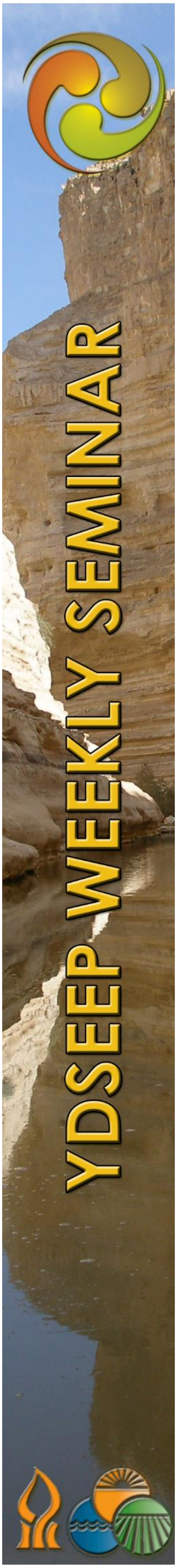

Ben-Gurion University of the Negev
Blaustein Institutes for Desert Research
The Swiss Institute for Dryland Environmental and Energy Research
Alexandre Yersin Department of Solar Energy and Environmental Physics

Title:

Emergence of oscillatory activity via spike timing dependent plasticity

Speaker:

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Abstract

Neuronal oscillatory activity has been reported in relation to a wide range of cognitive processes including the encoding of external stimuli, attention, and learning. In certain cases, changes in the oscillatory activity have been related to pathological states. Although the specific role of these oscillations has yet to be determined, it is clear that neuronal oscillations are abundant in the central nervous system. These observations raise the question of the origin of these oscillations: are the mechanisms responsible for generation of these oscillations and that allow the propagation of the oscillatory signal genetically hard-wired or can they be acquired via a learning process?

In my talk I will focus on the process termed spike timing dependent plasticity (STDP), in which the synaptic weights (interaction strength between different neurons) change according to the neuronal activity – I will describe the empirical. Our study has investigated under what conditions this unsupervised learning rule can enable the propagation of oscillatory activity downstream in the central nervous system.

Can STDP also facilitate the emergence of oscillatory activity? To this end we studied the STDP dynamics in a toy-model with simplified architecture. To analyze the system it is convenient to study the phase-diagram that depicts the possible dynamical states of the network as a function of the synaptic weights. We find that this phase diagram displays a rich repertoire of possible dynamical behaviors including regions of different fixed point solutions, bi-stability and a region in which the system exhibits oscillatory activity. STDP introduces dynamics for the synaptic weights themselves; hence, induces a flow on the phase-diagram. We derived the dynamical equations for the synaptic couplings, and studied the conditions under which the flow will converge to an oscillatory state of the neuronal network.

Date & Location:

Tuesday, October 24, 2017, 11:00
Lecture room, Physics Building (ground floor)