MATH CCES Center for Computational Engineering Science

RWTH AACHEN UNIVERSITY

Bachelor Thesis

Mixed Parallelization of a Lattice Boltzmann Solver for nVidia Kepler or Intel Xeon Phi

Course of study:	Computational Engineering Science, Simulation Sciences, Computer Science
Kind of thesis:	High Performance Computing
Programming language:	Fortran 2003
Start:	Anytime from January 2014

Problem

The Lattice Boltzmann Method (LBM) is becoming more and more popular for simulations in the field of Computational Fluid Dynamics (CFD). Due to its highly local structure the LBM enables highly parallel implementations. Up to this day most of these implementations are purely based on distributed memory parallelism.
MathCCES hosts two accelerator-based systems – a 16 core, dual nVidia Kepler GPGPU system; and a 16 core, dual Intel Xeon Phi system. In this project a Lattice Boltzmann code shall be modified to use these accelerators efficiently.

Preliminary work

The APES (Adaptable Poly-Engineering Simulator) framework developed by the group Applied Supercomputing in Engineering at the German Research School for Simulation Sciences (now Simulation Techniques and Scientific Computing at the University of Siegen) contains the highly parallel LBM solver Musubi. The Musubi solver is a pure distributed memory implementation utilizing the MPI API.

Task

Different possible paths could be followed:

- Implementing a mixed MPI and OpenMP version of the code.
- Implementing a version of the code utilizing offloading capabilities to either GPGPUs or Xeon Phi cards.
- Implementing a version running mixed MPI and OpenMP on the host and Intel Xeon Phi cards within one or several servers.

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