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

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# TAXONOMY OF LEO SPACE DEBRIS POPULATION FOR ADR SELECTION

**Abstract**

To avoid a future onset of the self-sustaining cascading process, the Kessler syndrome, there is a general consensus that the mitigation measures alone are inadequate to stabilize the current space debris environment. Therefore, Active Debris Removal missions (ADR) should be performed in the near future to reduce the in-orbit mass and thus sources for the growth of the current population.

However, choosing one ADR method over another in the preliminary phases of the mission planning is a difficult and time consuming task mainly due to the dimensions of the parameter space describing each method and target object.

One way of tackling this problem is by providing a proper scientific classification of space debris population, where the main traits of objects are evidenced and then used to properly identify, group, and discriminate space objects. However, this field of research is currently in its infancy (given the limited number of papers on the matter, i.e., only two) despite the fact that the ancestral decent of objects is generally well known in advance or at least it should be known.

In this context, the following paper presents a taxonomy of LEO space debris population to support ADR decision making and classification of the space debris so that their most prominent features can be identified easily and an ADR method can be recommended for that particular object. The taxonomic scheme presented hereafter is an evolution of the scheme built by Frueh, C. et al. in 2013 and consists essentially of two taxonomic layers. In the first layer, an ancestral hierarchical tree based on a priori physical and dynamic knowledge (using mainly publicly available data) is established. Already at this stage some conclusions about the most suitable ADR capture method for a selected class of objects can be made. However, ambiguities are present. Thus, a second layer of taxonomy is introduced based on levels of non-cooperativeness of individual objects and their weighted risk index reflecting their potential hazard to the mission based on their passivation state, age and on-board propellant.

In the end, examples of application of the developed taxonomy are presented using the available data from the ESA's DISCOS database and conclusions are drawn regarding the identified best methods to be used for the main categories of space debris under investigation for ADR, i.e., rocket bodies, spacecrafts and medium sized fragments.