

Departmental Seminar

Neural Computations Underlying Spatial Memory

2:30pm – 3:30pm | June 4, 2025 (Wednesday) Chamber, 11/F, The Jockey Club Tower | Centennial Campus | The University of Hong Kong



Dr. Zilong Ji Research Fellow Institute of Cognitive Neuroscience University College London

Abstract

Memory for events ('episodic memory') and locations ('spatial memory') is of critical importance to all species, allowing us to learn from past successes and failures to guide subsequent behaviour. The neural systems supporting both episodic and spatial memory are closely linked, with spatial memory in rodents providing a powerful model for studying the neural basis of episodic memory, as recognised by the 2014 Nobel Prize. Recent advances in neurophysiology have revealed many spatially tuned cell types within distributed brain regions involved in spatial memory — for example, place cells, head direction cells, grid cells, and border cells. While experimental data are being generated at an unprecedented pace in the current era of neuroscience, fundamental challenges persist in the study of spatial memory. First, much research remains descriptive, lacking mechanistic explanations. Second, recordings are often restricted to a limited number of brain regions and cell types. These limitations underscore the need for computational approaches to identify the biologically plausible computations that underlie observed neural dynamics and cognitive functions. In this talk, I will present my recent work on modelling the spatial memory system, focusing on brain regions including the hippocampus, entorhinal cortex, parasubiculum, and thalamus. These models explain neuronal and population-level dynamics in place, grid, and head direction cells, as previously observed empirically. They provide mechanistic interpretations of experimental findings and generate testable predictions. I will also discuss ongoing work aimed at understanding spatial memory by unifying these models into a large-scale computational framework. This framework is used to investigate the contribution of each component to spatial cognition and memory, and to examine how these functions break down in disease states such as Alzheimer's disease.

About the Speaker

Dr Zilong Ji is a research fellow at the Institute of Cognitive Neuroscience, University College London, working with Neil Burgess. He previously completed his PhD in Cognitive and Computational Neuroscience with Si Wu at Beijing Normal University. His research focuses on the neural computations underlying spatial cognition and episodic memory. His work integrates computational modelling, rodent electrophysiology, two-photon imaging, machine learning, and large-scale data analysis. He has published first-author papers in neuroscience journals such as *Current Biology, Nature Communications, eLife, Neural Networks, Hippocampus*, and *Frontiers in Computational Neuroscience*, as well as in

AI and computational neuroscience conferences including NeurIPS, ECCV, Cosyne, and CCN.

Zoom Meeting (For participants who couldn't attend the Seminar in person)

https://hku.zoom.us/j/6985555998?pwd=V05yTGJWNTlzazd2OFZ0Q3FReHVkdz09 Meeting ID: 698 555 5998 | Password: Psyc

~All are Welcome~

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