



GPU Workshop at Universität Hamburg

(SMB & Applied Parallel Computing LLC joint program proposal)

Day 1: GPU ecosystem, hardware and software overview

- 9:30-10:00** Opening.
- 10:00-11:30** The architecture of modern GPUs. NVIDIA Kepler. Brief overview of GPU compute application development systems: CUDA for C and Fortran, directives, libraries and frameworks. CUDA programming model. Simplest CUDA program. Key principles. Parallelism of blocks and threads. Transferring data between GPU and main system.
- 11:30-13:00** **Hands-on:** configuring remote GPU cluster access, getting familiar with CUDA developer tools. GPU capabilities. Simple CUDA program.
- 13.00-14.00** Lunch.
- 14.00-15.30** GPU-enabled math libraries and frameworks. CUDA math libraries: CUBLAS, CUSPARSE, CUFFT, CURAND. Thrust for STL-like GPU computing in C++. Accelerereyes ArrayFire.
- 15.30-17.00** **Hands-on:** Using GPU-enabled math libraries and frameworks: power method for maximum eigenvalue problem using BLAS and CUBLAS, data processing examples in ArrayFire and Thrust (sort large array, solve sparse system with iterative method).

Day 2: Rapid GPU applications development using OpenACC

- 9.30-11.00** Simplest program example. OpenACC concepts, programming model, memory model. Basic OpenACC directives, intercomparison and examples: parallel, kernels, loop, independent and seq. CUDA compute grid mapping: gang and vector. Data directive, memory synchronization attributes. Program compilation example.
- 11.00-12.00** **Hands-on:** getting familiar with PGI OpenACC compiler. Simplest example. Data regions example.
- 12.00-13.30** Understanding compiler feedback. OpenACC in complex cases: limitations and workarounds. Extra OpenACC directives.
- 13.30-14.30** Lunch.



- 14.30-16.00** **Hands-on:** complex OpenACC usage example: solving 3d wave equation with finite differences, power method for maximum eigenvalue problem. Step by step porting of existing CPU programs. Performance comparison.
- 16.00-16.30** Profiling applications with PGI Profiler (PGPROF).
- 16.30-17.00** Q&A.