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## Transition between spike patterns induced by spike sorting errors in multi-unit recordings

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Multiple, extracellular electrode recordings offer the chance to detect assembly activities, and to identify the network composition and functions. In order to extract the single unit spiking activities spike sorting is performed. This is a crucial step of data pre-processing in preparation for further analyses. However, due to noise and variability the improvement of spike sorting techniques is still open field of research. Indeed, spike sorting is subject to errors [1], whose consequences on subsequent analyses are poorly understood. Here we present work on the impact of imperfect sorting for different analysis methods, such as Unitary Event analysis [2,3] and cross-correlation function.

We modeled the effect of spike sorting errors by "polluting" parallel spike trains with typical failures: falsely assigned (false positive, FP) and erroneously missed (false negative, FN) spikes. In a former study we concentrated on pairs of simultaneous spike trains [4] and found that the significance of the correlation is reduced for both FNs and FPs. Furthermore, FNs have a stronger effect. Tolerant sorting strategies seem thus preferable. Interestingly, inserted FPs do not introduce false positive correlation [4].

For more simultaneous processes, considerations on higher-order correlations come into play. We study a system of  $N$  parallel processes by use of the following model: 1) in a subset of  $\omega$  out of the  $N$  neurons we inserted exactly coincident spikes (patterns of order  $\omega$ ) according

to a Poisson process; 2) the remaining  $N - \omega$  processes are statistically independent; 3) all processes follow a Poisson distribution of identical firing rates. The complexity  $\xi$ , the number of spikes within a bin, of the measured coincidences, typically differs from the order  $\omega$  of the underlying correlation patterns. Based on this model, we provide an analytical description of the effects of spike sorting errors on correlation analysis. Our results show that for direct cases, i.e.  $\omega = \xi$ , both kind of errors lead to an underestimation of the significance of synchronization – as found for the case of pairs of spike trains. For cross-cases, i.e.  $\omega \neq \xi$ , inserted patterns of a given order may even lead to an increase of significance of coincidence patterns of lower ( $\xi < \omega$ ) complexity, due to FNs destroying higher order patterns.

Thus, understanding the effects of data pre-processing procedures on subsequent data analysis is an important step to rule out inconsistencies in the interpretation of results.

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### References

1. Harris K, Henze D, Csicsvari J, Hirase H, Buzsáki G: **Accuracy of tetrode spike separation as determined by simultaneous intracellular and extracellular measurements.** *J Neurophysiol* 2000, **84**:401-414.

2. Grün S, Diesmann M, Aertsen A: **Unitary events in multiple single-neuron spiking activity: I. Detection and significance.** *Neural Comput* 2002, **14**:43-80.
3. Grün S, Diesmann M, Aertsen A: **Unitary events in multiple single-neuron spiking activity: II. Nonstationary data.** *Neural Comput* 2002, **14**:81-119.
4. Pazienti A, Grün S: **Robustness of the significance of spike synchrony with respect to sorting errors.** *J Comput Neurosci* 2006, **21**:329-342.

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