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GRASPING MECHANISM CONCEPTS ORIENTED TO DEBRIS FOR REMOVAL APPLICATION

Abstract

Decades of space activities laid nowadays to a compelling necessity of space debris regulation and reduction. With its Clean Space Initiative, in 2012, ESA sensitised the main characters in the Aerospace field on Debris for Removal activities.

In this context, ESA is evaluating the hypothesis of equipping every device that will be launched in space in future with a passive interface in order to simplify and systematize an End of Life disposal operation. This standardized passive interface should be studied to be coupled with an active interface on a robotic manipulator.

In order to study a possible solution that fits the requirements given by ESA for the development of the capture interface a set of four possible mechanical concepts was developed.

A preliminary design of all of them was developed with a special attention on the main functional requirements: maximum encumbrance, maximum mass at passive interface to be assembled on the system to be removed and forces and torques to be transmitted.

Two mechanisms are based on the probe and drogue layout, while the others consider the use of fingers.

The first of them is based on the well-known probe and drogue mating system which is one of the most employed and well established system in space operations.

The second mating device is a Central Active System provided with a linear central actuator on the active side and a conical socket as passive interface. This layout shows several advantages by the point of view of encumbrance.

Thirdly, a three fingers mechanism with linear actuator has been conceived in order to be mated with a pine cone shaped passive interface. This solution is not known for space application and could show some advantages in terms of durability and reliability of the passive interface.

The last mechanical concept is inspired by a chuck mechanism commonly used in several mechanical applications and that after a redesigning process could be applied in robotic mating operations. Here again the concept is new for space application and could show some advantageous features.

The paper describes the preliminary draft of all the proposed concepts and intend to lay the foundation for a trade-off analysis to select the most suitable concept that could be used in debris for removal activities.