

Optical fibre FBG sensors and monitoring systems for Structural Health Monitoring (SHM) of civil engineering structures

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This paper shows results from few installations of monitoring systems with optical fibre Bragg grating (FBG) sensors.

Sensor embedded reinforcing textiles provide the engineer with a new tool for the seismic retrofit of unreinforced masonry structures. These multifunctional materials add strength, improve ductility, and provide the opportunity to conduct structural health monitoring. Experimental investigations about the behaviour of unreinforced masonry (URM) structures in comparison with masonry structures, sensor-embedded fibre reinforced cement (FRC) in a seismic wallpaper concept, is carried out on the large shaking table. This paper reports the validation of these textiles on a stone and mortar two storey structure similar to those damaged by the L'Aquila earthquake in early 2009 which struck central Italy. The focus of this test is to characterise the performance of the reinforcing textile and the ability of the embedded sensors to capture data that enables the Structural Health Monitoring (SHM) techniques using detection and monitoring of crack openings dynamically using FBG sensors.

This paper also reports the SHM system, which consists of FBG sensors, installed on the two bridges and also in tunnel. The process of detecting, localizing, classifying, and providing a prognosis for damage (i.e. change in material and/or geometric properties, boundary conditions and so on) to engineered structures is referred to as Structural Health Monitoring (SHM). This process often involves the observation of a system over time using periodically sampled dynamic response measurements from an array of sensors, the extraction of damage-sensitive features from these measurements, and analysis methods to determine the current state of system health. SHM can be used for rapid condition screening and aims to provide, in near real time, reliable information regarding the integrity of the structure. FBG sensors monitoring system is suitable instrument for SHM especially because of its only passive optical cable installation and electromagnetic immunity, which means in practice no needs of any power supply for installed sensors. FBG system has also wide dynamic range together with high linearity, long operation distances and life-time with almost no maintenance needs.