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A high performance distributed sensor system with multi-intrusions simultaneous detection capability based on phase sensitive OTDR

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Abstract:

A high performance distributed sensor system with multi-intrusions simultaneous detection capability based on phase sensitive OTDR (Φ−OTDR) has been proposed and demonstrated. To improve system performance, three aspects have been investigated. Firstly, a model of one−dimensional impulse response of backscattered light and a Monte Carlo method have been used to study how the laser line width affects the system performance. Theoretical and experimental results show that the performances of the system, especially the signal−noise−ratio (SNR), decrease with the broadening of laser linewidth. Secondly, a temperature−compensated fibre Bragg grating with a 3 dB linewidth of 0.05 nm and a wavelength stability of 0.1 pm has been applied as an optical filter for effective denoising. Thirdly, a novel interrogation method for multi−intrusions simultaneous detection is proposed and applied in data denoising and processing. Consequently, benefiting from the three−in−one improvement, a high performance Φ−OTDR has been realized and four simultaneous applied intrusions have been detected and located at the same time along a 14 km sensing fibre with a spatial resolution of 6m and a high SNR of 16 dB. To the best of our knowledge, this is the most multifunctional Φ−OTDR up to now and it can be used for perimeter and/or pipeline intrusion real−time monitoring.