

The function of fiber optic grating fixed inclinometer

Article Overview

A Fiber Optic Grating Fixed Inclinometer uses fiber Bragg grating (FBG) sensors to measure tilt or angular displacement with high sensitivity, accuracy, and environmental robustness.

Working Principle

Fiber optic inclinometers employ fiber Bragg gratings (FBGs) inscribed in optical fibers, which reflect specific wavelengths of light. When the sensor experiences tilt, the FBGs undergo strain or bending, causing a shift in the reflected wavelength. This shift is measured by a demodulator and converted into angular displacement. Designs often use cantilever or pendulum structures to translate tilt into strain on the FBG, enhancing sensitivity and accuracy .

Sensor Design

- o Cantilever-based FBGs: Thin cantilevers with FBGs mounted on them detect deflection due to tilt. Perpendicular arrangements reduce cross-axis sensitivity, achieving values as low as 0.9275% .
- o Suspension or pendulum structures: Bearings or plumb-based suspension reduce mechanical friction, improving repeatability and long-term stability .
- o Array configurations: Multiple FBGs along a tube or fiber allow reconstruction of the sensor contour and detection of complex deformations .

Performance Characteristics

- o Sensitivity: Can reach 305.2 pm/? in high-accuracy designs .
- o Resolution and Accuracy: Typical resolutions are in the sub-degree range, with accuracies around 2% and repeatability errors below 2% .
- o Environmental Robustness: Immune to electromagnetic interference, resistant to corrosive environments, and suitable for harsh or hazardous locations such as offshore structures, hydroelectric plants, and electrical transformers .
- o Long-term Stability: Favorable creep resistance ensures reliable monitoring over extended periods .

Applications

- o Geotechnical monitoring: Detecting slope deformation, landslides, and soil displacement .
- o Structural health monitoring: Bridges, buildings, and offshore platforms benefit from continuous tilt measurement .
- o Seismic and vibration monitoring: Can be integrated with accelerometers for multi-axis monitoring .

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o Real-time monitoring: AI-based algorithms, such as XGBoost and polynomial interpolation, can reconstruct deformation contours with high accuracy (

Utilizing Fiber Bragg Grating (FBG) makes the design rotation independent, ensuring measurement accuracy despite installation

The new optical fiber sensor based in-place inclinometer can overcome the above limitations. This paper introduces a

This paper addresses the analysis and design of a high-resolution and temperature-insensitive inclination sensor

Download scientific diagram | Schematic of proposed inclinometer design. from publication: A Rotation Independent In-Place

Fig. 1 shows the schematic diagram of the proposed fiber-optic pendulum-type inclinometer-based FBG sensor device

The FBG-based inclinometer is categorized into this type of optical fiber sensor in which deformation of the host

This paper presents a self-designed in-place inclinometer based on fiber Bragg grating (FBG) technology and

Abstract A high precision and small size Fiber Bragg Grating (FBG) inclination sensor which is used for slope

To overcome the shortcomings of traditional inclinometers, a distributed optical fiber inclinometer (DOFI) is developed

A new in-place fiber-optic inclinometer (FOI) is developed based on a vertical cantilever beam and dual fiber Bragg

An in-fiber Michelson interferometer (MI)-based inclinometer, which consists of misalignment-spliced fiber with end

Inclinometer and extensometer are examples of the conventional geotechnical instruments for monitoring the

In this paper, a novel design of an in-place inclinometer utilizing fiber Bragg grating (FBG) sensor technology is presented. The

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Landslide monitoring and forecasting have always been important research topics in geotechnical engineering. This

Request PDF | Theoretical and experimental study on the fiber Bragg grating-based inclinometer for slope

PDF | On Aug 7, 2023, Umar Zada and others published Comparative study of slope displacements using distributed fiber optic

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