Metasurface for Rational OAM and Large Angle of View Hologram Generation

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Metasurfaces composed of ultrathin subwavelength structures are versatile in manipulating light properties over a wide spectrum range and are promising for integrated optoelectronics for their compactness and compatibility for large volume manufacturing. In this talk I will introduce a simplified binary metasurface, photon sieves, for optical wavefront manipulation for hologram and optical vortex generation, including high tolerance and large angle of view hologram using nano photon sieves, spatial multiplexing of optical angular momentum using plasmonic nanosieves, and arbitrary rational order optical vortex generation using gratings with an aperture.

Large Angle of View Hologram

Holography is of great interests to optics but has always concerned with the sensitivity to wavelength and polarization of the incident light and especially the small angle of view. We use photon nano sieves to mimic the forward radiation field of the point light sources to ease some of the concerns form conventional holograms [1, 2]. Ultrahigh capacity photon nano sieves are designed with the help of analytical model in different structural orders of randomness. They showed uniform optical hologram with high diffraction efficiency throughout the visible to near IR wavelength range. This robust hologram offers polarization independence, a large angle-of-view and a unique lensing effect, which can work as a high-resolution and lens-less micro-projector. This might open an avenue to high-tolerance holographic technique for electromagnetic as well as acoustic waves.

Optical Vortex and Rational OAM Generation

Optical vortex beam is useful in optical tweezers and optical spanner, large bandwidth optical communication, and super resolution imaging in stimulated emission depletion microscopy. Microscopic generation of optical phase profile by using metasurfaces provides an avenue compact and integrated optics. We demonstrated plasmonic nanosieve based helical metasurfaces with multi-functionalities, such as vortex beam generation, spatial multiplexing of optical topological charges, non-diffraction propagation and multiple focusing along propagation direction in a single device by controlling the geometric phase of spin light through rotating the nano-voids [3-6]. The number of focal planes, focal lengths and corresponding topological charges are readily tailored to meet different requirements. By combining bilaterally symmetric gratings with an aperture, we also created an arbitrary rational-order optical vortex beam without a theoretical limit [7]. The vortex beam has a distinguished spiniform wavefront with phase singularities located equidistant along a line and tunes its average OAM by changing the number of singularities the beam accommodates. The approach realizes both non-integer and arbitrary rational-order generation of OAM and enables the exploration of quantum entanglement using such continuous OAMs.

References:

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