SPACE DEBRIS SYMPOSIUM (A6)
Mitigation, Standards, Removal and Legal Issues (4)

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LARGE SPACE DEBRIS REORBITER USING ION BEAM IRRADIATION

Abstract

The number of space debris has increased since the beginning of the space age, and in resent years, space debris problems have become very serious for space development. The worst case occurs in low earth orbits (LEO) around 800 to 1000 km altitudes where it is recognized that debris-to-debris collisions generate new debris. Though debris-to-debris collisions do not occur in geosynchronous orbit (GEO), the situation there is as bad as in LEO because debris from breakup events has few cleansing modes. Thus, we have proposed a new concept of a reorbitor to reorbit large space debris (dead satellites being left on orbit after the end of mission), which is especially useful for reorbiting GEO debris. The concept is based on an idea of thrusting a dead satellite by irradiating it with ion beam. After the reorbitor equipped with two ion engines approaches space debris, the ion beam exhausted from one of the ion engines irradiates the debris, thrusts it, and changes its orbit. The other ion engine with higher thrust, installed on the opposite side, is also operated so that the reorbitor follows the debris within a certain distance apart. In the applications to GEO debris, the current reorbiting requirement is to raise its orbit by about 300 km. Thus, after the reorbitor pushing the debris rises up to this altitude, only the reorbitor returns to GEO for approaching another debris. Debris reorbiting concepts proposed so far depend on catching debris by robotic arms or others, but they require extremely high technologies because debris is a non-cooperative object and usually rotating. The proposed concept makes it possible to reorbit debris without catching it. Thus, it can be applied to a wide range of debris without regard to its shapes and rotation. A system study was conducted for reorbiting from GEO to a 300-km higher altitude orbit, assuming the debris in 2-m diameter to be 2000 kg. Using 40-mN-class ion engines, it takes 26 days for reorbiting. The distance to be kept between the debris and reorbitor depends on how convergent the ion beam is. An ion engine with a divergent half angle of 10 degrees including 95