SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Issues (5)

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COMPARISON OF ACTIVE DEBRIS REMOVAL MISSION ARCHITECTURES

Abstract

The threat induced by the large debris, dead satellites or rocket bodies, in Low Earth Orbit has been identified years ago. The risk has been quantified under the "Kessler syndrome" term, which from simulation results makes explicit the fact that the LEO debris population is likely to exponentially increase in the coming years, thereby potentially forbidding any safe access to this zone, unless a minimum of 5 "old" debris are eliminated every year. Different mission architectures can be designed to fulfil the objective to eliminate the necessary number of critical debris. The present paper compares end to end the efficiency of a number of typical in orbit Active Debris Removal missions. The traded mission architectures are a priori defined from a number of parameters, namely the type of launcher, the size of the de-orbiting vehicle, the selection of low or high thrust de-orbiting technique, the choice of single body de-orbiting or 2 bodies de-orbiting through the use of de-orbiting kit, The methodology proposed in this analysis in order to objectively evaluate these missions is based on a systematic approach: a database of the target debris of highest [mass x collision probability] product is first established from an adequate filtering of the NORAD/NASA catalog. Then groups are created from this selected population mainly based on similarities in their orbital parameters. Each mission architecture performance to eliminate a given group is assessed for the 2 main de-orbiting strategies of LEO objects: putting them on a 25 years re entry orbit or on a direct re entry orbit. This allows after a relative cost estimate, to compare the mission architecture between themselves through a non ambiguous criterion, the cost per debris. The most overall cost efficient ADR mission architectures are then identified. It is also concluded that there is not a single architecture optimized for the 2 considered de-orbiting strategies and all the debris groups.