LABORATORY OF COMPUTATIONAL NEUROSCIENCE (LCN)

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15h15, Room AAC 132

Computational Neuroscience Seminar

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Coding of weak stimuli and looming/receding stimuli with adaptation

Temporal spike patterns exhibiting interspike interval (ISI) correlations are a common feature of many neural systems, and reflect intrinsic adaptation processes. We establish that such an intracellular adaptation model can efficiently represent the spike pattern of the electroreceptor afferents of the weakly electric fish Apteronotus. This adaptation---based representation is formed by an invertible transformation of the correlated ISI sequence, thereby containing all the information of the spike pattern. This transformation is based on a sequence of independent molecular---like dynamic variables. The representation forms a statistically efficient encoding of the spike train, whereby the probability of any spike pattern can be readily computed and can be utilized for sensory decision making. We further demonstrate that a power law form of spike rate adaptation transforms an electroreceptor afferent's response to "looming" object motion, effectively parsing information about distance and approach speed into distinct measures of the firing rate. Neurons with dynamics characterized by fixed time scales are shown to confound estimates of object distance and speed. Conversely, power law adaptation modifies an electroreceptor afferent's response according to the time scales present in the stimulus, generating a rate code for looming object distance that is invariant to speed and acceleration.