

Abstract for 6th Chinese Computational and Cognitive Neuroscience Conference (CCCN 2024) (July 3-5, 2024)

Fractional Neural Sampling: Exploiting Complex Spatiotemporal Dynamics for Flexible Computation

Pulin Gong

School of Physics, The University of Sydney, Australia

Email: puhin.gong@sydney.edu.au

Brain activity unfolds across diverse spatial and temporal scales, exhibiting rich and complex spatiotemporal dynamics. This talk introduces fractional neural sampling (FNS), a theory that leverages these dynamics to facilitate flexible and efficient neural computations. We will begin by demonstrating how FNS is implemented in a biophysically realistic neural circuit model, with a particular focus on the role of heterogeneous neural connectivity in generating complex dynamics. Subsequently, we will employ a mathematical model derived from fractional diffusion formalism to reveal the algorithmic nature of FNS and its computational advantages for flexibly sampling multimodal probabilistic distributions. Additionally, we will illustrate how FNS provides a unified account of a variety of brain functions, including visual perception inference, attentional sampling, and interareal communication.