Statistical analysis of multi-cell recordings: Linking population coding models to experimental data

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Duration: One day. Wednesday, July 22

Abstract

Modern recording techniques such as multi-electrode arrays and 2-photon imaging are capable of simultaneously monitoring the activity of large neuronal ensembles at single cell resolution. This makes it possible to study the dynamics of neural populations of considerable size, and to gain insights into their computations and functional organization. The key challenge with multi-electrode recordings is their high-dimensional nature. Understanding this kind of data requires powerful statistical techniques for capturing the structure of the neural population responses and their relation with external stimuli or behavioural observations.

The goal of this workshop is to present recent advances in the statistical modelling of neural populations, and to discuss the following central questions:

1. What classes of statistical methods are most useful for modelling population activity?
2. What are the main limitations of current approaches, and what can be done to overcome them?
3. How can statistical methods be used to empirically test existing models of (probabilistic) population coding?
4. What role can statistical methods play in formulating novel hypotheses about the principles of information processing in neural populations?

Program: (Wednesday, July 22nd)

9.00 Introduction (M. Bethge)

9.10 Jakob Macke Computational Vision and Neuroscience Group, MPI for Biological Cybernetics, Tübingen: Gaussian process models of cortical maps

09.50 Stefano Panzeri Italian Institute of Technology, Genoa: The impact of high-order correlation on the information about whisker kinetics encoded by rat barrel cortex neurons

10.30 Break

10.40 Christian Machens

11.20 Maneesh Sahani Gatsby Computational Neuroscience Unit, University College London.: Gaussian process methods for single-trial population analysis of dynamical data

13.30 Jonathan Victor Cornell Weill Medical College.: Modelling response properties of V1 neurons: The effect of higher-order correlations

14.10 Andrea Benucci Institute of Ophtalmology, University College London.: Decoding sequences of population responses in visual cortex

14.50 Break

15.10 Yasser Roudi: What can we infer about the statistics of neuronal activity in large populations from measurements on small ones?

15.50 Bruno Olshausen Helen Wills Neuroscience Institute and School of Optometry, UC Berkeley, and Redwood Center for Theoretical Neuroscience: How do populations in V1 respond to natural scenes? Liam

16.30 Panel Discussion

Bibliography

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- Mark M Churchland, Byron M Yu, Maneesh Sahani, Krishna V Shenoy "Techniques for extracting single-trial activity patterns from large-scale neural recordings," *Current Opinion in Neurobiology* 17, no. 5 (10/2007)
- Jonathan W. Pillow, Jonathon Shlens, Liam Paninski, Alexander Sher, Alan M Litke, EJ Chichilnisky, Eeero P Simoncelli, "Spatio-temporal correlations and visual signalling in a complete neuronal population," *Nature* no. 454, (7/2008)
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