MULTIPLEXED HARTMANN WAVEFRONT SENSOR FOR COMPLEX, BROADBAND AND VECTOR WAVEFIELDS

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Keywords: wavefront sensing, lateral shearing interferometry, multiplexed imaging

Optical sensors are limited to measuring intensity. For this reason, wavefront sensors need to convert phase information into intensity modulations. One method to achieve this involves using a Hartmann mask positioned near a camera sensor. This technique is compatible with low-coherence illumination and has been implemented using various encoding optical elements, such as arrays of holes or microlens arrays. For instance, high-resolution and quantitative phase imaging has been demonstrated using a diffraction grating [1], a method known as lateral shearing interferometry (LSI) [2].

In this presentation, we will illustrate how LSI can also measure broadband speckle wavefields generated through multiple scattering media [3], enabling digital fluorescence phase conjugation through tissues [4]. Additionally, we will present a generalization of LSI using a birefringent diffraction grating to perform polarimetric LSI of vector beams [5], which is relevant for optical metrology and polarization-resolved fluorescence microscopy. Finally, we will demonstrate that this generalized principle can be applied to single-shot hyperspectral wavefront sensing, leveraging the spectral dispersion of thin scattering media, with applications in the metrology of ultrashort lasers [6].

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