Paired spiking is an ubiquitous response property in network activity

Abstract:
In paired spiking (PS), a neuron generates two action potentials within a time window of 2-5 milliseconds followed by a refractory period of several hundred milliseconds. Regardless of the neuroscientific context, whether in cultured neural networks or in intact brain architectures, in spontaneous activity or in response to stimuli, PS has been found in any type of spike trains. Recent evidence shows that PS forms spatiotemporal patterns and participates in establishing functional and effective connectivity in networks of cultured neurons of different types [1]. Another prominent example is PS participation in neural communication at the retinogeniculate synapse in vivo [2]. However, little is known on the richness and robustness of its function and its coding mechanisms at both single cell and network level. Here, we show that PS activity forms robust activity patterns with most frequently occurring inter-paired spike intervals (mfoIPSIs) of 1 ms. Its shape within the recorded spike trains of retinal ganglion cells (RGCs) is furthermore preserved between local sites and at network level under different stimuli conditions. Furthermore, PS carry information on the stimulus that was applied to the receptive field of the recorded RGCs. However, the information density differs for different cell types. This suggests that PS may change its contribution to information transmission relative to the type of the recorded cell according to its morphological, physiological and structure-function classification.

Stichworte:
Mutual Information; Paired Spiking Activity; Cultured Neurons; Multielectrode Array

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