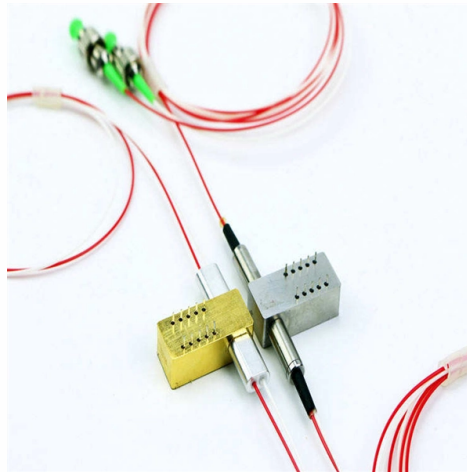


Resolution methods for multimode optical fibers



Article Overview

Resolution in multimode optical fibers can be enhanced using computational imaging, wavefront shaping, compressive sensing, modal decomposition, and deep learning-based super-resolution techniques.

Computational Imaging Approaches

Wavefront shaping (WFS) and raster-scan imaging are widely used to control the input light field in MMFs, compensating for mode mixing and speckle formation. By precisely modulating the phase and amplitude of the input beam, WFS enables the reconstruction of high-resolution images at the fiber output, effectively overcoming the limitations imposed by inter-modal interference and the small core size of MMFs. Compressive imaging (CI) leverages sparse sampling and computational reconstruction to achieve super-resolution. By using fewer measurements than traditional raster scanning, CI can reconstruct high-resolution 3D images efficiently, making it suitable for flexible, thin probes in biomedical applications.

Modal Decomposition Techniques

Modal decomposition involves characterizing the individual modes propagating in an MMF. Two main methods are used:

- Spectrally and spatially resolved imaging, which maps the intensity distribution of modes at the fiber output, suitable for large-mode-area fibers.



Article Content

Computational super-resolution imaging with multimode fiber using ...

Imaging through a multimode fiber (MMF) with a spatial-resolution beyond the diffraction limit has recently been

Time multiplexed super resolution of multicore fiber endoscope using ...

In this paper we describe a method that uses a multimode illumination fiber to project different high-resolution patterns

Efficient dispersion modeling in optical multimode fiber

A parametric dispersion model that describes mode mixing in multimode fiber enables calibration of the fiber's

Fast mode decomposition in few-mode fibers

Characterizing the modes at the output of a multimode fiber is time consuming due to computational cost. Here the

Multimode Fibers – optical glass fiber, large-core fibers,

We discuss various aspects of multimode fibers: their main parameters, launching light into multimode

High-resolution single-pixel imaging based on a probe of single-mode ...

The reason lies in the limited number and compromised spatial resolution of low-correlated speckle patterns provided

Subcellular spatial resolution achieved for deep-brain imaging in vivo ...

Here, we adopted an endoscopic approach utilizing multimode optical fibers (MMFs). The principles behind the MMF

Multimode optical fiber based spectrometers

The studies presented above demonstrate that multimode optical fibers can be used as high-resolution, general purpose

Optical-resolution photoacoustic microscopy by use of a multimode fiber ...

We demonstrate Optical-Resolution Photoacoustic Microscopy (OR-PAM), where the optical field is focused and

Modal decomposition in multimode optical fibres by solving the ...

Phase ambiguity and large datasets are two big challenges for mode decomposition based on deep-learning

Optical fibers for high-resolution in vivo microendoscopic fluorescence ...

Abstract Optical fiber-based high-resolution fluorescence imaging techniques have promising applications in clinical

Numerical mode decomposition for multimode fiber: From multi

Multimode fibers are gaining a resurgence of interest in both fundamental and applied research in recent years. Thanks

Quantitative phase imaging with a multimode fiber

Label-free quantitative phase imaging is vital for optical microscopy and metrology

Dual holographic and polarization encoding for high fidelity image ...

Our method leverages angular correlations in the far-field regime of MMFs, providing a mechanism to exploit the fiber's

ARCNL Institutional Repository: High-resolution Imaging Through a ...

In this thesis, we investigated two computational imaging methods, wavefront shaping (WFS) based raster-scan (RS)

Seeing through multimode fibers with physics-assisted deep learning

The object is scanned using this optical spot, and the backscattered light is collected through a multimode fiber to

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

Unfortunately, these methods are ineffective against severe deformation. The successful application of deep learning in

Polarization Mode Dispersion: Concepts and Measurement

There are three fundamentally different dispersive phenomena in optical fiber, of which polarization mode dispersion (PMD) is the

High-resolution Imaging Through a Multimode Fiber:

In this thesis, we investigated two computational imaging methods, wavefront shaping

All-optical image transportation through a multimode fibre using a ...

Here we develop a miniaturized diffractive neural network (DN2s) integrated on the distal facet of a MMF for the direct

Using a multimode fiber as a high resolution, low loss spectrometer

We propose and demonstrate that a conventional multimode fiber can function as a high resolution, low loss spectrometer. The

Rapid Focused Spot Scanning Imaging Using Multimode Fiber with a

In this paper, we present a rapid beam-focusing method for multimode fiber (MMF) that integrates a Convolutional

Time multiplexed super resolution of multicore fiber endoscope using ...

This creates a pixelated image having reduced resolution for small overall fiber diameter and it is being damaged by

Modal decomposition in multimode optical fibres by solving the ...

Abstract Mode decomposition (MD), which can obtain the amplitude and phase of each propagating mode in

All-optical image transportation through a multimode fibre using a ...

A miniaturized diffractive neural network is fabricated on the distal facet of a multimode fibre, allowing all-optical image

Super-resolution imaging through a multimode fiber: the physical ing of ...

ation of imaging endoscopes has proven crucial for minimally invasive surgery in vivo. Recent progress enabled by super-resolution

Robust real-time imaging through flexible multimode fibers

In this paper, we propose a real-time imaging system using flexible MMFs, but which is robust to bending. Our

New optical frequency domain differential mode delay measurement method ...

Abstract: A novel mode analysis method and differential mode delay (DMD) measurement technique for a multimode optical fiber

Optical resolution photoacoustic microscopy based on multimode fibers

Optical resolution photoacoustic microscopy (OR-PAM) is a non-invasive, label-free method of in vivo imaging with

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