LABORATORY OF COMPUTATIONAL NEUROSCIENCE (LCN)

Prof. Wulfram Gerstner
EPFL – IC & SV– LCN
SG –AAB119 (Bâtiment SG-AAB)
Station 15
CH - 1015 LAUSANNE, Switzerland

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

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13h45, Room: AAC 120

Computational Neuroscience Seminar

Eilif MULLER,

The Blue Brain Project, EPFL

Self-organized criticality emerges when synapses compete to potentiate

Spontaneous low-frequency synchronous bursting is an indicator of insufficient inhibitory control of local recurrent excitation in neural tissues or sufficiently detailed neuronal network models. Such rhythmic activity in recurrent networks poses significant problems for a broad class of STDP models commonly studied. The strong potentiation at many synapses due to bursts reinforces bursting and can trigger an upward spiral of potentiation towards non-biological extremes. To oppose this trend, we hypothesized that synapses in close spatial proximity are in competition during network bursts for resources needed to potentiate, and that this competition is sufficient to counter-balance run-away potentiation. We explored experimentally whether network bursts interfere with STDP pairing protocols. In particular, we found that pairing protocols yielding potentiation switched to depression if a burst preceded the STDP protocol by 20ms, suggesting a confirmation of the hypothesis. We developed a novel phenomenological model of resource consumption compatible with common STDP rules, which accounts for competition for resources to undergo potentiation. We show in a point neuron network that this model counter-balances run-away potentiation while leaving the STDP rule otherwise unperturbed. The resulting network states are desynchronized, and exhibit rare bursting events of highly variable amplitudes governed by a power-law distribution - a signature of self-organized criticality