

Article Overview

An optical fiber displacement sensor can be designed using a multimode fiber probe with intensity modulation or interferometric techniques, optimized for sensitivity, linear range, and minimal dead zones.

Key Components and Principles

1. Fiber Type and Probe Design

- o Multimode fibers are preferred due to their large core radius, high numerical aperture, and ability to collect significant reflected or transmitted light from the target, enhancing sensitivity and signal strength .
- o The probe geometry is critical. A pentafurcated fiber bundle, with a central transmitting fiber surrounded by concentric rings of receiving fibers, improves linear range and sensitivity while minimizing dead zones .

2. Measurement Techniques

- o Intensity Modulation: Measures displacement by comparing the transmitted light intensity to the launch intensity. A silicon photodiode detects the reflected or transmitted light, providing a simple, non-contact method suitable for industrial and medical applications .
- o Interferometry: Offers higher sensitivity by detecting phase changes in light caused by displacement, though it is more complex and requires precise alignment .

3. Sensor Configuration

- o Azimuthally symmetric bundles enhance linearity and measurement range. The pentafurcated design can achieve ranges up to 10.5 mm with sensitivities around 2 mm⁻¹ and dead zones as low as 2.5 mm .
- o Fiber arrangement affects coupling efficiency and measurement accuracy. Proper alignment ensures maximum light collection and minimal signal loss.

4. Light Source and Detection

- o Laser diodes or LEDs can be used as light sources depending on required coherence and stability.
- o Photodetectors (e.g., silicon photodiodes) convert optical signals into electrical signals for processing. Signal conditioning circuits may include amplification and filtering to improve resolution.

5. Calibration and Signal Processing

- o Calibration involves mapping light intensity to displacement values, accounting for non-linearities in the fiber response.
- o Signal processing can include averaging, linearization, and compensation for environmental factors such as temperature or vibration.

6. Applications and Considerations

- o Suitable for confined spaces, high electromagnetic interference environments, and precision measurement tasks such as turbine monitoring, micro-assembly, and surface deformation analysis .
- o Design trade-offs include balancing sensitivity, linear range, and probe size to meet specific application requirements. By carefully selecting the fiber type, probe geometry, modulation technique, and detection system, a high-performance optical fiber displacement sensor can be realized, offering compact, flexible, and precise displacement measurements.

Design an optical fiber displacement sensor

Fiber optic displacement sensor (FODS) with two asymmetrical inclined fibers is studied

Fiber optic technology offers the possibility for developing of a variety of sensors for a wide range of applications [1-4]. Fiber optic

Abstract This paper presents a linear fiber optic displacement sensor for the use over a large range based on the

Abstract and Figures Two main concepts in design and construction of stress and fine motion detection system using

Distance measurement is an essential issue in modern industry. Differential intensity sensors based on optical fibers

Various optical fiber technologies, including intensity modulation-based systems, have been employed to develop displacement

This paper presents the design, development, and implementation of a displacement sensor system using Plastic Optical Fiber

Optical fiber Fabry-Perot (F-P) sensor is a high-sensitivity sensor based on fiber-optic sensing and interference

Trifurcated optical fiber displacement sensors (OFDSs) are increasingly used in industrial and aerospace applications. The critical

Fiber optic sensor is commonly used in control and monitoring system for material deformation, strain, temperature, pressure and

This paper describes the optimal design of a miniature fiber-optic linear displacement sensor. It is characterised by its

Fiber optic sensors are very promising because of their inherent advantages such as very small size, hard environment

Introduced Fiber Optic Displacement measurement principle, Through setting the reference channel, using of modulation and

A fiber-optic displacement sensing scheme based on high-precision detection of differential phase is proposed,

Design an optical fiber displacement sensor

with

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

chieved by either beam-through or reflective techniques. A change in displacement of the through-beam and reflective sensors are

Web: <https://www.millstraining.co.za>

