Stochastic modeling of the effect of noise on the transfer of information between neurons

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The nervous system acts by processing and integrating information about the external and internal environment of the animals and using this information to generate behaviors that help the animal to reach its objectives and supply its needs. The functioning of the nervous system requires constant transmission of information between neurons, the main cells (computational units) of the nervous system. The two main neurotransmitters used in the brain are glutamate, which "excites" neurons, stimulating the generation of action potentials, and gamma-aminobutyric acid (GABA), which "inhibits" neurons, which hampers the generation of an action potential. In this work, we developed a stochastic cellular automata, in a square lattice, with probabilistic SIRS-like model rules, with states representing rest, activation and refretariness, in addition to the action of the sites that may inhibit the activation of neurons neighbors. Through numerical simulations we investigated issues related to oscillation and synchronization of signals transmitted between neurons. The oscillations were analyzed by autocorrelation and Fourier transform functions. And we construct a complete phase diagram indicating that the transmission of information is susceptible to variations in the balance between excitation and inhibition of neurons and disturbances at the optimal point of this equilibrium can corrupt the information being passed from one neuron to another due to the addition of noise to the signal transmitted.

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