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ESA DRAMA ARES AND CROC: EVALUATION OF CROSS SECTION AND ESTIMATED COLLISION ALERTS

Abstract

In order to enable ESA space programs to assess their compliance with the guidelines in European Code of Conduct for Space Debris Mitigation, the DRAMA (Debris Risk Assessment and Mitigation Analysis) tool has been.This tool is currently updated by TUBS and DEIMOS, under ESA/ESOC contract, to include additional capabilities and improve the performances of existing features. Updated DRAMA is composed of six individual software applications. The individual applications have been designed and developed to address different aspects of debris mitigation.

This paper focuses on ARES (Assessment of Risk Event Statistics) and CROC (CROss Section of Complex Bodies) modulea. ARES allows the computation of statistical collision probability between an operational spacecraft and objects orbiting the Earth, the mean number of required manoeuvres, risk reduction and residual risk, false alarm rate, required DV and propellant mass fraction. The collision probability depends on the geometry of the encounter, the collision cross section and the uncertainty in the knowledge of state vector of two involved objects. CROC allows the computation of projected cross-sectional areas for user-defined bodies. Thus, CROC can serve as the basis for subsequent computations in ARES module.

ARES capabilities have been improved to account for an updated population model using MASTER 2009 down to small objects, with the option to include population clouds, including different catalogue coverage laws and improved default values for orbital uncertainties associated to the catalogued objects. The user can select different catalogue performances and define the uncertainties per orbit group and size. Uncertainties in the catalogued population are accounted as per TLE, CSM or for user-defined values.

CROC allows computing the cross section of complex satellites defined as a set of primitives. These primitives are a set of basic shapes (sphere, sphere cap, box, cylinder, or cone) which allows to build up complex geometries. The computation of the projected cross-section of the complex geometry needs to address two different issues: the cross section of every primitive and the shadowing effects among them.

The paper focuses on the capabilities of both tools and report some example cases of missions with different geometries and orbiting at different orbital regimes, showing the impact of the satellite cross-section, the required trade-off between risk reduction and accepted false alerts when defining the operational procedures for a mission. It is also highlighted the different needs on catalog accuracy to ensure a reduced number of false alarms.