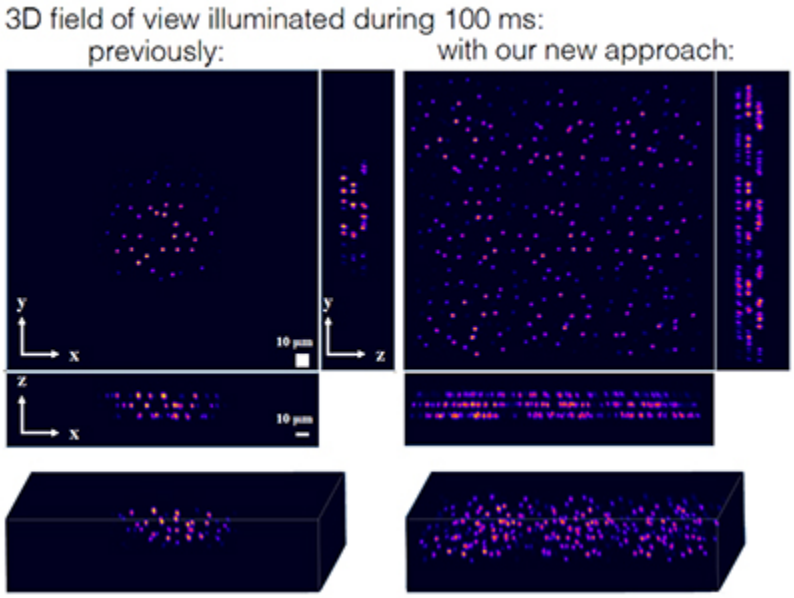
Docket #: S15-079

Optical microscopy system for precise 3D imaging and control of neurons

Researchers in Prof. Karl Deisseroth's laboratory have developed an optical imaging and optogenetics two photon laser system that uses a single beam to illuminate many sites in three-dimensions. The invention employs a low repetition rate, high peak energy laser with a programmable diffractive element to precisely deliver femtosecond pulsed laser light to cellular-sized regions under a microscope. This technology enables all optical closed loop observations and control of neural activity.



Stage of Research

The inventors were able to sample calcium signals at 10 Hz from 104 locations spanning 200 microns in depth through a cranial window over S1 barrel cortex in head-fixed mice (N=2) virally transduced with GCaMP6m (AAVdj-Camk2a-GCaMP6m) undergoing whisker stimulation.

Applications

- **Optical imaging** - including 3D calcium or voltage imaging in rodent *in vivo* applications
- **Optogenetic control** - 3D control, possibly in a closed loop configuration which would enable end users to perform circuit screening in animal models for neuropsychiatric disease

Advantages

- **Structured 3D illumination** - can illuminate many **more sites**, over a much **larger 3D field of view** than previous systems
- **Two photon excitation** - can generate **more signal** than previous systems, with **longer dwell times** than scanning-based systems
- **Precise** - femtosecond pulsed laser enables **spatially precise** delivery of light using two photon excitation to achieve a greater penetration depth in scattering tissue

Publications

- PCT Published Patent WO 2016209654 A1, "Methods and devices for imaging and/or optogenetic control of light-responsive neurons".
- U.S. Published Patent Application 20180177401, "Methods and Devices for Imaging and/or Optogenetic Control of Light-Responsive Neurons".
- Samuel J. Yang, William E. Allen, Isaac Kauvar, Aaron S. Andalman, Noah P. Young, Christina K. Kim, James H. Marshel, Gordon Wetzstein, and Karl Deisseroth, "Extended field-of-view and increased-signal 3D holographic illumination with time-division multiplexing,". *Optics Express* Vol. 23, Issue 25, pp. 32573-32581 (2015).

Patents

- Published Application: WO2016209654
- Published Application: 20180177401

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Innovators

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