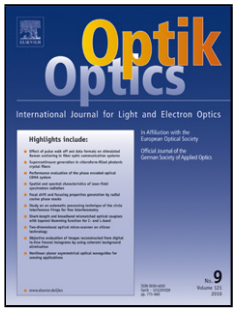

Title: Efficient measurement of temperature, humidity and strain variation by modeling reflection Bragg grating spectrum in WSN

Authors: Tahar Ezzedine, Amira Zrelli

PII: S0030-4026(17)30082-7
DOI: http://dx.doi.org/doi:10.1016/j.ijleo.2017.01.061
Reference: IJLEO 58764

To appear in:

Received date: 8-9-2016
Revised date: 29-11-2016
Accepted date: 24-1-2017

Please cite this article as: Tahar Ezzedine, Amira Zrelli, Efficient measurement of temperature, humidity and strain variation by modeling reflection Bragg grating spectrum in WSN, Optik - International Journal for Light and Electron Optics http://dx.doi.org/10.1016/j.ijleo.2017.01.061

<AT>Efficient measurement of temperature, humidity and strain variation by modeling reflection Bragg grating spectrum in WSN

< AFF > Tahar Ezzedine [a,c] and Amira Zrelli[a,b,c]

[a]National engineering School of Tunis,University Tunis El Manar,Tunisia

[b]National engineering School of Gabes,University of Gabes,Tunisia

[c]Communication System Laboratory Sys'Com

<ABS-HEAD>Abstract

<ABS-P>Measurement and monitoring of temperature, humidity and strain variation are very requested in great fields and area such as structural health monitoring (SHM) systems. Currently, the use of fiber Bragg grating sensors (FBGS) based on wireless sensor network (WSN) has been recommended in SHM due to the specifications of these sensors. In this paper, we proposed an architecture of wireless SHM system based on FBGS and wireless sensor network, therefore we try to measure the efficient variation of strain, temperature and humidity (SV, ST, SH) by modeling the spectrum of FBGS. Thus, we deduce the fundamental relation between these parameters and the wavelength of Bragg grating.

<KWD>Keywords: FBGS; Strain;Temperature; Humidity; measurement; bragg spectrum;wsn; SHM

<H1>1 Introduction

Recent progress and development of FBGS technology and wireless sensor network (WSN) have provided an excellent choice for civil engineers. Civil structures like tunnels, bridges and mines can be monitoring using these technologies. The monitoring of the safety of these structures is the aim of Wireless Structural Health Monitoring (WSHM). WSHM must be able to detect damage (fire, strain, shaking, etc) and to localize the exact emplacement of the damage. As well, the smart optical sensor technologies have become one of the key technologies in WSHM.

FBG sensors are characterized by small dimensions, good resolution, the error rate of temperature is 0.5°C and the fidelity of strain is 5 με, as well as FBGS have an excellent ability to transmit signal at long distances. Therefore, optical fiber grating and FBG sensors specially, are robust against radio frequency interference [3]. Thus, these beneficial make FBGS the better method in civil engineering. Monitoring of the structural condition of various civil structures is critical to the extent and safety of structures. To see any anomalies that result, more and more measures should be carried out in various strategic areas of the structure, also the use of FBGS are recommended. Huynh et al. (2016) have used wireless vibration sensor nodes to monitor accelerations in the desk of Hwamyung Bridge [11]. Chen et al. (2016) have proposed a WSN for concrete strength monitoring and they designed the hardware and the software architecture of wireless node which can monitor concrete structures [12]. Kim et al. (2014) and Park et al. (2015) have investigated the performance of the WSHM and they reported the wind-induced variation of the bridge's dynamic characteristics during the typhoons [13] [14]. In WSHM system, several parameters can derange hugely our daily life, like vibration, temperature, pressure, deformation, etc. SHM is considered as a data acquisition system from a civil structure, this structure receives internal or external stimuli. More importantly, SHM systems are used to quantify the change in state of the

structure. Hence, we can deduce about the prognosis aspects such as capacity and remaining life. FBGS are extremely sensitive to changes of temperature and strain, and are an extremely useful candidate for measuring and monitoring of strain variation (SV), temperature change (TC) and humidity change (RH) in the civils structures [6]. Furthermore, SV, TC and RH are always considered as annoying settings which can affect human life.

FBGS are used to ensure reliable and continuous monitoring associated to optical fiber (OF) which is a new technology, sensitive to many kinds' parameters [16] [7]. Thus, to assure security and safety of human life, simultaneous monitoring of SV, TC and RH are very important and must be controlled in real time. Specifically, to keep an adequate humidity, temperature and strain, FBGS have been used for vibration and humidity sensing [7].

Leandro et al. (2015) have presented a novel sensor system for simultaneous measurement of strain and temperature using a unique combination of a long period grating (LPG) and a one fiber laser based on a FBG. They demonstrate that vibration and temperature variation can be obtained by using a unique emission line [4]. Wu et al. (2003) have studied simultaneous temperature and strain sensing by dual wavelength FBG for