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ExaHyPE: An Open-source Exascale Engine for Solving First-Order Hyperbolic PDEs

Anne Reinarz[1], Michael Bader[2], Tobias Weinzierl[3]

[1] Technical University of Munich, Garching, reinarz@in.tum.de
[2] Technical University of Munich, Garching, bader@in.tum.de
[3] Department of Computer Science, Durham, tobias.weinzierl@durham.ac.uk

ExaHyPE [1] is a hyperbolic PDE engine intended to be used to solve systems of first order hyperbolic PDEs written in a conservative formulation. In this talk, I present the current status of the ExaHyPE project in general and in particular the parallel capabilities of the engine. The project provides a space-tree discretization of the computational domain, various higher-order DG schemes and a-posteriori subcell limiters. This allows users to write only their own application specific code and benefit from the engines efficient adaptive mesh refinement algorithms and from the numerical schemes built into the engine.

The two main applications currently tackled with this engine are long-range seismic risk assessment and the search for gravitational waves emitted by binary neutron stars [2]. Both of these applications require the simulation of large times scales and large domains to compute new physically relevant results, thus a naive implementation of the numerical schemes is insufficient. In the ExaHyPE project the classic ADER-DG solver phases are reordered to realise the algorithm with a pipelined single-touch policy, process cells concurrently and overlap MPI data exchange with the actual computation [3].

This is joint work with groups from Frankfurt's FIAS, the University of Trento, Ludwig-Maximilians-University Munich and the University of Durham.

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