ExaHyPE - An Exascale Hyperpolic PDE Engine: Seismic Wave Propagation in the Alps High Performance Scientific Computing

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Abstract: ExaHyPE 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 goals are to develop an engine with flexible support for various applications which shall be tailored towards expected exascale architectures. The end-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 [2].

In this presentation we will give a practical example from a developer's point view on how to implement a scalable seismic wave propagation algorithm within the ExaHyPE engine. We will show various examples of seismic wave propagations in the alpine area including AMR. A newly developed curvilinear mesh approach allows us to model complex topographies including faults with branches. We were able to implement this approach only by transforming flux and source terms. We did not have to change the engine internals, based on Cartesian grids. Furthermore, we present a novel Riemann solver [1], which realizes perfect matched layers on the boundaries of our simulation.

References

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[2] Tobias Weinzierl. The peano software - parallel, automaton-based, dynamically adaptive grid traversals. *CoRR*, abs/1506.04496, 2015.

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