Statistics of irregular bursting

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We study dynamical mechanisms and statistical properties of irregular bursting oscillations arising in a class of neuronal models of Hodgkin-Huxley type with and without noise. Specifically, we consider a phenomenological model of a square-wave bursting neuron in the regime close to the transition from tonic spiking to bursting. We identify two distinct mechanisms for irregular bursting oscillations. The first mechanism is based on chaotic spiking dynamics arising near the transition to bursting, while bursting oscillations generated by the second mechanism are induced by small random perturbations. For each case, we present a (randomly perturbed) Poincare map and analyze statistical properties of the trajectories of the discrete system. Our mathematical analysis suggests that the number of spikes within one burst are distributed geometrically in each case. However, the parameters of the geometric distributions are determined by different factors depending on the underlying dynamical mechanism.

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References
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