Geophysical Research Abstracts
Vol. 21, EGU2019-17726, 2019
EGU General Assembly 2019

The ExaHyPE Hyperbolic PDE-Engine: Mesh generation avoiding schemes for the Earthquake simulation in Alpine Regional Areas.

Leonhard Rannabauer, Kenneth Duru, Thomas Ulrich, Alice Gabriel, Anne Reinarz, and Michael Bader
Department of Informatics, Technical University of Munich, Garching, Germany, (rannabau@in.tum.de)

ExaHyPE (www.exahype.eu) is a Horizon 2020 EU project to develop a high-performance engine to solve hyperbolic systems of PDEs using the high-order discontinuous Galerkin finite element method. The project's goals are to develop an engine with flexible support for various applications which shall be tailored towards expected exascale architectures. The user is provided with an abstraction of the complicated algorithms to implement the ADER-DG numerical scheme and of the issues related to scalability and parallel adaptive mesh refinement (AMR), which are handled internally by the Peano framework (www.peano-framework.org).

We'll show the integration of a novel diffuse interface method. This method introduces a characteristic function to model topographies implicitly by identifying the location of solid and the surrounding air. The price-to-pay is that the PDE system becomes nonlinear.
We'll also demonstrate the implementation of a new curvilinear mesh approach, which allows us to model complex topographies by mapping the domain from physical space to the internal Cartesian mesh. The scheme is accompanied by a novel Riemann solver (K. Duru et al., 2015) which realizes perfectly matched layers at the boundaries of our simulation.
In then end we plan to present various comparisons of time to solution for standard Benchmarks for both methods.

The project focuses on the simulation of wave propagation problems motivated by the European AlpArray project (www.alparray.ethz.ch), which aims to an understating of Alps generation and connection to plate tectonics. The engine allows us to easily include static and dynamic AMR with which we plan to analyze problems in the northern alpine area in detail.
A current snap-shot of the ExaHyPE-Engine including all presented applications can be downloaded as open-source from http://www.peano-framework.org.