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

Author: Dr. Anilkumar A K
Vikram Sarabhai Space Centre (VSSC), India

Ms. Pooja Dutt
Indian Space Research Organization (ISRO), India
Mr. Anandhaselvan A
India

EFFECTIVE DRAG AREA COMPUTATION FOR ACTIVE DEBRIS REMOVAL USING DE-ORBIT SAIL

Abstract

After the launch of 'SPUTNIK-I' in October 4th 1957, the number of launches has increased many folds. As the number of artificial satellites in Earth orbit increases, the probability of the collision between them also increases. Satellite collision would produce orbiting fragments, each of which could increase the probability of further collision, leading to growth of the space debris in space. This is called 'Kessler Syndrome' [1]. Predictive studies show that in order to stabilize the space environment, apart from space debris mitigation, Active Debris Removal (ADR) of 5-6 high risk space debris annually is necessary [2]. A variety of solutions has been proposed under ADR to clean the space debris from the space debris like Attaching De-orbiting kit, Ground or space based laser system, De-Orbit sail , Robotic arm, Harpoons, Nets, Ion Beam Shepherd, Electro-Dynamic Tether, Sling-Sat, Deploying clouds of tungsten dust, Blocks of Aerogel, Gas balloons. Apart from legal and political issues during implementation of ADR, every ADR method has some unique advantages and some disadvantages. De-orbit sail can be attached to future satellites and upper stages during their design itself. So that during their active lifetime, the de-orbit sail will be in folded condition. Once the useful life of these objects is over, the de-orbit sail will be unfolded to increase the drag area so that the space object re-enters faster [3]. In case of orbiting high collision risk space debris, these de-orbit sails coupled with a small rocket engines can be launched as a piggy-back, which will rendezvous and attach themselves to the already identified high collision risk space objects, and unfurl immediately. The present study is divided into two parts. First high collision risk space objects in Sun Synchronous Orbit region are identified based on their size, mass, lifetime and orbital flux. Second, the minimum area of the De-Orbit Sail is estimated so that the high risk space object's orbital life is reduced to less than 25 years.

References

1. D.J. Kessler and B.G. Cour-Palais, "Collision Frequency of Artificial Satellites: The Creation of a Debris Belt", Journal of Geophysical Research, Vol. 83, No. A6, 1978, pp. 2637-2646.

2. J.C. Liou, "An active debris removal parametric study for LEO environment re-mediation", Advances in Space Research Vol. 47, No. 11, 2011, pp 1865–1876.