Nonlinear Fokker-Planck models in neuroscience: analysis and numerics

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Abstract. In this talk we analyse Fokker-Planck models, which describe the behavior of neuronal networks. Specifically, we study the Nonlinear Noisy Leaky Integrate and Fire (NNLIF) model for neurons networks. We show blow-up in finite time for fully excitatory neurons and extend this result to the case when neurons, after firing, enter a refractory state for a given period of time. We also show that spontaneous activity may occur when, additionally, randomness is included on the firing potential V_F. NNLIF describes the neuronal membrane potential considering as variable only the voltage, we will also discuss some extensions to models with conductance variables. (This talk is based on works in collaboration with J. A. Carrillo, B. Perthame and L. Tao [1, 2, 3]).

References

[1] Cáceres, M. J. and Carrillo, J. A. and Perthame, B. Analysis of nonlinear noisy integrate & fire neuron models: blow-up and steady states. *Journal of Mathematical Neuroscience* (2011), 1-7.

[2] Cáceres, M. J. and Carrillo, J. A. and Tao, L. A numerical solver for a nonlinear Fokker-Planck equation representation of neuronal network dynamics. *J. Comp. Phys.* **230** (2011), 1084–1099.

[3] Cáceres, M. J. and Perthame, B. Beyond blow-up in excitatory nonlinear noisy integrate & fire model; refractory period and spontaneous activity. In preparation.