

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Smart Materials and Adaptive Structures (5)

Author: Mr. Stephan Rapp
Technische Universität München, Germany

Mr. Arnd Reutlinger
Germany

Mr. Karl-Heinz Zuknik
Germany

Prof. Horst Baier
Technische Universität München, Germany

AN INTEGRATED TEMPERATURE SENSOR NETWORK FOR SATELLITE SANDWICH PANELS

Abstract

Today's satellites are equipped with hundreds of sensors for the observation of the satellites conditions, e.g. mechanical and thermal loads, during testing, launch and operation. This induces a high integration effort and high additional weight, if conventional electrical sensors like strain gages and thermistors are used. The use of fiber optic sensors (FOS) with their low density, electromagnetic immunity, the capability of multiplexing a lot of sensors in a single fiber and measuring mechanical strains as well as temperatures, offers an advantageous alternative. Because of that the Institute for Lightweight Structures and the company Kayser-Threde GmbH develop an integrated temperature sensor network for satellite sandwich panels as a structural demonstrator in the scope of the ESA project FOSAT to show the feasibility and benefits of this monitoring technology. The developed temperature sensor network is using fiber Bragg grating (FBG) sensors to measure discrete temperatures on a wide spread panel area. The environmental conditions of a satellite structure including high dynamic and static mechanical loads as well as high thermal loads and vacuum conditions required special sensor design for the decoupling of thermal and mechanical strain as well as adequate integration techniques which have negligible impact on the structural integrity of the sandwich panel. Using proper algorithms the temperature field on the satellite panel can be determined and possible hot spots detected. Although the focus of this article is on the monitoring of temperatures on equipment panels during operation, the FOS can be used as well for the detection of mechanical strains or accelerations during the whole lifecycle beginning with curing monitoring of composite parts and ending with the deorbiting of the spacecraft.