Optogenetic fMRI and the Investigation of Global Brain Circuit Mechanisms

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Abstract:
Understanding the functional communication across 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 network elements remains elusive. With the development of optogenetic functional magnetic resonance imaging (ofMRI), it is now 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. ofMRI uniquely enables mapping global patterns of brain activity that result from the selective and precise control of neuronal populations. Advances in the molecular toolbox of optogenetics, as well as improvements in imaging technology, will bring ofMRI closer to its full potential. In particular, the integration of ultra-fast data acquisition, high SNR, and combinatorial optogenetics will enable powerful systems that can modulate and visualize brain activity in real-time. ofMRI is anticipated to play an important role in the dissection and control of network-level brain circuit function and dysfunction. In this talk, the ofMRI technology will be introduced with advanced approaches to bring it to its full potential, ending with examples of dissecting whole brain circuits associated with neurological diseases utilizing ofMRI.

Short Bio:
Dr. Lee received her Bachelor's degree from Seoul National University and Masters and Doctoral degree from Stanford University, all in Electrical Engineering. She is a recipient of the 2008 NIH/NIBIB K99/R00 Pathway to Independence Award, the 2010 NIH Director's New Innovator Award, the 2010 Okawa Foundation Research Grant Award, the 2011 NSF CAREER Award, the 2012 Alfred P. Sloan Research Fellowship, the 2012 Epilepsy Therapy Project award, the 2013 Alzheimer's Association New Investigator Award, and the 2014 IEEE EMBS BRAIN young investigator award. As an Electrical Engineer by training with Neuroscience research interest, her goal is to analyze, debug, and engineer the brain circuit through innovative technology.