LABORATORY OF COMPUTATIONAL NEUROSCIENCE (LCN)

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Thursday, February 20th, 2014
13h45, Room AAC 108

Computational Neuroscience Seminar

Mark van ROSSUM,

Institute for Adaptive and Neural Computation
University of Edinburgh

Homeostatic control of neurons: a control theory approach

Neurons are equipped with homeostatic mechanisms that counteract long-term perturbations of a neuron's average activity and are thought to maintain neurons in a healthy and information-rich operating regime. However, systematic analysis of homeostatic control has been lacking.

The analysis presented here reveals two important aspects of homeostasis. First, we consider networks of neurons with homeostasis and show that homeostatic control can destabilize activity in otherwise stable recurrent networks. This can be prevented by dramatically slowing down the homeostatic control. Next, we consider homeostatic control in which feedback is mediated via a cascade of multiple intermediate stages. Counter-intuitively, the addition of extra stages in the homeostatic control loop further destabilizes single neurons and networks. Our theoretical framework for homeostasis thus reveals previously unconsidered constraints on homeostasis in biological networks, and provides a possible explanation for the slow time-constants of homeostatic regulation observed experimentally.