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## Agenda October 14th, 2009

**10:30AM** Welcome, DLR-C<sup>2</sup>A<sup>2</sup>S<sup>2</sup>E : Norbert Kroll

**10:40AM** Nvidia : Timothy Lanfear  
*High Performance Computing with  
NVIDIA Tesla GPUs*

GPU computing is the use of a GPU (graphics processing unit) to do general purpose scientific and engineering computing. The architecture of a GPU matches well to many scientific computing algorithms where the same operation is applied to every element of a large data set. Many algorithms have been ported to GPUs and benefited from significant increases in performance when compared with implementations on traditional microprocessors.

**11:20AM** Intel : Hans-Joachim Plum  
*Intel Performance Forward Scaling*

As we see Moore's Law still continuing for years to come, more and more parallelism is introduced to all computing platforms and on all levels of integration and programming. Especially in the area of High-Performance Computing (HPC) users can entertain a combination of different hardware and software parallel architectures and programming environments. Those technologies range from vectorization and SIMD computation over shared memory multi-threading to distributed memory message passing on cluster systems. We will be discussing the move to multi/many-core processors as building blocks for high performance and energy efficient solutions and its related potential new hardware technologies, and how this compares to GPU solutions. However, it also puts more and more demand on software (development) tools for parallel computing in respect to the various challenges and opportunities. This talk will briefly outline major hardware architectural trends in HPC (including multi-core) and its associated parallel software tools. We will cover the respective Intel® Software Tools for the main phases of parallel software development: implementation, correctness, analysis and performance. For all tools, scalability and ease-of-use is very important to enable users for higher productivity.

**12:00PM** T-Systems SfR : Christian Simmendinger  
*Exploring the Unknown: Programming  
Languages and HPC Hardware in 2015.*

The talk discusses current and future Programming Models and associated Programming Languages suitable for HPC. The talk also includes wild guesses about how HPC Hardware might look like in 5 years. Since any such guess inevitably is bound to fail, the talk will focus on the implications of this failure in the context of Programming Models and associated Programming Languages.

**12:40PM** Lunch break



**13:30PM** DLR-C<sup>2</sup>A<sup>2</sup>S<sup>2</sup>E :  
Jens Jägersküpper, Thomas Gerhold  
*The German HICFD-Project and DLR's TAU  
code on Many-Cores*

The HICFD project ("highly efficient implementation of CFD codes on many-core architectures") is presented. Taking the DLR's CFD-code TAU as an example, the main aspects of HICFD are discussed: SIMD vectorization and MPI/shared-memory hybrid parallelization.

**14:10PM** Technical University of Dresden : Olaf Krzikalla  
*Scout - a source-to-source transformator for  
SIMD-Optimization*

We present Scout, a source-to-source transformator for optimizing C code at the source level. Beside common optimizations like inlining and loop splitting Scout especially focuses on SIMD-optimizations. It is already able to deal with several SSE instruction levels or even the Larabee instruction set. However we also want to present and discuss some ideas to open Scout for a wider range of SIMD approaches like e.g. CUDA.

**14:50PM** BAE Systems Advanced Technology Centre -  
Bristol : Jamil Appa  
*Unstructured CFD-Solver on GPUs*

**15:30PM** Break

**16:00PM** University of Bristol : Felipe Cruz  
*Fast Multipole Methods on the GPU with  
application to the Adaptive Vortex Method*

The talk presents the Adaptive Vortex Method (VM) for incompressible flow simulations on GPUs. The VM is an interesting alternative to grid-based methods for solving continuum systems. However, in VM, the computational cost of the solution of an N-body interaction is its biggest challenge. In this talk, we will discuss the implementation of the Fast Multipole Method on the GPU, and its application to the VM to overcome the computational cost of the N-body calculation.

**16:40PM** FZ Jülich : Willi Homberg  
*Energy efficient Many-Core systems at JSC*

**17:20PM** CAPS : Laurent Morin  
*Innovative software tools for high performance  
applications*

**18:00PM** End of 1st day  
**19:15PM** Common dinner

## Symposium

# CFD on Future Architectures - Many-Cores, GPUs, FPGAs, ...

14th and 15th of October 2009

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Please, RSVP the number of  
attendees with Edna Aust  
until 30th of September 2009.

## Agenda October 15th, 2009

**09:00AM University of Cambridge, Whittle Laboratory :  
Tobias Brandvik  
A New CFD Solver for Many-Core Processors**

A new three-dimensional Navier-Stokes solver for flows in turbomachines has been developed. The new solver is based on the latest version of the Denton codes, but has been implemented to run efficiently on many-core processors such as GPUs. The change in processor enables an order-of-magnitude reduction in run-time due to the higher performance of the GPU.

A key technique for the practical implementation of large-scale CFD solvers on rapidly changing many-core processors is the combination of a high-level solver definition with the use of source-to-source transformation. This technique as it has been applied for the new solver is presented. In addition, two different test cases are shown to demonstrate the impact of the new solver for turbomachinery CFD.

Scaling results for a 16 node GPU cluster are also presented, showing almost linear scaling for typical turbomachinery cases. For validation purposes, a test case consisting of a three-stage turbine with complete hub and casing leakage paths is described. Good agreement is obtained with previously published experimental results. The simulation runs in less than 10 minutes on a cluster with four GPUs.

**09:40AM INTA : Mario J. Martin, Esther Andres  
Solving the Euler Equation for Unstructured  
Grids on GPUs**

**10:20AM Break**

**10:40AM Polytechnic University of Madrid : Gabriel  
Caffarena  
Ongoing developments with FPGAs and  
PCI-Express technologies**

**11:20AM Autonomous University of Madrid,  
High Performance Computing  
and Networking Group : Ivan Gonzalez  
CFD implementation with In-socket  
FPGA accelerators**

**12:00PM Lunch break**

**12:50PM Fraunhofer ITWM : Franz-Josef Pfreundt  
FVM - how to program Multi-Core and a  
critical view on GPUs**

The talk will present the Fraunhofer Virtual Machine FVM, a simple and very effective PGAS API. Benchmarks and productive applications based on the FVM will be presented. The second half of the talk will present a critical view on GPU's, look deeper into published performance numbers and will try to analyse future developments.

**13:40PM ONERA/Airbus-France :  
Michel Gazaix, Steeve Champagneux  
Recent Results with elsA on Many-Cores**

**14:20PM Technical University of Dortmund :  
Markus Geveler  
Hardware oriented numerics for real-time  
CFD applications on parallel hardware  
architectures.**

The talk is about an open-source collection of libraries offering a hardware oriented approach to numerical calculations. The concept of application-specific kernels enables applications to be efficiently executed on a wide range of different architectures including x86 CPUs, GPUs, the CELL BE and clusters. We demonstrate the flexibility and performance of the approach with real-time capable test applications from the CFD domain using the Lattice-Boltzmann method.

**15:00PM Closing**

