Paper ID: 39379
student

15th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations (IP)

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SPIN AXIS ORIENTATION AND ROTATION PERIOD DETERMINATION OF DEBRIS IN SUN-SYNCHRONOUS ORBIT USING LIGHT CURVE

Abstract

Since the launch of the first satellite in 1957, an increasing number of satellites have been sent to space. More than 15000 objects that can be tracked by radar and telescope from ground are currently in orbit around the earth, of which only approximately 6% are active satellites. The rest can be classified as space debris, including non-operational satellites, launch vehicle stages, mission-related hardware and fragments resulting from explosions and collisions. And the debris may decrease the available room for the active satellites to take and even pose a serious hazard to them. Thus, effective measures to mitigate it are becoming urgent.

The most useful orbits, i.e. geostationary earth orbit (GEO) and low Earth orbit (LEO), are where the most crowded region with the largest number of man-made objects, most of which are debris. Thus, active removal of large debris from the LEO region is an effective way to prevent the debris collisions from cascading. Specifically, the sun-synchronous orbits (SSO) is considered to be the first candidate region, for it attracts high commercial interest and intensive use, especial for remote sensing missions. Among the large debris in SSO, the upper stage of rocket body is targeted because it is definitely debris and sturdy enough to be handled in remove stage. Considering the deficiency of present research in the determination of spin axis orientation and spin period, this paper focuses on the problem of determining the spin station of the target debris using the light curves obtained by telescope located in different observation sites. And the UKF is chosen for state estimation because it has at least the accuracy of a second-order filter without the requirement of computing Jacobians like the EKF.

The proposed works will be divided into four segments. The first part builds the attitude system model. The second part studies the observation models, including astrometric model and light curve observation model. Then unscented filtering using light curve data will be described in the third part. The Last part comes with the simulation output and the analytics.