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**Structural Monitoring using "Optically-Rugged" Fibre-Optic Methods :
Group Delay Measurements and Wavelength Interrogation of Gratings**

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Abstract

The paper describes progress with two multiplexed methods which have been designed for strain sensing in optical fibres. Both methods depend, effectively, on monitoring changes in optical propagation velocity. They are therefore expected to be less affected by fibre bending and lateral pressure than systems based on polarimetry. Unlike complex interferometric systems, they do not require to reference fringe positions (the latter could have difficulty in fringe tracking under conditions of severe mechanical shock or vibration).

Two basic methods are used in our work, both based on optical communications hardware. The first method (1), our long-gauge-length system, uses a high-precision form of Optical Time Domain Reflectometer (OTDR). This relies on pseudo-random modulation of a laser source, where the returning signals from reflective discontinuities are correlated with the transmitted code. This firstly improves the signal/noise ratio, and secondly, allows easy (and unambiguous) separation of signals from reflective points situated at different distances. The optical delay measurements for signals from each of the reflective points are all taken relative to that of the reflection from the first discontinuity, so optoelectronic delays are cancelled. In our presentation we will report on recent progress, with our system, describing in particular, improvements in the noise-limited resolution.

The second method we shall report upon, our short-gauge-length method, (2), is based on the interrogation of in-fibre Bragg gratings using an electronically-tuneable acousto-optic filter (AOTF). This frequency-agile filter is capable, firstly, of being scanned to determine the Bragg-grating wavelength, and secondly, to be locked onto the grating using a frequency-locked loop. We shall report recent progress on our multiplexed system designed to monitor multiple in-fibre gratings under PC control.

- (1) "New OTDR technique for monitoring the range of reflective markers", Geiger, H., Dakin, J.P., Eaton, N.C., Chivers, P.J. Proc. OFS Glasgow '94 SPIE, Vol 2360 (1994), pp 150-153.
- (2) "Novel interrogation system for fibre Bragg grating sensors, using an acousto-optic tuneable filter", Xu, M.G., Geiger, H., Archambault, J-L., Reekie, L., Dakin, J.P. Electronics Letters (1994), Vol 29, no 17, pp 1510-1512.

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