MHz. It functions as a Bragg cell in reflection mode, and displays good efficiency and single-side-band purity.

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CWC4 **9:00 am**

In-fiber grating sensing network with a combined SDM, TDM, and WDM topology

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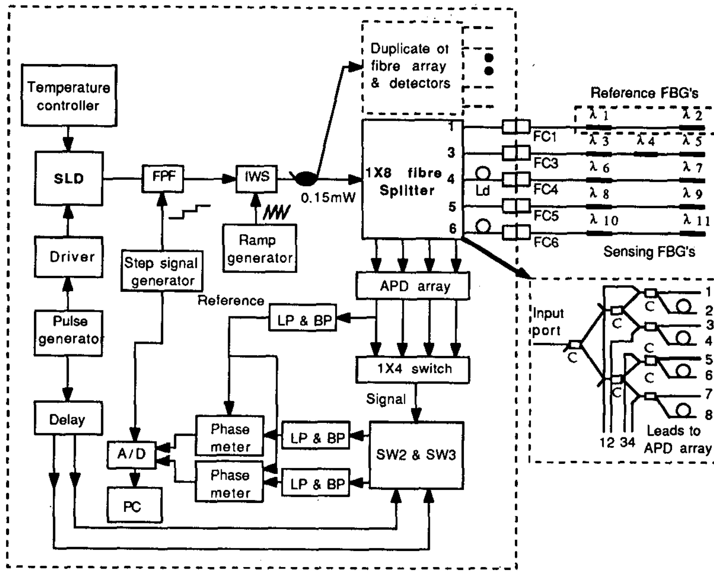
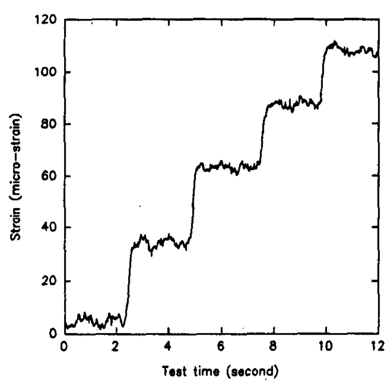
In-fiber Bragg grating (FBG) sensors appear to be ideally suited for structural health monitoring of modern composite materials and civil engineering-based applications as they have the potential of offering many distinct advantages over conventional electrical sensors.[1] In this paper, we propose and demonstrate a simultaneous SDM, TDM, and WDM topology combined with a tunable wavelength filter (TWF) and an interferometric wavelength scanner (IWS). The schematic diagram of the (SDM + TDM + WDM) system demonstrated is shown in Fig. 1. The light source used was a pigtailed temperature-stabilized superluminescent diode (SLD) with a bandwidth of ~18.5 nm (818–836.5 nm), supplied by Superlum Ltd. (Russia). It was pulsed at a frequency of ~1.1 MHz with a pulse width of ~300 ns (duty cycle: ~1/3); an average output optical power of ~2 mW was launched into the network. With the TWF tuned to match the center wavelength of the sensing FBG, the maximum interference signal occurred. The amplitude of the interference signal decreases when a strain is applied to the FBG. This amplitude change is determined by the spectral envelope of the TWF and it should not have any influence on the measurement accuracy as only the phase change induced by the wavelength-shift of the FBG is detected. The phase change detection is based on an unbalanced interferometer with signal processing using a pseudoheterodyne technique. The IWS was modulated by using a ramp (serrodyne) function. By detecting the differential phase between the sensing FBG and the reference FBG with similar center wavelength, the thermal drift of the TWF and the IWS can be eliminated.[2] The output signals from the phase meter were sent to a PC via an analogue-to-digital converter (A/D). The TWF was then tuned to next sensing FBG and a phase reading was again obtained. This process was repeated for other subsequent FBGs in the network. The TWF used here was a Fabry-Perot filter (FPF) (Queensgate Instruments QF100) with a free spectral range of 40 nm, a bandwidth of ~0.65 nm and a scale factor of 11.43 nm/V. The IWS was a bulk Michelson interferometer also developed by Queensgate Instruments Ltd, in which the piezoelectric transducer (PZT) in one of the arms of the IWS was driven by a ramp modulation function at a frequency of 300 Hz. The OPD of the IWS used here was set at ~0.7 mm (equal to a FSR of ~0.98 nm). The commercial 1 × 8 fiber-optic splitter shown in the inset of Fig. 1 was specially designed for this demonstration system. The return pulse signals from the FBG sensors were coupled back into the splitter and detected by an array of four avalanche photodetectors (APD) followed by integral separated high-speed amplifiers. The length of the fiber delay lines shown in Fig. 1 was ~40 m, corresponding to a time delay of λ400 ns. Cross talk between two adjacent TDM channels was measured to be <−36 dB.



CWC4 **Fig. 1** Schematic diagram of the experimental system. SLD: superluminescent diode; FPF: tunable Fabry-Perot filter; IWS: interferometric wavelength scanner; APD: avalanche photodetector; BP: band pass filter; LP: low-pass filter; SW2, SW3: high-speed switches.



CWC4 **Fig. 2** Experimental results for the quasi-static strain measurement.

To investigate the resolution of this system for quasi-static strain measurement, several ~0.5 Hz strain steps of ~28 $\mu\varepsilon$ peak-to-peak amplitude were applied to one of the sensing FBGs (λ_4 = 830.5 nm), using three-point bending. The experimental results are shown in Fig. 2 and as can be seen from these results, a resolution of ~2 $\mu\varepsilon$ rms (~0.38 $\mu\varepsilon/\sqrt{Hz}$) was achieved with a 30-Hz measurement bandwidth.

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CWC5 **9:15 am**

Fiber Bragg grating networks for time-delay control of phased-array antennas

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The use of fiber optics for the control and distribution of signals within microwave phased-array antenna (PAA) systems has been investigated for many years.[1] For wide-bandwidth applications, true time-delay (TTD) control, rather than simple phase shift, is required in order to prevent beam 'squint'[2] at the extremes of the scan. In optical RF beamforming networks the required delay is produced by switching the optical carrier, with the RF signal impressed on it as an intensity modulation, through an appropriate length of optical fiber. The technique re-