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COMPLIANCE OF DISPOSAL ORBITS WITH THE FRENCH SPACE ACT: THE GOOD PRACTICES AND THE STELA TOOL

Abstract

In the frame of the French Space Act, whose objective is to ensure that the technical risks associated with space activities are properly mitigated, CNES provides the French government with technical expertise on space operations regulations, and will check the operators case files before they are submitted for approval to the minister in charge of space activities. Space debris mitigation is one objective of the law, in line with IADC (Inter-Agency Space Debris Coordination Committee) recommendations, through removal of non-operational objects from populated regions. At the end of their mission, space objects are to be placed on orbits that will minimize future hazards to space objects orbiting in the same region. The protected regions have been defined by IADC: region A for LEO and region B for GEO. The verification of these rules requires long term orbit propagation to evaluate the evolution of the orbital elements over long time scales (up to more than 100 years). CNES recommends Good Practices as well as a dedicated tool, STELA (Semi-Analytical Tool for End of Life Analysis), to address the compliance of disposal orbits with the law technical requirements.

The Good Practices define the minimum dynamical model required to compute the orbital evolution with sufficient accuracy, and detail key computation hypotheses such as drag and reflecting areas, drag coefficient, reflectivity coefficient, solar activity, atmospheric density model and so on. They also recommend a methodology adapted to each orbit type (LEO, GEO, GTO) to assess the criteria of the French Space Act. For GTO orbits especially, some couplings occur between dynamic perturbations. A small change in the initial conditions or on the estimation of the drag effect will significantly change the entrance conditions in resonances and thus the orbital evolution. Consequently, some statistical methods have been developed.

The STELA software is the reference and official tool to check the compliance of disposal orbits against the criteria of the French Space Law. It implements the Good Practices using semi-analytical methods in order to propagate the orbits in an efficient way. STELA also provides functions to select the appropriate disposal orbits during mission design studies and to compute the mean cross sectional area of a spacecraft. STELA is available as a freeware on the CNES website (http://logiciels.cnes.fr/STELA/en/logiciel.htm).

This paper will give an overview of good practices, present the STELA software and provide some results obtained for LEO, GEO and GTO orbits.