Neocortex Modeling on GPU

Giacomo Spigler

Abstract.
LISSOM (Laterally Interconnected Synergetically Self-Organizing Map) is a model of human neocortex (mainly modeled on primary visual cortex) at a neural column level, and was developed by Bednar, Choe, Miikkulainen and Sirosh [BM00] [MBCS05], at the University of Texas and the University of Edinburgh. The MPI-CUDA-LISSOM project aims to implement LISSOM on GPU hardware using CUDA by NVIDIA, further supporting GPU clusters through MPI. At the moment the library can run up to 9 times faster (single GPU) than on modern CPUs, and can be run on multi-GPU systems, with an almost linear scaling rate. The main problems the project faces are the lack of memory to store network data and the computing power required to simulate the model. With the help of this GPU implementation, I am currently researching large-scale simulations of primary visual cortex (V1), investigating properties of perception in human neocortex at many levels of processing using parallel-friendly adaptations of the model. The goal of this research is eventually to be able to simulate sensorial processing at realistic scales in real time, allowing us to test and improve our understanding of these important processes.

References

[BM00] James A. Bednar and Risto Miikkulainen, *Tilt aftereffects in a self-organizing model of the primary visual cortex*, Neural Computation **12** (2000), no. 7, 1721–1740.

[MBCS05] Risto Miikkulainen, James A. Bednar, Yoonsuck Choe, and Joseph Sirosh, *Computational maps in the visual cortex*, Springer, Berlin, 2005.