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Coherent oscillations in ensembles of discrete two-state excitable units with global delay coupling

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A two-state excitable unit is considered as an abstract modification for an ion chanel of a neuron. Each state is characterized by a different waiting time density function. This approach allows for a renewal process description of the system dynamics. Exact formulas for the interspike interval distribution and spectral power density are found. At the limit of an infinity ensemble of globally coupled units the mean-field equations for the populations of the two states are derived. Depending on the coupling strength and on the noise intensity the ensemble undergoes saddle-node bifurcations and demonstrates bistability, while a pitchfork bifurcation emerges on a critical point. The ensemble undergoes Hopf bifurcations and coherent oscillations emerge, in the onset of firing events, only in the case that global coupling affect the system with a certain time delay. The stochastic simulations of large ensembles in both cases are in good agreement with the analytical approach.

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[1] T. Prager, B. Naundorf and L. Schimansky-Geier, Physica A 325 (2003) 176.

[2] L. S. Tsimring and A. Pikovski, *Phys. Rev. Lett.*, 87 (2001) 250602.