CNIR SYMPOSIUM

Brain, Mind and Computation

Program Book

2022. 7. 22. (금) 9:30~17:30
성균관대학교 자연과학캠퍼스, N센터 86120호

뇌과학이미징연구단
Center for Neuroscience Imaging Research
기초과학연구원
Institute for Basic Science

CNIR SYMPOSIUM

- Brain, Mind and Computation -

When 2022. 7. 22 (금) 9:30~17:30 Where 성균관대학교 자연과학캠퍼스, N센터 86120호

시 간	내 용	연 자
09:00 - 09:30	Registration	
09:30 - 09:40	Opening ceremony	김성기 (성균관대/CNIR)
<Session1: Animal Research> 좌장 : 김형구, 유승범 (성균관대 / CNIR)		
09:40 - 10:00	Brief summary of naturalistic behavior	유승범 (성균관대/CNIR)
10:00 - 10:40	How do we process 3D information while we move around the world?	김형구 (성균관대/CNIR)
10:40 - 11:40	Neural coding during natural behavior and active vision	Cris Niell (Univ. of Oregon)
11:40 - 12:40	Lunch Time	
<Session2: Young Investigators> 좌장 : 이준열, 심원목 (성균관대 / CNIR)		
12:40 - 13:15	Behavioral and neural dynamics during naturalistic memory recall	이홍미 (Johns Hopkins Univ.)
13:15 - 13:50	A computational journey from the eye to the spinal cord	장재선 (Brown Univ.)
13:50 - 14:25	What neurobiological insights do computational models of language provide in natural speech comprehension?	최훈석 (성균관대/CNIR)
14:25 - 14:40	Break Time & Poster Presentation (2022 CNIR Summer school)	
<Session3: Human Research> 좌장 : 홍석준 (성균관대 / CNIR)		
14:40 - 15:40	World Models for High-Level Cognition	안성진 (KAIST)
15:40 - 16:20	Implications of multiple trace theory to generative models of mind	강민석 (성균관대/CNIR)
16:20 - 17:20	Understanding the neural representations of flexible behaviour	James Whittington (Univ. of Oxford)
17:20 - 17:30	Closing	

Brief summary of naturalistic behavior

Seng Bum Michael Yoo
Center for Neuroscience Research, IBS
Sungkyunkwan University

Neuroscientists have recently reemphasized the importance of naturalistic behavior for understanding the brain. Despite their significance, the definition of naturalistic behavior and research methods are rarely mentioned. In the current presentation, I will briefly review the criteria for naturalistic behavior and suggest new experimental paradigms.

How do we process 3D information while we move around the world?

HyungGoo R. Kim
Center for Neuroscience Research, IBS
Sungkyunkwan University

In the laboratory experiments studying visual processing in the brain, subjects are stationary on a chair. However, in real life, animals and humans constantly move around the world and make decisions (e.g., chasing the prey closer to the animal). While subjects move, objects in the visual scene move on the eyes depending on their depth (motion parallax). I will show a series of experiments in macaque monkeys and computational modeling demonstrating how the visual cortex computes depth and reconstructs 3D space from motion parallax information. Furthermore, I will show a neural mechanism by which the brain can detect moving objects based on the conflict between depth cues.

Neural coding during natural behavior and active vision

Cristopher Niell
University of Oregon

In the natural world, animals use vision to analyze complex scenes and enable a wide range of visually-driven behaviors, many of which require movement through the environment. However, in practice most studies of vision are performed in stationary subjects performing artificial tasks in response to simple stimuli. In order to bridge this disconnect between how vision is actually used and how it is studied in the lab, we are investigating the neural circuits mediating ethological behaviors that mice perform. We have developed two behavioral paradigms, prey capture and gap crossing, that have provided insight into behavioral strategies and neural circuits for detection of relevant stimulus features within a complex and dynamic sensory environment. We have also implemented novel experimental approaches to measure neural coding of the visual scene as animals freely move through their environment, which has revealed the impact of movement-related signals and active sampling on visual processing.

Behavioral and neural dynamics during naturalistic memory recall

Hongmi Lee
Johns Hopkins University

In this talk, I present studies examining how the human brain stores and recalls memories for naturalistic experiences. Using complex and continuous naturalistic stimuli with functional neuroimaging, I demonstrated that the structure of connections and disconnections between events shapes the neural and behavioral signatures of memory. I also discovered generalized brain activity patterns in the higher-order cortices of the brain associated with spontaneous memory transitions during narrated recall. My ongoing research program investigates how the structure of real-world memories is built and manifested through self-guided actions and thoughts such as exploratory web browsing, taking a walk around a familiar place, and mind wandering. By capturing human memory behaviors in the most natural and ecologically valid contexts, these studies offer insights for promoting better learning, mental health, and decisions in daily life.

A computational journey from the eye to the spinal cord

Jaeson Jang
Brown University

Computational approaches have provided insight into various fields in neuroscience, and several examples will be introduced in this presentation. The first half will show how functional circuits in the visual system could arise initially. During my doctoral course, we showed that the feedforward afferents could project the regular pattern in the retinal cell mosaics into the cortex and initiate the systematic structure of functional circuits in the primary visual cortex. By extending this notion, higher cognitive functions could also be spontaneously initiated by untrained circuits in deep neural networks. Next, my recent postdoctoral project regarding spinal cord injury (SCI) will be introduced. Epidural electrical stimulation (EES) of the spinal cord can assist the restoration of motor function following SCI, but it has been a challenge to optimize the parameters of EES because of the high complexity of the motor control circuits. By using high-density electrode arrays and state-of-the-art machine learning algorithms, we are developing an intelligent spinal interface that does not require an external modulation. We aim to reconnect the active tissues across the damaged area of the spinal cord by decoding the intended movement from neural signals and providing proper electrical stimulation to induce the movement.

What neurobiological insights do computational models of language provide in natural speech comprehension?

Hun Seok Choi

Center for Neuroscience Research, IBS
Sungkyunkwan University

Not only does understanding speech require identifying words in a sentence but it also involves interpreting them in the context in which each word is incrementally unfolded. This aspect of language understanding necessitates a recurrent projection over time in order to alter the way that an input word is processed depending on its preceding context. Here, we investigate the neurobiological underpinnings of predictive processing reflected in the spatiotemporal patterns of neural activity while listening to a natural sentence. For this purpose, we review a variety of computational models encapsulating the recurrent dynamics of incremental processes either implicitly or explicitly in their architectures. Our results corroborate that the bilaterally distributed fronto-temporo-parietal network is dynamically engaged in different aspects of predictive processing during incremental speech comprehension.

World Models for High-Level Cognition

Sungjin Ahn
KAIST

The world embraces various forms of structure in it. It is governed by time and three-dimension space, partial-observability, uncertainty, causality, and is also composed of modular entities like objects. The main role of the human brain is therefore often said to discover such structure and build models of the world. Lacking such ability, contemporary deep learning systems fail on various tasks requiring high-level cognition abilities such as reasoning, planning, and temporal abstraction. In this talk, I introduce recent research efforts of my research group toward this direction of discovering world structure in a self-supervised way to build world models for AI systems. These models may be seen as a foundation toward deep learning for high-level cognition, corresponding to the role of the prefrontal cortex in the human brain.

Implications of multiple trace theory to generative models of mind

Min-Suk Kang
Center for Neuroscience Research, IBS
Sungkyunkwan University

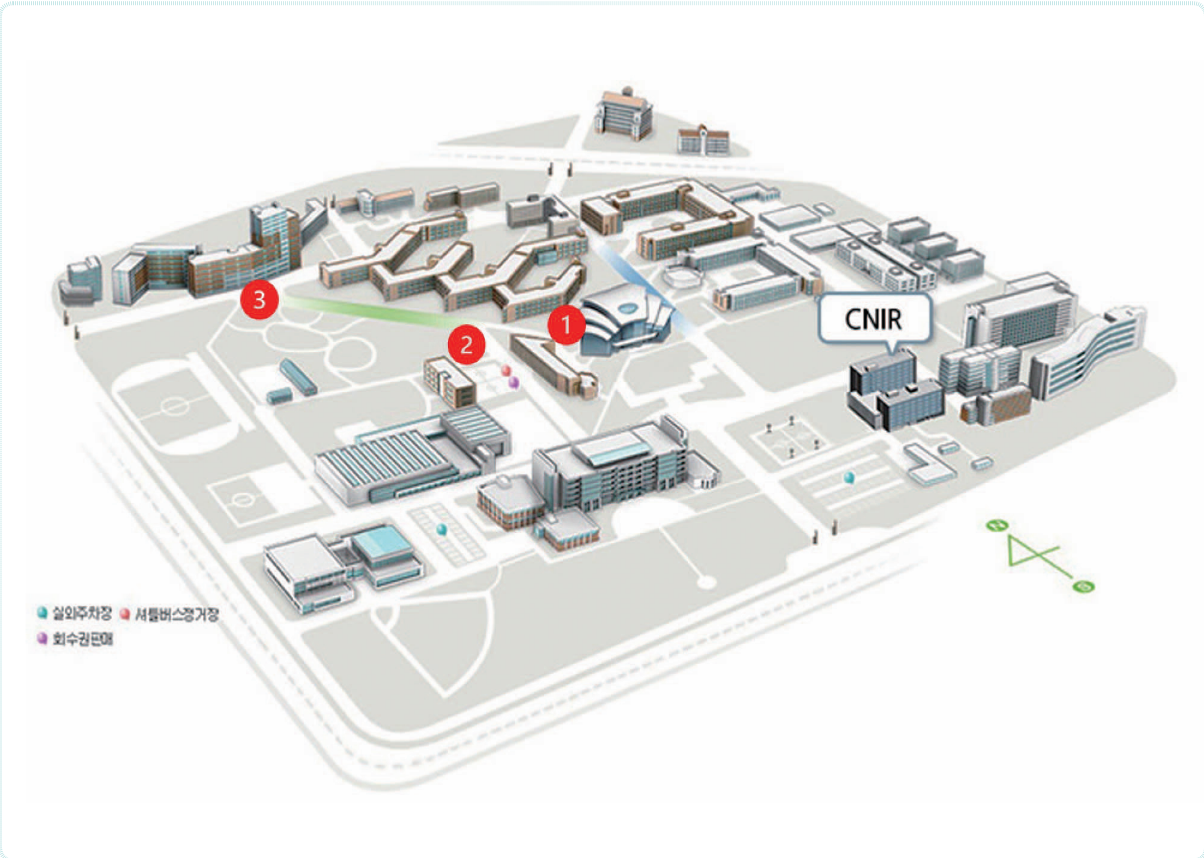
Do we have generative models in our brain? It is difficult to argue against its presence because we can imagine a scene and create a sentence from a keyword. Does then a generative model create a distribution of potential scenes and sentences by varying parameters of the model as machines do? I do not argue against this possibility but, in this talk, I share an alternative view that has been around in psychology called multiple trace theory. Multiple trace theory posits that every experience leaves its trace in memory, and a cue (e.g. keyword) retrieves associated past experiences for perception, cognition and action. This theory has been successfully explaining human category learning, skill acquisition, temporal preparation, and other types of adaptive behaviors without assuming a particular model in our mind. I will discuss key empirical studies associated with the multiple trace theory and then open a question whether we can distinguish a dumb generation based on episodes against a smart generation based on models.

Understanding the neural representations of flexible behaviour

James Whittington
University of Oxford

Animals behave flexibly, seamlessly generalising knowledge between apparently different scenarios. This is the hallmark of intelligence. To do this, representations and computations in the brain must also be flexible and generalise. In this talk, I formalise how neural representations can be learned, combined, and reused to understand any new situation. I show that models built within this formalism, when trained on spatial tasks, display diverse cellular properties of the hippocampal formation. I propose how similar principles can build an understanding of prefrontal interactions with hippocampus, afford behavioural generalisation in complex tasks, and provide insight into how prefrontal representations organise themselves.

교내식당 안내



지 도	식당/편의점	위 치
1	학생식당(행단골)	학생회관 1층
	써브웨이	학생회관 2층
2	GS편의점	복지회관 1층
	교직원식당(구시재)	복지회관 3층
3	도미노피자	기숙사 신관 1층

WIFI 안내

- WIFI : SKKU-SEMINAR
- 학술세미나 참석(Guest) 클릭
- Key: Seminar220718 (대소문자 구분)

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