

RoSI lecture series winter term 19/20

Date: Monday, 02.12.2019, 14:50 – 16:20, APB 3105

Speaker: Harald Köstler, Department Informatik Friedrich-Alexander Universität Erlangen- Nürnberg

Titel: Code generation approaches for HPC

Abstract: In recent years the principle of separation of concerns has increasingly been investigated for simulation software. Applications scientists want to be able to easily run the software for different input data and configurations, but they also want to include new physical models or modify existing ones. Additionally, they sometimes have also experience which discretizations or numerical algorithms. Framework developers are familiar with modern software design and low-level architecture-specific optimizations instead. From the computer science perspective, this separation of concerns can be supported by providing interfaces with different levels of abstraction for different roles. Code generation technology can then be used as a tool to automatically map the abstract descriptions to concrete code and thus to improve the development of simulation software. After intense research in the last years, code generation is now mature enough to find its way into real-world applications and existing software frameworks and to offer embedded or external domain-specific languages (DSL) as an interface to users. We will present several examples for successful use of code generation technology including the external DSL ExaStencils, the embedded DSL pystencils and the Petalisp approach for just-in-time compilation.

<https://www.cs10.tf.fau.de/person/harald-koestler>

Curriculum Vitae

Prof. Dr.-Ing. Harald
Köstler November 2019

1 Personal Data

Birth date: 27 January 1978

Birth place: Marktredwitz

Address: Lehrstuhl für Systemsimulation
Department Informatik
Friedrich-Alexander Universität Erlangen-Nürnberg
Cauerstr. 11
91058 Erlangen
Tel.: (09131) 85-28359 (work)
Fax: (09131) 85-28928 (work)
E-mail: harald.koestler@fau.de

2 Education and Degrees

2003: Diploma (Computer Science), Friedrich-Alexander Universität Erlangen-Nürnberg

2003: Diploma (Business studies), FernUniversität Hagen

2008: Dr.-Ing., Friedrich-Alexander Universität Erlangen-Nürnberg

2014: Habilitation, Friedrich-Alexander Universität Erlangen-Nürnberg

2018: Promotion to Professor, Friedrich-Alexander Universität Erlangen-Nürnberg

3 Employment

September 2003 – August 2008: Research assistant, Lehrstuhl für Systemsimulation, Friedrich-Alexander Universität Erlangen-Nürnberg.

since September 2008: Akademischer Oberrat, Department Informatik, Friedrich-Alexander Universität Erlangen- Nürnberg.

References

- [1] C. Feichtinger, H. Köstler, J. Habich, T. Aoki, and U. Rüdè. Performance Modeling and Analysis of Heterogeneous Lattice Boltzmann Simulations on CPU-GPU Clusters. *Journal of Parallel Computing*, 46:1–13, 2015.
- [2] B. Gmeiner, H. Köstler, M. Stürmer, and U. Rüdè. Parallel multigrid on hierarchical hybrid grids: a performance study on current high performance computing clusters. *Concurrency and Computation: Practice and Experience*, pages 1–24, 2012.

- [3] Ch. Godenschwager, F. Schornbaum, M. Bauer, H. Köstler, and U. Røde. A Framework for Hybrid Parallel Flow Simulations with a Trillion Cells in Complex Geometries. In *Proceedings of the International Conference on High Performance Computing, Networking, Storage and Analysis, SC '13*, pages 35:1–35:12, New York, NY, USA, 2013. ACM.
- [4] H. Köstler and U. Røde. The CSE software challenge – covering the complete stack. *it-Information Technology*, 55(3):91–96, 2013.
- [5] H. Köstler, C. Schmitt, S. Kuckuk, F. Hannig, J. Teich, and U. Røde. A scala prototype to generate multigrid solver implementations for different problems and target multi-core platforms. *Int. J. of Computational Science and Engineering*, 14(2):150–163, 2017.
- [6] H. Köstler, M. Stürmer, and T. Pohl. Performance engineering to achieve real-time high dynamic range imaging. *Journal of Real-Time Image Processing*, pages 1–13, 2013.
- [7] S. Kuckuk and H. Köstler. Automatic generation of massively parallel codes from exaslang. *Computation*, 4(3):27, 2016.
- [8] R. Membarth, O. Reiche, Ch. Schmitt, F. Hannig, J. Teich, M. Stürmer, and H. Köstler. Towards a Performance-portable Description of Geometric Multigrid Algorithms using a Domain-specific Language. *Journal of Parallel and Distributed Computing*, 74(12):3191–3201, 2014.
- [9] B. Reuter, V. Aizinger, and H. Köstler. A multi-platform scaling study for an OpenMP parallelization of a discontinuous Galerkin ocean model. *Computers and Fluids*, 117:325–335, 2015.
- [10] C.H. Wolters, H. Köstler, C. Moller, J. Härdtlein, L. Grasedyck, and W. Hackbusch. Numerical Mathematics of the Subtraction Method for the Modeling of a Current Dipole in EEG Source Reconstruction Using Finite Element Head Models. *SIAM J. on Scientific Computing*, 30(1):24–45, 2007.