Sequence learning through reverse replay and preplay in hippocampal circuit models

Tomoki Fukai
RIKEN Brain Science Institute

The circuit mechanisms of episodic memory have been extensively studied in spatial navigation task, in whichthe replay of hippocampal activity plays a pivotal role for the formation of place memory. Reverse replay occurs frequently at rewarded locations, suggesting its crucial contribution to goal-directed pathway learning. However, CA3 has symmetric spike-timing dependent plasticity (STDP). Therefore, how reverse replay selectively strengthens forward pathway to rewarded locations, but not reverse pathway leaving from these locations, remains unclear. In the first part of my talk, I show computationally that reverse replay actually enhances goal-directed spatial memory under symmetric, but not asymmetric, STDP in the co-presence of short-term synaptic plasticity.In the second part, I demonstrate in a computational modelthat spontaneous firing sequences ("preplay") enable one-shot memory of spatial experiences. Formulating canonical correlation analysis in a two-compartment neuron model, I will argue the possible role of dendritic computing in this procedure.