Solving the Kuramoto Oscillator Model on Random Graphs

Jeffrey Kelling[1]

[1] Helmholtz-Zentrum Dresden-Rossendorf, Department of Information Services and Computing, Dresden, Germany

The problem of synchronization is recently attracting much attention because it relates to current topics in science. The dynamics of electrical grids can be affected by de-synchronizations between supplier and consumer nodes. In brains, synchronization of neuronal activity plays an important role in most functions.

The Kuramoto model describes systems of coupled oscillators which, which exhibit non-trivial behavior on complex graphs, making it a suitable tool to study the synchronization dynamics of brains and other systems. Numerical solution of Kuramoto type ordinary differential equations for long times and large systems requires strong computation power, due to the inherent chaoticity of this nonlinear system.

In this talk we present a GPU implementation of Kuramoto models on sparse random graphs. The key to performance here, is the presented memory layout which supplements the SIMT usage of our design. Our implementation uses the VexCL [1] library to abstract GPUs and as a backend for ODE solvers provided by boost odeint [2].

[1] https://github.com/ddemidov/vexcl

[2] https://odeint.org