Abstract

Performance Evaluation of Fiber Bragg Grating Temperature Sensor: Apodized Fiber Bragg Grating Design and Simulation

In this work,different FBG temperature sensors are designed and evaluated with various apodization profiles. Evaluation is done under a wide range of controlling design parameters like sensor length and refractive index modulation amplitude,targeting a remarkable temperature sensing performance.New judgment techniques are introduced such as apodization window roll-off rate,asymptotic sidelobe decay level, number of sidelobes, and average sidelobe level.Evaluation techniques like reflectivity,Full Width at Half Maximum(FWHM),and Sidelobe Suppression Ratio(SLSR) are also used.For a single accurate temperature sensor measurement in extensive noisy environment,optimum results are obtained by the Nuttall apodization profile with a length of 19mm and a refractive index modulation amplitude of 4 10 4. The Nuttall apodization profile achieves a high reflectivity of 97.97%, a narrow FWHM of 0.2135 nm, a very low sidelobe-strength of 89.71 dB, a very low sidelobe average of 90.79 dB,and finally a very high SLSR of 89.62 dB. For a quasi-distributed FBG temperature sensor in extensive noisy environment, optimum results are obtained by the Nuttall apodization profile with a length of 10 mm and refractive index modulation amplitude of 2.6 10 4. It achieves an acceptable reflectivity of 51.43%, a narrow FWHM of 0.1985 nm (less than 25 GHZ), a very low sidelobe strength of 100.94 dB, a very low sidelobe average of 121.74 dB, a very high SLSR of 98 dB and a high main lobes lope of about 73.5 dB/nm. These satisfactory results of both cases came on the expense of roll-off rate that is turned out to be low.Nuttall apodization is used to construct an optimum and reliable quasi-distributed temperature sensing system that has an adjacent channel isolation of more than 17 dB at 0.4 nm channel spacing, which is suitable for DWDM sensing systems