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STANDARD INTERFACE FOR ROBOTIC MANIPULATION (SIROM): CURRENT STATE AND FUTURE DEVELOPMENTS FOR ONE OF THE MAIN BUILDING BLOCKS FOR SPACE ROBOTICS ADVANCEMENT

Abstract

On-orbit servicing (OOS) in the form of space-manufacturing, refueling, assembly and robotic manipulation are deemed to become a fundamental part of the space market in the short-to-middle term. In 2020, the first commercial mission to repurpose an out-of-service satellite was successfully carried out with the docking of Intelsat 901 and MEV-1 [1]. Other endeavors such as SpaceX's strategy of refueling their Starship rocket in LEO [2] or OrbitFab's vision to routinely refuel satellites [3] are examples of the tendencies of the field towards OOS. However, widespread and extensive use of OOS in space operations will only become the norm when it can be performed in an efficient, profitable and sustainable manner. One of the key aspects to reach this point is having a standardized, reliable, and cost-effective interface that also embeds as much functionality as possible to simplify operations. In this context, SENER Aeroespacial has developed the SIROM (Standard Interface for Robotic Manipulation) [5]. SIROM provides in a single, compact and integrated solution four functionalities/interfaces: mechanical coupling, electrical interface, thermal and data transfer. This device has a mass lower than 1.5 kg, an external diameter of 120 mm and a height of26.5 mm above its interface plane. Apart from being a standard-interconnect interface, SIROM can act as the end-effector of a robotic arm for robotic manipulation in space. It is capable of withstanding translational inaccuracies of +/- 5mm and rotational inaccuracies of +/- 1.5 in any axis.

A SIROM can be configured in two fashions: active and passive. Active SIROMs are capable of latching both with active and passive SIROMs, and are equipped with the full embedded electronics and a BLDC motor to actuate the latches. This provides full functionality and control of all interfaces that a SIROM offers, while keeping the solution as compact and integrated as possible. Passive SIROMs are not actuated and only incorporate the electronics to enable the interfaces between SIROMs. This reduces the mass and envelope of passive SIROMs considerably.

In this paper, the current design for SIROM is presented, with a focus on the electronics subsystem, the part it plays on providing flexibility and reliability to SIROM and the future developments that will further optimize its design, enabling and simplifying space refurbishing, reconfiguration and servicing and

possibly becoming one of the main building blocks for European Space Robotics missions.