NENS Report

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My training stay at the Laboratory of Computational Neuroscience (LCN) at the *École polytechnique fédérale de Lausanne* (EPFL) headed by Wulfram Gerstner was a very interesting learning experience. I had the pleasure to work with some of the biggest experts in the field of computational neuroscience and learn from them.

During my stay I explored the capabilities of a phenomenological model of inhibitory spike-time dependent synaptic plasticity rule (iSTDP) [2] on the behaviour of recurrently connected networks of spiking neuron models. To this end I had to learn how to efficiently simulate large scale networks (up to 10000 integrate-and-fire neurons) and perform analyses of their spike trains. I used the NEST simulator [1] as a tool to achieve that. The advantage of NEST is its performance which comes at the cost of flexibility. Because of this lack of flexibility I had to implement the iSTDP in the source code of NEST (using C) itself which will be integrated in the NEST architecture and made available for future users. One of the many interesting results of our simulations was the discovery that given a certain amount of shared input from external sources two sub-populations of neurons in the excitatory population – quantified by completely different firing rates – can be observed (see Figure 1). This effect was never observed before and will be investigated in more detail after my training stay at the EPFL.

During my stay I learned how to simulate large networks, implement STDP-type learning rules in the NEST framework, systematically analyse the state of networks of neurons and try to uncover the complicated dynamics that such networks can achieve. The NENS travel grant therefore was of a tremendous help for me to increase my capabilities and become a better computational neuroscientist. I believe that the experience I gained in Lausanne will be invaluable in my future research career.

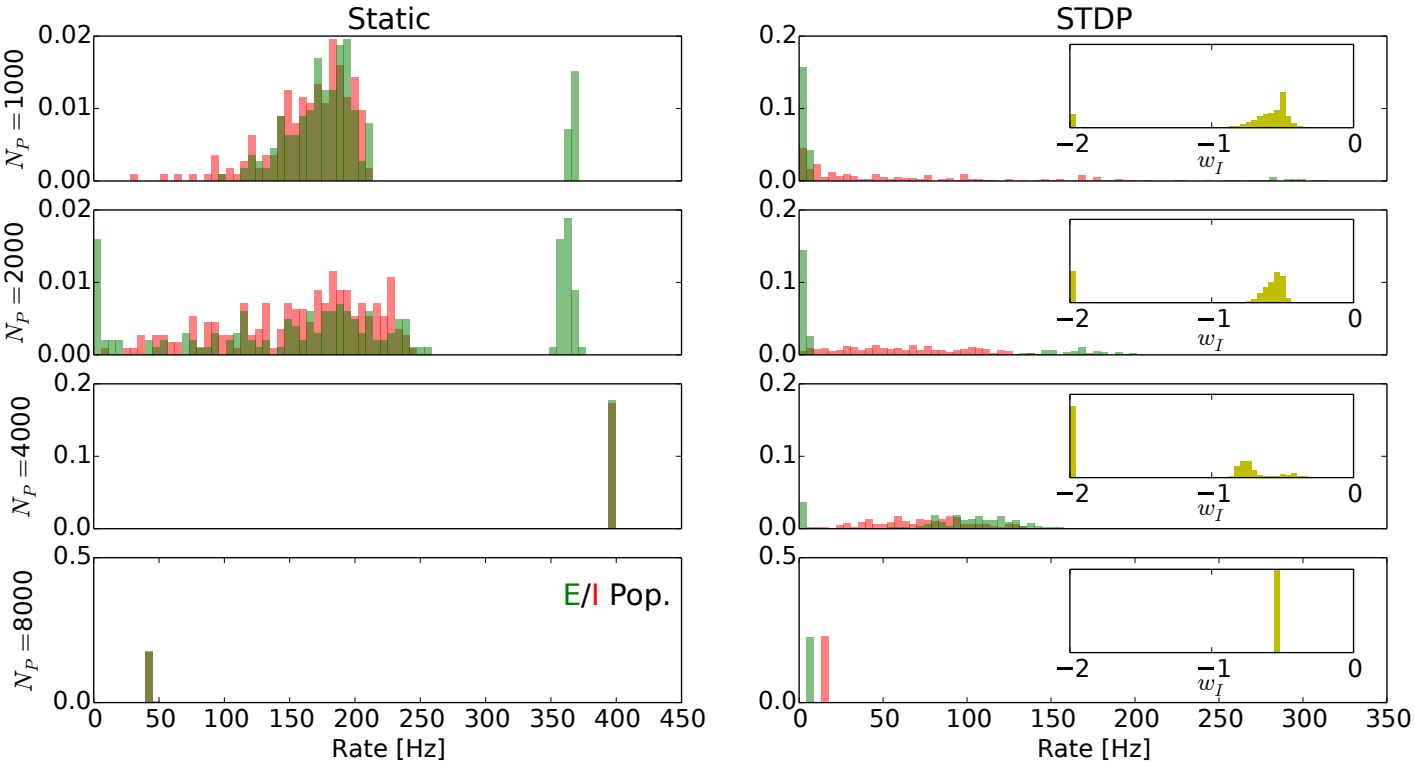

Figure 1: Development of firing rate distribution across the network in the excitatory and inhibitory population for different values of external shared input (N_P the bigger N_P the less shared input was provided) **left panel** Static simulation **right panel** simulations with iSTDP. Insets in the plots show the final distribution of inhibitory weights which underwent iSTDP.

References

References

[1] M.-O. Gewaltig and M. Diesmann. Nest (neural simulation tool). *Scholarpedia*, 2(4):1430, 2007.

[2] T. Vogels, H. Sprekeler, F. Zenke, C. Clopath, and W. Gerstner. Inhibitory plasticity balances excitation and inhibition in sensory pathways and memory networks. *Science*, 334:1569–1573, 16 December 2011.