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Effect of Inhibitory Firing Pattern on Coherence Resonance in Random Neural Networks

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Abstract: The effect of inhibitory firing patterns on coherence resonance (CR) in random neuronal network is systematically studied. Spiking and bursting are two main types of firing pattern considered in this work. Numerical results show that, irrespective of the inhibitory firing patterns, the regularity of network is maximized by an optimal intensity of external noise, indicating the occurrence of coherence resonance. Moreover, the firing pattern of inhibitory neuron indeed has a significant influence on coherence resonance, but the efficacy is determined by network property. In the network with strong coupling strength but weak inhibition, bursting neurons largely increase the amplitude of resonance, while they can decrease the noise intensity that induced coherence resonance within the neural system of strong inhibition. Different temporal windows of inhibition induced by different inhibitory neurons may account for the above observations. The network structure also plays a constructive role in the coherence resonance. There exists an optimal network topology to maximize the regularity of the neural systems.

Key Words: Coherence resonance; firing pattern; neuronal network; noise