Abstract View

DYNAMIC CLAMP OF CORTICAL NEURONS IN VITRO SIMULATES IN VIVO ACTIVITY PATTERNS.

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Intracellular recordings from neocortical neurons during active states in vivo have depolarized membrane potentials (Vm), highly fluctuating background activity and a high variability of spontaneous discharge. To investigate to what extent background activity can account for these properties, we used a dynamic clamp with in vitro recordings and computational models to recreate the activity pattern seen in cortical neurons in vivo. The biophysical characteristics of synaptic background activity were represented by a point-conductance model using two stochastic variables. This model produced a "fluctuating conductance" with the same spectral characteristics as the activity resulting from thousands of excitatory and inhibitory synapses releasing randomly in a correlated manner. The output conductance from this single compartment model was injected in pyramidal cells and interneurons in rat prefrontal cortical slices. The neurons produced the characteristics typical of neurons intracellularly recorded in vivo: a reduced input resistance, a depolarized Vm (around -60 mV), large-amplitude Vm fluctuations and a high variability of spontaneous firing (CV around unity). We study the variation of these quantities when the amount of synchrony and the relative balance between inhibition and excitation were manipulated in the model. These combinations of experiments and models suggest that the electrophysiological characteristics of neocortical neurons in vivo can be recreated in vitro by using a point-conductance representation of synaptic background activity.
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