The Spontaneous Spiking in Up and Down Oscillations and Its Energy Feature

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Abstract Up and down oscillations of membrane potentials are viewed as one kind of significant spontaneous periodic activities. This kind of oscillation always shows that membrane potentials make spontaneous transitions between two preferred states called up and down states, which characterized by some features as follows in level of membrane potentials: bistability, directivity, spontaneity, synchronicity and spontaneous spikings. Here, we focus on the spontaneous spiking and its energy feature. We studied the influence of the intrinsic characteristics and synaptic transmission of spontaneous spiking during up and down activities. The simulated results showed that persistent sodium current was critical to spontaneous fluctuation without any stimulus, while the fast sodium current had the dominant position in generation of spontaneous neural firing. Considering the noise, we found the role of persistent sodium current was partially replaced by oscillation of noise. And energy consumption of neurons in spontaneous activities also shows bistable feature and bimodal distribution as same as the membrane potential, which indicated that the energy consumption can encode up and down states in this kind of activities.

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