Hyperspectral Compressive Imaging

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ABSTRACT

Researchers at the University of California, Davis have developed two designs capable of capturing hyperspectral images that can be processed using compressive sensing techniques. These advanced component technologies for hyper-spectral imagers realizing 100x reduced size, weight, and power while supporting 1000x framerates in support of high performance.

FULL DESCRIPTION

Hyperspectral imaging captures a wide range of wavelengths in the electromagnetic spectrum. Since materials emit or reflect unique combinations of electromagnetic radiation, hyperspectral imaging is useful for identifying specific materials in astronomy, chemistry, environmental imaging, and other research fields. Most hyperspectral imaging setups require large optical grating devices to take up significant amounts of space and suffer from poor resolving strength relative to the amount of power consumed. Furthermore, hyperspectral imaging is not often used with compressive signal processing techniques, which limits the maximum signal bandwidth that can be captured. The creation of a more compact hyperspectral imaging device that is compatible with compressive sensing is needed for a variety of applications.

Researchers at UC Davis have developed two novel designs to achieve hyperspectral compressive imaging in a compact form factor.

- The first method involves using metalenses to capture images at different wave polarizations, where each lens has a reconfigurable aperture. This design's versatility allows for optimization for various imaging applications that can be trained with machine learning algorithms.
- The second proposed method uses an array of waveguide routers to capture hyperspectral image data. Both techniques can capture data across several wavelength spectra simultaneously, offering an advantage over the common line-scan approach.

Each design is compatible with compressive sensing imaging processing and requires less sophisticated hardware to fit in a compact footprint. This high-resolution hyperspectral imaging system is useful in various tasks due to its compact design, image resolution, and power efficiency.

APPLICATIONS

- Snapshot spectral imaging to capture multiple light wavelength spectra simultaneously
- Material detection in geology, astronomy, chemistry, other fields

FEATURES/BENEFITS

- Up to 1000x more power and size efficient than existing hyperspectral imaging solutions
- High resolution images can be processed with compressive sensing hardware

PATENT STATUS

Country	Type	Number	Dated	Case
Patent Cooperation Treaty	Reference for National Filings	2022/225975	10/27/2022	2021-604

Patent Pending

INVENTORS
- Yoo, S.J. Ben

OTHER INFORMATION

KEYWORDS

hyperspectral imaging, compressive sensing, metalens, waveguide router

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Imaging**
  - 3D/Immersive
- **Medical**
  - Imaging
- **Sensors & Instrumentation**
  - Analytical
  - Environmental Sensors
  - Medical
  - Scientific/Research

RELATED CASES

2021-604-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
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- Athermal Nanophotonic Lasers
- Photonic-Electronic Convolutional Neural Networks
- Ultra-High Resolution Multi-Platform Heterodyne Optical Imaging
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