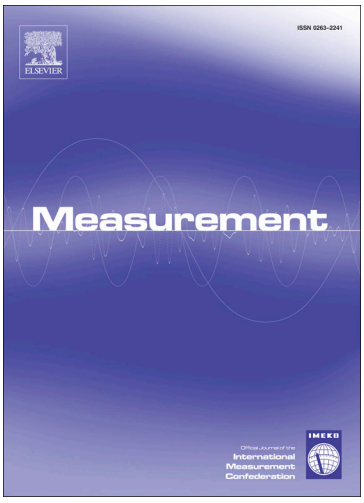

Low weight additive manufacturing FBG accelerometer: design, characterization and testing

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PII: S0263-2241(17)30801-1
DOI: https://doi.org/10.1016/j.measurement.2017.12.030
Reference: MEASUR 5161

To appear in: *Measurement*

Received Date: 21 July 2017
Revised Date: 18 December 2017
Accepted Date: 19 December 2017

Please cite this article as: N. Gutiérrez, P. Galvín, F. Lasagni, Low weight additive manufacturing FBG accelerometer: design, characterization and testing, *Measurement* (2017), doi: https://doi.org/10.1016/j.measurement.2017.12.030

Low weight additive manufacturing FBG accelerometer: design, characterization and testing

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Preprint submitted to Measurement

Abstract

Structural Health Monitoring is considered the process of damage detection and structural characterization by any type of on-board sensors. Fibre Bragg Gratings (FBG) are increasing their popularity due to their many advantages like easy multiplexing, negligible weight and size, high sensitivity, inert to electromagnetic fields, etc. FBGs allow obtaining directly strain and temperature, and other magnitudes can be also measured by the adaptation of the Bragg condition. In particular, the acceleration is of special importance for dynamic analysis. In this work, a low weight accelerometer has been developed using a FBG. It consists in a hexagonal lattice hollow cylinder designed with a resonance frequency above 500 Hz. A Finite Element Model (FEM) was used to analyse dynamic behaviour of the sensor. Then, it was modelled in a CAD software and exported to additive manufacturing machines. Finally, a characterization test campaign was carried out obtaining a sensitivity of 19.65 pm/g. As a case study, this paper presents the experimental modal analysis of the wing of an Unmanned Aerial Vehicle. The measurements from piezoelectric, MEMS accelerometers, embedded FBGs sensors and the developed FBG accelerometer are compared.

Key words: structural health monitoring (SHM); Fibre Bragg Grating (FBG); accelerometer; additive manufacturing

1. INTRODUCTION