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COLLISION RISK ASSESSMENT AND AVOIDANCE MANOEUVRES - THE NEW CORAM TOOL FOR ESA

Abstract

The new CORAM tool, developed by DEIMOS Space for ESA, addresses two main aspects for the implementation of appropriate collision avoidance mechanism for identified conjunction events: the computation of the actual collision risk associated with an event, and the implementation of appropriate avoidance manoeuvres considering operational constraints. CORAM is composed of two main software modules, the Collision Risk Computation Software (CORCOS), which computes the collision risk associated to an event and the Collision Avoidance Manoeuvre Optimisation Software (CAMOS), devoted to the computation of avoidance strategies.

With the aim of addressing these two aspects, CORAM has been designed and implemented to be complementary to ESA's operational Collision Risk ASSessment (CRASS) tool. Once CRASS has identified the possible encounters for a mission, the resulting events are analysed with CORAM in order to refine the risk computation, and, if needed, to define the most appropriate avoidance manoeuvres to mitigate the risk associated with the conjunction. A brief description of the SW architecture is provided. In this paper, we describe the flexibility of the tool regarding the multiple input types (operational state vector, ephemerides files, TLE or CSM) to define the encounter geometry, the different possibilities to define the satellite geometries (simple spherical case and complex geometries) and the large variety of collision risk algorithms (for simple and complex geometries and high and low relative velocities). They include the computation of a maximum collision risk for an encounter and cover the well-known algorithms based on spherical objects and high velocities, modern algorithms for complex geometries and low encounter velocities, and Monte Carlo simulation.

This paper focuses on the avoidance manoeuvre CAMOS software with an overall description of the CORAM tool.

Regarding the computation of avoidance manoeuvres, CAMOS assesses the suitability of different avoidance strategies to reduce the risk of collision, allowing, e.g., to reduce the risk to a predefined level while minimising the manoeuvre size, or to achieve the lowest possible collision risk for given maximum manoeuvre size. In this paper, we describe the capabilities of CAMOS to analyse different manoeuvre strategies, including, e.g., a very flexible definition of the location and the time sequence for the manoeuvres, consideration of various types of constraints (on the manoeuvre parameters, encounter geometry, collision risk, trajectory geometry, etc) and cost functions (collision risk, total delta-V, etc) during the parameter optimisation process, or the capability to model impulsive and low thrust manoeuvres.