

Article Overview

Spatial light modulators with gratings use programmable diffraction or phase control to modulate light with high speed, resolution, and efficiency.

Grating Light Valve (GLV)

The Grating Light Valve (GLV) is a MEMS-based SLM consisting of thousands of micro-ribbons on a silicon chip. By electronically controlling the displacement of these ribbons, the GLV acts as a programmable diffraction grating, modulating laser light in amplitude and phase. When active ribbons are co-planar with static ribbons, light reflects normally; when displaced by a quarter-wave, the reflected light interferes destructively, scattering into diffraction orders. Intermediate displacements allow analog grayscale control, enabling precise light modulation for imaging and display applications .

Piezoelectrically Actuated Resonant Waveguide Gratings

High-speed SLMs can also be realized using piezoelectrically actuated resonant waveguide gratings on silicon nitride. These devices support >100 MHz modulation speeds and high extinction ratios (>20 dB), with individually addressable pixels. They are suitable for visible to near-infrared wavelengths and applications requiring multimodal optical control, such as quantum information processing, laser ranging, and AR/VR .

Liquid Crystal SLMs with Grating Calibration

Liquid crystal SLMs (LC-SLMs) can implement grating-based phase modulation. Techniques like vortex-grating lateral-shearing interferometry allow full-pixel grayscale-phase calibration, improving modulation accuracy and stability. This enables precise control of light phase and amplitude for holography, beam shaping, optical trapping, and communication .

Graphene-on-High-Contrast Grating SLMs

Emerging SLMs integrate graphene with high-contrast gratings (HCGs) to modulate surface-normal reflection. By applying voltage to graphene layers, these devices achieve high extinction ratios and can be fabricated in large 2D arrays using CMOS-compatible processes. They offer potential for MHz-speed operation, free-space optical modulation, and scalable, low-cost applications in imaging and optical interconnects .

Applications

SLMs with grating structures are widely used in:

Spatial light modulator with grating

- o Laser beam shaping and switching
 - o Holographic displays and imaging
 - o Quantum optics and atom-based experiments
 - o Optical communication and interconnects
 - o AR/VR and adaptive optics
- These devices leverage the wave nature of light and grating interference to achieve high-speed, high-resolution, and tunable modulation, making them versatile tools in both research and industrial photonics.

A spatial light modulator (SLM) is a pixellated liquid crystal device that can individually control the phase value of each pixel. It

The compact spatial light modulator (EXULUS-SE1) consists of a built-in SLM panel with compact housing.

Nevertheless, optimal phase triplicator gratings have been demonstrated with spatial light modulators (SLMs), with geometric

Spatial Light Modulators (SLMs) are quasi- planar devices, allowing for the modulation of the amplitude, phase and polarization, or a

We study the diffraction efficiency of linear phase (blazed) diffraction gratings displayed onto spatial light modulators

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

To fulfill these requirements, we introduce a modulator technology based on piezoelectrically actuated silicon nitride

Several spurious effects are known to degrade the performance of phase-only spatial light modulators. We introduce a

Structured illumination microscopy (SIM) is a method that can double the spatial resolution of wide-field fluorescence

Abstract Liquid crystal spatial light modulators (LC-SLMs) have gained substantial interest of the research fraternity

Grating Light Valve (GLVTM) The GLV is a high-speed diffractive MEMS light modulator fabricated from aluminum & silicon-nitride

Spatial light modulator with grating

The Grating Light Valve (GLV) is a high-performance spatial light modulator comprising a linear array of thousands of micro

We develop custom spatial light modulators with segmented micromirror arrays and a high pixel

We introduce a scalable modulator technology based on piezoelectrically actuated silicon nitride resonant waveguide

This method utilizes a 2D grating for lattice projection and a spatial light modulator (SLM) for phase shifting.

A phase-only spatial light modulator (SLM) is capable of precise transverse laser shaping by either functioning as a

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