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论文

基于同步载波提取的光纤传感器相位生成载波解调方法

张毅,贾波,许海燕,吴红艳,肖倩

(复旦大学 光纤研究中心,上海 200433)

摘要:

利用 3×3 耦合器和法拉第旋转镜等光学元件,构造了一个基于迈克尔逊干涉系统的光纤振动传感器.使用外调制的方法对传输光进行相位生成载波调制,并将该光纤振动传感器应用于长距离的安全监测中.通过对该传感器的干涉输出信号进行贝塞尔展开分析,发现干涉输出信号中含有与外调制所使用的载波频率相同的信号成分.因此,使用一个中心频率为载波频率且通带很窄的带通滤波器,可以同步地提取载波信号.同步提取的载波信号用于干涉输出信号的相位生成载波被动零差解调,可以得到作用于光纤振动传感器上的外界振动信号.本文提出了从输出信号中同步提取载波的方法,通过理论推导得出了该方法的可行性,并且通过软件仿真和实验验证了该理论的正确性.文中还对提取的载波受低频信号干扰,造成其幅度不稳定的现象进行分析并提出了解决方法.研究表明,同步载波提取法适用于相位调制器与干涉信号输出端距离较远,相位生成载波解调需要的同源载波获取较困难的情况.

关键词: 光纤光学 分布式光纤传感器 同步载波提取 相位生成载波解调

Synchronous Carrier Extracting Method Based Demodulation Scheme for Fiber Optic Sensor Using Phase Generated Carrier

ZHANG Yi,JIA Bo,XU Hai-yan,WU Hong-yan,XIAO Qian

(Optic-Fiber Research Center,Fudan University,Shanghai 200433,China)

Abstract:

A Michelson interferometer based fiber optic sensor was constructed with the application of a 3×3 coupler, faraday rotator, and other optical elements. Phase generated carrier method was applied to modulate the laser. The constructed fiber disturbance sensor was used to a long-distance field safety monitoring. According to the analysis of the interferometer system output, a signal component with the same frequency of the carrier was found in the output signal. Consequently, the carrier signal could be extracted synchronously with a narrow-band band pass filter with center frequency being set to the carrier frequency. When the extracted carrier signal was used to passive homodyne demodulation procedure of phase generated carrier method, the external disturbance signal could be acquired. The method of synchronous carrier extraction was introduced, the feasibility of this method was obtained through theoretical derivation, and the correctness of this theory was authenticated through software simulation and experiment. The low frequency influence to the extracted carrier was also discussed, and the solution was given for the limit of the influence caused by the low frequency signal. This method can be applied especially in the condition when modulation is set far from the output signal to make it hard to acquire the carrier signal.

Keywords: Fiber optics Distributed fiber-optic sensor Synchronous carrier extracting Phase Generated Carrier(PGC) demodulation

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通讯作者: 贾波 (1970-),男,教授,主要研究方向为光纤传感与光纤通信等.Email: jiabo@fudan.edu.cn

作者简介:

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