Abstract View

MODULATION OF THE FREQUENCY PREFERENCE AND ATTRACTOR STRUCTURE OF PREFRONTAL CORTICAL NEURONS

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Neurons in vitro respond to repetitive injection of the same fluctuating input current with reproducible patterns of precisely timed action potentials. These spike patterns, called attractors, are robust against slow drifts in neuronal response properties that occur during experiments, the effects of intrinsic membrane noise, and small changes in the input. Larger variations in the input lead to new spike patterns that may have different number of spikes (spike insertions or deletions) and different spike times.

We introduce a spike timing reliability measure based on pair-wise correlations between trials, and a clustering method for identifying stationary attractors. We compare this approach to classical histogram-based reliability measures, and we assess its robustness to missing spikes, spontaneous spikes and spike time jitter. Using a conductance-based model, we show that several intrinsic membrane currents modulate the frequency preference of model cells, as measured by their reliability in response to sinusoidal current injection. We confirm the modeling experiments by artificially introducing membrane conductances in vitro layer 5 prefrontal cells using the dynamic clamp technique. The slow potassium current K_slow is especially effective in modulating the frequency preference of pyramidal cells within a range of 5-50 Hz and in inducing transitions between attractors. We discuss the consequences of these findings for rhythmogenesis and its neuromodulation.
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