

Parallel-Adaptive Simulations based on DUNE and DUNE-FEM with Applications to Compressible Flow

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In this paper an overview on the development of the software framework DUNE [1] with respect to parallel-adaptive simulations is presented. In particular, the implementation of modern simulation techniques in the DUNE modules DUNE-FEM [2] and DUNE-FEM-DG is discussed, including continuous and discontinuous Galerkin schemes [3, 4], local grid adaptivity, dynamic load balancing, and hybrid parallelization techniques. Applied to different problems such as the compressible Euler or compressible Navier-Stokes equations the performance of the code is analysed. This includes scalability studies for a large number of cores, comparison with other state of the art numerical software, and a performance study in terms of floating point operations per second.

References

- [1] P. Bastian, M. Blatt, A. Dedner, C. Engwer, R. Klöforn, R. Kornhuber, M. Ohlberger, and O. Sander. A Generic Grid Interface for Parallel and Adaptive Scientific Computing. Part II: Implementation and Tests in DUNE. *Computing*, 82(2–3):121–138, 2008. <http://www.springerlink.com/content/gn177r643q2168g7>.
- [2] A. Dedner, R. Klöforn, M. Nolte, and M. Ohlberger. A Generic Interface for Parallel and Adaptive Scientific Computing: Abstraction Principles and the DUNE-FEM Module. *Computing*, 90(3–4):165–196, 2010. <http://www.springerlink.com/content/vj103u6079861001>.
- [3] A. Dedner and R. Klöforn. A Generic Stabilization Approach for Higher Order Discontinuous Galerkin Methods for Convection Dominated Problems. *J. Sci. Comput.*, 47(3):365–388, 2011. <http://dx.doi.org/10.1007/s10915-010-9448-0>.
- [4] S. Brdar, A. Dedner, and R. Klöforn. Compact and stable Discontinuous Galerkin methods for convection-diffusion problems. *SIAM J. Sci. Comput.*, 34(1), 2012. <http://dx.doi.org/10.1137/100817528>.