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CNES FLIGHT DYNAMICS OPERATIONS DESIGN FOR THE END OF LIFE OF FOUR SATELLITES FLYING IN FORMATION

Abstract

French mission ELISA was made of a fleet of four microsatellites flying in formation which were launched in December 2011 in a Low Earth Orbit and operated from ground by CNES Toulouse Space Center until 2021. They were based on the "Myriade" micro spacecraft bus, developed by CNES for its science missions.

Formation flying encompasses several technical and operational challenges starting from the Launch and Early Orbit Phase to the End Of Life. In particular, the latest phase of the mission lifetime is critical since it is designed to ensure deorbitation and passivation of all satellites, in the frame of the French Space Operation Act. These operations are also designed to face some contingencies, the probabilities of occurrence of the latter increasing with time.

This paper will first provide a brief presentation of ELISA mission, operational organization and satellites characteristics. Then, it will present some particular aspects that had a noticeable impact on the maneuvering capability, such as propulsion limitations.

The strategy designed for the End Of Life phase, in order to limit as much as possible the four satellites reentry time while ensuring passivation, will be explained. In particular, it will be detailed how the vertical separation, the eccentricity and the drift of the satellites have been tuned to minimize the collision risk at any time.

In addition, the adaptations in the deorbiting strategy that had to be performed to cope with significant contingencies that affected or could have affected the navigation will also be described in this paper, in particular failures related to the Attitude control and propulsion systems.