

Article Overview

Spatial Light Modulators (SLMs) are devices that control the amplitude, phase, or polarization of light in a spatially varying manner using electrically or optically addressable pixels.

Core Principle

SLMs function by modulating the properties of light across a two-dimensional array of pixels. Each pixel can independently alter the light passing through or reflecting off it, enabling precise control over the optical wavefront. The modulation can target phase, amplitude, or polarization, depending on the SLM type and application. This allows SLMs to shape beams, encode information, or correct wavefront distortions in real time .

Construction and Operation

Most SLMs use liquid crystal (LC) technology, where the orientation of LC molecules changes in response to an applied voltage. This alters the refractive index locally, producing a phase shift in the transmitted or reflected light without significantly affecting intensity . The LC layer is typically sandwiched between a transparent electrode (like ITO) and a substrate, with each pixel independently addressable via photolithographically patterned electrodes . Reflective SLMs, such as Liquid Crystal on Silicon (LCoS), incorporate a mirror on a CMOS backplane, allowing high-resolution phase and amplitude control. Transmissive SLMs allow light to pass through the LC layer, modulating it directly . Other SLM types include Digital Micromirror Devices (DMDs), which modulate light amplitude using tiny tilting mirrors, and deformable mirrors, which mechanically adjust the wavefront .

Modulation Mechanisms

- o Phase Modulation: Achieved by changing the optical path length through the LC layer, producing a tunable phase shift up to one full wavelength between adjacent pixels .
- o Amplitude Modulation: Can be realized by controlling the polarization of light and using polarizers to vary transmitted intensity .
- o Polarization Modulation: Some SLMs can rotate the polarization of light, enabling advanced optical control for imaging or communication applications .

Applications

SLMs are widely used in beam shaping, holography, optical computing, ultrafast pulse shaping, adaptive optics, and data storage. They are also applied in laser output control, Fourier transform correlation, and

Principles and Applications of Spatial Light Modulators

optical image processing. Their ability to dynamically control light makes them essential in both research and industrial photonics .

Summary

In essence, SLMs are programmable optical devices that manipulate light at the pixel level. By controlling phase, amplitude, or polarization, they enable precise wavefront engineering for a wide range of scientific and technological applications, combining high resolution, flexibility, and real-time control .

1. Introduction Spatial light modulators (SLMs) are electro-optical devices, pertaining to manipulating the fundamental

CHAPTER 5: SPATIAL LIGHT MODULATOR SYSTEM 5.1 SPATIAL LIGHT MODULATOR Spatial Light Modulator (SLM) is a

This special section of Optical Engineering devoted to Spatial Light Modulators: Devices and Applications includes contributed and

PDF | On Oct 26, 2023, Yiqian Yang and others published A review of liquid crystal spatial light modulators: devices and applications

This chapter contains sections titled: Introduction LCOS-Based SLMs Some Applications of Spatial Light Modulators

Spatial Light Modulators (SLMs) are quasiplanar devices, allowing for the modulation of the amplitude, phase and

Discover the principles, types, and applications of Spatial Light Modulators in optics, including their role in beam

These devices modulate the amplitude, phase, or polarization of light waves passing

A spatial light modulator (SLM) is a device that can control the intensity, phase, or polarization of light in a spatially varying manner.

In this review, we summarize the recent progress of THz spatial light modulators from the

Spatial Light Modulators represent a cornerstone of modern optical innovation, offering unmatched precision

and

1.1 Introduction Spatial light modulator (SLM) is a general term describing devices that are used to modulate amplitude, phase, or

Meadowlark Optics award-winning Spatial Light Modulators (SLMs) provide precision retardance control for spatially varying phase

Emerging demands for dynamic wavefront modulation in holographic displays, augmented/virtual reality, and light

The content covers various types of SLMs, including liquid crystal-based devices, micro-electromechanical systems (MEMS), and

Versatility and Integration Our SLMs support free-space optics, modulators for continuous wave (CW) sources, and advanced

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