High-Speed, High Field-Of-Field Of View Hybrid Polarimetric Camera With Compressive Sensing

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OTHER INFORMATION

KEYWORDS

bio-inspired, biomimetic, polarization, polarimetric camera, wide field of view, coded diffraction, coded aperture, hybrid imaging, Stokes measurement, object marking, polarimetric sensing, multi-scale structures, hyperspectral imaging

CATEGORIZED AS

- **Optics and Photonics**
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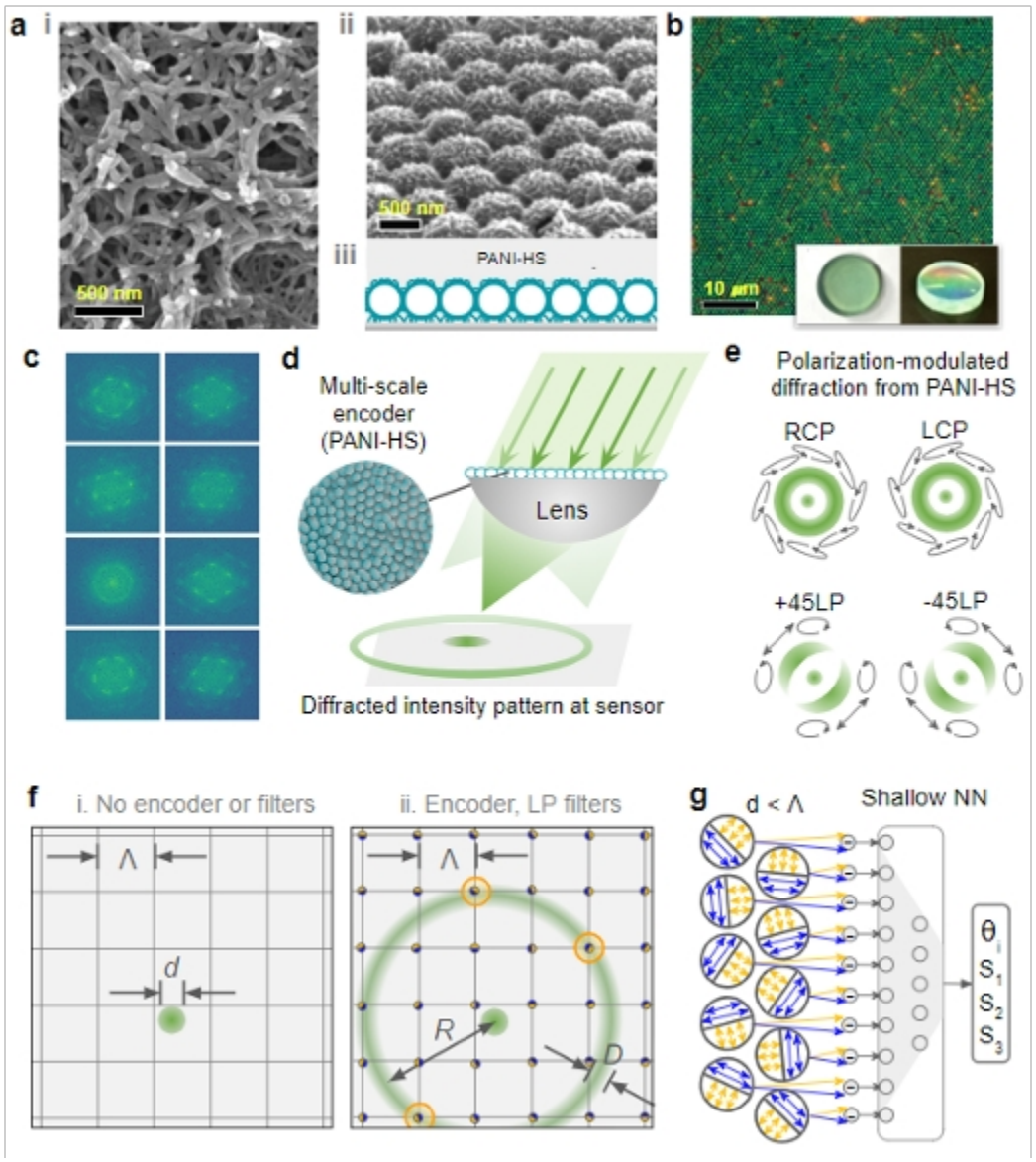
FULL DESCRIPTION

Background

Polarimetric sensing offers the ability to image through turbid environments, distinguish shadows and see otherwise transparent objects and full Stokes sensitivity to degree of polarization (DoP) and circularly polarized (CP) light would enable 3D object marking. Nevertheless, polarimetric imaging is expensive requiring precise alignment, results in loss of resolution and in bulky designs with moving parts. The compactness of the imaging system is reduced with metasurfaces. But, with metasurfaces, the field-of-view is low and fabrication is expensive.

Technology

Prof. Luat Vuong and her team have developed a wide field-of-view, polarimetric imaging system that does not reduce resolution. The uniqueness of this technology is the co-design of the encoder and sampling to achieve polarimetric sensing. Employing meso-scale ordering, multi-scale structures and information theoretic design, the team has achieved proper multiplexing of data which enables polarization cameras to sample less than the Nyquist frequency and image polarization without loss of resolution. With meso-ordering, the material carries dispersion and a frequency dependent spatial response.



(a-d) Multi-scale, meso-ordered material, which enables (d-e) spatial multiplexing of multiple beam components. (f-g) information theoretic analysis and shallow neural networks to achieve compressed sensing of beam polarization.

ADVANTAGES

The novel and significant benefits of this technology are:

- Wide field-of-view polarimetric sensing (~ 150 degrees)
- Compact imaging system that is inexpensive, and has no moving parts
- Does not require a polarized sensor array or multiple measurements (single shot)
- Compressed sensing and simultaneous sensing of polarization degree and direction
- Usage of sparse sampling and simple back-end algorithms enables high-speed and more robust camera-like imaging
- Enables hyperspectral imaging or detection of light direction, polarization and color.

SUGGESTED USES

Applications, including imaging, are:

- Polarized channel marking
- Polarized lidar
- AR/VR applications
- Beam/object segmentation as used in satellite/mobile communications
- Turbulence aberrometry wavefront sensors with higher dynamic range.

INVENTOR INFORMATION

- Please review all inventions by Luat and her team at UCR
- Please visit Luat's group website to learn more about their research
- Please read recent press coverage of Luat at UCR

RELATED MATERIALS

- Non-Line-of-Sight Full-Stokes Polarimetric Imaging with Solution-Processed Metagratings and Shallow Neural Networks

PATENT STATUS

Patent Pending

RELATED TECHNOLOGIES

- Real-Time Imaging in Low Light Conditions

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