Aerospace Europe Conference 2023
Joint 10th EUCASS – 9th CEAS Conference

Abstract #XXX *(to be filled by the organizers)*
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Title

Just-in-time Collision Avoidance (JCA) using nanosatellite swarms (nanotugs)

Authors

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Abstract

In recent years, thanks to the increasing number of private companies launching their satellites, space is becoming more accessible and affordable for everyone. Indeed, 2022 was a record year for space with 180 successful launches (44 more than in 2021), the highest number ever. This growing number of objects in space, also implies to consider the elimination of space debris, whose number should grow according to the Kessler syndrome. Many solutions are under study in the world to keep the number of collisions between debris under control.

The objective of this study is to demonstrate the feasibility of the JCA (Just in time Collision Avoidance) method, one of the most promising methods in the field of space debris removal [1].

We propose another solution which relies on the deployment of a swarm of nanotugs, all along the debris, in order to modify its trajectory to avoid the collision with another debris. This solution has been studied recently by Marchionne, Mc.Knight, Santoni, Bonnal & Piergentili [2]. The configuration of the swarm that we have chosen constitutes a new approach, never studied before: in the manner of a giant "octopus", a primary body (service module) will be permanently fixed on the debris and the consequent expansion of its "legs" (by a deployable structure) around the debris will be able to drive its movement throughout the avoidance phase. All the vital functions of the satellite are located in the service module, which contains the propulsion system tank, the communication system, the electrical power system and the thermal protections. We may also need some partial thermal protection at the end of the "legs", and on the "legs" themselves, for instance to avoid that the propellant lines freeze. The drift maneuver, which is the main activity of the satellite, is performed by small thrusters at the end of each "leg".
Therefore, the study will present and detail all the preliminary functions on each system, as well as the different trade-offs and their motivations. Finally, a cost estimate will be provided to give an idea of the operational feasibility of the whole project.

References

[1] Christophe Bonnal, Darren McKnight, Claude Phipps, Cédric Dupont, Sophie Missonnier, Laurent Lequette, Matthieu Merle, Simon Rommelaere, Just in Time Collision Avoidance – A review, Acta Astronautica Volume 170, May 2020.

[2] Lorenzo Marchionne, Darren McKnight, Fabio Santoni, Christophe Bonnal, Fabrizio Piergentili, "Conceptual Design and Performance Analysis of Nano-tugs as a Space debris Remediation Tool, IAC-21, A65.4 x65403.