844. Accepted as a invited paper Proc. SPIE V2294, paper 10, 1994 San Diego

Multiplexed Point And Stepwise-Continuous Fibre Grating Based Sensors: Practical Sensor For Structural Monitoring?

M. G. Xu, H. Geiger and J. P. Dakin

Optoelectronics Research Centre, University of Southampton
Southampton SO9 5NH, United Kingdom

Tel +44 703 593172 Fax +44 703 593149
Email mgx@orc.soton.ac.uk

Submit to "Distributed and Multiplexed Fibre Optic Sensors IV" (Conference Chairs: Alan D. Kersey and John P. Dakin) at San Diego'94

Abstract

We report on recent progress on developing a complimentary pair of optical-fibre-based sensor methods for structural monitoring, for potential application in aerospace composites or civil engineering structures. Particular emphasis is placed on a method for addressing arrays of grating sensors using an acousto-optic tunable filter (AOTF), and on a longer-gauge-length system based on optical-time-domain reflectometry (OTDR).

The AOTF possesses the desired frequency-agile capability for random multiplexed access and has a wide tuning range. It is suitable for both dynamic and quasi-static strain sensing. The scheme involves frequency-shift-keying of the RF drive to an AOTF to track the wavelength changes of gratings. We are currently constructing a compact interrogation system based on the concept.

For many sensing applications, it is desirable to have a system able to monitor the average strain over a longer length of the structure. This is being researched using a specially-designed high-resolution OTDR. It enables us to determine the optical path length between partially-reflected points (eg gratings) along the fibre. From the measured optical range of each individual discontinuity, changes in length in each intervening fibre section can be determined. In terms of distance, a resolution equivalent to 100 μm over a 5 m long fibre section has been achieved within a measurement time of 5sec. Work is being directed towards extending the number of sections monitored, and reducing the measurement time using improved processing algorithms, and to extend performance using communications components.

Key Words multiplexed, fibre optic sensors, strain sensing, fibre gratings