

纤维与波导光学

基于偏振模干涉的光纤光栅动态应求解调系统

郝文良¹,甄胜来¹,曹志刚¹,吕亮¹,彭军²,俞本立¹

1安徽大学光电信息获取与控制教育部重点实验室, 安徽 合肥 230601;
2北京市微技术研究所, 北京 100200

摘要:

基于保偏光纤中正交偏振模干涉,提出了一种简单、新颖的光纤光栅动态应求解调系统,并且通过实验证实了该方案的可行性。该解调系统光学核心部分仅由一段带有反射镜的高双折射光纤和一个光纤起偏器构成。实验中动态应求解调分辨率达到了,频率范围为0.1Hz~7.9kHz微纳振动幅度信号获得了保真拾取。实验表明,该系统适合宽频率范围、微纳幅度的动态应变检测,为光纤光栅传感提供了一种简单、经济、适用范围更广的解调方案。

关键词: 纤维与波导光学 偏振模干涉 光纤光栅 动态应变 传感系统

A fiber Bragg grating interrogating dynamic strains sensor system using interference of polarized mode

Hao Wenliang¹, Zhen Shenglai¹, Cao Zhigang¹, Lu Liang¹, Peng Jun², Yu Benli¹

1 Key Laboratory of Opto-electronic Information Acquisition and Manipulation of Ministry of Education, Anhui University, Hefei 230601, China;
2 Beijing Institute of Micro Technology, Beijing 100200, China

Abstract:

A simple novel fiber Bragg grating interrogating system is proposed and experimentally demonstrated based on interference of polarized Mode. The essential part of the system is only comprised of a high birefringence fiber with fiber reflector and a fiber polarizer. The vibration micro-nano signals from 0.1Hz to 7.9 kHz have been picked up fidelity; Measurements of dynamic strains with resolutions of in 50Hz bandwidth were demonstrated. Experiments show that the system is suitable for wide frequency range, micro-nano range of dynamic strain detection. This system potentially offers a low-cost and high-performance solution for the interrogation of FBG sensor.

Keywords: fiber and waveguide optics interference of polarized mode fiber Bragg grating dynamic strain interrogating sensor system

收稿日期 2011-05-16 修回日期 2011-06-02 网络版发布日期 2012-07-01

DOI:

基金项目:

国家自然科学基金(60940022),教育部博士点基金(20093401110002),高校省级优秀青年人才基金(2011SQRL015)

通讯作者:俞本立(1963-)安徽五河人,教授,博导,主要从事光传感和光通信器的研究。

作者简介:郝文良(1972-)河北卢龙人,博士,从事光纤传感研究。E-mail: hwl1972@gmail.com

作者Email: benliyu@ahu.edu.cn

扩展功能

本文信息

- ▶ Supporting info
- ▶ PDF(809KB)
- ▶ [HTML全文]
- ▶ 参考文献[PDF]
- ▶ 参考文献

服务与反馈

- ▶ 把本文推荐给朋友
- ▶ 加入我的书架
- ▶ 加入引用管理器
- ▶ 引用本文
- ▶ Email Alert
- ▶ 文章反馈
- ▶ 浏览反馈信息

本文关键词相关文章

- ▶ 纤维与波导光学
- ▶ 偏振模干涉
- ▶ 光纤光栅
- ▶ 动态应变
- ▶ 传感系统

本文作者相关文章

- ▶ 郝文良
- ▶ 甄胜来
- ▶ 曹志刚
- ▶ 吕亮
- ▶ 彭军
- ▶ 俞本立

PubMed

- ▶ Article by Hao,W.L
- ▶ Article by Zhen,Q.L
- ▶ Article by Cao,Z.G
- ▶ Article by Lv,l
- ▶ Article by Peng,j
- ▶ Article by Yu,B.L

参考文献:

- [1] Zhao Y, Liao Y B. Discrimination methods and demodulation techniques for fiber Bragg grating sensors [J]. Optics and Lasers in Engineering, 2004, 12(1): 71-86.
- [2] Majumder M, Gangopadhyay T K, Chakraborty A K, et al. Fiber Bragg gratings in structural health monitoring - Present status and applications[J]. Sensors And Actuators A-Physical, 2008, 147(1):150-164.
- [3] Jung E J, Kim C, Jeong M Y, et al. Characterization of FBG sensor interrogation based on a FDML wavelength swept laser[J]. Optics Express, 2008, 16(21):16552-16560.
- [4] Paterno A S, Haramoni N, Silva J C C, et al. Highly reliable strain-tuning of an Erbium-doped fiber laser for the interrogation of multiplexed Bragg grating sensors[J]. Optics Communications, 2007, 273(1):187-192.
- [5] Davis M A, Kersey A D. Matched-filter interrogation technique for fiber Bragg grating arrays[J]. Electronics Letters, 1995, 31(10):822-823.
- [6] Kersey A D, Berkoff T A, Morey W W. Multiplexed fiber Bragg grating strain-sensor system with a fiber Fabry-Perot wavelength filters [J]. Optics Letters, 1993, 18(16):1370-1372.
- [7] Y XF, Z CL, P QZ, et al. FBG sensor interrogation with high temperature insensitivity by using a HiBi-PCF Sagnac loop filter[J]. Optics Communications, 2005, 250(1-3):63-68.
- [8] Chung S, Kim J, Yu B A, et al. A Fiber Bragg Grating Sensor Demodulation technique using a polarization maintaining fiber loop mirror[J]. Photonics Technology Letters, IEEE 2001.13(12):1343 - 1345.
- [9] Wu Q, Rajan G, Wang P, et al. Optimum design for maximum wavelength resolution for an edge filter-based ratiometric system[J]. Optics & Laser Technology, 2010, 135(2):311-314.
- [10] Sheng L, Tjin S C, Ngo N Q, et al. Novel tunable fiber-optic edge filter base on modulating the chirp rate of a pi-phase-shifted fiber bragg grating in transmission[J]. Optics Communications, 2009. 282: (7) 1363 - 1369.
- [11] Evans J W. Solc Birefringent Filter[J]. Journal of the Optical Society of America, 1958, 48(3):142-143.
- [12] Jones R C. A New Calculus for the Treatment of Optical Systems [J]. Journal of the Optical Society of America, 1941, 31(7):488-493.
- [13] Lobo Ribeiro A B, Ferreira L A, Santos J L, et al. Analysis of the reflective-matched fiber Bragg grating sensing interrogation scheme[J]. Applied Optics, 1997, 36(4):934-939.
- [14] Yu Benli, Xu Changchun. A vibration sensor using all polarization-maintaining fiber waveguide modulator[J]. Chinese journal of Quantum Electronics(量子电子学报), 2007,24(1):118-121(in Chinese).

本刊中的类似文章

1. 桑明煌 张祖兴 况庆强 聂义友 詹黎.双泵浦两段高非线性光纤级联的光纤参量放大器[J]. 量子电子学报, 2009,26(3): 356-359
2. 王执山 冯素娟 尚亮 孙青 毛庆和.掺铒光纤ASE宽带光源的实验研究[J]. 量子电子学报, 2009,26(3): 376-379
3. 殷德京.自傅立叶信号在光纤中的传输特性?[J]. 量子电子学报, 2009,26(4): 499-504
4. 余瑞兰 朱灵 张龙.光纤傅里叶变换光谱技术中激光辅助干涉仪的研究[J]. 量子电子学报, 2009,26(5): 513-517
5. 陶珺 穆磊 杜平.多点光纤光栅测温系统在渗流监测中的应用研究[J]. 量子电子学报, 2010,27(1): 105-109
6. 赵玲君 余震虹 鱼瑛 马仁坤.单光纤光栅的温度、压力双参量测量分析[J]. 量子电子学报, 2010,27(4): 503-507
7. 黄杰 沈为民 徐贲 陈继宣 余潘.本征型光纤倏逝波化学传感器的研究[J]. 量子电子学报, 2010,27(4): 508-512
8. 关建飞.空气孔正方形排列光子晶体光纤的有限元分析[J]. 量子电子学报, 2010,27(4): 430-434
9. 鱼瑛 余震虹 赵玲君 马仁坤.光纤Bragg光栅温度与应力的测量分析[J]. 量子电子学报, 2010,27(5): 632-636
10. 石猛 黄文 张国平.负折射率及零折射率光纤的光学特性[J]. 量子电子学报, 2010,27(5): 637-640
11. 付加友,董伟伟,邵景珍,陶汝华,王效顺,余吟山,方晓东.准分子激光在液芯光纤中传输特性的实验研究?[J]. 量子电子学报, 2011,28(2): 163-167
12. 赵恒磊 冯素娟 王会娟 赵佳生 毛庆和.基于轴向压缩技术的宽调谐光纤光栅滤波器的研制[J]. 量子电子学报, 2011,28(3): 375-379
13. 赵玲君,余震虹,鱼瑛,马仁坤.提高光纤光栅传感器测量精度的研究[J]. 量子电子学报, 2011,28(4): 495-500
14. 李炳祥,谢应茂.含左手材料和单负材料三层平板波导中TE模的传输特性[J]. 量子电子学报, 2011,28(4): 501-506
15. 李建华 王荣 汪井源 徐智勇 赵继勇.基于液体选择填充光子晶体光纤的波分解复用器研究[J]. 量子电子学报, 2011,28(4): 507-512