双层Hodgkin-Huxley神经元网络中的随机共振

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通过信噪比的评价方式，用单个Hodgkin-Huxley神经元模型以及其所构建的双层神经元网络，来模拟生物感觉系统中检测微弱信号的随机共振现象。结果表明：单个神经元在阈值下存在噪声优化检测性能的随机共振现象，但是最优的噪声强度却随外部信号性质的改变而变化；双层神经元网络不但可以在固定的噪声强度上对一定幅度范围内的阈下信号进行优化检测，而且噪声的存在并没有降低网络对阈上信号的检测能力。

Stochastic resonance in a double layer Hodgkin-Huxley neuronal network

Stochastic resonance is a phenomenon, where a weak periodic signal is enhanced at a nonzero level of noise. Hodgkin-Huxley neuronal model was adopted for constructing a double layer neuronal network in this paper for studying the mechanism of weak signal detection in the biological neural system. The structure of this network is similar to biological sensory systems. Stochastic resonance in a single neuron was characterized with signal to noise ratio for showing the positive role of noise in subthreshold signal detection. But the optimal level of noise for stochastic resonance varies as the nature of the external signal changes. Furthermore, the double layer neuronal network was investigated and displayed the characteristics of stochastic resonance. Results indicate that the network has the ability of detecting the subthreshold signal varying in a range of amplitude at a fixed noise level and the noise does not degrade the ability of the network to detect suprathreshold signals. This can be the interpretation that the biological sensory systems can detect various stimuli in a relatively unchanged noisy environment.

关键词

随机共振(stochastic resonance)；Hodgkin-Huxley网络(Hodgkin-Huxley network)；信噪比(signal to noise ratio)