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高电压技术

架空输电线路覆冰监测光纤光栅拉力倾角传感器的研制

马国明，李成榕，全江涛，程养春，蒋建，孟晨平，田晓

高电压与电磁兼容北京市重点实验室(华北电力大学)

摘要： 输电线路覆冰危害电网安全稳定运行。为解决现有输电线路覆冰在线监测系统需要现场电源，易受电磁干扰，不能分布式测量，使用寿命短等缺点，开发基于光纤布喇格光栅(fiber Bragg grating，FBG)传感技术的输电线路覆冰在线监测系统。基于光纤光栅传感技术，提出一种抗电磁干扰的光纤光栅拉力倾角一体化传感器。在该传感器中，通过设计双闭环U型槽结构形成了高精度抗偏载能力强的拉力传感单元；基于等强度梁易形变的特点研制了高分辨率小型化的倾角传感单元；采用增设不受力光纤光栅的方法解决了温度与应变交叉敏感问题。实验表明，所研制的光纤光栅传感器拉力倾角测量单元线性度高，传感器的灵敏度和分辨率较好，测量误差较小。基于该传感器的监测系统可实现准分布式测量，其测量范围可达100 km。

关键词： 架空输电线路 覆冰监测 拉力倾角传感器 光纤布喇格光栅 准分布测量

Development of Fiber Bragg Grating Tension & Tilt Sensor for Icing-monitoring of Overhead Transmission Lines

MA Guoming, LI Chengrong, QUAN Jiangtao, CHENG Yangchun, JIANG Jian, MENG Chenping, TIAN Xiao

Beijing Key Laboratory of High Voltage & EMC (North China Electric Power University)

Abstract: Icing on overhead transmission lines is a threat to the safety of power grid. To overcome the drawbacks of the existing icing-monitoring systems, such as the requirement for field power, the sensitivity to electromagnetic interference (EMI), the unavailability of distribution measurement and a short lifespan, a novel on-line icing-monitoring system was constructed on the basis of the fiber Bragg grating (FBG) sensing technique, and a FBG tension-angle sensor was developed, which was immune to EMI. In the sensor, the tension-sensing section was designed as a closed-loop U-structure to improve the measurement accuracy of the tension-sensing section under eccentric load; a beam with uniform strength was used to achieve a high resolution angle measurement; an unforced FBG was placed in the sensor to solve the problem of cross-sensitivity between strain and temperature of FBG sensing. Results of tension and tilt angle experiment indicated that the sensor has the advantages of lower non-linear error, better sensitivity and higher resolution. The on-line icing-monitoring system based on the proposed sensor can achieve the quasi-distribution measurement for overhead transmission lines up to 100 km long.

Keywords: overhead transmission lines icing-monitoring tension-angle sensor fiber Bragg grating quasi-distribution measurement

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通讯作者: 马国明

作者简介:

作者Email: maguoming@ieee.org

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