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SPACE SYSTEMS SYMPOSIUM (D1)
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FIBER-OPTICAL SENSING ON-BOARD SPACECRAFT

Abstract

In order to reduce mass, AIT effort and overall costs of classical point-to-point wired temperature sensor harness on-board spacecraft, OHB System has introduced the Hybrid Sensor Bus (HSB) system, which interrogates sensors connected in a bus architecture. In order to use the advantages of electric as well as of fiber optic sensing technologies, the HSB system is a modular measurement system built as combination of an electrical sensor bus based on IC and a fiber-optic sensor system based on fiber Bragg grating (FBG) sensors.

Fiber-optical sensor bus networks on-board satellites are well suited for temperature measurement due to low mass, electro-magnetic insensitivity and the capability to embed them inside structure parts. The light weight FBG sensors inscribed in radiation tolerating fibers can reach every part of the satellite.

For the HSB development telecommunication satellite platform requirements have been considered for operating at least 15 years in a geostationary orbit. HSB has been developed in the frame of an ESA program with European and German co-funding and will be verified as flight demonstrator on-board the German Heinrich Hertz satellite (H2-Sat).

In its basic configuration HSB consists of three modules which are the Intelligent Power Module, the Interrogator Controller Module and the Analog Front-End for the fiber-optical interrogation. The Interrogator Controller Module handles both, the electrical and fiber-optical sensor network. For the latter it is to be completed by the Analog Front End. On this front-end a tunable laser is implemented for the scanning of the FBG sensors.

The reflected spectra are measured on multiple fiber channels and are then converted to temperatures by use of a peak find algorithm. To guarantee a stable operation over the full mission an in-orbit recalibration means is implemented on the Analog Front End.

In this paper the development of HSB and the analysis of different fiber-optical sensor bus networks are presented. Different approaches for increasing the reliability in fiber-optical sensor bus networks have been modeled and analyzed. Environmental test results of the HSB engineering model with connected space representative fiber-optical sensor networks are presented. The paper concludes with an outlook regarding the HSB flight module development and its in-orbit verification.