Technology Offer

Dynamic control of three-dimensional light distributions through wavefront engineering: hardware and software system

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Engineering light distributions in a three-dimensional volume to achieve selective illumination profiles is an instrumental task shared by many optical and microscopy techniques. The optimization of the light distribution can lead to significant enhancement of relevant performance figures and ultimately to the extension of the instrument or experimental protocol capabilities1,2,3,4,5. Targeted illumination profiles can be used either to mechanically interact with molecules at nanometer precision, as in an optical tweezer application, or to optically induce a change in the conformational state of molecules. Technology enabling selective control of light distributions has found an ideal match in the field of optogenetics, enabling high resolution light-based control of neuron activity. This technique is rapidly developing, and was awarded as method of the year 2010 by Nature Methods and was named as one of the breakthroughs of the decade by Science Magazine. The precision and power of optogenetic approaches are limited by the degree of spatio-temporal control in the delivery of light. Using wavefront engineering, a very precise light field distribution can be generated in a three-dimensional volume. This enables neuroscientists to selectively target specific sets of neurons in vivo for activation, to explore neural circuits and connectivity. This is a cutting edge technique, which is only starting to reach the market, and would be a desired add- on module to many microscopes.

Technology

Scientists at the Max Planck Institute of Neurobiology engineered a dedicated optical path and a convenient software tool for the generation and control of three-dimensional light distributions according to user-selected patterns. The software comprises the following key features:

- Python-based control software with a Qt-based graphical user interface
- Server-client architecture to control and calibrate relevant hardware components
- Flexible communication protocol enables integration with commonly used programming languages and microscope software interfaces
- Modular and scriptable pattern and timing control
- Automatic calibration procedure to align holographic system to the microscope's coordinate system
- Two-photon holography, for restricted axial activation

Benefits

- Modular user interface and control system eases addition of three-dimensional holographic stimulation to microscope systems
- Upgrade already existing devices to be among the first on the market in the growing market of three-dimensional holographic microscopy

Licensing Information

This control software is available through a non-exclusive license agreement with Max-Planck-Innovation, the tech-transfer agency of Max Planck Society.

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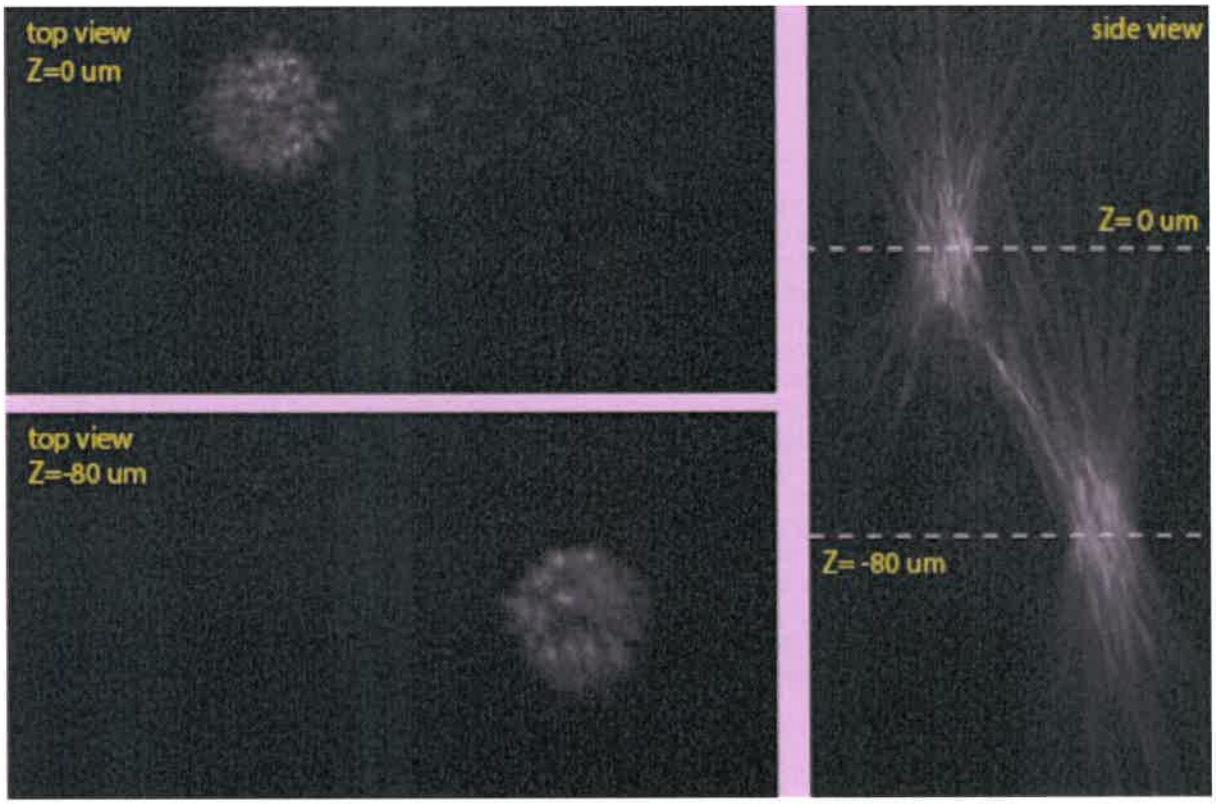
Figure



Literature

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