Abstract View

IRREGULAR FIRING OF CORTICAL INTERNEURONS.

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Cortical GABAergic interneurons, in contrast to pyramidal neurons, fire highly irregular spike trains in vitro in response to constant current injection. The coefficient of variation (CV) of the inter-spike intervals (ISIs) of these spike trains is >1, comparable to the CVISI of spike trains recorded in vivo. We investigated whether the temporal structure of these spike trains is caused by a random process or a low-dimensional deterministic process. Linear and non-linear time series analysis of the data uncovered no evidence for deterministic chaos. The same methods applied to spike trains generated by the Hindemarsh and Rose model of neural excitability detected deterministic temporal structure. We examined the irregular firing using numerical simulations (in NEURON) to uncover the mechanisms underlying the observed stochastic firing. In simulations, a decrease of the time constant of the potassium current responsible for the after-hyperpolarization from ¡Ö100 msec to ¡Ö 6 msec shifted the firing behavior from those observed in pyramidal neurons to those in interneurons. Analysis showed how this transition arises from an increased selection of only high slope and high amplitude upward voltage fluctuations. The differences in the spiking characteristics between the two main classes of cortical neurons in vitro has implications for the temporal structure of spike trains recorded in vivo.

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