Grayscale control of liquid crystal light modulator

Article Overview

Grayscale control in LC-SLMs modulates the phase or intensity of light by varying pixel voltages, with calibration required to correct nonlinear and spatially nonuniform responses.

Principle of Grayscale Control

Liquid crystal spatial light modulators (LC-SLMs) manipulate light by exploiting the birefringence of liquid crystals, where the refractive index experienced by light depends on the orientation of the molecules. Applying a voltage across the LC layer changes the molecular alignment, which in turn alters the phase shift or intensity of transmitted or reflected light. Each pixel can be addressed with a specific grayscale value, corresponding to a voltage that produces a desired optical effect . In phase-only SLMs, the grayscale input ideally maps linearly to a phase shift, but in practice, the relationship is nonlinear due to the intrinsic properties of liquid crystals and manufacturing variations . This nonlinearity can lead to global grayscale-phase mismatch and spatial nonuniformity, reducing modulation accuracy .

Calibration Methods

To achieve precise grayscale control, LC-SLMs require calibration:

• Interferometric Calibration: Measures the phase shift induced by each grayscale level using interference patterns. Techniques like vortex-grating lateral-shearing int...

Article Content

Generalized phase calibration method of liquid crystal spatial light ...

Liquid crystal spatial light modulator (LC-SLM) is a programmable dynamic optical device. By applying a certain

Measurement of phase and intensity by Dual-imaging Interferometry

In order to evaluate the performance of liquid crystal spatial light modulator Dual-imaging Interferometry is proposed by

Phase Modulation of Liquid Crystal Spatial Light ...

Based on the Tyman-Green interference system, the phase modulation character of the phase-only liquid crystal

Liquid Crystal Modulators

Liquid crystal modulators are a type of optical modulator which utilize liquid crystals to control the intensity, phase, or polarization of

Progress in Phase Calibration for Liquid Crystal Spatial Light Modulators

Abstract: Phase-only Spatial Light Modulator (SLM) is one of the most widely used devices for phase modulation. It has been

Phase modulation time dynamics of the liquid-crystal spatial light ...

In this paper, liquid-crystal spatial light modulators are presented for precise dynamic manipulation of coherent light

Progress in Phase Calibration for Liquid Crystal Spatial Light ...

To generate the measured beam, a series of grayscale patterns are uploaded on the modulated zone and the wave

Utilization of a liquid crystal spatial light modulator in a gray scale ...

Applicability of a commercial twisted-nematic liquid-crystal display is examined at approximately 400 nm. Different

Spatial Light Modulators

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

Phase response calibration method for liquid crystal spatial light ...

It enables the pixel-by-pixel detection of time-domain interferometric images to obtain phase distribution. A

Phase Compensation of the Non-Uniformity of the Liquid Crystal

A phase modulation characteristic calibration and compensation method for liquid crystal on silicon spatial light

Utilization of a liquid crystal spatial light modulator in a gray scale ...

This paper introduces a new modification for the well-known binary detour phase method, which is largely used to represent Fourier

Phase response calibration method for liquid crystal spatial light ...

Abstract In order to accurately calibrate the liquid crystal spatial light modulator (LC-SLM), a phase response

Wavefront control of laser beam using optically addressed liquid ...

An optically addressed liquid crystal modulator for wavefront control of 1053 nm laser beam is reported in this paper.

Calibration Method of Liquid-Crystal Spatial Light Modulator Based on

In this paper, based on a phase retrieval algorithm, a novel phase calibration method with high efficiency and

Analysis of Charge-Controlled Gray Scale in Ferroelectric Liquid ...

In an optically addressed spatial light modulator (OASLM) with ferroelectric liquid crystal (FLC) and p-i-n photodiode hydrogenated

Multifunctional light beam control device by stimuli-responsive liquid ...

In this work, a novel technique to control the light phase by stimuli-responsive liquid crystals in combination with ITO

Complete polarization control of light from a liquid crystal spatial ...

We present a method to generate complete arbitrary spatially variant polarization modulation of a light beam by

Grayscale-phase calibration of liquid crystal spatial light modulator ...

In this paper, vortex-grating lateral-shearing interferometry is introduced into the grayscale-phase calibration, which can theoretically

High Precision Optical Wavefront Generation Using Liquid Crystal ...

In recent years, due to the rapid developments of liquid crystal display and VLSI technology and the abun-dance of liquid crystal

Grayscale-phase calibration of liquid crystal spatial light modulator ...

Liquid crystal spatial light modulators (LC-SLMs) are widely used in optics, and grayscale-phase calibration can effectively improve

Study on the Phase Modulation Characteristics of Liquid Crystal

A special Twyman-Green interferometer is designed to measure the phase modulation characteristics of liquid crystal

Liquid Crystal Modulators

While most liquid crystal modulators utilize nematic liquid crystals, which offer analog modulation

Two-dimensional full-Stokes characterization of parallel-aligned liquid ...

Abstract Parallel-aligned liquid crystal on silicon (PA-LCoS) spatial light modulators (SLMs) are critical components in

Spatial light modulator

Spatial light modulator Schematic of a liquid crystal-based Spatial Light Modulator. Liquid crystals are birefringent, so applying a

Integrated Visible-Light Liquid -Crystal Phase Modulator

2. Liquid-Crystal Theory In the proposed liquid-crystal modulator, phase modulation is achieved via the birefringence of the liquid

Local and global calibration of liquid crystal spatial light modulators ...

We record and post-process this pattern to determine the irradiance spatial response as a function of the gray levels of

Liquid-Crystal Spatial Light Modulators 28 and Their Applications

Introduction Liquid-crystal spatial light modulators achieve control of the light path by modula-tion of the refractive index. As an

Calibration of phase-only liquid-crystal spatial light modulators by ...

Liquid-crystal spatial light modulators (SLMs) are widely used in various fields, benefitting from their advantages of high

Phase response calibration method for liquid crystal spatial light ...

Liquid crystal spatial light modulators (LC-SLMs) are widely used in optics, and grayscale-phase calibration can

Study on the Phase Modulation Characteristics of Liquid Crystal

Phase modulation characteristics of LC-SLM Liquid crystal spatial light modulators use nematic liquid crystal cells as phase shifters,

Progress in Phase Calibration for Liquid Crystal Spatial Light Modulators

Liquid crystal photovoltaic spatial-light modulators use photovoltaic layers as an integrated power source to switch

Direct calibration of liquid crystal spatial light modulators using a ...

We propose and demonstrate, both theoretically and experimentally, a direct interferometric method for calibrating

Calibration of phase-only liquid-crystal spatial light modulators by ...

Phase-only spatial light modulator (SLM) is a key device for light manipulation. It is critical to calibrate the grayscale

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