

# Performance analysis & comparative study of uniform, apodized and pi-phase shifted FBGs for array of high performance temperature sensors

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In this paper, Theoretical analysis and numerical simulations are carried out to evaluate the performance of Different FBG types including Uniform, pi-phase shifted ( $\pi$ FBG) and various profiles Apodized FBGs for Temperature Sensing. The comparison and evaluation are done under a number of controlled parameters including grating length (L) and refractive index modulation amplitude ( $\Delta n_{ac}$ ). Various evaluation techniques are used like Reflectivity, Side Lobes Analysis - including Side Lobes Strength, Side Lobe Suppression Ratio (SLSR), Difference between Main Lobe & Side Lobe and Number of observed Side lobes - Full Width at Half Maximum (FWHM), Roll-off Rate and Ripple Factor for judging the sensitivity and targeting an optimum performance of the temperature sensors. Our Analysis and comparison revealed that the uniform FBGs have three important areas that require improvement for temperature detection: Bandwidth, Sensitivity & Number of Harmonics (Side Lobes). This Problem is vanished when using pi-phase shifted FBG ( $\pi$ FBG) which recorded optimum results in terms of the introduced evaluation techniques. Also Nuttall & Proposed ( $\cos^8$ ) Apodized FBGs showed remarkable results in suppressing the side lobes but on the expense of decreasing the peak reflectivity. A simple experimental design of temperature sensor was also introduced in this paper. Finally, it was concluded that uniform FBG can't be used as efficient temperature array sensor but  $\pi$ FBG can be used instead.

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*Keywords:* Fiber Bragg Grating (FBG), Uniform, Apodized, pi-phase shifted FBG ( $\pi$ FBG), Array of fiber-optic Sensors, Temperature Sensors, Ultrasonic Detection

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