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Suppression of chaotic bursting synchronization in clustered scale-free networks by an external feedback signal

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ABSTRACT

Oscillatory activities in the brain, detected by electroencephalograms, have identified synchronization patterns. These synchronized activities in neurons are related to cognitive processes. Additionally, experimental research studies on neuronal rhythms have shown synchronous oscillations in brain disorders. Mathematical modeling of networks has been used to mimic these neuronal synchronizations. Actually, networks with scale-free properties were identified in some regions of the cortex. In this work, to investigate these brain synchronizations, we focus on neuronal synchronization in a network with coupled scale-free networks. The networks are connected according to a topological organization in the structural cortical regions of the human brain. The neuronal dynamic is given by the Rulkov model, which is a two-dimensional iterated map. The Rulkov neuron can generate quiescence, tonic spiking, and bursting. Depending on the parameters, we identify synchronous behavior among the neurons in the clustered networks. In this work, we aim to suppress the neuronal burst synchronization by the application of an external perturbation as a function of the mean-field of membrane potential. We found that the method we used to suppress synchronization presents better results when compared to the time-delayed feedback method when applied to the same model of the neuronal network.

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