Spatial Light Modulator Principles

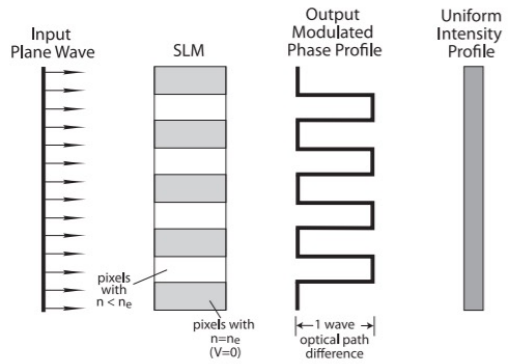
Meadowlark Optics award-winning Spatial Light Modulators (SLMs) provide precision retardance control for spatially varying phase or amplitude requirements. Our SLMs consist of liquid crystal (LC) pixels, each independently addressed, acting as separate variable retarders. These SLMs are easily incorporated into optical systems requiring programmable masks and variable input/output devices. Applications include correlation, spectroscopy, data storage, ultrafast pulse shaping, optical computing, beam steering and wavefront correction for active and adaptive optics.

Basic construction and operation of an SLM is similar to our standard LC Variable Retarder. The ITO transparent conductor is photolithographically patterned into individual electrodes, creating independently controllable pixels.

Minimizing pixel spacing is critical to optimize performance and resolution. Proprietary designs and techniques enable Meadowlark Optics to offer tight interpixel spacing. Custom pixel configurations are possible.

Phase Control

Spatial phase control or modulation is accomplished without altering the intensity profile of an incident beam. Light linearly polarized parallel to the extraordinary axis of the LC material is phase modulated by the voltage applied across individual pixels. An optical path difference between adjacent pixels, tunable to one full-wave, is easily accomplished.



With phase modulation, an optical path difference of up to one full-wave is produced between adjacent pixels of the Spatial Light Modulators. The output intensity remains uniform.

Spatial Light Modulator Applications

Spatial Light Modulators are being used in a diverse range of new applications including:

- Microscopy
- Imaging polarimetry
- Optical data storage
- WDM gain flattening
- Wavefront correction
- Arbitrary pulse shaping
- Optical transform masks
- WDM add/drop modulators
- Multi-channel PMD correction
- Beam steering for live cell manipulation
- Holographic Displays
- Cinematography
- Optical Tweezers
- Astronomical Observation
- Fluorescence Photomasking

Amplitude Control

Spatial Light Modulators are also used for amplitude control or modulation. Here, the SLM modifies the beam intensity, but also spatially alters the phase profile, which may be undesirable. Correction is accomplished by using two spatial light modulators in series. The first performs the necessary amplitude modulation, also introducing a phase change. The second SLM restores the original, or desired phase relationship between pixels. Polarizers are optional with an amplitude SLM. These polarizers are both rotatable and removable from the SLM housing.

The compact optical head is designed so that two units can be placed back-to-back, minimizing the path distance between modulators. Electrical connections exit one side of the optical head for convenience in handling and mounting.