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Noise-sensitivity in bursting: new approaches for quantitative analysis

The phenomenon of bursting, composed of alternating periods of active spiking and near quiescence, is observed in a variety of biological applications including neural and cellular dynamics. It has a complex sensitivity to noise which exhibits dynamical features from both the underlying deterministic behavior and the stochastic elements. We use a combined approach of approximating both the time dependent probability density and the stochastic multi-scale dynamics in order to understand contributions from both the deterministic and stochastic features. This approach leads to simplified approximate models which can be analyzed or simulated efficiently, providing quantitative measures of the noise sensitivity. To illustrate the new approaches, we focus on a model of bursting in dendritic spines. Generalizations to other applications with similar dynamics will also be discussed.