of debris objects without regard to their shapes or rotations. A mission scenario was made to conduct efficient maneuvers. In GEO region, a number of debris objects are distributed on orbit planes close to each other, and they can be reorbited one after another using a single reorbiter. For a typical model mission, the mission time and total impulse of the ion engines were calculated to show that six debris objects can be reorbited in 170 days. Studies were conducted on the approach to an uncollaborative object, maintenance of the separation distance, cameras and sensors, and the control and propulsion systems. The reorbiter is targeted for 2500-kg mass and 6.9-kW power. Highly converged beam is required to make efficient debris irradiation. Numerical calculations were conducted to achieve it. Irradiation of debris objects may cause sputtering of their surfaces, and the depositions of the back-sputtered materials on the reorbiter surface. Data were obtained experimentally to evaluate the effects of the depositions.