High-speed demodulator for fiber optic gratings

AI Overview

High-speed demodulation of fiber Bragg gratings (FBGs) can achieve rates up to tens of kHz using microwave photonics, chromatic dispersion, and advanced signal processing algorithms.Microwave Photonics and Chromatic Dispersion MethodsOne of the most effective high-speed demodulation techniques uses microwave photonics combined with chromatic dispersion. In this approach, a broadband light source is modulated with a frequency-swept microwave signal and reflected by the FBGs. The reflected signal is mixed with the original microwave, producing a beat frequency that varies with the FBG wavelength shift. A dispersion compensation fiber (DCF) converts wavelength changes into measurable frequency changes. By employing a crossing microwave sweep and signal processing algorithms like Chirp-Z and Hanning window, multiple FBGs can be demodulated at high speed, achieving rates up to 40 kHz with an accuracy of about 8 pm for weak FBGs with low reflectivity .Cross-Correlation and Variable-Step AlgorithmsAnother approach involves cross-correlation algorithms with variable step sizes. This method interpolates the FBG spectrum using cubic splines to improve resolution, then performs a coarse-to-fine cross-correlation search to determine the central wavelength. This technique can achieve pm-level resolution and is robust against noise, making it suitable for distributed sensing networks. Experimental results show stable performance with minimal measurement variation and high sensitivity to temperature and strain changes .Ratio and Spectral Peak Minimization TechniquesFor single-parameter or multiparameter FBG sensors, ratio-based demodulation methods can optimize speed by reducing the number of spectral peaks processed. By measuring only two or three spectral peaks instead of four, the system can maintain high-speed performance while still accurately detecti...

Article Content

Research on High-Speed Interrogation Method for Optical Fiber Fabry ...

Optical fiber Fabry-Perot (FP) sensors are widely used for measuring parameters such as strain and temperature. However, they still face limitations in measurement rates when dealing with high

Design of Fiber Grating Demodulation System Based on Tunable

Aiming at dynamic torque measurement system, fiber Bragg grating sensing principle is used to measure rotating shaft torque, and a fiber Bragg grating demodulation system based on

High-Speed Demodulation of weak FBGs Based on Microwave

A high speed quasi-distributed demodulation method based on the microwave photonics and the chromatic dispersion effect is designed and implemented for weak fiber Bragg gratings (FBGs).

High-speed demodulation of weak fiber Bragg gratings

A high-speed demodulation technique based on microwave photonics and chromatic dispersion is proposed for distributed weak fiber Bragg gratings (FBGs). A

A miniaturized, low-cost and portable fiber Bragg grating interrogation ...

A miniaturized, low-cost, 4-channel fiber Bragg grating (FBG) interrogation system for real-time remote monitoring is presented in this paper. A superluminescent light emitting diode (SLED) as

FPGA low-power fiber grating demodulation system

To address this need, a low-power tunable laser-based fiber grating demodulator has been developed in this paper, employing a variable step-length

FPGA-Based Hardware Implementation of Homodyne

Homodyne demodulation is a convenient technique for signal detection in interferometric sensors. The demodulation process is typically

Fiber optic volatile organic compound gas sensors: A review

Fiber optic sensors, as intrinsically safe, miniature, portable, immune to electromagnetic interference, and easy to remote sensing and multiplexing sensing technology, are utilized in VOC

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The results reveal strong dependence on both material bandgap and grating field distribution, providing guidance for designing high LIDT gratings. Versatile neuromorphic photonic processor for next

A three-points tracking-based high-speed fiber Bragg grating ...

A three-points tracking-based high-speed fiber Bragg grating (FBG) demodulation method based on wavelength-tunable laser is proposed. The wavelength-tunable laser scans just three

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Fiber-optic distributed disturbance sensor (FDDS) can locate a single-disturbance effecting on sensing optical fiber cable, while simultaneous multi-disturbances is possible in the practical ...

Research and Implementation of Super High-Speed Fiber Bragg

Abstract: A super high-speed fiber grating demodulator capable of simultaneously demodulating four grating channels is designed. The demodulator uses Fourier domain mode locked laser which

Fast and High-Precision Shape Sensing Based on Dual-Comb Fiber

This paper presents an innovative and efficient shape-sensing approach for optical fiber Bragg grating (FBG) arrays, employing the dual-comb spectroscopy (DCS) technique for

Fiber Bragg Grating Sensors for Structural and Railway

In recent years, fiber-optic sensors and particularly fiber Bragg grating (FBG) sensors have attracted a lot of interests and are being used in numerous

Scanning Frequency 1kHz Demodulator Unit for Precise Signal

High quality Scanning Frequency 1kHz Demodulator Unit for Precise Signal Processing and Data Transmission in Industrial Applications from China, China''s leading product market 1kHz scanning

Ultrahigh-speed phase demodulation of a Fabry–Perot

An ultrahigh-speed phase demodulation system was designed for the Fabry–Perot (F–P) interferometric sensor based on fiber array parallel spectral

All-optical 8-QAM signal demodulator based on 2D photonic crystals

In this paper, we propose a high-speed coherent optical communication signal demodulator based on a PCW structure for demodulation 8 quadrature amplitude modulation (QAM)

A bionic seal whisker Karman vortex street sensor with wet-end ...

Compared with traditional electrical methods, this study for the first time adopts an optical approach—integrating fiber Bragg grating (FBG) sensors with the designed bionic sensing

Development of high speed fiber Bragg grating demodulator based on ...

The demodulation method of fiber grating is the key technology of fiber grating sensor. The paper proposes of the model of fiber grating demodulation system, which, based on Single...

Ultra-high-resolution phase demodulation based miniature fiber-optic ...

A miniature fiber-optic Fabry–Perot (F-P) accelerometer based on phase demodulation is demonstrated for improving sensitivity. The accelerometer is co

HTF DWDM equipment,OTN Solution,QSFP28 OSFP

HTFuture offers industry-leading fiber optic products and WDM system solutions with global recognition for excellence and innovation.

Design and development of an economical temperature compensated ...

Abstract A target-type cantilever based temperature compensated fiber Bragg grating (FBG) flow sensor is designed and developed with economical demodulation and data acquisition

A Tracking-Based High-Speed Demodulation Method for Fiber Bragg

In this article, a tracking-based high-speed demodulation method for FBG sensing systems based on the wavelength-tunable laser is proposed. The wavelength-tunable laser only

A Fast Demodulation Algorithm for Fibre Bragg Grating Based on

This study provides a novel and effective technical solution for real-time high-precision FBG demodulation, validates the effectiveness of pure MLP architectures in spectral analysis, and lays a

A Fast Demodulation Algorithm for Fibre Bragg Grating Based on

Fibre Bragg Grating (FBG) demodulation technology is central to structural health monitoring. However, spectral distortion and noise caused by complex environments, along with the

Digital Control and Demodulation Algorithm for Compact Open-Loop Fiber ...

2. Demodulation and Control Algorithm 2.1. Demodulation Algorithm The open-loop optical fiber gyroscope constructed in this work is based on the minimization structure of all fiber-optic

A hybrid demodulation algorithm with high-sensitivity and wide-range ...

This paper presents a novel hybrid demodulation scheme for quasi-distributed fiber-optic acoustic sensor utilizing ultra-weak fiber Bragg grating (UWFBG) arrays as the discrete reflectors.

High-speed spectrum demodulation of fiber-optic Fabry–Perot sensor ...

A high-speed spectrum demodulation method with a large dynamic range for fiber-optic Fabry–Perot sensor is presented. The demodulation system only consists of a near-infrared

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