Neurons multiplex assembly membership during motor behavior

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The cell assembly hypothesis postulates that groups of neurons are formed by their coordinated spiking activity and that sequences of such active groups form the basis of information processing. Here, we test this hypothesis by evaluating parallel spiking activity recorded during a reach-to-grasp experiment for the presence of significant ms-precise spatio-temporal spike patterns (STPs). For this purpose, parallel spike trains were analyzed for STPs by the SPADE method [1], which detects and counts patterns and evaluates them for their significance occuring above chance level by surrogate data [2]. As a result we find STPs in 19/20 data sets from two monkeys, but only a small fraction of the recorded neurons in a data set of 15 min are involved in STPs (about 5-10%). To account for the different behavioral states during the task, we analyzed the data in a quasi time-resolved analysis, by dividing the data into different, behaviorally relevant epochs. During a particular behavioral epoch, typically one particular STP occured, which was highly specific - in terms of neurons involved and temporal lags between the spikes of the STP. Furthermore we find, that the STPs often share individual neurons, such that a neuron participates in different epochs of the task in different STPs. Since we interprete the occurrence of a particular STP as a signature of a particular active cell assembly, we consider the neurons to multiplex assemblies over time. In a related study, we model these findings by a network with embedded synfire chains [3].

References

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