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Hot-Spot Detection and Location over an Optical Fibre

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Abstract content
   (Max 300 words)

Fibre-based distributed sensors for real-time temperature monitoring have been intensively studied and developed for several years. These fibre sensor systems offer tremendous advantages compared to conventional electronic sensors which includes anti-electromagnetic interference, corrosion resistant and multi-sensing points. The most common applications comprise pipeline monitoring, for oil and gas transportation, and power cables as well as fire detection systems. Spontaneous Raman scattering effect is commonly exploited to implement Distributed Temperature Sensor systems. In general, temperature sensing along the fibre is achieved through optical time domain reflectometry (OTDR), where light pulses are coupled into the fibre, and backscattered Stokes and anti-Stokes light are detected. In Raman-based schemes, by monitoring the anti-Stokes power and normalizing it with Stokes power, one can measure the value of the temperature along the sensing fibre. One limitation of the OTDR schemes is that high peak power must be used to ensure good spatial and temperature resolution. An alternative approach of Raman based temperature sensor is the optical frequency-domain reflectometry (OFDR). In OFDR the spatial signatures of a fibre are obtained as the inverse Fourier transform of the Optical frequency domain reflectometry data. In this abstract, investigation on a distributed Raman temperature sensor using Incoherent optical frequency domain reflectometry (IOFDR) is reported. We develop a mathematical model to obtain the temperature profiles over a fibre under various conditions. In our IOFDR system the modulation frequency is changed stepwise to obtain an exact inverse Fourier transform. Temperature measurements on 10km of standard single mode fibre with a spatial resolution varying from 1m to 6m are simulated. The effects of starting frequency, frequency increment, and highest modulation frequency on IOFDR temporal response on the sensing performance are examined. A temperature resolution of 1oC to 3oC range is achieved with measurement time of a few minutes. Furthermore, linear filters and wavelet denoising are used for signal-to-noise ratio improvement in IOFDR technique.

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PhD

Main supervisor (name and email)
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