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Multi-modality Imaging – A Powerful Key Opens for Neuroscience Studies

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With its ultimate precision and complexity in structure and functions, brain is the most complex and yet marvelous organelle of human beings. However, exploring or understanding brain structure and function, comparing with gene sequences, is a much more complicated and difficult task that we have ever encountered. Investigations into brain structure and function require a diverse array of tools to create, analyze, visualize, and interact with models of the brain. As a step towards neuroscience studies, functional neuroimaging efforts currently permit visualization of mental or cognitive processes of the brain and help to understand their localization, sequencing, and network interactions.

One of the most effective approaches to observe and trace the neuron interactions or functions spatially and temporally during a specific stimulus is to quantify (or visualize) their communication pathways via various advanced functional neuroimaging modalities, including functional magnetic resonance imaging (fMRI), positron emission tomography (PET/microPET), electro- and magneto-encephalography (EEG/MEG), and other optical imaging apparatus, etc. The neuroimages obtained from these imaging modalities provide meaningful, complementary functional information of the brain undergoing stimulations.

In this lecture, we will begin with basic principles of these imaging modalities and then present several clinical and research examples that directly related to their specific functional brain studies.