G-CSC - Kolloquium

A Map Model of Primary Visual Cortex and more

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Abstract

In my talk I will first present results from a map model of primary visual cortex, where we analysed how much evidence recent single unit recordings from cat area 17 provide for a particular cortical "operating point". Using a Bayesian analysis we find, that the experimental data most strongly support a regime where the local cortical network provides dominant excitatory and inhibitory recurrent inputs (compared to the feedforward drive). Most interestingly, the data supports an operating regime which is close to the border to instability, where cortical responses are sensitive to small changes in neuronal properties.

Secondly, I will talk about new ways to quantify spike count correlations among populations of neurons. I will use copulas to construct discrete multivariate distributions that are appropriate to model dependent spike counts of several neurons. With copulas it is possible to use arbitrary marginal distributions such as Poisson or negative binomial that are better suited for modeling single neuron noise distributions than the most often applied normal approximation. Copulas place a wide range of dependence structures at the disposal and can thus be used to quantify higher order interactions. I will apply this framework to multi-tetrode data recorded from macaque prefrontal cortex, where standard noise models fail to accurately describe the measured spike-count distribution.

Finally, I will show results of a study where we investigated visual attention in humans in a probabilistic reward-based visual discrimination task. We find that behavioural performance is not optimal but consistent with a heuristic based on a moving average estimate of stimulus predictability and reward. We also found that the amplitudes of early visual, attention-related EEG signals quantitatively reflect these estimates. Thus, information about stimulus statistics and reward are already integrated by low-level attentional mechanisms.