

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Upper Stages, Space Transfer, Entry and Landing Systems (3)

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ROBOTIC GRIPPER TECHNOLOGY FOR CARGO TRANSFER IN LOW EARTH ORBIT

**Abstract**

The consensus to a study phase for an IXV (Intermediate eXperimental Vehicle) successor, a preoperational vehicle called PRIDE (Programme for Reusable In-orbit Demonstrator in Europe), has been recently enlarged, as approved during last EU Ministerial Council. One of the main project task consists in developing PRIDE to conduct on orbit servicing activity with no docking. PRIDE would be provided with a robotic manipulator system (arm and gripper) able to transfer cargos, such as scientific payloads, from low Earth orbiting platforms to PRIDE cargo bay. The platform is a part of a space tug designed to move small satellites and other payloads from LEO to GEO and viceversa. A study on this robotic technology is here presented. This research is carried out by Politecnico di Torino and Thales Alenia Space Italy. The system configuration of the robotic manipulator is first described in terms of volumes and masses. The assumed housing cargo bay requirements in terms of volume ( $<100$  l) and mass ( $<50$  kg) combined with the required overall arm dimensions (4 m length), as defined following the stated mission scenario, and mass of the cargo (5-30 kg) force to developing an innovative robotic manipulator with the task-oriented end effector. It results in a 7 degree-of-freedom arm to ensure a high degree of dexterity and a dedicate end-effector designed to grasp the cargo interface. The gripper concept here developed consists in a multi-finger hand able to lock both translational and rotational cargo degrees of freedom through an innovative under actuation strategy to limit its mass and volume. A configuration study on the cargo handle interface has also been performed together with some computer aided design models and multibody analysis of the whole system to prove its feasibility. Finally, the concept of system control architecture, organized in three main blocks is defined.