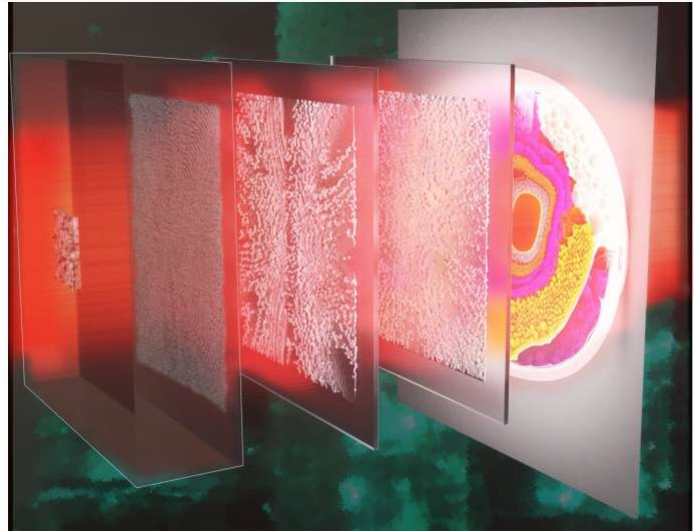


# A new compact diffractive imager for subwavelength resolution

USA, June 18, 2024 /EINPresswire.com/

-- The researchers propose a new method for achieving subwavelength resolution imaging for phase and amplitude objects. Their technique relies on diffractive encoding and decoding with a [solid-immersion](#) layer to recover high-frequency information corresponding to the subwavelength features of an object. This method is implemented using terahertz radiation and validated through the fabrication of a monolithic diffractive processor. The successful retrieval of subwavelength features paves the way for a compact and cost-effective imaging technique.



This technique relies on diffractive encoding and decoding with a solid-immersion layer to resolve the subwavelength features of an object.

Scientists have created a new type of imager that can capture features much smaller than the limitations of traditional optical systems. This innovation has the potential to revolutionize fields like bioimaging, lithography and material science.

The traditional limit for resolution in optical imaging, known as the diffraction limit, restricts the ability to see details smaller than half the wavelength of light. This new imager overcomes this hurdle by employing solid-immersion diffractive encoding of spatial information.

Here's how it works: light from the object first interacts with a high-index material that is spatially structured using an optimized physical code, which encodes high-frequency information beyond the traditional diffraction limit. Then, a diffractive decoder that is jointly optimized with the encoder material processes this encoded information and creates a magnified image of the object, revealing subwavelength features.

This imaging system and its spatial structures, as part of the encoder and decoder materials, are designed using deep learning-based optimization. The resulting smart imager is particularly

compact, with a design that is less than 100 times the wavelength of light in thickness. It also offers the advantage of directly performing quantitative phase retrieval – eliminating the need for lengthy and power-hungry computer processing.

The researchers successfully tested the imager at terahertz frequencies and demonstrated its ability to resolve features as small as  $\lambda/3.4$  (where  $\lambda$  is the wavelength). They also showed that the imager can handle various types of objects, including both phase and amplitude structures.

This new approach (<https://doi.org/10.1186/s43593-024-00067-5>) has the potential to be highly adaptable for different parts of the electromagnetic spectrum. By physically scaling the diffractive features, the imager can be designed to work with different illumination wavelengths without needing a redesign.

The researchers believe this solid-immersion diffractive imager, due to its compact size, cost-effectiveness, and ability to capture subwavelength features, will lead to significant advancements in bioimaging, sensing, and material inspection.

DOI

10.1186/s43593-024-00067-5

Original Source URL

<https://doi.org/10.1186/s43593-024-00067-5>

Funding information

This work was supported by Fujikura and the Harvey Engineering Research Prize from the Institution of Engineering and Technology.

Lucy Wang

BioDesign Research

[email us here](#)

---

This press release can be viewed online at: <https://www.einpresswire.com/article/720926570>

EIN Presswire's priority is source transparency. We do not allow opaque clients, and our editors try to be careful about weeding out false and misleading content. As a user, if you see something we have missed, please do bring it to our attention. Your help is welcome. EIN Presswire, Everyone's Internet News Presswire™, tries to define some of the boundaries that are reasonable in today's world. Please see our Editorial Guidelines for more information.

© 1995-2024 Newsmatics Inc. All Right Reserved.