Temperature Measurement of Power Cable Based on Distributed Optical Fiber Sensor

Xiaoqing Shen, Yang Yang, Bo Cong, Fenghai Ding, Bin Qiu, Lingling Ye

China Satellite Maritime Tracking and Control Department, Jiangyin, China,214431

shxq1st@126.com

Abstract. To measure the temperature of the power cable onboard ships efficiently, a design scheme based on distributed optical fiber sensor is proposed. In this paper, its principle and hardware are described in detail and its feasibility and effectiveness is verified through real test.

1. Introduction

Electrical power cable is one of the most important part of the ship's power infrastructure and for the safety of the ship, close inspection and monitoring of the cable is necessary but this can't be achieved by conventional methods and equipments, so there is an urgent need for a temperature monitoring system for this purpose.

The existing cable temperature monitoring systems can be classified into two kinds, i.e., electric signal and optical signal sensor. Electrical signal sensors include traditional thermocouple sensor and thermal resistance sensor, etc. and have the advantage of high precision, fast response, but the disadvantage of low reliability due to complicated structure. The optical fiber temperature sensor have the ability of anti-corrosion, immune to electromagnetic interference immunity and high sensitivity, can realize distributed real-time measurement. At present, the distributed optical fiber temperature measurement technology[1]is mainly based on Raman scattering.

The design scheme proposed in this paper is based on Raman optical time-domain reflectometry[2], and it only needs a piece of sensing optical fiber, which is used as sensing element and the transmission element simultaneously. This temperature measurement system can be deployed in a large area, has simple structure and low cost.

2. Design of distributed optical fiber temperature measurement system

The distributed optical fiber temperature sensing system is shown in Figure 1. The sensing system comprises a semiconductor laser, divider, calibration unit, optical switch, highly sensitive detector and low noise amplifier circuit, laser driver and coding circuit, high speed data acquisition and signal processing module and optical fiber.

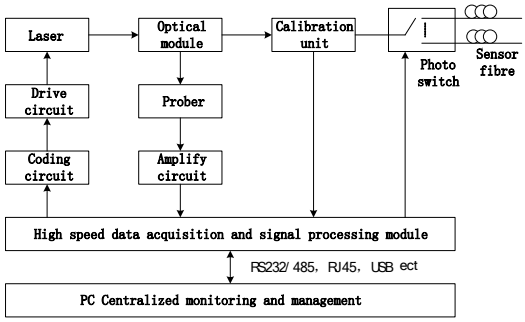

Figure 1. Block diagram of distributed optical fiber temperature sensing system.

The laser diode emits pre-coded pulse train, which is coupled into the fiber through an optical switch. In the fiber, backscattering is produced in three types, i.e., Rayleigh, anti-Stokes and Stokes. The anti-Stokes ray is temperature-sensitive and is used as signal. The Stokes ray is not sensitive to temperature and used as reference.

The two kinds of ray are detected, amplified and the data acquired can be processed to show the temperature distribution.

References

[1] Yanbiao Liao 2003 *Chinese Journal of Physics* vol 9 (China: Institute of Physics CAS Press) pp 323-326

[2] Zhang Zaixuan, Wang Jianfeng and Guo Ning 2001 *Journal of Optoelectronics Laser* vol 6 (China:Science Press) pp 596-600