



Compound Metaoptics for Amplitude and Phase Control Of Wavefronts

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OVERVIEW

A means to control the phase, amplitude, and polarization state of an arbitrary wavefront

- Enabled control without reflection, absorption, or active components
- Useful in radar, far-field radar communications, and holographic

BACKGROUND

Control of the amplitude and phase of a light beam is important across several optics applications such as optical trapping, optical microscopy, and spectral imaging. This manipulation is usually accomplished through the use of spatial light modulators or deformable mirrors, though these methods suffer from poor spatial resolution and a narrow field of view. While advances in the optical field have led to the development of electromagnetic metasurfaces, they can only either modulate phase, amplitude, or polarization state, but not two or more of these at the same time. Thus, if a complex optical pattern is desired, it cannot typically be achieved with a single metasurface. Furthermore, metasurfaces have typically suffered from impedance mismatch problems and speckle noise. A need exists for a method to control the phase, amplitude, and polarization state of an arbitrary wavefront.

INNOVATION

Researchers have combined two gradient metasurfaces to control the phase, amplitude, and polarization state of an arbitrary wavefront. The technology allows for two degrees of freedom in design, enabling control of complex field distributions without reflection, absorption, or active components. The paired metasurfaces are separated by a distance on the order of a

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Category

Hardware

Engineering & Physical Sciences

Semiconductors, MEMS, and

Electronics

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wavelength. The design does not require lenses and thus has the potential to decrease the size of optical systems, while improving holographic display and optical trapping. Due to the flexibility of the design procedure, an arbitrary incident field can be used as a source to produce a desired complex field pattern. The system operates in transmission instead of reflection, and it could therefore have further applications including use in radar as well as producing custom far-field radiation patterns and 3-dimensional holograms.

PATENT APPLICATION

Number:16/502,817

References

1. Raeker, Brian and Grbic, Anthony. , Compound Metaoptics for Amplitude and Phase Control of Wave Fronts. Phys. Rev. Lett. 122, 113901. Published 22 March 2019