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Interferometer based demodulation technique of phase shifted fiber Bragg grating sensor for acoustic signal sensing

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Abstract

Grating based sensors are ideal candidates for strain and temperature measurement. Many researchers have already anticipated detecting low strain signal by using an fiber Bragg grating (FBG) sensor instead of the conventional lead- zirconate-titanate (PZT) sensor due to the benefits of the FBG together with flexibility, immunity from electromagnetic interference, corrosion resistance, small size, ability to be embedded, and multiplexing capabilities [1]. Especially, FBG sensors are playing a noteworthy role towards the detection of low amplitude dynamic signal. Therefore, there are two essential necessities for detecting low strain signal: broad bandwidth and high sensitivity. FBG is not capable to detect low strain signal because if the wavelength of low strain signal is much lesser than the Bragg wavelength, no change will arise in FBG reflection spectrum. Towards this direction, many researchers developed phase shifted grating based ultrasonic sensors to achieve broader bandwidth and superior sensitivity. The schematic of a phase-shifted FBG is shown in Fig. 1(a). It consists of a phase jump of π at the center of an otherwise periodic modulation of the refractive index in the core of a single mode fiber. Thus, the π phase shift region in the middle results in two identical gratings separated by half the grating pitch (Λ). This phase jump leads to a spectral peak at the center of the transmission spectrum of the grating. Fig. 1(b) shows the transmission spectrum of a phase-shifted FBG of length L=25 mm, which is characterized by a very narrow linewidth transmission peak at the center. The bandwidth of this transmission peak measured as FWHM (full width at half maximum) is ~ 26 pm. The phase variation in middle of the grating decreases the requirement of effective length of the sensor and delivers an extremely narrow peak for high sensitivity measurement we have presented an innovative and simple idea based on phase variation for efficient measurement of wavelength-shift of the transmission peak. This phase-variation detection in realized using a fiber-based Mach-Zehnder interferometer (F-MZI) wherein the significant reduction in the bandwidth (Δ□: FWHM) can be exploited to maintain a longer optical path difference (OPD). As the wavelength-shift to phase-shift responsivity of a fiber interferometer is directly proportional to the OPD, an increased OPD leads to better wavelength shift detection sensitivity. According to theoretical analysis minimum strain detection limit is 4 □□/√□□ is easily achievable by this

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Biography:

Deepa Srivastava completed M.E. in Electronics and Communication Engineering from Panjab University, India, in 2017. Since June 2009, she is working as a Technical Officer at CSIR-Central Scientific Instruments Organization (CSIO), Chandigarh, India. Her current research interests include Opto-Electronics, Embedded Systems, Optical fiber-based sensors, Interrogation techniques of FBG sensors.

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