Smartphone Technology Applied in an Approach for Multiplexing of Fibre Optic Intensity-Modulated Macro-Bend Based Sensors

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Abstract: An approach for multiplexing intensity-modulated sensors was experimentally tested. The intensity of the transmitted light detected by the smartphone camera in the RBG channels was used to determine the location and magnitude of a perturbation.
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1. Introduction

Fibre optic sensing research area has been extensively exploited in the last few decades resulting in successfully systems and devices applied in different areas. Optical fibre outstanding characteristics as low weight and small size, mechanical flexibility, immunity to electromagnetic interference and electrical passivity have contributed to the success of the fibre sensing technology. Interferometric as well as intensity-modulation and wavelength interrogation methods have been used for decoding signals from this class of sensors. Among these methods, intensity-modulation interrogation schemes are especially attractive for low-cost applications. Several self-referencing techniques, applied to avoid errors caused by undesired fluctuations of source intensity, were investigated and reported in literature [1,2].

Multiplexing ability, one of the most interesting optical fibre properties, has contributed for the development of techniques that allow simultaneous interrogation of a large number of sensors. Multiplexing techniques applied to fibre optic sensors arrays enable quasi-distributed mapping of different parameters as pressure, temperature and strain and guarantee a reduction of cost per sensing element. Frequency-division, wavelength-division and time-division are examples of multiplexing techniques used in fibre optic sensing applications [3,4].

In this work, a method for multiplexing macro-bend based fibre optic sensors is reported. In the used approach, the smartphone camera detects the light of a broadband source transmitted by intensity-modulated sensors. The intensity of the light in each one of the RGB (Red-Green-Blue) channels is computed and used to sense perturbations imposed to the sensors. The method was experimentally tested with an array composed of three sensors, showing the ability of determining the location and magnitude of a perturbation applied to the array.

2. Methodology

2.1. Sensing System

Three in series macro-bend based sensors, a white light source (LS-1, Ocean Optics, 360 to 2000 nm) and a smartphone are the main elements of the experimental setup shown in the diagram of Fig. 1.

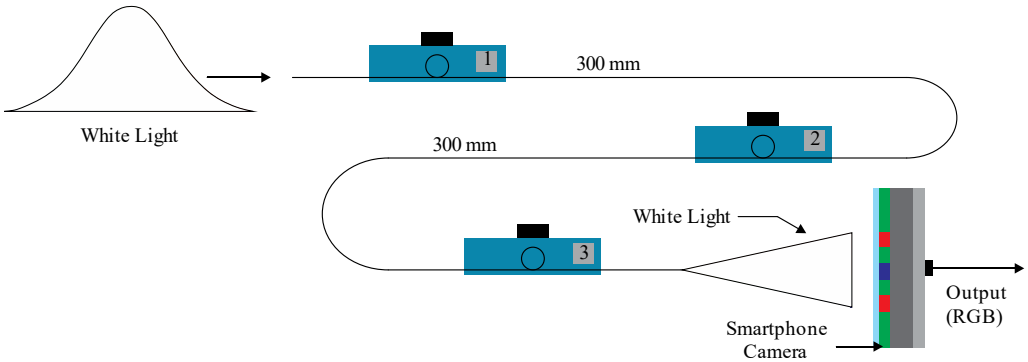

Fig. 1. Diagram of the experimental set-up used for multiplexing the intensity-modulated sensors.