SCALABLE APPROACHES FOR ENCODED OPTICAL IMAGING OF THE BRAIN

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Reverse-engineering the mammalian nervous system is one of the greatest challenges in life sciences and is complicated by the large number and small size of its cellular elements. However, the traditional way of exploring neuronal function with microelectrodes is limited to few neurons and simple nervous systems.

Many innovative approaches studying the brain employ molecules engineered to be activated or interrogated by photons. Such advanced optical techniques can explore living brain tissue with cellular and even subcellular resolution. However, requirements for optical techniques to investigate neural systems extend beyond spatial resolution to distinguish neuronal elements and temporal resolution to monitor neuronal signaling. Because of the non-linear and non-stationary nature of the nervous system, multiple neuronal sites need to be accessed simultaneously.

Optical techniques using Dynamic Diffractive Optical Elements (DDOEs) can be successfully applied to multi-site interrogation for mapping functional connections and image neural activity with high spatio-temporal resolution. I will present a few advanced approaches of optical microscopy with DDOEs to analyze structure, function and connectivity in *in vitro* and *in vivo* preparations. Emerging techniques of Encoded High-Throughput Systems to study large populations of neurons will be discussed.