ORAL DEFENCE ANNOUNCEMENT

Tan Teck Liang

A Theory of How The Brain Computes

We study a network of Izhikevich neurons to explore what it means for a brain to be at the edge of chaos. We first constructed the phase diagram of a single Izhikevich excitatory neuron, and identified a small region of the parameter space where we find a large number of phases to serve as our edge of chaos. We then couple the outputs of these neurons directly to the parameters of other neurons, so that the neuron dynamics can drive transitions from one phase to another on an artificial energy landscape. We measure the statistical complexity of the parameter time series, while the network is tuned from a regular network to a random network using the Watts-Strogatz rewiring algorithm. We find that the statistical complexity of the parameter dynamics is maximized when the neuron network is most small-world-like. We also study the ability of Izhikevich neurons to synchronise and the conditions under which such synchronisation occurs. We then imploded the robust hierarchical clustering technique with sliding window analysis based on interspike-intervals (ISI) distance to find the synchronisation clusters of neurons their evolution through over time in the form of an alluvial diagram. We seek to gain insights into how a neuronal network processes information from this method.

Date: 12 March 2018
Time: 10.00 AM
Venue: Conference Room, SPMS Level 2
Research & Graduate Studies Office
Supervisor: Assoc Prof Cheong Siew Ann