SELF-SUPERVISED MACHINE-LEARNING ADAPTIVE OPTICS FOR OPTICAL MICROSCOPY

Tech ID: 33642 / UC Case 2024-167-0

PATENT STATUS

Patent Pending

BRIEF DESCRIPTION

Image quality and sample structure information from an optical microscope is in large part determined by optical aberrations. Optical aberrations originating from the microscope optics themselves or the sample can degrade the imaging performance of the system. Given the difficulty to find and correct all sources of aberration, a collection of methods termed adaptive optics is used to measure and correct optical aberrations in other ways, to recover imaging performance. However, state-of-the-art adaptive optics systems typically comprise complex hardware and software integration, which has impeded their wide adoption in microscopy. UC Berkeley researchers recently demonstrated how self-supervised machine learning (ML)-based adaptive optics can accurately estimate optical aberrations from a single 3D fluorescence image stack, without requiring external datasets for training. While demonstrated for widefield fluorescence microscopy, many optical microscopy modalities present unique challenges.

In the present technology, UC Berkeley researchers have developed a novel self-supervised ML-based adaptive optics system for two-photon fluorescence microscopy, which should also be extensible to confocal and other modalities. The system can effectively image tissues and samples for cell biology applications. Importantly, the method can address common errors in optical conjugation/alignment in commercial microscopy systems that have yet to be systematically addressed. It can also integrate advanced computational techniques to recover sample structure.

SUGGESTED USES

» Improve imaging performance of two-photon, confocal, and other cell biology optical microscopy applications

ADVANTAGES

» Perform ML-based adaptive optics (estimate optical aberrations) from single image stack

» No external data sets required for training

» Correct common types of conjugation/alignment errors in commercial microscopy systems

» Suitable for two-photon, confocal, and challenging cell biology microscopy applications

RELATED MATERIALS

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INVENTORS

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OTHER INFORMATION

CATEGORIZED AS

» **Imaging**

» 3D/Immersive

» Medical

» Other

RELATED CASES

2024-167-0

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