ANALYSIS OF SPIKE SYNCHRONIZATION IN MASSIVELY PARALLEL SPIKE TRAINS. SPADE: SYNCHRONOUS PATTERN DETECTION AND EVALUATION

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ABSTRACT. The cerebral cortex is organized into a network of highly interconnected neurons. Hebb (1949) suggested that such neurons organize in assemblies of co-activated cells that act as basic information processing units . In this framework, a signature of assembly activity would be patterns of synchronous action potential of assembly member neurons. Modern experimental technologies allow to record from as many as 100 or more single neurons simultaneously (Buzsaki, 2004; Riehle et al, 2013), raising considerably the chances to observe such concerted activity. However, detecting synchronous spike patterns from such large data and assessing their statistical significance is not straightforward. Counting the occurrences of all individual spike patterns is computationally prohibitive, while the assessment of their statistical significance poses a severe multiple testing problem. To address these two issues, we recently proposed an analysis method called SPADE (synchronous pattern detection and evaluation; see Torre et al, 2013). SPADE is based on three steps: i) frequent item set mining, which efficiently collects synchronous spike patterns and their occurrence counts in massively parallel spike trains while avoiding redundant search (Picado-Muiño et al., 2013), ii) pattern spectrum filtering, to assess via surrogate data (Louis et al, 2010) the significance of patterns based on their size and occurrence counts, and iii) pattern set reduction, to perform pairwise conditional tests and remove false positive patterns. In this talk, I will present the SPADE analysis which is used in the companion talk to investigate spike synchronization in electrophysiological data.

References

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