

Synchronization of complex interaction networks of reaction-diffusion systems. Application in neuroscience

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Abstract: Neuroscience consists of the study of the nervous system and especially the brain. The neuron is an electrically excitable cell processing and transmitting information by electrical and chemical signaling, the latter via synapses, specialized connections with other cells. A.L. Hodgkin and A. Huxley proposed the first neuron model to explain the ionic mechanisms underlying the initiation and propagation of action potentials in the squid giant axon. Here, we are interested in the asymptotic behavior of complex networks of reaction-diffusion (PDE) systems of such neuron models. We show the existence of the global attractor and the identical synchronization for the network. We determine analytically, for a given network topology, the onset of such a synchronization. We then present numerical simulations and heuristic laws giving the minimum coupling strength necessary to obtain the synchronization, with respect to the number of nodes and the network topology.

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