SPACE SYSTEMS SYMPOSIUM (D1)
Enabling Technologies for Space Systems (2)

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TOWARDS A STANDARDIZED GRASPING AND REFUELLING ON-ORBIT SERVICING FOR GEO SPACECRAFT

Abstract

Exploitation of space must benefit from the latest advances in robotics. On-orbit servicing is a clear candidate for the application of autonomous rendezvous and docking mechanisms. However during the last three decades most of the trials took place combining Extravehicular activities (EVA) with tele-

manipulated robotic arms. The European Space Agency (ESA) considers that grasping and refuelling interfaces are promising near mid-term capabilities that could be performed by servicing spacecraft. Minimal add-ons on spacecraft to enhance their serviceability would protect them for a changing future in which satellite servicing may have become mainstream.

ESA aims to conceive and promote standard refuelling provisions that can be installed in present and future European commercial GEO satellite platforms and scientific spacecraft. Hence ESA has started the ASSIST activity addressing the analysis, design and validation of internal provisions (such as modifications to fuel, gas, electrical and data architecture) and external provisions (such as integrated berthing fixtures with electrical, gas, liquid connectors, leak check systems and corresponding optical and radio markers for cooperative rendezvous and docking). This refuelling solution is being agreed with several European space companies (OHB System and Thales Alenia Space) and expected to be consolidated with European commercial operators as a first step to become an European standard; this approach is also being considered for on-orbit servicing spacecraft, such as the SpaceTug, by Airbus DS. ASSIST activity is led by GMV together with MOOG for propulsion provisions, NTUA for the air-bearing table testing and DLR regarding contact dynamics.

This paper will detail the operational means, structure, geometry and accommodation of the system. Internal and external provisions will be designed with the minimum impact on the current architecture of GEO satellites, so that accommodating them in future satellites will not be seen as a major complication, nor will it introduce additional risks. End-effector and berthing fixtures are being designed in the range of few kilograms and linear dimensions around 15cm. A central mechanical part is expected to perform first a soft docking followed by a motorized retraction ending in a hard docking phase using aligning pins. Mating and de-mating and leakage-free fuel transferring will be analysed and tested to ensure robustness of operations.

The validation of the ASSIST system through dedicated environmental tests in a vacuum chamber together with dynamic testing using an air-bearing table will allow for the demonstration of concept feasibility and its suitability for becoming a standard of the space industry.