LABORATORY OF COMPUTATIONAL NEUROSCIENCE (LCN)

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Thursday, December 6th, 2012
13h30, Room SG 0213

Computational Neuroscience Seminar

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Group for Neural Theory, LNC, DEC, ENS

Balanced spiking networks can implement dynamical systems with predictive coding

Neural networks can integrate sensory information and generate continuously varying outputs, even though individual neurons communicate only with spikes---all-or-none events. Here we show how this can be done efficiently if spikes communicate "prediction errors" between neurons. We focus on the implementation of linear dynamical systems and derive a spiking network model from a single optimization principle. Our model naturally accounts for two puzzling aspects of cortex. First, it provides a rationale for the tight balance and correlations between excitation and inhibition. Second, it predicts asynchronous and irregular firing as a consequence of predictive population coding, even in the limit of vanishing noise. We show that our spiking networks have error-correcting properties that make them far more accurate and robust than comparable rate models. Our approach suggests spike times do matter when considering how the brain computes, and that the reliability of cortical representations could have been strongly under-estimated.