

Speckle Pattern of Multimode Fiber



Article Overview

Speckle in multimode fibers arises from interference between multiple guided modes, producing complex intensity patterns that can be exploited for sensing or need mitigation in imaging.

Origin of Speckle

When coherent light propagates through a multimode fiber, it excites many spatial modes, each with a slightly different propagation constant. The superposition of these modes at the fiber output leads to interference patterns, known as speckles, which appear as bright and dark spots in the intensity distribution. The speckle pattern is highly sensitive to fiber geometry, length, input coupling conditions, and environmental perturbations such as strain, temperature, or pressure.

Factors Affecting Speckle

- **Modal Power Distribution:** The relative excitation of higher-order versus lower-order modes affects speckle contrast. Tilting the input Gaussian beam can transfer power to higher-order modes, reducing inter-mode interference and lowering speckle contrast.
- **Fiber Length:** Longer fibers increase the group delay differences between modes, which can reduce speckle contrast by partially decorrelating the modes.
- **Coherence of Light Source:** Highly coherent sources produce more pronounced speckles, while temporal incoherence or broadband sources can reduce speckle visibility.

Applications

Article Content

High definition images transmission through single multimode fiber ...

Multimode fiber (MMF) plays a vital role in promoting the miniaturization of endoscope. However, real-time and high

Multimode optical fiber transmission with a deep learning network

Multimode fibers (MMF) scramble the waves propagating inside them and produce seemingly random patterns known

Speckle-based image reconstruction via uniform illumination in single ...

Abstract Conventional multimode fiber (MMF) imaging systems based on Gaussian illumination often suffer from

Investigation on Speckle-Free Imaging at the Output of

Speckle-free imaging using a multimode fiber has been widely used for imaging systems.

Speckle classification of a multimode fiber based on

Based on the speckle pattern of a HERLEV dataset cell image transmitted by a multimode

Multimode optical fiber based spectrometers

The fiber-based spectrometer consists of a multimode fiber and a monochrome CCD camera that images the speckle pattern at the

Correlation Processing of Speckle Pattern in Multimode ...

Fiber speckle patterns contain the information about propagation of coherence modes in fiber, which can be used in metrological

Deep learning and superoscillatory speckles empowered multimode

This work introduces an in-situ nano-displacement measurement system via a multimode fiber probe with

Space division multiplexing in standard multi-mode optical fibers

Our results show that the proposed space division multiplexing on standard multimode fibers is robust to mode-mixing

Anti-perturbation multimode fiber speckle imaging and recognition ...

Specifically, we propose a speckle imaging model that consists of a lightweight encoder-decoder architecture and a

Influence of Optical Fiber Parameters on the Speckle Pattern and ...

This work investigates the influence of transmitted mode numbers on speckle patterns by using fibers with different

Speckle Analysis in Multimode Optical Fibers for Chemical and

We examine how these algorithms perform when analyzing speckle patterns from a polymer optical fiber exposed to

Speckle-correlation imaging through a kaleidoscopic multimode fiber

Abstract Speckle-correlation imaging techniques are widely used for noninvasive imaging through complex scattering media. While

Spatial correlation analysis of multimode fiber speckles generated

A coherent superposition of mode fields in a multimode fiber (MMF) can introduce a speckle pattern, of which the

Influence of Optical Fiber Parameters on the Speckle

Since the fiber speckle is formed by mode interference, the speckle pattern is related to the

Reconstructing Images Through Multimode Fibers From the Up

The mode mixing and mode dispersion in the multimode fiber (MMF) will produce complex speckle patterns in the

Speckle pattern of a multi-mode optical fiber.

The speckle pattern of multi-mode optical fiber is shown in Fig. 1. If an intruder makes some speckle pattern changes, then the output

Fast and high-resolution multimode fiber speckle imaging via optical ...

We propose and demonstrate a silicon photonic integrated circuit (PIC) for exciting different spatial modes launched

Speckle Brightness Control in a Multi-Mode Fiber

Background: Multi-mode fibers Multimode fibers differ from single mode fibers in the diameter of the core. The larger diameter makes

Speckle classification of a multimode fiber based on Inception V3

Multimode optical fiber plays an important role in endoscope miniaturization. With the development of deep learning

Multimode optical fiber core measurement by speckle correlation

The measurement of a multimode fiber core is proposed using a speckle autocorrelation algorithm to obtain the

Machine-Learning-Enabled Multimode Fiber Specklegram Sensors: A

Multimode fiber (MMF) specklegram sensors have recently drawn significant attention due to the incorporation of machine learning

Global and local speckle variation in tensioned multimode fiber

This tendency has nothing to do with the input wavelength and the length of multimode fiber (MMF), thus the operating

(PDF) Experimental characterization of the speckle pattern at the ...

Using a conventional semiconductor laser and a multimode optical fiber we study experimentally how the speckle

Multimode optical fiber based spectrometers

In a multimode fiber spectrometer, the interference between the guided modes creates a wavelength-dependent speckle pattern,

Imaging through multimode fibers using deep learning: The effects of ...

Impressive reconstruction fidelity and classification accuracy of the fiber inputs from the intensity-only images of the

(PDF) Multimode optical fiber based spectrometers

A standard multimode optical fiber can be used as a general purpose spectrometer after calibrating the wavelength

Spatial correlation analysis of multimode fiber speckles generated

In this work, we numerically simulated various speckle patterns generated from different MMF modes, and analyzed

Contact Us

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