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DECOMMISSIONING AND COLLISION AVOIDANCE IN DEGRADED MODE

Abstract

Most operators have now integrated the strong need to apply efficient mitigation measures in order to limit space debris proliferation and thus contribute to keep Space a usable and useful resource for mankind.

Among these measures, disposal operations and collision avoidance often imply heavy and complex operations : similar to station acquisition for decommissioning with dedicated studies, development, validation and training, and with high reactivity for avoidance with expert on-call teams that are ready at any time to deal efficiently with a collision risk.

Collision risk avoidance as well as end-of-life disposal operations require manoeuvres, which are executed in the same way as nominal station-keeping manoeuvres. They are performed in a so-called "normal mode", generally meaning that attitude during thrust is constant in the local orbital frame, so that the global thrusters acceleration is given tangentially to the orbit or perpendicularly to the orbit plane.

In some circumstances however, it may happen that nominal manoeuvres cannot be commanded and executed because of an anomaly which prevents the satellite to acquire or maintain its attitude in "normal mode", temporarily or permanently. Of course the satellite may be nearly lost with few commandability or on-board energy which are extreme cases. But most of the time, the satellite may be in a "safe" attitude mode, slowly spinning around a sun-pointed axis, with sufficient energy and commandablity and a perfectly healthy propulsion subsystem.

In such a case, it can still be possible to perform thrusters activation in order to (try to) comply to some mitigation guidelines : re-orbitation for GEO, de-orbitation for LEO, fluidic passivation, collision avoidance.

Another degraded case can alter the manoeuvre capability : although attitude can be controlled nominally, thrusts may be limited in duration for various reasons.

These degraded cases will be analysed, methods and guidance to proceed with such difficult operations will be given, as well as constraints and limits. The discussion will be illustrated by several examples in geostationary orbit and low earth orbit.