Network Disruption in Brain Disease

Organizers: Louis Lemieux and Hyang Woon Lee

Room: # 104

Date and Time: Monday, October3 / 17:00-18:00

Network Disruption in Neurological and Psychiatric Disorders

This symposium will consist of a combination of speakers in clinical neuroscience field for various neurological and psychiatric disorders. The aims of this symposium are to cover the latest topics in multimodal neuroimaging such as EEG, MEG, functional MRI, and DTI, with emphasis on connectivity mapping, provide training on the updated researches and latest methods, and provide a forum for rich discussion on more general approaches for multimodal brain mapping techniques, interpretations of the combined results, as well as future directions. Overall, studies on network properties and functional connectivity are becoming important tools for assessing abnormal brain organization in various neurological and psychiatric disorders and will help expand our understanding of identifying networks disruption in these conditions.

Speakers:

- **Louis Lemieux** (Univ. of College London, UK)
  "Multimodal functional neuroimaging in clinical neuroscience"

  As the first speaker, I will open the symposium with an overview of the role of multimodal imaging in clinical neuroscience, with emphasis on the role of synchrony of acquisitions as a function of the phenomena under study and the hypotheses being tested. I will place this discussion in the context of a more general data fusion framework. I will illustrate the points made using key examples in the investigation of a number of neurological conditions.

- **Maxime Guye** (Aix-Marseille Univ., France)
  "What can we learn from functional connectivity in neurological diseases?"

  Functional connectivity (FC) has been extensively studied in neurological disorders and showed complex and sometimes discordant results. FC measured by resting-state fMRI showed rather decreased connectivity in diseased brain networks concordant with brain network disruption due to the pathology. However, increased FC has also been evidenced at the whole-brain scale from fMRI data with the hypothesis to be linked to cognitive adaptations. By compelling multimodal connectivity data both from imaging (fMRI, DTI) and electrophysiology (EEG, MEG) we will discuss how better interpreting these FC changes in selected models of pathology encompassing: models of localized network dysfunction (partial epilepsy), models of widespread networks dysfunction affecting principally gray or white matter (Alzheimer's disease and multiple sclerosis respectively). In addition, we will discuss the fact that despite the information offered by the multimodal approach, there is a need to decipher these complex changes occurring at different time and spatial scales by measuring functional connectivity dynamics.

- **Hyang Woon Lee** (Ewha Womans Univ., Korea)
  "Network dynamics explored by functional connectivity analysis in neurological disorders"

  Examination of network dynamics can provide a better understanding of pathophysiologic mechanisms underlying various neurological disorders. Recent studies have reported various measures of connectivity using functional electrophysiologic and structural brain imaging studies to better understand the properties of brain networks involving neurological disorders. I will present recent use of various

measures for functional connectivity to assess physiologic and pathologic brain networks and their application in both clinical and research fields, especially in epilepsy, REM sleep behavior disorder with or without Parkinson's disease. In particular, functional connectivity can also identify cortical regions that are organized differently in epilepsy patients either as a direct function of the disease, or comorbid conditions such as cognitive dysfunction, or even indirect compensatory responses. Functional connectivity mapping may help identify epileptogenic tissue, whether this is a single focal location or a network of seizure-generating tissues. I will review recent studies of connectivity analysis in epilepsy especially using intracranial EEG and their clinical implications for patients with intractable epilepsy.

- **Riki Matsumoto** (Kyoto Univ., Japan)
"Probing dynamics of cortico-cortial connectivity with direct cortical stimulation in physiological and pathologic states"

Functional brain connectivity in a broad sense is further divided into functional connectivity and effective connectivity. Effective connectivity refers to the causal influence between brain regions. There are two approaches to probe effective connectivity - non-interventional and interventional. Here, I introduce an interventional approach of cortico- cortical evoked potentials (CCEPs) that use perturbations to directly infer effective connectivity. Single pulse electrical stimulation is applied directly to the cortex and the evoked cortical potentials/induced high gamma activities are recorded directly from electrocorticogram (ECoG). We review its academic impact on understanding the functional brain networks, and clinical utility for functional 'system' mapping. With its excellent temporal resolution, CCEP could also assess dynamic alteration of cortico-cortical connectivity & excitability during physiological and pathologic states. I will introduce recent studies focusing on the dynamics of connectivity & excitability during epileptogenesis, tumor surgery and sleep.