

Oberseminar Mathematische Stochastik

Mittwoch, 14. Januar 2015, 17:00 Uhr, M 2

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Propagation of chaos for a (simple) system of interacting neurons

Abstract:

We consider a system of N neurons which are described by their membrane potentials. Each neuron spikes (i.e. emits an action potential) randomly with rate depending on its membrane potential. At its spiking time, the spiking neuron is reset to an equilibrium potential 0 , and simultaneously, the other neurons receive an additional amount of potential $1/N$. Additionally, a deterministic drift attracts the values of all neuronal potential to the average value of the system. We show that, as the size of the system tends to infinity, the distribution of membrane potentials becomes deterministic and is described by a limit density which obeys a non-linear PDE which is a conservation law hyperbolic type.

Finally we propose a probabilistic study of the limit process. We show that it admits two invariant probability distributions and that the trivial one is not attractive. Moreover, we prove convergence in total variation in some cases.

(Joint work with Anna De Masi, Nicolas Fournier, Antonio Galves and Errico Presutti)