RUHR-UNIVERSITÄT BOCHUM

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Principles of Brain Wiring

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Spike Train Correlations Induced by Anatomical Microstructure

Correlations in neuronal spike trains reflect the structure of the underlying network. Pairwise correlations are caused, for instance, by direct synaptic interaction and by shared input. The contributions of more indirect, multi-synaptic pathways, however, are also very important and can be described by accounting for the connectivity motifs that arise in recurrent networks of arbitrary topology. Higher-order correlations can be dealt with in an analogous way, and partial results will be presented on how one can manage the associated combinatorial problems. In recent work we were also able to demonstrate that the inverse problem of inferring (directed) connectivity from (undirected) pairwise correlations can be approximately solved by a method based on L1-optimization, provided that the networks are sparsely coupled but the level of sparsity is not too low. Applications of such methods to neuronal populations that are observed through mass signals (e.g. ECoG or MREG) are now pursued, using improved versions of the algorithm that exploit its specific algebraic structure.

Pernice V, Staude B, Cardanobile S, Rotter S. How Structure Determines Correlations in Neuronal Networks. *PLoS Computational Biology* 7(5): e1002059, 2011

Pernice V, Staude B, Cardanobile S, Rotter S. Recurrent interactions in spiking networks with arbitrary topology. *Physical Review E* 85: 031916, 2012

Pernice V, Rotter S. Reconstruction of sparse connectivity in neural networks from spike train covariances. Journal of Statistical Mechanics P03008, 2013

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