

新型埋入式长距离应变光纤传感器研制及性能研究

作者：毛江鸿, 何勇, 金伟良

单位：浙江大学

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摘要：

基于布里渊散射的分布式光纤传感技术可检测长距离光纤沿线的分布式应变和温度，非常适用于结构健康监测。但如何保证传感光纤在铺设及后期监测过程中的安全性是其应用于土木工程领域的关键问题。本文介绍了一种新型埋入式长距离光纤传感器的研制方法，首先在结构施工过程中根据监测网设计预埋微管，再通过气吹技术将传感光纤铺设至微管内部，最后利用真空辅助灌浆技术将水泥净浆灌入微管以固定传感光纤。通过理论分析和实验研究分别对影响该光纤传感器性能的填充层厚度、微管物理特性等因素进行了分析研究。分析结果表明埋入式长距离光纤传感器应变测量精度随外径减小、微管弹性模量增大而提高。标定试验结果表明各传感器工作性能和理论分析结果一致，均能准确感应结构内部应变信息。

关键词：健康监测；分布式光纤传感器；埋入式传感器；长距离；测量精度

Preparation and performance research on a novel embedded long-distance optical fiber sensor

Author's Name:

Institution:

Abstract:

Due to the characteristics of the optical fibers, the distributed optical fiber sensor based on Brillouin scattering is quite suitable for structural health monitoring of strain and temperature. The technology of protecting the brittle optical fiber from damage is the key point on its application to civil engineering. In this paper, a novel preparation method of embedded long-distance optical fiber sensor is introduced. The optical fibers are laid into micro-tube by air-blowing technique, and then fixed tightly in micro-tube after hardening of cement grouts which are infused by vacuum grouting technique. The performance of the novel sensor is mainly depended on the diameter of the grout layer and the physical characteristics of the micro-tube. The influence to accuracy of strain measurement is studied by theoretical analyses and experiments. The experiment results which agree with theoretical analyses show that the sensor with smaller diameter and higher elastic modules has better measuring performance. The calibration test proves that all different forms of embedded long-distance fiber optical sensors can monitor inner strain of structure accurately.

Keywords: health monitoring, distributed optical fiber sensor, embedded sensor, long distance, measurement accuracy

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