Paper ID: 26694
oral

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

Author: Dr. Giuseppe Rufolo
CIRA/ASI Technical Assistance to ESA, Italy

Mr. Carlos Pereira
beyondgravity, Switzerland
Mr. Flavio Camarri
Thales Alenia Space Italia, Italy

ESA INTERMEDIATE EXPERIMENTAL VEHICLE IN-FLIGHT EXPERIMENTATION. OBJECTIVES, EXPERIMENT IMPLEMENTATION, QUALIFICATION AND INTEGRATION

Abstract

The main objective of the ESA IXV Project, scheduled for launch in last quarter 2014, is the in-flight verification at system level of all the technologies deemed critical for the autonoumus re-entry from Low Earth Orbit (LEO). Among such critical technologies a special attention is given to the Aerodynamics and Aerothermodynamics and the Thermal Protection System (TPS). A lack of in-flight validation for Europe in numerical tool for re-entry application implies the application of large uncertainties to the heat fluxes estimations and consequently large margins in the design of TPS components. IXV will provide valuable data in an environment representative for most of the critical aerothermodynamics phenomena with the aim at obtaining a concrete and measurable reduction of uncertainties. For what concerns the TPS, the severity of the re-entry environment induces several criticalities that make very complex the design of solution compliant with the system requirements. The exploitation of IXV flight data will allow the verification, and characterization and, eventually, the improvement of the design strategy for TPS. To fulfil the above experimentation objectives IXV is fully instrumented with about 300 sensors. The objective of the sensor definition and placement in the vehicle is to maximize the amount of data while minimizing number of sensors. The nose of the vehicle uses a total of twenty thermocouples and nine pressure sensors to capture angle of attack, stagnation pressure and thermal gradients of the C-SiC ceramic. Displacement sensors and high temperature strain gauges record mechanical loads and measure the differential expansion between the nose cap and the vehicle carbon composite structure. Similar combination of sensors is used in the windward TPS. A coated patch is applied on one of the tiles to quantify the catalytic level of the ceramic material in a re-entry environment. The leeward, lateral and base of the IXV vehicle are covered by ablative material. Its behaviour requires a dedicated design of the thermocouple measuring system. At the rear of the vehicle the flaps and hinge are instrumented using thermocouples. An infrared camera with periscope optics based on a sapphire mirror generates thermal maps of the flaps. Images are compressed for transmission and stored in the data handling unit which analyzes them and sets gain and exposure of the camera. This work describes the implementation of the various experiment, the qualification of the adopted solution for the IXV environment, the integration on the vehicle and the final testing.