



## Presentation Abstract

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Presentation Title: A novel 3-D microfabricated lightguide array for optogenetic control of distributed neural circuits in the mammalian brain

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Abstract: A key feature of neural circuits in the mammalian brain is their 3-dimensionality and geometric complexity. The ability to optically drive or silence neural activity in complex shaped brain circuits for milliseconds to seconds at a time, would enable analysis of the time-resolved contribution of specific neural circuits, and specific neural activity patterns, to behaviors and pathological states. However, the ability to manipulate neural circuits in their geometric complexity still requires significant innovation, to confront the dense and difficult matter of the brain. Recently we developed a new kind of thin implantable probe for light delivery into the brain, which comprises many parallel waveguides, each terminating at a different point along the length of the probe (Zorzos et al., 2010). This probe is capable of independently delivering light to multiple targets along the probe axis, thus enabling versatile optical control of sets of distributed brain targets along a linear axis. We now present a novel 3-D neuromodulation array which is a 2-D array of many individual such 1-D probes, held in a custom microfabricated holder and connected to an computer-controlled light source array consisting of a laser and digital micromirror device (DMD). We demonstrate its use in the living mammalian brain to modulate neural dynamics in 3-D neural circuits. Such a device may enable new kinds of experiment, for example the control of complexly-shaped targets such as hippocampus, the tiling of distributed circuits such as limbic networks, or the high-throughput or systematic screening of neural circuit targets, using optogenetic molecules. Also, such innovations may serve as prototype optical neural control prosthetics, which may be of use in the treatment of intractable brain disorders.

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