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ROSPA, SPACE-LIKE CONTACT DYNAMIC SCENARIO SETUP AND EUROPEAN FACILITIES CROSS-VALIDATION

Abstract

The in-space Robotic Servicing Physical Assessment (ROSPA) is a demonstrator with the purpose of recreating and studying the dynamics during/after contact between target and chaser in a rendezvous and capture mission. In the scope of the activity, the space-like environment simulation functionality of the platform-art facility at GMV (Madrid, Spain) has been exploited. This facility has been used and validated within previous collaborations between ESA and GMV, for projects such as ANDROID (Active Debris removal mission), for navigation purposes based on optical cameras for NEOGNC (Interplanetary mission, MarcoPolo-R) and with flight data coming from PRISMA mission. The output of ROSPA activity is to demonstrate its validity for contact dynamics and to produce a database of illumination-representative images. The images are taken during an open loop test involving a manipulator arm approaching and gripping the launch adapter ring (LAR) of a small satellite. A mock-up of the TANGO spacecraft (target of the PRISMA mission) was used during the experiments. The set of images include various sensor degradation effects such as fuel on lens, micro pieces of MLI floating and thruster plume in the field of view of the camera. Two sets of images have been captured, from a camera placed at the tip of the robotic arm approaching the target and from a camera considered to be placed on the chaser for navigation purposes. The data package also contains forces and torques measured by a load cell put on the tip of the robotic arm. The capability of reproducing realistic contact dynamics at platform-art has been cross-validated with the ORBIT facility at ESTEC (Noordwijk, The Netherlands). The facility located within ESTEC's Automation and Robotic laboratories provides several air-bearing platforms which can move friction-less on a 45 m flat floor. During the experiment, a robotic arm approaches a specifically designed mock-up mounted on an air-bearing platform (or a second robotic arm in case of platform-art), touches it through a compliance device (a load cell measures the contact forces/ torques) and leaves the dynamic evolve in free-drift. A representative database of images has been obtained which will eventually be useful for other activities like image processing algorithm testing. Under specific conditions, the contact dynamic reproduced in both facilities has been proven to be equivalent and coherent with space dynamic recreated through numerical simulation.