

Optical Spatial Modulator Mode Decomposition



AI Overview

Optical spatial modulators, such as phase-only SLMs, enable the decomposition of complex light fields into constituent spatial modes, revealing both amplitude and phase information for applications in communications, imaging, and quantum optics.

Overview of Mode Decomposition Mode decomposition is the process of breaking down a complex optical field into a set of orthogonal spatial modes, such as Hermite-Gaussian (HG), Laguerre-Gaussian (LG), or Gaussian basis modes. This allows the characterization of the intensity, phase, polarization, and orbital angular momentum (OAM) of light, which is critical for applications like fiber communications, microscopy, and quantum information processing.

Techniques Using Spatial Light Modulators Phase-only spatial light modulators (SLMs) are widely used for mode decomposition. They act as correlation filters, where a computer-generated hologram is displayed on the SLM to match a target mode. The overlap between the input beam and the hologram allows the extraction of the modal weights and relative phases. This method can handle a large number of modes, including up to ~80 fiber modes in multimode fibers, and is effective in both linear and nonlinear propagation regimes. Digital holography is another key approach, where the SLM encodes the phase pattern of the desired mode. By measuring the resulting interference pattern, one can reconstruct the full complex field of the input beam, including its wavefront, Poynting vector, and polarization distribution.

Integrated Photonic Approaches Recent advances include reconfigurable photonic integrated circuits that function as spatial mode decomposers. These devices can simultaneously provide the relative amplitudes and phases of multiple modes and can even decompose polarization states into circular bases. Such integrated platforms offer compact, stable, and pro...

Article Content

Partially coherent light beam shaping via complex

In addition, the optical beam with low spatial coherence provides more controllable (statistical) degrees of freedom for light beam shaping, compared to the fully

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 authors present an algorithm for few-mode-fiber mode decomposition

Spatial light modulators

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Creation and detection of optical modes with spatial light modulators

Modal decomposition of light has been known for a long time, applied mostly to pattern recognition. With the commercialization of liquid-crystal devices, digital holography as an enabling tool has become

Universal photonic processor for spatial mode decomposition

In this paper, we introduce a new modal decomposition technique based on a 16-pixel reconfigurable photonic integrated circuit programmed as a spatial mode decomposer. This device uniquely

Full-range, complex spatial light modulator for real-time holography ...

A full-range complex and transmissive spatial light modulator (SLM) for simultaneous and independent amplitude and phase modulation of an input wave field of arbitrary scalar complex optical fields is

Metasurface-enhanced spatial mode decomposition | Phys. Rev. A

Acquiring precise information about the mode content of a laser is critical for multiplexed optical communications, optical imaging with active wave-front control, and quantum-limited

Fast modal decomposition for optical fibers using digital

As such, spatial light modulator (SLM) is a good substitute for the lithographic CGH 12. In this paper, we propose a novel complete MD technique

New Methods for Modal Decomposition in Multi-Mode fibres

We propose and demonstrate two methods for modal decomposition in multi-mode fibres. Linearly polarized modes propagating in a slightly multi-mode fibre are easily retrieved from intensity

Mode decomposition of multimode optical fiber beams by phase-only ...

Request PDF | Mode decomposition of multimode optical fiber beams by phase-only spatial light modulator | Multimode optical fibers (MMF) recently attracted a renewed attention,

Mode decomposition of multimode optical fiber beams by phase-only ...

Mode decomposition of multimode optical fiber beams by phase-only spatial light modulator Mikhail Gervaziev, Innokentiy Zhdanov, Denis S. Kharenko, V. A. Gonta, V. M. Volosi, E.

Universal photonic processor for spatial mode decomposition

The device also demonstrates its capabilities in analyzing and decomposing a mixed mode beam with up to six constituting modes, showcasing its potential for complex mode analysis.

Mode decomposition of multimode optical fiber beams by phase-only ...

In this work, based on a computer digital holography method using a phase-only spatial light modulator (SLM) as a correlation filter, we experimentally demonstrate a method of mode decomposition

Creation and detection of optical modes with spatial light modulators

A practical tutorial on how to perform an efficient and effective optical modal decomposition, with emphasis on holographic approaches using spatial light modulators, highlighting

Mode decomposition of multimode optical fiber beams by phase-only ...

Mode decomposition of multimode optical fiber beams by phase-only spatial light modulator To cite this article: M D Gervaziev et al 2021 Laser Phys. Lett. 18 015101 View the article online for updates and

Modal decomposition of transverse mode-locked laser beam

Modal decomposition of light is well-known for pattern recognition in studies of waveguides, solid-state lasers as well as fiber lasers. In this letter, we present a modal

Accuracy of Holographic Real-Time Mode

Mode decomposition is a powerful tool for analyzing the modal content of optical multimode radiation. There are several basic principles on

Universal photonic processor for spatial mode decomposition

These modes are typically produced by optical resonators or external spatial mode converters, wherein phase structuring is applied to the fundamental Gaussian mode.

FPGA-accelerated mode decomposition for multimode fiber-based

Fig. 1 Schematic of optical fiber crosstalk and the pipeline of FPGA-based mode decomposition for a CLC system. Abbreviations: CAM: camera; SLM: spatial light modulator.

Modal analysis of structured light with spatial ...

Here, we present a practical tutorial on how to perform an efficient and effective optical modal decomposition, with emphasis on holographic approaches using spatial light modulators,

Mode Decomposition Method for Investigating the Nonlinear ...

We overview our recent experimental studies on the nonlinear spatial reshaping of multimode beams at the output of multimode optical fibers.

Laguerre-Gaussian mode sorter

We demonstrate an optical device capable of decomposing a beam into a Cartesian grid of identical Gaussian spots each containing a single Laguerre-Gaussian component, using just a

Spatially degenerated mode decomposition for few-mode fibers

A mode decomposition algorithm for spatially degenerated modes within few-mode optical fibers is proposed. This proposed algorithm recovers the mode coefficients of two orthogonal

The Creation and Detection of Optical Modes with Spatial Light Modulators

In particular we review the known approaches for creating arbitrary optical modes by complex amplitude modulation on phase-only spatial light modulators, and provide some examples of the power of this

Mode decomposition of multimode optical fiber beams

In this work, based on a computer digital holography method using a phase-only spatial light modulator (SLM) as a correlation filter, we experimentally

Spatial mode decomposition for fiber lasers

With the rapid advancement of fiber laser technology, challenges including modal competition, intermodal coupling, and differential mode group delay (DMGD) in multimode and few

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