The response of a neural system to periodic synaptic input is analyzed using the new integrated-input technique, in which the randomly arriving synaptic inputs are summed and an action potential is generated when the postsynaptic potential reaches threshold (i.e., integrate-and-fire neurons). The results provide a quantitative understanding of the decrease of the synchronization index with increasing frequency of acoustical stimulation in the auditory pathway. The conditions under which the observed enhancement of synchronization in globular bushy cells of the cochlear nucleus may occur are elucidated. The dependence of the synchronization index upon the frequency of stimulation is analyzed for a range of neurophysiological parameters, including the number of afferent fibres, the membrane time constant, the amplitude of the individual postsynaptic potentials, timing jitter in the axonal propagation of spikes, and the time course of the postsynaptic response. The inclusion of an absolute refractory period to the model is found to have little effect upon the period histogram. The interspike interval histogram and the period histogram for the neural response to ongoing periodic inputs are evaluated using the stationary solution to the phase transition matrix, which relates the phase at which the output spike is generated to the initial phase of the inputs. Spontaneous activity is included in the model, and the possible role of stochastic resonance in threshold detection is addressed.
Minerva Access is the Institutional Repository of The University of Melbourne

Author/s:
Burkitt, A. N.; Clark, Graeme M.

Title:
The dependence of synchronization upon stimulus frequency for integrate and fire neurons [Abstract]

Date:
1999

Citation:

Persistent Link:
http://hdl.handle.net/11343/27036

File Description:
The dependence of synchronization upon stimulus frequency for integrate and fire neurons [Abstract]