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F-34

Stochastic Spiking Coherence in An Inhibitory Population of Subthreshold Neurons

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We study coherent population dynamics in an inhibitory ensemble of subthreshold neurons. Particularly, stochastic spiking coherence (i.e., collective coherence between noise-induced irregular neural spikings) is investigated. In a range of noise intensity D, "stripes" (indicating collective coherence) are found to be formed in the raster plot of spikings. However, these stripes are partially occupied, in contrast to the full occupation for the case of excitatory coupling. Each excitatory neuron fires spikes phase-locked to the global ensemble-averaged potential V_G at every cycle of V_G. On the other hand, inhibitory neurons exhibit intermittent spikings phase-locked to V_G at random multiples of the period of V_G. Due to this "random spike skipping," partial occupation occurs. To characterize this collective coherence, we introduce a new type of spiking coherence measure M_s, based on the stripes in the raster plot. We note that the degree of spiking coherence depends on both the stripe density and the stripe smearing. Hence, the measure, M_s, is given by the product of the average fraction of firing neurons (representing the average density of stripes) and the average pacing degree of spikings (denoting the average smearing of stripes) per each stripe. In terms of M_s, we characterize the stochastic spiking coherence in coupled subthreshold neurons by varying D. Such spiking coherence measure M_s is found to reflect the degree of collective coherence seen in the raster plot well.