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SPACE CLEANER: A NEW MAGNETIC CONTACTLESS WAY TO RECOVER SPACE DEBRIS

Abstract

With the increase in commercial and military missions and explosions, such as Cosmos 1408, the space debris' issue becomes ever more central for the orbital security. Therefore, the aim of this paper is to propose and apply a new method to recover the space debris. The suggested method is based on the magnetic principle which, by means of an axial magnetic field gradient, makes the localised targeted debris in LEO decelerate. In this regard, the paper develops a spacecraft with a liquid monopropellant engine, called Space Cleaner, and it analyses the latter's structure, assuming methods to minimise its mass. Thus, minimising the structural mass, it is possible to maximise the propellant ratio and to achieve the maximum recovery number. Following and implementing the mentioned magnetic principle, the spacecraft's case and the actuator's supporting structure are designed to be stored in the Vega carrier rocket and to “eat” the targeted debris. To assess the project's feasibility, the paper simulates a mission and uses the Space Cleaner to recover the Cosmos 1408 debris. Among them, the paper focuses on 200 small debris with a mass ranging from 1 kg to 10 kg and a semi-circular orbit and it demonstrates that it is possible to develop a mission consisting of three manoeuvres: the spacecraft carries out a little plane change, it then performs a Hohmann descend manoeuvre and it, lastly, completes a rendez-vous from the front. After the last manoeuvre, the Space Cleaner incorporates the debris and switches on the actuator able to generate a force that ejects the object and puts it into an elliptical orbit. Once in the latter, the debris reaches the perigee and thus interacts with the atmosphere. Lastly, the spacecraft is conceived to plan a less expensive multi-recovery mission and to clear the orbit from several debris. For future research, the paper finally suggests the use of superconductors for the actuator's development, in order to improve the Space Cleaner's performance.