

Article Overview

Fiber optic sensors can accurately measure displacement by converting light intensity variations into voltage signals, which can be acquired and processed in LabVIEW for real-time monitoring and analysis.

Principle of Fiber Optic Displacement Measurement

Fiber optic displacement sensors operate by transmitting light through a fiber optic probe toward a target surface and receiving the reflected light. The intensity of the reflected light varies with the distance between the probe and the target. This variation is converted into a voltage signal by a photoelectric conversion circuit, creating a direct relationship between displacement and voltage output. The system can detect very small movements, vibrations, or surface irregularities with high sensitivity, especially when the probe is close to the target surface .

Types of Fiber Optic Probes

- o Random fiber distribution probes: High sensitivity, short measurement range, suitable for precise displacement detection.
- o Hemispherical probes: Longer measurement range, lower sensitivity, ideal for larger displacements.
- o Concentric transmit-receive probes: Intermediate sensitivity and range, less affected by target tilt.
- o Edge or shadow probes: Designed for measuring thin targets or edges, effective for runout or ultrasonic horn displacement .

Hardware Setup

A typical LabVIEW-based displacement measurement system includes:

- o Fiber optic probe: Transmits and receives light.
- o Sensor module: Converts optical signals to electrical voltage (e.g., CSY-998G or Fotonic(TM) sensors).
- o Signal amplifier: Enhances the voltage signal for accurate acquisition.
- o Data acquisition card: Interfaces the sensor with a PC (e.g., NI myDAQ), enabling real-time data collection.
- o Reflective surface or target: Provides the light reflection necessary for measurement .

LabVIEW Integration

LabVIEW provides a graphical programming environment for controlling the measurement system and processing data:

Fiber optic sensor for displacement measurement LabVIEW

- o Data acquisition: LabVIEW collects voltage signals from the sensor via the DAQ card.
- o Signal processing: The software converts voltage readings into displacement values using calibration curves.
- o Automation: LabVIEW can control stepping motors to adjust probe-target distance, perform gap setting, and automate measurements.
- o Visualization: Real-time display of displacement, voltage, and processed graphs for analysis.
- o Data storage: LabVIEW can cache and save measurement data for further processing or reporting .

Advantages of Fiber Optic Sensors

- o Immunity to electromagnetic interference (EMI) and radio frequency interference (RFI).
- o High sensitivity and precision.
- o Non-contact measurement, suitable for delicate or moving targets.
- o Tolerance to extreme temperatures and harsh environments.
- o Lightweight and safe for high-voltage or explosive conditions .

Applications

- o Laboratory experiments for displacement, vibration, and surface condition measurements.
- o Industrial monitoring of mechanical components.
- o Automated test systems for optical networks or precision instruments.
- o Integration with remote fiber test systems (RFTS) for error detection in optical fibers . By combining fiber optic displacement sensors with LabVIEW, users can achieve highly accurate, automated, and real-time displacement measurements, making it suitable for both research and industrial applications.

Furthermore, high-resolution fiber-optic sensors designed for precise angular displacement measurements have

This paper presents a displacement sensor designed to achieve the Optical Vernier Effect (OVE) through a simple yet

Our paper begins by describing the mathematical model that underlies advanced sensor

Exemplary results of distributed fibre optic strain and displacement measurements performed under laboratory

fiber based sensors are also presented in this chapter. The application of the FODSs in liquid refractive index measurement is

Compared to conventional transducers, optical fiber sensors show very high performances in their response to

many physical

This article reviews specifically the advanced fiber optic displacement sensing techniques that have been developed in the past two

In this paper, a simple intensity-based fiber optic displacement sensor with a large measurement range is proposed.

Application note describes how the MTI-2100 Fotonic Sensor uses fiber optics to performs displacement measurement in gaseous or

The optical fiber probe is mounted on the platform probe holder in the actual test, and the probe is vertically aligned with the center of

In this article, we propose an optical fiber F-P displacement sensor based on a flexible hinge structure, and develop a

A simple fiber-optic displacement sensor based on reflective intensity modulated technology is demonstrated using a

Results of the manual and automatic measurements and the analysis of the measurement trace obtained from the optical time

These sensors measured the parameter by allocating a fiber displacement in lateral, longitudinal, angular, or

Optical Fiber Displacement Sensors (OFDSs) provide several advantages over conventional sensors, including their

In this paper, a fiber optic microprobe displacement sensor is proposed considering characteristics of micro-Michelson

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