Experiment on Fiber Optic Sensing Characteristics



Overview

Help students deeply understand the principle of optical fiber sensing and practical application, grasp basic skills. This experiment can be used as thematic or comprehensive experiment for related courses.

Key Takeaways

Fiber optic sensing experiments allow students to explore strain, temperature, and other physical parameters using FBG and distributed fiber technologies with hands-on setups.

Overview of Fiber Optic Sensing Experiments

Fiber optic sensing experiments are designed to help students understand the principles and applications of optical fiber sensors. Common types of sensors include Fiber Bragg Gratings (FBG), distributed fiber optic sensors, and fiber optic interferometers. These experiments typically use optical fibers as transmission devices, allowing students to observe changes in light reflection, transmission, or scattering caused by physical phenomena such as strain or temperature changes.

Typical Laboratory Exercises

Connector Installation and Fiber Handling Students practice terminating plastic optical fibers into connectors, using room-temperature epoxy and mechanical crimping to secure fibers. This develops manual dexterity and ensures proper installation for reliable measurements.

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Single-

Point Strain Measurement with FBG FBG sensors are embedded in fibers with periodic refractive index changes. When the fiber is strained, the reflected light wavelength shifts, which can be measured to determine strain magnitude. Multiple gratings in series allow quasi-distributed sensing.

Distributed Sensing with OFDR Optical Frequency Domain Reflectometry (OFDR) uses backscattered Rayleigh signals along the fiber to measure strain or temperature with high spatial resolution. This method enables large-scale deployment and point-to-point high-precision measurements. Calibration Experiments Standard beams or reference structures are used to calibrate fiber optic sensors.

Repeated loading and unloading tests verify linearity, continuity, and cyclic stability of the sensors. Errors in strain measurements are typically below 2%, demonstrating high repeatability. Temperature and Strain Mapping Distributed Temperature Sensing (DTS) instruments inject light pulses along the fiber and measure backscatter to map temperature or strain over long distances.

This is widely applied in civil engineering, hydrogeology, and structural health monitoring.

Educational Benefits

These experiments provide students with: Hands-on experience in fiber handling, connectorization, and sensor installation Understanding of optical principles such as reflection, scattering, and wavelength shifts Exposure to real-world applications in structural health monitoring, civil engineering, and environmental sensing Skills in data analysis, calibration, and interpretation of sensor outputs Recommended ResourcesCNIlaser Fiber Sensing Experiment Guide for practical setups and observation of sensing phenomena FOA Fiber Optics Lab Manual for step-by-step exercises and connectorization practice IF-LMH Lab Manual for component identification and hands-on fiber experiments By following these experiments, students can gain a solid foundation in fiber optic sensing, preparing them for advanced applications in research and industry.

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Article Content

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Help students deeply understand the principle of optical fiber sensing and practical application, grasp basic skills. This experiment can be used as thematic or comprehensive experiment for related courses.

Design, development and characterization of a 3D-printed low-force ...

Before integrating the fiber into the cross beam structure, a feasibility study was conducted to establish the suitability of an MMF as a sensing element for the development of the proposed sensor.

Experimental study on a parallel optical fiber Sagnac loops-based ...

In this experiment, we proposed a wide-range and ultra-sensitive optical fiber sensor based on VE combined with FBG. One sensor could realize both strain and temperature

Strain Measurement Technology and Precision Calibration Experiment ...

In this paper, accuracy calibration experiments and the related analyses of two fiber-optic sensing technologies, the fiber-optic grating (FBG) and optical frequency domain reflectometry

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