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Facing the Multicore-Challenge II

Aspects of New Paradigms and Technologies in Parallel Computing

Springer

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Preface

The Multicore Challenge is still causing agonizing pain on users of scientific computing, software developers, and vendors. While in theory the exponential increase of computing power is about to continue at least for the next couple of years, it is more and more difficult to harness the capabilities of parallel hardware in practical implementations. With the conference for young scientists "Facing the Multicore Challenge", which was held in Heidelberg in 2010, we initiated a platform for the mutual exchange between young researchers and experienced specialists in the domain of high-performance computing. The paper contributions, recent discussions, and the observations within the current computing landscape gave rise to the idea to have a second edition of the conference in 2011. The present proceedings are the outcome of this second conference for young scientists – "Facing the Multicore Challenge II" – held at the Karlsruhe Institute of Technology (KIT), September 28–30, 2011. The conference focused on the topics and the impact of multicore, manycore and coprocessor technologies in science and for large-scale applications in an interdisciplinary environment.

The 2011 conference – partially funded by KIT – placed emphasis on the support and the advancement of young researchers. It brought together leading experts as well as motivated young researchers in order to discuss recent developments, the present status of the field, and its future prospects in a pleasant atmosphere stimulating the exchange of ideas. It was the designated goal to address current issues including mathematical modeling, design of parallel algorithms, aspects of microprocessor architecture, parallel programming languages, compilers, hardware-aware computing, heterogeneous platforms, emerging architectures, tools, performance tuning, and requirements for large-scale applications. The results of the presented research papers clearly show the potential of emerging technologies in the area of multicore and manycore processors that are paving the way toward personal supercomputing and very likely toward exascale computing. However, many issues related to parallel programming environments, development of portable and future-proof concepts, and the design of scalable and manycore-ready algorithms still need to be addressed in future research. Some of these points are the subject of the presented papers.

These proceedings include diverse and interdisciplinary research work. In the contributed papers the status of the parallel evolution is investigated and theses for further development of hardware and software are discussed. Then, a load-balancing approach for hybrid programming models is considered and benefits of a task-based programming model are underlined. Research papers on parallel programming environments include a productivity and performance analysis and a case study of a programming model with high-level description of algorithms and automated vectorization. An application and performance study based on a simulator considers aspects of asymmetric manycore architectures. Furthermore,

the mapping of a matrix estimation algorithm to an FPGA platform is investigated. Scheduling techniques for graphics processing units (GPUs) are presented in another paper. In the context of GPU computing, two research paper deal with the mapping and GPU acceleration of graph algorithms. The proceedings further describe the experience with high-level programming approaches for GPUs. Finally, the issues of parallel numerical methods in the manycore era are discussed in four research papers – highlighting aspects of a hybrid parallelization of a realistic simulation as well as of algebraic and geometric multigrid solvers and parallel preconditioners.

The conference organizers and editors would like to thank all the contributors for submitting exciting and novel work and providing multifaceted input to the discussions. Special thanks is devoted to the Technical Program Committee for their exhaustive work and effort in the reviewing process and their helpful feedback for the authors. Last but not least, we would like to acknowledge the financial support from Karlsruhe Institute of Technology in the context of the KIT Startup Budget 2011.

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September 2011

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David Kramer
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