PROGRESS IN NEUROSCIENCE PINS

Seminar Series of the
Brain & Mind Research Institute
Weill Cornell Medical College (WCMC)
&
The Graduate Program in Neuroscience of
WCMC and Sloan Kettering Institute

Thursday, 5/8/14, 4 PM, coffee at 3:45 PM
Weill Auditorium

Optogenetic fMRI (ofMRI): *In Vivo* Visualization and Control of Neural Circuits

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Abstract:

Understanding the functional interactions of the whole brain has been a long sought-after goal of neuroscientists. However, due to the widespread and highly interconnected nature of brain circuits, the dynamic relationship between neuronal networks often remains elusive. The recent development of optogenetic functional magnetic resonance imaging (ofMRI) provides a key technological advancement in addressing this problem. Using ofMRI, it is possible to observe whole-brain level network activity that results from modulating with millisecond-timescale resolution the activity of genetically, spatially, and topologically defined cell populations. The significance of ofMRI lies in its ability to map global patterns of brain activity that result from the precise control of distinct neuronal populations. No other method exists to bridge this gap between whole-brain dynamics and the activity of genetically, spatially, and topologically defined neurons. Advances in the molecular toolbox of optogenetics, as well as improvements in imaging technology, both stand to benefit ofMRI and bring it closer to its full potential. In particular, the integration of ultra-fast data acquisition, high SNR, and combinatorial optogenetics will enable powerful systems of closed-loop ofMRI to modulate and visualize brain activity in real-time. Further research into the nature of the ofMRI BOLD response may also make it possible to extract detailed information about the neural activity underlying a given signal. Finally, the application of ofMRI to translational research has the potential to fundamentally transform how therapies are designed for neurological disorders. Therefore, ofMRI is anticipated to play an important role in the future dissection and treatment of network-level brain circuits. In this talk, the ofMRI technology will be introduced with advanced approaches to bring it to its full potential, ending with some examples of dissecting neurological disease circuits utilizing ofMRI.

Recent relevant publications:

Lee et al., Global and local fMRI signals driven by neurons defined optogenetically by type and wiring. Nature. 2010; 465 (7299): 788-92

Lee, Informing brain connectivity with optogenetic functional magnetic resonance imaging. Neuroimage. 2012; 62 (4): 2244-9

Fang and Lee, High-throughput optogenetic functional magnetic resonance imaging with parallel computations J Neurosci Methods 2013; 218 (2), 184-195.

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