论文

光纤表面等离子体共振传感检测系统中的数据分析

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摘要
该文给出了光纤表面等离子体共振(SPR)传感检测系统的输出信号模型,采用偏度峰度检验法检验了其噪声为高斯噪声,提出采用均值估计,降低方差。进一步分析了均值估计中存在的噪声也是高斯噪声,采用线性模型进行估计,确定共振波长和峰值强度,结果表明经过两次估计获得的共振波长精度达到了光纤SPR系统中光谱仪的波长检测精度,峰值精度达到了光谱仪的光强检测精度。最后,分析了数据处理量和提出了优化方法,使得在微小牺牲检测精度的前提下数据处理工作量降为原有工作量的2%,特别适用于被测对象变化急剧的情形。

关键词   光纤SPR传感器   噪声分析   均值估计   线性估计

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Data Analysis in the Optical Fiber Surface Plasmon Resonance Sensing Systems

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Abstract
The output signal model of optical fiber Surface Plasmon Resonance (SPR) sensing systems is presented in which the noise is proved as Gaussian distribution by adopting skewness and kurtosis test, so signal averaging method has been used and the stand deviation is decreased. Further, the estimated mean after signal averaging processing still includes some noise which has also been proved as Gaussian noise by using the same test method and linear estimate model is used to determine the resonant wavelength and the light intensity at the wavelength. The results show that both the wavelength and the normalized light intensity detection precisions are approximate to the ones of the used spectrometer. Finally, the optimization method on the data processing is discussed and the data processing work is decreased as 2% of the initial one by used the method, which is particularly adaptable to measure the sensing medium whose refractive index varies with time quickly.

Key words   Optical fiber SPR sensor   Noise analysis   Mean estimate   Linear estimate

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