

Design Scheme for Fiber Optic Weighing Sensor



Overview

Design of a Flexible Weight Sensor Using Optical Fibre Macrobending It is desirable to produce sensors which can be constructed from standard low cost opti.

Key Takeaways

A fiber optic weighing sensor can be designed using macrobending or Fiber Bragg Grating (FBG) principles, converting applied weight into optical signal variations through bending loss or strain-induced wavelength shifts. Sensor Principles

1. Macrobending-Based Sensors: Macrobending sensors rely on the principle that bending an optical fiber causes light to leak from the core, reducing transmitted intensity. The degree of bending correlates with the applied force or weight. This approach allows the use of standard low-cost optical fibers and simple intensity-based detection, avoiding complex spectral analysis or grating fabrication . 2. Fiber Bragg Grating (FBG) Sensors: FBG sensors use periodic refractive index modulations along the fiber. Applied strain or pressure shifts the Bragg wavelength, which can be measured to determine the applied weight. FBGs offer high sensitivity, multiplexing capability, and immunity to electromagnetic interference, but require precise grating fabrication and spectral analysis equipment .

Mechanical Design

1. Pneumatic Tube and Diaphragm System: A practical low-cost design involves a pneumatic tube filled with incompressible fluid, embedded in a rubber pad. A diaphragm converts pressure from applied weight into displacement, which is then sensed optically. The diaphragm can be coupled to a light-blocking element that modulates light intensity in a fiber-optic displacement sensor . 2. Fiber Placement and Packaging:

- For macrobending sensors, the fiber is routed over a curved support or groove that bends under applied weight.
- For FBG sensors, the fiber is clamped to a mechanical structure (e.g., a rail or plate) so that applied weight induces strain along the grating.
- The mechanical support (rubber pad or metallic package) ensures even load distribution and protects the fiber from damage .

Optical Signal Detection

- Intensity Modulation: Light intensity decreases with bending or diaphragm displacement. A photodetector measures the transmitted light, converting it into an electrical signal proportional to weight .
- Wavelength Shift (FBG): A spectrometer or wavelength interrogator detects shifts in the Bragg wavelength caused by strain, providing a precise measurement of applied weight .

Calibration and Signal Processing

- Calibration: Apply known weights to establish the relationship between optical signal (intensity or wavelength shift) and force.
- Signal Conditioning: Use filters and amplifiers to reduce noise and compensate for temperature effects.
- Data Acquisition: For distributed or multiplexed systems, multiple sensors can be read sequentially or simultaneously to provide spatially resolved weight measurements .

Advantages and Considerations

- Advantages: High sensitivity, immunity to electromagnetic interference, potential for distributed sensing, and minimal electrical components in hazardous environments.
- Considerations: Macrobending sensors are simpler but less precise; FBG sensors are more accurate but costlier. Mechanical design must prevent fiber damage and ensure repeatable bending or strain under load . This design scheme provides a flexible framework for developing fiber optic weighing sensors suitable for applications ranging from laboratory-scale measurements to weigh-in-motion systems in transportation infrastructure.

Article Content

Design of a Flexible Weight Sensor Using Optical Fibre

This work presents a simplified optical macrobending sensor design with a flexible construction, where a simple base mat made of a

Microbending Design for Fiber Weight Sensor

The document summarizes the design of a micro bending deformer for an optical fiber weight sensor. It describes how micro bending

Optical Fiber Weight System Prototype | PDF | Optical Fiber ...

This document discusses the development of a weight measuring system that utilizes optical fiber Bragg grating (FBG) sensors

Weight Measurement System Using Plastic Optical Fiber

In the present work, we present the design, implementation, and testing of a weighting sensor that implies the use of plastic optical

(PDF) Weight-in-motion (WIM) measurements by fiber optic sensor ...

In the present study the authors are discussing the possibility of fibre optic sensor application for weighing road vehicles

(PDF) Fibre-optic weigh-in-motion sensor

This paper presents a fibre-optic sensor to measure weight in motion based on a multiple fibre-optic interferometer. The

A LOW -COST FIBER OPTIC WEIGH-IN-MOTION SENSOR

Among the various advantages offered by fiber-optic sensors, the low cost, high accuracy, and immunity from EMI are particularly

FIBER OPTIC SENSING SYSTEM FOR WEIGHING IN MOTION

Abstract The aim of this work is to illustrate the design, the development and the full engineering of a novel fiber optic sensing system

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The initial phase involves the design of a bridge trajectory model for the Weigh-in-Motion (WIM) system employing fiber optic

FIBER OPTICS FOR WEIGHT-IN-MOTION (WIM)

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(PDF) Fabrication and Analysis Signal Optical Fiber Sensor Based On ...

This paper presents results from an investigation on a special optical fiber as a load sensor for application in Weigh-in

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Perform a comprehensive review of the literature for fiber optic sensors for measurement of in-motion weight or weigh-in-motion

PROBLEMS OF FIBRE OPTIC SENSOR APPLICATION IN WEIGHT

This paper presents results from an investigation on a special optical fiber as a load sensor for application in Weigh-in

A Special Fiber Optic Sensor for Measuring Wheel Loads of ...

This paper presents results from an investigation on a special optical fiber as a load sensor for application in Weigh-in

A LOW -COST FIBER OPTIC WEIGH-IN-MOTION SENSOR

In an effort to reduce the cost and improve the accuracy associated with weight-data collection, a new concept for weighing-in

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The paper gives a report of the design and creation of microbending optical fiber weight sensor created for teaching purposes,

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This document is for preliminary research. Verify specifications against current standards, product documentation and project requirements.

