RUHR-UNIVERSITÄT BOCHUM

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SFB 874 Kolloquium

Prof. Friedrich Sommer

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Date: Thursday, 29.03.2012
Time: 16:00 (s.t.)
Room: GA 04/187

Host: Prof. Sen Cheng

Combining compressed sensing and representational learning: How regions in the brain can communicate without loss of information

Abstract:
Models of representational learning which optimize the efficiency and sparsity of neural representations of sensory input have succeeded in explaining characteristic properties of neural responses in early sensory pathways. First, I will describe a model for learning overcomplete sensory representations. When trained on natural images, the model not only reproduces characteristic response properties, such as orientation tuning. In addition, the diversity of response properties of different neurons in the model match data from recordings in primary visual cortex quantitatively.

Second, I will address the question how high-dimensional neural representations, such as feature representations in the visual stream, can be communicated from one brain region to the next. This communication is challenging because the population of neurons projecting from one region to another may constitute a severe wiring bottleneck. I will describe how the combination of compressed sensing and representational learning can solve this communication problem. Specifically, we assume that the feature representation in an upstream region is subsampled by the population of neurons projecting to a particular downstream region. One can then show that representational learning in the downstream region (using only subsampled signals) can form the decoding circuit for reconstructing the full feature representation in the upstream region. Interestingly, the learning principle that solves the communication problem when trained with subsampled data leads to traditional efficient coding when trained with sensory data that are critically sampled. Thus, a single learning principle can account for efficient coding and lossless communication in the brain.

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