香港浸會大學
HONG KONG BAPTIST UNIVERSITY

物理系
DEPARTMENT OF PHYSICS

Chaotic Neural Dynamics Facilitate Probabilistic Computations Through Sampling

Prof. Taro Toyoizumi

Team Leader, Japan RIKEN Center for Brain Sciences

Adjunct Professor, Department of Mathematical Informatics, Graduate School of Information Science and Technology (The University of Tokyo, Japan)

Register Now

Date: July 3, 2023 (Monday)

Time: 3-4pm

Venue: OEE1017, HSH Campus

ABSTRACT

Cortical neurons exhibit highly variable responses over trials and time. Theoretical works posit that this variability arises potentially from chaotic network dynamics of recurrently connected neurons. Here we demonstrate that chaotic neural dynamics, formed through synaptic learning, allow networks to perform sensory cue integration in a sampling-based implementation. We show that the emergent chaotic dynamics provide neural substrates for generating samples not only of a static variable but also of a dynamical trajectory, where generic recurrent networks acquire these abilities with a biologically-plausible learning rule through trial and error. Furthermore, the networks generalize their experience in the stimulus-evoked samples to the inference without partial or all sensory information, which suggests a computational role of spontaneous activity as a representation of the priors as well as a tractable biological computation for marginal distributions. These findings suggest that chaotic neural dynamics may serve for the brain function as a Bayesian generative model.

BIOGRAPHY

Professor Taro Toyoizumi is a Team Leader at RIKEN Center for Brain Science. He received his B.S. in physics from Tokyo Institute of Technology in 2001. Then, he obtained his M.S. and Ph.D. in computational neuroscience from the University of Tokyo in 2003 and 2006, respectively. He stayed at the Center for Theoretical Neuroscience at Columbia University as a JSPS and Patterson Trust Postdoctoral Fellow. He came to RIKEN Brain Science Institute as a Special Postdoctoral Researcher in 2010 and was promoted to Lab Head in 2011. He took the current position in 2018. He has been studying the theory of how neural circuits self-organize and adapt to the environment. Toyoizumi received the International Neural Network Society Young Investigator Award in 2008 and the Commendation for Science and Technology by the MEXT Japan Young Scientists' Prize in 2016.

Enquiries: heidichan@hkbu.edu.hk