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המחלקה להנדסה ביורפואית
הפקולטה למדעי ההנדסה

סמינר מחלקתי (מיוחד) – הנדסה ביורפואית

יום רביעי בשעה 14:00 בניין 30 חדר 300

Special BME Seminar, Wednesday 14:00, Building 30, room 300

Information transmission and neuronal learning with dynamic synapses

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Temporal code is believed to play important roles in neuronal representation of sensory information. Neuronal learning of temporal code is thus essential for successful extraction of information encoded in spike timing. Understanding neural learning has been complicated, however, by the intrinsic stochasticity of synaptic transmission. Using a computational model of a learning neuron, the tempotron, we studied the effects of synaptic unreliability and short-term dynamics on the neuron's ability to learn spike-timing rules. Our results suggest that such a model neuron can learn to classify spike-timing patterns even with unreliable synapses, albeit with a significantly reduced success rate. We explored strategies to improve correct spike-timing classification and found that firing clustered spike bursts significantly improves learning performance. Furthermore, rapid activity-dependent modulation of synaptic unreliability, implemented using realistic models of dynamic synapses, further improved classification of different burst properties and spike-timing modalities. Neuronal models with only facilitating or only depressing inputs exhibited preference for specific types of spike-timing rules, but a mixture of facilitating and depressing synapses permitted much improved learning of multiple rules. We test applicability of these findings to real neurons by considering neuronal learning models with naturally distributed input release probabilities found in excitatory hippocampal synapses. Our results suggest that spike bursts comprise several encoding modalities that can be learned effectively with stochastic dynamic synapses, and that distributed release probabilities significantly improve learning performance. Synaptic unreliability and dynamics may thus play important roles in the neuron's ability to learn spike-timing rules during decoding.

About the Lecturer

Ziv Rotman is a postdoctoral research associate at Washington University in St Louis, school of medicine (Klyachko Lab). He obtained his PhD in Physics in Tel Aviv University in 2011.