21st IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Operations in Space Debris Environment, Situational Awareness - SSA (7)

Author: Mr. Jerome Thomassin
Centre National d'Etudes Spatiales (CNES), France

Mr. Jules Grauby
Centre National d'Etudes Spatiales (CNES), France
Mr. Noé Charpigny
Centre National d'Etudes Spatiales (CNES), France

# AUTONOMOUS ORBIT CONTROL FOR ON-BOARD COLLISION MANAGEMENT: ASTERIA

**Abstract**

This is not breaking news for the space community: the number of objects in Earth orbit is increasing and represents a growing danger for active satellites. Whatever the type of objects, active or defunct satellites, launch vehicle stages or debris of any kind, the proliferation of this population is of particular concern for both low-Earth and geostationary orbits. This crowded space environment requires daily monitoring of objects in orbit and a permanent capacity for action. Operators can be mobilized on a daily basis to urgently modify the trajectory of their satellites to avoid a possible collision. In addition, space systems are becoming more and more autonomous. The quest of advanced autonomy reduces the satellites' interaction with the ground segment and decreases the operational load. In that respect, CNES has developed an on-board autonomy concept for collision risks management in Low Earth Orbit (LEO). The concept, called ASTERIA, is part of a global vision of an autonomous onboard system for orbit control. ASTERIA enables coupling between station-keeping on LEO orbit, collision risk identification and calculation, and implementation of avoidance maneuvers. Coupling is entirely done autonomously on board, without any ground intervention. This concept reconsiders orbit control management. In non-autonomous systems, collision avoidance maneuvers are scarce activities that interrupt the mission. In ASTERIA, on the other hand, orbit-keeping and risk management are considered as a whole and the reactivity of the autonomous on-board system allows to avoid the latency induced by the on-board/ground interface inherent in non-autonomous LEO missions. This paper aims to explain the ASTERIA concept in more detail. It first describes the on-board orbit control method. It highlights in particular the innovation that consists in coupling and arbitrating different, potentially contradictory, orbital correction needs. It then presents results obtained on a realistic case study, based on an operational context. These results highlight how control reactivity enables an appropriate response to the collision risk evolution. It will be shown that, for several High Interest Events (HIE) studied, on-board collision risk estimation detects false-positive collisions less than ten hours prior to the event, thus avoiding unnecessary avoidance maneuvers and maintaining mission availability. Next, the paper presents the method used for computing optimized collision avoidance maneuvers that enables multi conjunctions management. The theoretical basis of the method is first established. In a second time, the perspectives related to an autonomous system are discussed, particularly those concerning space traffic management.