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Phase synchronization of connected neurons under the effect of Poissonian inputs

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Resumo:

This project investigates the emergence of phase synchronization in a network of randomly connected neurons by chemical synapses. The study uses the classic Hodgkin-Huxley model to simulate the neuronal dynamics under the action of a train of Poissonian spikes. In such a scenario, we observed the emergence of irregular spikes for a specific range of conductances, and also that the phase synchronization of the neurons is reached when the external current is strong enough to induce spiking activity but without overcoming the coupling current. Conversely, if the external current assumes very high values, then an opposite effect is observed, i.e. the prevention of the network synchronization. We explain such behaviors considering different mechanisms involved in the system, such as incoherence, minimization of currents, and stochastic effects from the Poissonian spikes. Furthermore, we present some numerical simulations where the stimulation of only a fraction of neurons, for instance, can induce phase synchronization in the non-stimulated fraction of the network, besides cases in which for larger coupling values it is possible to propagate the spiking activity in the network when considering stimulation over only one neuron.