NOISE-INDUCED BURSTING IN THE SPIKING ZONE OF THE HINDMARSH-ROSE MODEL

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We study the effect of random disturbances on the three-dimensional Hindmarsh-Rose model [1] of neural activity.

Due to the strong nonlinearity, even the original deterministic system displays a wide range of complex dynamic regimes, such as periodic oscillations of various types (spiking and bursting), oscillations zones with period doubling and adding, coexistence of several attractors, chaotic regimes.

Random perturbations can considerably affect the behavior of dynamical systems. Neuronal models are very sensitive to noise, and even small stochastic fluctuations can lead to significant qualitative changes in properties of such systems.

We consider the effect of random disturbances on the Hindmarsh-Rose model in a parametric zone, where the attractor of the system is a limit cycle of spiking type. We show that under the noise, the type of oscillations can change to bursting. The details of probabilistic distribution of random trajectories as well as the interspike intervals histograms are studied. For a quantitative analysis of this phenomenon, we suggest a constructive approach based on the stochastic sensitivity function technique [2].

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References.

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