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USING UNUSED LAUNCHER CAPACITY TO DE-ORBIT LEO SPACE DEBRIS

Abstract

Concerns about space debris have taken on major importance and the question arises of de-orbiting not only future debris but also past, uncooperative ones. In parallel to this, it appears essential and cost saving to harness the potential remaining capacity of a mission launching a primary payload, since hundreds of kilograms frequently remain unused. Therefore, this leads to the idea of a small system which would fit in the remaining load and would be able to move on different orbits in order to de-orbit space debris. As this "de-orbiter" would be an optional system, it must be a lightweight, low-cost solution and would be added inside the rocket fairing. This feasibility study is carried out by five students from the Ecole Polytechnique (France), with the support of ArianeWorks.

The primary objective of this study is to confirm and demonstrate that such a mission of de-orbiting space debris can be performed by a small system in compliance with the criteria previously mentioned. The second objective is to put forward a concept of de-orbiter, its optimized components and configuration. More specifically, we intend to fit with a launcher derived from Themis from ArianeWorks for LEO satellites, and we have focused on big size debris - from 1500kg to 2000kg, of which the trajectory is more accurately tracked, including Ariane rocket bodies orbiting at 700-800km.

This presentation will describe the studies conducted by our team's technical units in the fields of mission analysis, rocket propulsion, dimensioning and structural engineering, as well as cost study. In order to minimize the delta-v required in one mission, we have analyzed the different trajectories so as to move from a parking orbit all the way to the debris and to tackle the end of life of both the de-orbiter and the debris. Given this, we have identified the suitable means of propulsion according to the different stages of the mission. Besides, an important element needed attention: the rendezvous with the debris, mainly how to detect, approach and catch it. The main challenge was eventually to be compliant with the constraints of weight, size and cost of this system.

We believe that this work, which proves that space can inexpensively be cleaned of its largest debris, will pave the way for further detailed research to develop and launch such a de-orbiter, thereby providing an answer to the crucial issue of the proliferation of space debris.