Thursday, April 2nd, 2015
University of Zurich, Irchel Campus, Y35 F32
Swiss Computational Neuroscience Seminar

Christian MACHENS

Champalimaud Neuroscience Programme in Lisbon, Portugal

16h15 – 18h00

Distributed (or mixed) representations in the brain: from data analysis to circuit mechanisms

The brain represents information by distributing it across the activities of large populations of neurons. I will talk about two challenges that such distributed representations pose. (1) The first challenge is to precisely quantify the resulting population codes in recordings from large populations of neurons. I will focus on higher cortical areas, such as the prefrontal cortex, where neurons mix many sensory and motor variables in their responses. Using a novel dimensionality reduction technique that we developed - demixed principal component analysis (dPCA) - I will show that the population activity in various experimental designs can be decomposed into a few 'demixed' components that capture most of the variance of the data while highlighting the dynamic population tuning to various task parameters, such as stimuli, decisions, rewards, etc. (2) The second challenge is to understand how such population codes are generated on the level of neural circuitry. I will talk about progress that we have made in understanding how spiking neural networks can self-organize to distribute information across a population of neurons.

I will show that we can derive a network of integrate-and-fire-neurons, as well as the appropriate learning rules, from an objective function that seeks to construct an efficient code. The derived network has many properties observed in real systems, such as irregular firing, high trial-to-trial variability, balance of excitation and inhibition, and mixed selectivity of neurons. One consequence (and prediction) of our theory is a networks' ability to instantaneously restore its function when part of a circuit is perturbed or knocked out.

Hosted by:

Prof. Alexandre Pouget	Prof. Walter Senn	Prof. Wulfram Gerstner	Prof. Richard Hahnloser
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