INTERSPIKE INTERVAL STATISTICS IN THE ORNSTEIN-UHLENBECK NEURONAL MODEL WITH THE SIGNAL-DEPENDENT NOISE

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For a constant signal or under the steady-state conditions, characterization of the input-output properties of neurons, as well as of the neuronal models, is commonly done via so called frequency (input-output) transfer functions - the output frequency of firing is plotted against the level of the input signal. By constructing the transfer functions, it is implicitly presumed, that the information in the neuron is coded by the frequency of the action potentials. For the experimental data the firing frequency is quantified as a number of spikes per a predefined time window and this quantity corresponds to an inverse of average ISI'. Using the stochastic models, the firing frequency is calculated as the inverse of the mean ISI' From these facts we can see the importance of the mean ISI and in quantifying its variability also of higher order moments, namely of its variance.

The Ornstein-Uhlenbeck (OU) neuronal model of membrane depolarization is investigated in this contribution. This model is based on the leaky-integrate-and-fire principle but lacks direct interpretation of its parameters in neurophysiological terms when compared with its discontinuous counterpart (Stein, 1965). For this reason when the OU model was investigated, the amplitude of the noise and the signal were considered as independent quantities (Ricciardi and Sacerdote, 1979). Now, behavior of the mean ISI, its variance and the coefficient of variation are studied under the condition that the noise amplitude depends on the signal, which appears to be an important condition (Cecchi et al., 2000). It is shown that specific types of such a dependency implies unexpected behavior of the studied moments of ISIs. The results extend our recent work in this direction (Lánský and Sacerdote, 2001).

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