Fiber Optic Rotation Sensor for Speed Measurement



Overview

A vision- and fringe pattern-based rotational speed measurement system was proposed to measure the instantaneous rotational speed (IRS) with high accuracy and reliability.

Key Takeaways

Fiber optic sensors can measure rotation speed using phase shifts, polarization changes, or strain-induced effects, with Sagnac interferometers being a common approach.

Working Principle

Fiber optic rotation sensors detect rotation by monitoring changes in light traveling through an optical fiber. The most widely used method is based on the Sagnac effect, where two light beams propagate in opposite directions around a loop or disc. When the system rotates, a phase difference arises between the beams, which is proportional to the angular velocity of the rotation.

This phase shift is then converted into an electrical signal to determine the rotation speed accurately. Other approaches include Fiber Bragg Gratings (FBGs) and Fabry-Perot Interferometers (FPIs).

FB

Gs measure strain induced by torsion or twist in the fiber, which can be correlated to rotational motion, while FPIs are more commonly used for pressure but can be adapted for rotation sensing in specialized configurations.

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Types of Fiber Optic Rotation Sensors

Sagnac Interferometer-

Based Sensors: These are intrinsic sensors where the fiber itself acts as the sensing element. They are highly sensitive to angular velocity and widely used in gyroscopes for navigation and industrial applications. Rotary Displacement Sensors: These sensors measure angular displacement directly and can provide rotation speed by differentiating the displacement over time.

They offer high resolution (e.g., 0. 1°) and are immune to electromagnetic interference, making them suitable for harsh environments.

Advantages

High sensitivity and accuracy: Capable of detecting small angular velocities. Immunity to electromagnetic interference: Optical fibers are not affected by EMI or RF noise. Multiplexing capability: Multiple sensors can share the same fiber network.

Wide operational range: Can operate in extreme temperatures and harsh environments.

Applications

Fiber optic rotation sensors are used in: Industrial machinery monitoring: Measuring shaft rotation and motor speeds. Navigation systems: Fiber optic gyroscopes in aerospace and marine applications. Structural health monitoring: Detecting torsion or twist in bridges, turbines, and rotating equipment.

Performance Metrics

Resolution: Rotary fiber optic sensors can achieve resolutions as fine as 0. 1° per rotation. Operating speed: Typical sensors can measure rotation speeds up to 10 radians/second or higher depending on the design.

Accuracy: High-precision sensors can maintain angular accuracy within ±0. 25° over a full 360° rotation. In summary, fiber optic sensors detect rotation speed by converting mechanical rotation into measurable optical changes, with Sagnac interferometers and FBG-based systems being the most common.

Their high sensitivity, immunity to interference, and adaptability make them ideal for industrial, aerospace, and structural monitoring applications.

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Article Content

Design and Development of Fiber Optic Sensor System for Rotational ...

A vision- and fringe pattern-based rotational speed measurement system was proposed to measure the instantaneous rotational speed (IRS) with high accuracy and reliability.

Design and Development of Fiber Optic Sensor System for Rotational ...

In this paper, a fiber optic sensor system (FOSS) is proposed for the measurement of the rotational speed of a DC motor. FOSS is designed using a fiber optic displacement sensor...

Fibre optic sensors for the monitoring of rotating electric ...

In this paper, several FOSs, which use different optical sensing principles for multiple physical parameter measurements of EMs, are reviewed.

Fiber-Optic Sensors for Measurements of Torsion, Twist and Rotation:

In these configurations, conventional fiber-optic strain sensors (mostly FBGs) are applied to measure directly the shear stress at the surface of the measurement body, while this measured

Fibre optic sensors for the monitoring of rotating electric ...

In this paper, sensors used for diferent EM physical parameter monitoring (temperature, vibration, rotating speed, torque etc.) are reviewed and discussed, including both conven-tional electric or

Fiber Optic Sensor for Measuring Rotation

The two arms consist of optical fiber wounded in circular shape. Each laser beam propagates in opposite direction to the other. When the system was rotated, a time difference between these two laser

Nanosecond-latency all-optical fiber sensing with in-sensor computing

Here, we propose an all-optical fiber sensing architecture with in-sensor computing (AOFS-IC) that achieves fully optical-domain sensing signal demodulation at the speed of light.

Speed measurement

Optical fibre speed sensor for non-contact tachometric measurement with long optical probes. 100KHz bandwidth and TTL output.

Fiber optic sensor embedded in robotic systems for 3-D orientation ...

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We integrated three rotational sensors on a single optical fiber to measure rotation of roll, pitch, and yaw and installed on robot manipulator where three scenarios are considered.

Wireless optical rotation speed sensor tachometer

Thanks to the innovative design of ultra-low power technology from Broadsens, the sensor is able to monitor high-speed machines rotation speed wirelessly,

Design and Development of Fiber Optic Sensor System for Rotational ...

Design and Development of Fiber Optic Sensor System for Rotational Speed Measurement Shrikant M. Maske 1 Assistant Professor, Department of Electronics, Shivaji

Fiber-Optic Sensors for Measurements of Torsion, Twist and Rotation:

Optical measurement of mechanical parameters is gaining significant commercial interest in different industry sectors. Torsion, twist and rotation are among the very frequently measured mechanical

Novel rotational speed measuring method based on micro-indentation ...

This study proposes a novel rotational speed measurement method based on optical coherent displacement measurement. An optical coherence system is used to measure the relative

Design and Development of Fiber Optic Sensor System for Rotational ...

Abstract: In this paper, a fiber optic sensor system (FOSS) is proposed for the measurement of the rotational speed of a DC motor. It offers non-contact measurements.

Dynamic Rotational Sensor Using Polymer Optical Fiber for Robot ...

A simple and straightforward polymer fiber-optic dynamic rotational sensor for robot movement assessment was proposed in this work, relying on the intensity variation.

Fiber-Optic Rotation Sensors. Tutorial Review

Sofar wehave been concerned primarily with the basic principles of fiber rotation sensors with emphasis onthe measurement of small non reciprocal phase hift ina multiturn fiber i terferometer.

Fiber-Optic Sensors for Measurements of Torsion, Twist

Torsion, twist and rotation are among the very frequently measured mechanical parameters. Recently, twist/torsion/rotation sensors have become a

Optical fiber sensor used for measuring the rotation angle of the ...

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The fiber-optic angle sensor designed in this study was installed together with the high-precision MK415B Hall angle sensor on the rotating shaft of the disconnect switch blade for angle

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