Cognition, Computation, and Brain Diseases

Organizer: Jaeseung Jeong

Room: # 105

Date and Time: Thursday, October6 / 13:30-14:30

Cognitive and Computational Approaches to Understand Brain Diseases

This symposium discusses cognitive and computational approaches to understand neural circuits across the temporal to frontal lobe that generate flexible behaviors, thereby forming the neural basis of various brain diseases. Speakers provide a brief overview of progresses in applying advanced neural analysis techniques to brain data, such as an iEEG monitoring, a multivoxel pattern analysis, and a model-based fMRI analysis. These approaches provide effective tools for detecting impairment of neural circuits that may inform early diagnosis and systematic treatments for some brain diseases.

Speakers:

- **Yongseok Yo** (Hongik Univ., Korea)
  "Predictive Analytics for Temporal Lobe Epilepsy"

  This study investigates the sensitivity and specificity of predictive analytics for predicting temporal lobe epilepsy. A monitoring system is used to measure intracranial electroencephalography (iEEG) of epilepsy patients and applies a prediction model to generate an alarm upon detecting a precursor of as an epileptic seizure. The predictive method is evaluated by a cross-validation technique. The prediction results varied across patients. Predictive analytics based on the spectral feature of iEEG performs well for some patients but not all. This result highlights the need for patient-specific algorithms that can play a key role in predicting and ultimately preventing epileptic seizures.

- **Sue-Hyun Lee** (KAIST, Korea)
  "Decoding retrieved face information in humans"

  Despite the high similarity of human faces, we can easily discriminate and recognize face identity, and can retrieve how people look. Here, we asked how individual face information is represented in the visual cortex during perception and retrieval. To address this question, we performed an event-related functional magnetic resonance imaging (fMRI) experiment, comprising separate perception, learning and retrieval sessions. Using multivoxel pattern analyses, we found that anterior face-selective areas showed more discriminable patterns of response to individual faces during retrieval compared to those elicited during perception whereas those areas did not show any significant difference between perception and retrieval for individual shoe images. To determine whether the increased discrimination reflected a difference between perceived and retrieved face information and not an effect of learning, we conducted a similar fMRI experiment, comprising perception, learning, and the second perception sessions. Importantly, there was no difference in face discrimination between the first and second perception sessions in anterior face-selective areas. Taken together, these results suggest that retrieval of face information generates more discriminative neural responses for individual faces than that evoked by perception of the very same faces.

- **Sang Wan Lee** (KAIST, Korea)
  "Prefrontal cognitive controllability and mental disorders"

  The application of computational models to functional magnetic resonance imaging (model-based fMRI) has paved the way for deciphering neural codes of higher cognitive functions within the area of the prefrontal cortex, the place where multisensory information is integrated. We begin to understand that the ventrolateral prefrontal cortex serves as a meta-controller that allocates control over behavior to brain's subsystems in a way that is optimal for the agent for the given constraints. Losing this control inevitably leads to the development of abnormal behavior patterns. Here we overview the model-based fMRI approach to elucidate the role of the prefrontal cortex in meta-control, and discuss its potential implications in metal disorders, such as addiction and obsessive compulsive disorders.