Two-Photon Miniscope with Elliptical Point-Spread-Function and Temporal Focusing Scheme

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ABSTRACT

Researchers at the University of California, Davis have developed an imaging scheme for two-photon microscopes enhancing speed and resolution in neuroscience research.

FULL DESCRIPTION

This technology introduces an innovative imaging scheme for miniaturized two-photon (2P) microscopes, utilizing an elliptical point-spread-function (PSF) combined with temporal focusing (TF). Designed for neuroscience research, it enables high-speed imaging of neural activity in freely moving animals with improved axial confinement and cellular resolution. This invention allows significantly faster imaging speed by reshaping the excitation PSF into an elliptical spot, with the long axis aligned parallel to the scanning row direction. This configuration reduces the number of scanning rows needed to cover the field-of-view (FOV), thereby increasing the frame rate.

APPLICATIONS

- Neuroscience research for studying neural activity in freely moving animals.
- Biomedical applications such as handheld and endoscopic probes.
- Functional imaging of cellular and sub-cellular structures in living tissue.
- Brain mapping by functional imaging of neural circuits during behavior

FEATURES/BENEFITS

- Addresses slow imaging speed of conventional miniaturized two-photon microscopes by increasing imaging speed due to reduced scanning rows.
- Preserves high axial confinement and spatial resolution for detailed cellular studies.
- Miniaturized footprint suitable for head-mounted applications in freely moving animals.
- Enhances two-photon excitation efficiency through temporal focusing.
- Applicable to a wide range of multi-photon microscopes, including two-photon and three-photon microscopes.
- Solves loss of axial confinement due to elliptical beam shaping.
- Removes limitations in studying dynamic physiological phenomena in freely moving animals.

PATENT STATUS

Patent Pending

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OTHER INFORMATION

KEYWORDS

axial confinement, biomedical imaging, elliptical PSF, neuroscience, optical sectioning, temporal focusing, two-photon microscopy, ultrafast laser pulses, neural activity imaging, 2P miniscopes

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics

- **Biotechnology**
  - Health
- **Imaging**
  - Medical
  - Molecular
- **Research Tools**
  - Screening Assays

RELATED CASES

2025-478-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Fetal Oximetry Measurement via Maternal Transabdominal Spectroscopy
- Metasurface, Metalens, and Metalens Array with Controllable Angular Field-of-View

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