ENERGY-EFFICIENT NONLINEAR OPTICAL MICRO-DEVICE ARRAYS

Tech ID: 33686 / UC Case 2025-015-0

CONTACT

Michael Cohen
mcohen@berkeley.edu
tel: 510-643-4218.



INVENTORS

» Wang, Feng

OTHER INFORMATION

CATEGORIZED AS

» **Optics and Photonics**

» All Optics and Photonics

» **Imaging**

» Other

» **Materials & Chemicals**

» Chemicals

» Other

» **Semiconductors**

» Materials

RELATED CASES

2025-015-0

PATENT STATUS

Patent Pending

BRIEF DESCRIPTION

Optical neural networks (ONNs) are a promising computational alternative for deep learning due to their inherent massive parallelism for linear operations. However, the development of energy-efficient and highly parallel optical nonlinearities, a critical component in ONNs, remains an outstanding challenge.

To address this situation, researchers at UC Berkeley and Berkeley National Lab developed a nonlinear optical microdevice array (NOMA) compatible with incoherent illumination by integrating the liquid crystal cell with silicon photodiodes at the single-pixel level. The researchers fabricated NOMA with over half a million pixels, each functioning as an optical analog of the rectified linear unit at ultralow switching energy down to 100 femtojoules/pixel. The team demonstrated an optical multilayer neural network.

This work holds promise for large-scale and low-power deep ONNs, computer vision, and real-time optical image processing.

SUGGESTED USES

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Large-scale and low-power deep optical neural networks: The array's design is ideal for building expansive and energy-efficient neural networks that use light for computation.

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Computer vision: The NOMA can be applied in systems that require fast and efficient processing of visual data.

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Real-time optical image processing: The device's high-speed, parallel processing capabilities make it suitable for applications needing instantaneous image manipulation and analysis.

ADVANTAGES

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Ultralow energy consumption: Each pixel operates at a remarkably low switching energy of 100 femtojoules, making the device highly energy-efficient.

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High parallelism and scalability: The array contains over half a million pixels, enabling massive parallel operations, which is crucial for deep learning and other computationally intensive tasks.

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Integration with incoherent light: The device's compatibility with incoherent illumination expands its usability and simplifies system design.

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

▶ Apparatus and Method for 2D-based Optoelectronic Imaging

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2150 Shattuck Avenue, Suite 510, Berkeley,CA 94704
Tel: 510.643.7201 | Fax: 510.642.4566
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