MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Vehicles – Mechanical/Thermal/Fluidic Systems (7)

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OPTICAL SENSOR SYSTEM APPLICABILITY FOR SPACECRAFT TESTS

Abstract

Within the environmental testing on aerospace structures, one of the most complex tests in terms of set-up is the Thermal Test (vacuum or ambient cycling). Heaters and Thermocouples, conventional sensors installed in a large number on S/C, harness, interfaces, facility, typically compose the thermal set-up currently used for this kind of test. On one hand, these sensors are suitable to acquire, with a good degree of accuracy, the different temperatures of the thermal range used in the flight-testing hardware, but, on the other hand, they are characterized by a series of issues, which can be summarized in terms of a great number of interconnections on the facility, significant length, and weight. The highlighted problems involve difficulties of installation, connection and routing, which cause a detachment in transitional phases of testing (hot/cold).

The main objective of this paper is the identification and validation of a system based on the use of Optical Sensors to measure the temperature in a more competitive, flexible and reliable way than that obtained with conventional thermocouples. Among the fiber optical sensors the more interesting are the ones called fiber Bragg sensors.

As final result is to increase the reliability of the hardware aimed: 1) to the reduction of the risk of detachment of the sensor due to the effect of weight of the harness, 2) to the reduction in the number of interconnections on the thermal vacuum facility, 3) to increase the number of sensors per single cable, 4) to increase the accuracy of the measurement and finally the reliability of the acquisition system.

In the paper a new tempertature acquisition sensor system based on fiber Bragg technology will be presented and described, the test activity has been performed at Thales Alenia Space Italy Test Centre. The relevant experimental results obtained via optical sensors on a vacuum test-bed were compared with the ones obtained via standard thermocouples. In particular tests performed via fiber Bragg sensors provided a clear evidence of the following advantages: the possibility of reduction of cables, connectors and weight; easier and faster maintenance and repairs; the reduction of costs and of the complexity of the set-up; the accuracy and precision of measurement. An overall analysis on the benefits in terms of usability and duration of the set-up activities during the thermal vacuum test campaign will be also presented and discussed.