

# Detecting Correlations between Non-stationary Brain Signals

R. Fdez. Galán<sup>1</sup>, R. Ritz<sup>1</sup>, P. Szyszka<sup>2</sup>, A. V. M. Herz<sup>1</sup>

<sup>1</sup>Innovationskolleg Theoretische Biologie, Humboldt–Universität zu Berlin  
Invalidenstr. 43, D-10115 Berlin, Germany

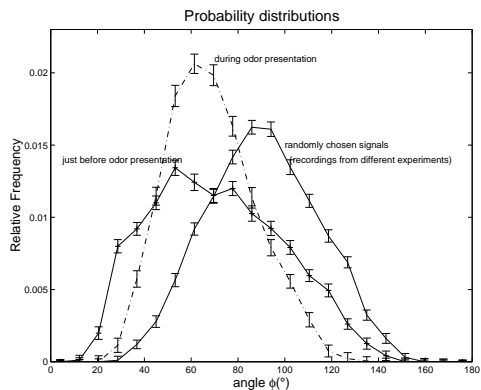
<sup>2</sup>Institut für Neurobiologie, Freie Universität Berlin  
Königin-Luise-Str. 28/30, D-10117 Berlin, Germany

A new approach is proposed to detect instantaneous correlations between neural activity in different parts of the brain measured with multi-site extracellular recordings. With this method one can also study how the coupling between different areas changes while the animal is performing certain tasks. The procedure presented here is based on analytical techniques from System Dynamics, Statistics and Information Theory. Our method can be used as a general tool for the analysis of multivariate (non)stationary data.

We illustrate this method by investigating the coupling between two symmetric main neural centers –the mushroom bodies– of the honeybee brain. We show that these areas present correlated activity, which is significantly increased during odor processing. The time scale in which the coupling is mostly detected is bounded between 100 and 150 ms.

From multi-site recordings our method yields one distribution of a variable called "angle" for each experimental situation. The angle, and more exactly, its distribution is closely related to the correlation between signals. In the figure below we present the results for our study of the correlated activity in both mushroom bodies of the bee brain.

The figure shows three distributions corresponding to ongoing activity, odor presentation to the bee and a third case in which the recordings were taken from different bees on different days. We may, therefore, intuitively define the coupling as the degree of dissimilarity between this distribution and a given one. We use the symmetrized Kullback-Leibler-Information to uniquely quantify such dissimilarity between distributions. Our calculations show that the coupling increases significantly during odor-processing and that it is mostly detectable on a time scale of 100 to 150 ms.



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