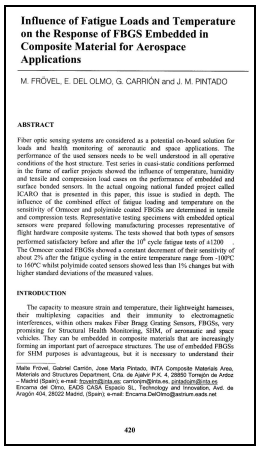

Influence of Fatigue Loads and Temperature on the Response of FBGS Embedded in Composite Material for Aerospace Applications

M. FRÖVEL, E. DEL OLMO, G. CARRIÓN and J. M. PINTADO

ABSTRACT

Fiber optic sensing systems are considered as a potential on-board solution for loads and health monitoring of aeronautic and space applications. The performance of the used sensors needs to be well understood in all operative conditions of the host structure. Test series in cuasi-static conditions performed in the frame of earlier projects showed the influence of temperature, humidity and tensile and compression load cases on the performance of embedded and surface bonded sensors. In the actual ongoing national funded project called ICARO that is presented in this paper, this issue is studied in depth. The influence of the combined effect of fatigue loading and temperature on the sensitivity of Ormocer and polyimide coated FBGSs are determined in tensile and compression tests. Representative testing specimens with embedded optical sensors were prepared following manufacturing processes representative of flight hardware composite systems. The tests showed that both types of sensors performed satisfactory before and after the 10^6 cycle fatigue tests of ±1200 The Ormocer coated FBGSs showed a constant decrement of their sensitivity of about 2% after the fatigue cycling in the entire temperature range from -100ºC to 160ºC whilst polyimide coated sensors showed less than 1% changes but with higher standard deviations of the measured values.

INTRODUCTION

The capacity to measure strain and temperature, their lightweight harnesses, their multiplexing capacities and their immunity to electromagnetic interferences, within others makes Fiber Bragg Grating Sensors, FBGSs, very promising for Structural Health Monitoring, SHM, of aeronautic and space vehicles. They can be embedded in composite materials that are increasingly forming an important part of aerospace structures. The use of embedded FBGSs for SHM purposes is advantageous, but it is necessary to understand their

Malte Frövel, Gabriel Carrión, Jose Maria Pintado, INTA Composite Materials Area, Materials and Structures Department, Crta. de Ajalvir P.K. 4, 28850 Torrejón de Ardoz – Madrid (Spain), e-mail: frovelm@inta.es carrionvg@inta.es, pintadojm@inta.es Encarna del Olmo, EADS CASA Espacio SL, Technology and Innovation, Avd. de Aragón 404, 28022 Madrid, (Spain), e-mail: Encarna.DelOlmo@astrium.eads.net

Код: 10604

M. Frovel, E. Del Olmo, G. Carrion, J.M. Pintado

Influence of Fatigue Loads and Temperature on the Response of FBGS Embedded in Composite Material for Aerospace Applications

Издательство DEStech Publications, Lancaster, 2010 год

6 стр; формат: 23,5 x 16 см; библиографический список: 11 единиц
ISBN: 978-1-60595-024-2

Fiber optic sensing systems are considered as a potential on-board solution for loads and health monitoring of aeronautic and space applications. The performance of the used sensors needs to be well understood in all operative conditions of the host structure. Test series in cuasi-static conditions performed in the frame of earlier projects showed the influence of temperature, humidity and tensile and compression load cases on the performance of embedded and surface bonded sensors. In the actual ongoing national funded project called ICARO that is presented in this paper, this issue is studied in depth. The influence of the combined effect of fatigue loading and temperature on the sensitivity of Ormocer and polyimide coated FBGSs are determined in tensile and compression tests. Representative testing specimens with embedded optical sensors were prepared following manufacturing processes representative of flight hardware composite systems. The tests showed that both types of sensors performed satisfactory before and after the 10^6 cycle fatigue tests of ±1200 The Ormocer coated FBGSs showed a constant decrement of their sensitivity of about 2% after the fatigue cycling in the entire temperature range from -100°C to 160°C whilst polyimide coated sensors showed less than 1% changes but with higher standard deviations of the measured values.

Ключевые слова:

Содержание.