Elevator Fiber Optic Sensing Principle



Overview

Fiber-optic technology emerged originally for applications in data transmission and telecommunications.

Key Takeaways

Elevator fiber optic sensors detect physical parameters like position, speed, and strain by monitoring changes in light properties within optical fibers, offering high precision and immunity to electromagnetic interference.

Working Principle

Fiber optic sensors in elevators operate by modulating light signals traveling through optical fibers in response to physical changes such as strain, vibration, or displacement. The system typically includes a light source, optical fiber, sensing element (or transducer), and a detector. When the elevator moves or experiences mechanical stress, the fiber's properties—such as intensity, phase, wavelength, or polarization of light—are altered.

These changes are captured by the detector and converted into electronic signals for monitoring or control purposes.

Types of Fiber Optic Sensors

Intrinsic Sensors: The fiber itself acts as the sensing element. Physical changes directly affect the light traveling within the fiber, allowing precise measurement of strain, vibration, or displacement along the elevator shaft. Extrinsic Sensors: The fiber transmits light to an external sensing element.

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The modulation occurs outside the fiber, and the fiber primarily serves as a light conduit, useful for detecting environmental conditions or mechanical movements. Fiber Bragg Gratings (FBG): Periodic variations in the fiber's refractive index reflect specific wavelengths. Shifts in the reflected wavelength correspond to strain or temperature changes, enabling sub-micron displacement detection and precise elevator position monitoring.

Distributed Sensing: Techniques like Rayleigh, Brillouin, or Raman scattering allow continuous monitoring along the entire fiber length. This is ideal for detecting vibrations, cable tension, or structural integrity in elevator systems.

Advantages in Elevator Applications

High sensitivity and precision: Detects minute displacements and vibrations. Electromagnetic immunity: Works reliably in environments with electrical noise. Lightweight and compact: Reduces installation complexity in elevator shafts.

Remote and distributed monitoring: Enables real-time tracking of elevator performance and safety parameters.

Practical Implementation

In modern elevators, fiber optic sensors can monitor cable tension, car position, and vibration, providing data for safety systems, predictive maintenance, and smooth ride control. For example, FBG sensors embedded along the elevator ropes can detect strain variations, while distributed acoustic sensing can identify unusual vibrations or mechanical faults before they escalate. By converting optical signals into actionable data, fiber optic sensing enhances elevator safety, reliability, and operational efficiency, making it a preferred technology in advanced vertical transportation systems.

Article Content

Optical Fiber Sensors: Working Principle, Applications, and Limitations

Fiber-optic technology emerged originally for applications in data transmission and telecommunications. However, sensors based on fiber-optics have been developed rapidly because of their excellent

Fiber Optic Sensors: Fundamentals, Principles & Applications

Radiation absorption creates electronic excited states that are trapped by localized defects for extended periods of time. Heating the material enables the trapped states to interact with phonons and decay

Optical Fiber Sensors: Working Principle, Applications, and Limitations

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Brief theory of sensing principle, fabrication method, applications, advantages and disadvantages of the different fiber-optic sensors, are addressed. Recent progress in numerous sensing fields, including

Fiber Optic Sensors: Types, Working Principle & Applications

Explore fiber optic sensors: their working principles, types (intrinsic, extrinsic, hybrid), and diverse applications in mechanical, chemical, and structural health monitoring.

Turning Fiber into a Sensing System: The Magic of

This is the power of fiber optic sensing, a technology that transforms ordinary optical fibers into the digital world''s sensory network. In 2023,

Review of Optical Fiber Sensors: Principles, Classifications and

Optical fiber sensors (OFSs) have emerged as essential tools in the monitoring of physical, chemical, and bio-medical parameters in harsh situations due to their high sensitivity,

Optical Fiber Sensors and Sensing Networks: Overview of the Main

This paper presents a more broad overview, providing the reader with a literature review that describes the main principles of optical sensing and highlights the versatility, advantages, and

Introduction to Fiber Optic Sensing

The fiber serves as sensor over its entire length, delivering real time information on physical surroundings and security. Furthermore, the data pinpoints the precise location of events and

Optical Elevator Door Sensor System with Planar Detection Area

A newly developed optical door sensor system improves detection performance, increases safety and overcomes the weaknesses of conventional door systems.

Sensors and encoders in elevators and lifts | Variohm

Whether the lift operates on a hydraulic, traction, machine-less or vacuum principle, the types of sensor that can be found in use is vast. It includes current, level, load, infra-red and hall

Review Advancements in fiber optic tactile sensors: A comprehensive ...

This review aims to provide an exhaustive discussion on the various types of fiber optic tactile sensors, focusing on their working principles, classification, applications, fabrication methods,

Special Issue “Fiber Optic Sensors and Applications”: An Overview

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The principle, characterization, and sensitivity optimization of this type of sensor were presented. In vivo experiments demonstrated its excellent performance in the detection of photoacoustic signals in

The Principle and Application of Optical Fiber Sensing Technology ...

In fact, optical fiber sensing technology has become increasingly popular due to its low price and the fact that this method overcomes the problems encountered with traditional sensor, such as in the high

Fiber-optic sensor

A fiber-optic sensor is a sensor that uses optical fiber either as the sensing element ("intrinsic sensors"), or as a means of relaying signals from a remote sensor to the electronics that process the signals

Principles of Optical Fiber Sensing | Springer Nature Link

In principal, different modulation/demodulation principles can be used for sensing multiple external physical parameter. According to those different principles, several techniques emerged for

What is Fiber Optic Sensing?

Learn how fiber optic sensing technology, including distributed acoustic sensing (DAS), distributed temperature sensing (DTS), and distributed temperature and strain sensing (DTSS), delivers real

Non-contact optical vibration sensing and dual-branch deep learning

Abstract This study proposes a non-contact optical vibration sensing system for intelligent elevator fault diagnosis. The system uses a laser retro-reflection configuration and a four-channel linear CCD array

Fiber Optic Sensing

The chapters in this edited volume are by scholars/experts working in academia in Taiwan, Egypt, Israel, Germany and Japan. The contents are intended to provide a common forum

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