Orbital Lifetime Estimation using ESA's OSCAR tool

Vitali Braun[a], J. Gelhaus[a], C. Kebschull[a], S. Flegel[a], M. Möckel[a], J. Radtke[a], C. Wiedemann[a], H. Krag[b], P. Vörsmann[a]

[a]*Institute of Aerospace Systems, Technische Universität Braunschweig , Hermann-Blenk-Str. 23, 38108 Braunschweig, Germany*
[b]*ESA/ESOC Space Debris Office, Robert-Bosch-Str. 5, 64293 Darmstadt, Germany*

Abstract

In 2008 the UN General Assembly adopted resolution 62/217, endorsing the space debris mitigation guidelines (SDMG) of the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS). These guidelines contain recommendations for satellite operators to implement measures for various mission phases in order to reduce the further accumulation of space debris especially within the protected regions. These are defined within the SDMG as being the LEO region (up to 2,000 km altitude) and the GEO region (±200 km in altitude around the GEO altitude and ±15 degrees latitude).

In the first version of ESA's DRAMA (Debris Risk Assessment and Mitigation Analysis) tool suite, OSCAR (Orbital SpaceCraft Active Removal) was designed as a tool to allow users the analysis of different disposal strategies for spacecraft in the LEO and GEO regions. The upgrade of the ESA DRAMA tool suite by TUBS and DEIMOS under ESA/ESOC contract included the development of a renewed version of the existing OSCAR tool, allowing (in its current version) the consideration of different future solar and geomagnetic activity scenarios. Furthermore, OSCAR also supports the analysis of the orbital evolution using drag augmentation devices, besides the already known disposal systems (chemical and electric propulsion, as well as electrodynamic tether) . Based on a given target orbit, a specified solar and geomagnetic activity forecast and a selected disposal strategy, OSCAR is able to compute the required end-of-life maneuver characteristics and the disposal orbit in order to be compliant with the SDMG.

In this paper, the OSCAR tool is presented giving a short overview first. The focus then lies on the methods used for the estimation of the residual orbital lifetime, as well as on the reverse process of finding a disposal orbit for a pre-defined residual lifetime. Results are shown for circular orbits in LEO and also for objects in high-eccentricity orbits (HEO), where e.g. many spent upper stages in GEO-transfer orbits (GTO) reside. The impact of solar and geomagnetic activity forecasts, provided by OSCAR, is also shown in this context.

Email address: v.braun@tu-braunschweig.de
(Vitali Braun)