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MOSAR-WM: A RELOCATABLE ROBOTIC ARM DEMONSTRATOR FOR FUTURE ON-ORBIT APPLICATIONS

Abstract

In the past few years, the raise of space robotics yielded novel potential applications. The utilization of more advanced and capable robotic manipulators opens a whole new horizon of possibilities for future space missions, ranging from On-Orbit Servicing (OOS) of existing satellites (for refuelling, ORU or de-orbiting) to On-Orbit Assembly (OOA) and reconfiguration of modular spacecraft. This paper deals with the design and MAIT activities of a novel robotic manipulator for such on-orbit applications. MOSAR-WM is a 7 dofs manipulator, 1.3-meter long, symmetrical and relocatable (aka. "walking" capable). Its overall structure is human-like with asymmetric joints. Manipulator joints are hollow-shaft for internal cable routing and includes cutting-edge space-compatible technologies. Each joint embeds a torque sensor in addition to position sensors (incremental and absolute encoders). The kinematic architecture of MOSAR-WM offers a wide end effector workspace, and its stiff structure guarantees a high accuracy and repeatability while allowing compactness for launching and storing purposes. Each extremity of MOSAR-WM is equipped with a HOTDOCK standard interface that allows for mechanical connection, powering and controlling the arm. Manipulator avionics consists in seven joint controllers (one per joint) and an embedded computer (OBC) running a real time operating system. The OBC receives high-level commands from the external computing unit through the connected HOTDOCK interface. It also calculates the dynamic model of the robot to provide proper feed-forward terms for the joint control. Depending on the desired behavior, the gains of the joint control loop are adaptive for optimal performance in position control. In addition, a Cartesian impedance control is implemented to allow for compliant operations. The joints controllers are daisy-chained through EtherCAT while the control of each HOTDOCK is performed through a CAN bus managed by the internal OBC. MOSAR-WM is developed in the context of the European Commission's Space Robotic H2020 MOSAR project. It aims to validate at TRL 4 pin-to-pin equivalent technologies, in a space representative scenario. This paper presents the MOSAR-WM design as well as the preliminary tests carried out with the MOSAR-WM prototype.