

Fiber Bragg Grating Wavelength Demodulation



Overview

Enhancing robustness in Fiber Bragg Grating wavelength However, the performance of conventional demodulation methods deteriorates significantly in the pres.

Key Takeaways

FBG wavelength demodulation methods include cross-correlation algorithms, cumulative sum preprocessing, spectral reconstruction using AWG, and FFT-based techniques, each offering trade-offs in accuracy, speed, and complexity. Cross-Correlation and Variable-Step Algorithms

One widely used method is the cross-correlation algorithm, often combined with a variable-step-size approach. This method interpolates the FBG spectrum to improve resolution, then calculates the cross-correlation between the measured spectrum and a reference to find the peak wavelength. A coarse search is first performed with a larger step size, followed by a fine search with a smaller step size to achieve pm-level resolution. This approach reduces computational load while maintaining high accuracy and stability, making it suitable for temperature and strain sensing in harsh environments .

Cumulative Sum Preprocessing



The cumulative sum (CUSUM) method is a simpler spectrum processing technique that reduces noise influence before determining the wavelength shift. It can be used alone or combined with other algorithms to simplify the demodulation process. While it may not significantly improve accuracy over classical methods, it offers low computational complexity and robustness against noise, making it practical for real-time applications .

Arrayed Waveguide Grating (AWG) Spectral Reconstruction

For ultra-short FBGs (US-FBGs), demodulation can be achieved using AWG-based spectral reconstruction. The AWG samples the FBG spectrum across multiple channels, and a convex optimization algorithm reconstructs the spectrum from underdetermined matrix equations. The peak of the reconstructed spectrum is then tracked to determine the wavelength. This method allows large-range demodulation with high accuracy (better than 4 pm) using only a few AWG channels, overcoming limitations of conventional AWG-based methods .

FFT-Based Cross-Correlation and Iterative Methods

Another approach uses Fast Fourier Transform (FFT)-based cross-correlation, which compares the FBG spectrum with a reference to detect shifts. Iterative improvements of this method enhance accuracy and reduce the peak-locking effect, which can occur due to limited spectral resolution. Compared to least squares fitting or centroid algorithms, FFT-based methods provide better precision and faster computation, making them suitable for dynamic sensing applications .

Summary

- Cross-correlation with variable-step size: High precision, pm-level resolution, moderate computational load.
- Cumulative sum preprocessing: Simple, noise-resistant, low computational complexity.
- AWG spectral reconstruction: Large-range demodulation, high accuracy, suitable for ultra-short FBGs.
- FFT-based cross-correlation: Fast, precise, reduces peak-locking, suitable for dynamic measurements. Each method balances accuracy, speed, and complexity, and the choice depends on the FBG type, measurement range, and application requirements.

Article Content

Enhancing robustness in Fiber Bragg Grating wavelength

However, the performance of conventional demodulation methods deteriorates significantly in the presence of severely

Improvement of Fiber Bragg Grating Wavelength Demodulation

Abstract: A high-performance, low-cost demodulation system is essential for fiber-optic sensor-based measurement applications.

FBG wavelength demodulation based on array waveguide grating

The study reveals that this AWG-based FBG demodulation scheme exhibits notable advantages including structural

Fast Demodulation of Fiber Bragg Grating Wavelength From

This paper presents a fast demodulation algorithm to determine fiber Bragg grating (FBG) from spectra acquired by low

Demodulation Algorithm for Fiber Bragg Grating Sensors

A demodulation algorithm is vital for a fiber Bragg grating (FBG) sensing system. In this paper, a novel demodulation algorithm based

Design of Fiber Grating Demodulation System Based on Tunable

In this paper, a photoelectric conditioning circuit for fiber Bragg grating demodulation is designed. The experimental

Improvement of Fiber Bragg Grating Wavelength Demodulation

This paper presents a demodulation system for FBG sensors based on a long-period fiber grating (LPG) driven by

Discrimination methods and demodulation techniques for fiber Bragg ...

The aim of this article is to give a comprehensive and systematic overview of discrimination measurement methods of

Research on Wavelength Demodulation Algorithm for Fiber Bragg

Introduction Fiber Bragg Grating (FBG), as a wavelength modulated sensor, reflects the changes of measured physical quantities by

FBG Demodulation With Enhanced Performance Based on

Abstract—Fiber Bragg grating (FBG) demodulation based on microwave photonics (MWP) would have a high resolution but the

(PDF) Demodulation of Fiber Bragg Grating Sensor Using Cross ...

In this letter, a demodulation algorithm for fiber Bragg grating (FBG) sensor is presented. The proposed demodulation

Fiber Bragg grating demodulation through innovative numerical

One of the most common and extensively employed optical devices is the Fiber Bragg Grating (FBG). Its reflection spectrum exhibits

Fiber Bragg grating-based optical filters for high-resolution sensing ...

A fiber Bragg grating (FBG) is a type of distributed Bragg reflector that is embedded into a relatively short length of

Design of Fiber Grating Demodulation System Based on Tunable

Based on the influence of hysteresis and creep of piezoelectric ceramics, a tunable F-P filter is calibrated with a

Optimal demodulation of wavelength shifts in a fiber Bragg grating ...

Recent work by our research group on the dynamic demodulation of strain-induced wavelength shifts in fiber Bragg

Full article: Fiber Bragg grating demodulation through innovative ...

The aim of this article is to introduce an innovative algorithm for the calculation of the shift of the maximum reflectivity

A Novel Demodulation Method of Fiber Bragg Grating Sensor Array

We propose a novel demodulation method of strong FBG sensor array based on wavelength-to-time mapping and multiloop OEO.

High-Speed and High-Precision Wavelength Demodulation of Fiber Bragg ...

The optical system and hardware circuit for demodulation system were designed specifically. To improve the accuracy

Related Video Reference

This video was associated with the source search result. Verify technical details against current product documentation and project requirements.

Contact Us

Continue your research online:

Website: <https://rivomultitrade.co.za>

Technical inquiry: <https://rivomultitrade.co.za/contact.html>

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

