Fiber Optic Deformation Detection Sensor



Overview

Find out distributed fiber optic sensors that can detect various deformations and measure tactile interactions in real life.

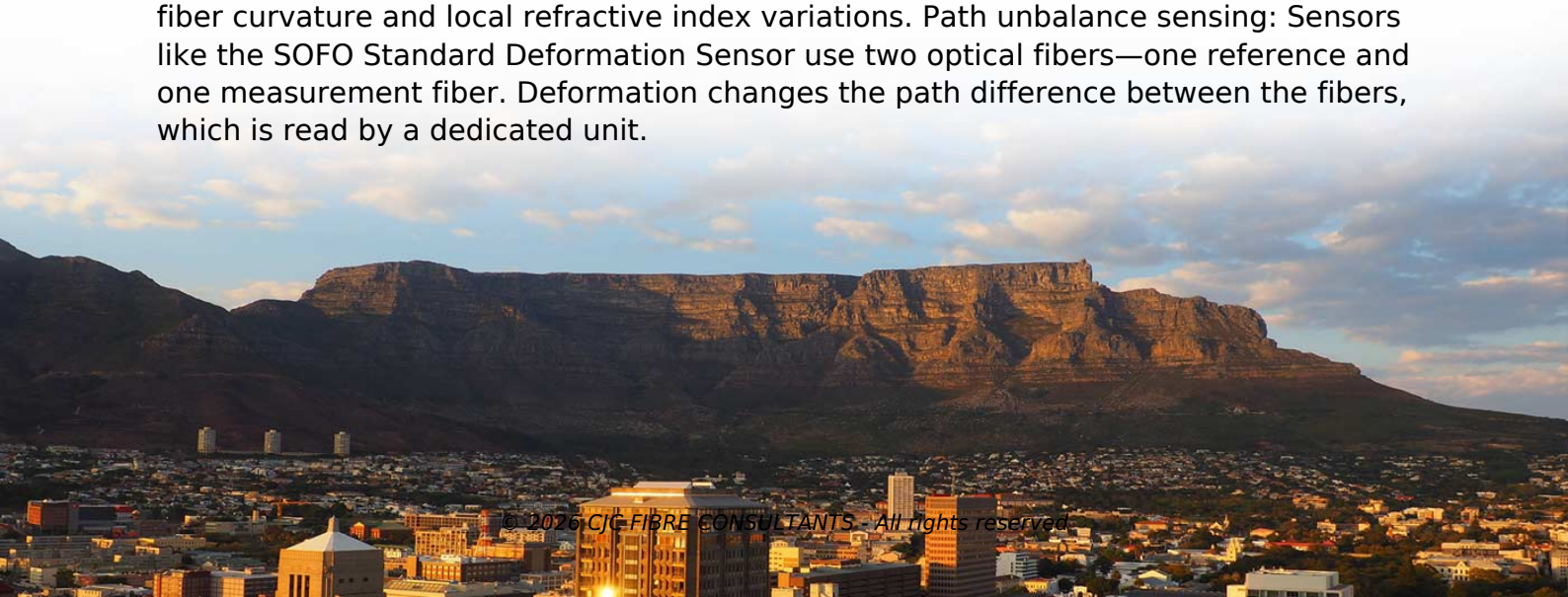
Key Takeaways

Fiber optic deformation sensors measure strain or structural deformation by detecting changes in light properties within optical fibers, offering high sensitivity, immunity to electromagnetic interference, and suitability for harsh environments.

Working Principles

Fiber optic deformation sensors operate by detecting changes in light caused by mechanical deformation of the fiber. There are several key mechanisms: Phase-based sensing: Deformation alters the optical path length and refractive index along the fiber, producing measurable phase changes in transmitted light. This principle underlies distributed acoustic sensing (DAS), which can detect strain along the entire length of a fiber, enabling applications in seismic monitoring, pipeline surveillance, and structural health monitoring.

Phase changes are related to the integral of strain along the fiber and are sensitive to fiber curvature and local refractive index variations. Path unbalance sensing: Sensors like the SOFO Standard Deformation Sensor use two optical fibers—one reference and one measurement fiber. Deformation changes the path difference between the fibers, which is read by a dedicated unit.



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These sensors can be surface-mounted or embedded in concrete, providing long-term structural monitoring with high reliability. Curvature or bending sensors: In Fiber Optic Curvature Sensors (FOCS), bending causes light to leak from the fiber core into the cladding, reducing transmitted light intensity. Structural modifications, such as trenches or teeth on the fiber surface, enhance sensitivity.

Positive or negative bending changes the light intensity in predictable ways, allowing precise measurement of fiber curvature.

Advantages

Fiber optic deformation sensors offer several benefits over conventional strain gauges: Electromagnetic immunity: They are unaffected by EMI/RFI or lightning, making them ideal for aerospace, defense, and industrial environments. Long-distance sensing: Optical fibers can transmit signals over kilometers without loss of accuracy. Intrinsic safety: No electrical current is required at the sensing point, suitable for hazardous environments.

High spatial resolution: Distributed sensing allows dense measurement points along a single fiber, useful for seismic or structural monitoring. Durability: Many sensors are designed for harsh conditions and long-term deployment, with some products offering decades of operational reliability.

Applications

Fiber optic deformation sensors are widely used in: Structural health monitoring: Bridges, buildings, and tunnels. Geotechnical monitoring: Landslides, slopes, and embankments. Seismology: Using DAS to detect seismic waves along pre-installed telecom fibers.

Aerospace and defense: Monitoring strain in aircraft or military structures. Industrial pipelines and perimeter security: Detecting vibrations or deformations over long distances.

Commercial Examples

Opsens OSP-A sensors: Compact, EMI-resistant, suitable for harsh environments, and capable of precise deformation measurement.

SOF

O Standard Deformation Sensors: Long-term structural monitoring with embedded or surface-mounted installation. Fiber Optic Curvature Sensors (FOCS): Sensitive to bending, used in experimental or specialized applications. Fiber optic deformation sensors combine high sensitivity, robustness, and versatility, making them a preferred choice for modern monitoring systems across civil, industrial, and scientific domains.

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Conventional deformation measuring methods such as fiber Bragg grating sensor-based deformation monitoring methods can not cover the global deformation due to their limited strain

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