3D optical imaging with rapid, volume-based data acquisition at high spatiotemporal resolution

Technology #cu13147

This technology is a 3D optical imaging system that enables simultaneous interrogation and monitoring of multiple local targets within a sample volume at high spatiotemporal resolution.

Unmet Need: Optical systems with fast, volume-based data acquisition at high spatiotemporal resolution

Conventional biological imaging methods involve mechanically scanning the sample and acquiring layer-by-layer images to generate 3D imagery, which results in low temporal resolution. There is a need for 3D imaging systems that can provide high temporal resolution without compromising spatial resolution, especially for applications such as the study of cell-to-cell communication that mandate high spatiotemporal resolution.

The Technology: Optical imaging with multi-site, three-dimensional targeting and sensing at high spatiotemporal resolution

This technology implements a spatial light modulator to deliver custom illumination patterns to the sample, enabling simultaneous measurement of optical signals from multiple targets within a sample volume. By engineering the point spread function, this technology achieves three-dimensional imaging of the sample volume without requiring mechanical movement of the system. As such, this technology provides extended depth-of-field and high spatiotemporal resolution for 3D imaging applications. Importantly, this technology can be used for precise control over optogenetic experiments such as imaging of neural circuits both in vitro and in vivo.

A prototype of this technology has been used to optically map synaptic circuits in mouse neocortical brain slices and to activate small dendritic regions and individual spines.

Applications:

- Three-dimensional microscopy
• High-frame-rate optical coherence tomography
• Functional imaging of neuronal activity
• Monitoring fluorescent signals indicative of cell-cell interactions
• Potential monitoring of therapies that change the optical properties of tissue
• Photo-stimulation of neuronal circuits using task-specific illumination patterns
• Quantification of neuronal activity in a 3D sample

**Advantages:**

• Provides high temporal resolution without compromising spatial resolution
• Enables 3D imaging without mechanical motion, eliminating vibration error
• Capable of simultaneous photo-interrogation and monitoring of many targets within the sample volume
• Reduces photo-exposure via use of targeted illumination patterns
• Compatible with existing microscopes or as a stand-alone product

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**Patent Information:**

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**Related Publications:**


**Tech Ventures Reference:**

• IR CU13147
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