

Abstract View

RELIABILITY OF MODEL V1 CELL RESPONSES TO NATURAL THALAMIC STIMULUS INPUTS

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We previously showed that combinations of correlated firing, bursting, and spatial grouping of synapses are candidate mechanisms for explaining the reliability of spike timing in cat V1 neurons despite the presence of large amounts of noise from background synaptic inputs, the highly stochastic nature of synaptic release, and the fact that only about one tenth of the synapses in a layer 4 smooth stellate cell come directly from LGN. Here, we enhanced the original model to include active channels in the dendritic tree of the reconstructed cat V1 stellate neuron, and tested it with natural thalamic stimulus inputs recorded from in vivo experiments. These inputs activated inhibitory and probabilistic excitatory synapses, some of which had short-term use-dependent facilitation and depression. We corroborated the previous finding that reliable firing patterns could be obtained by conditioning pre-synaptic LGN inputs with either low levels of temporal correlation or with the addition of bursts. However, the effect of spatial grouping on synaptic spike time reliability was greatly dependent on the distribution and characteristics of dendritic active channels. These results place morphological and physiological constraints on information flow from the LGN to V1 and highlight interactions between spatial distribution, timing of excitatory and inhibitory inputs, and the effects of active channels.

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