Technische Berichte

Autor(en): Kristof Unterweger, Tobias Weinzierl, David I. Ketcheson, Aron Ahmadia

Titel des Berichts: PEANOCLAW—A FUNCTIONALLY-DECOMPOSED APPROACH TO ADAPTIVE MESH REFINEMENT WITH LOCAL TIME STEPPING FOR HYPERBOLIC CONSERVATION LAW SOLVERS

Abstract: We present an application framework applying spacetime-based adaptive mesh refinement (AMR) to solvers for hyperbolic partial differential equations (PDEs) specified on logically quadrilateral grids. The AMR framework decomposes the adaptive grid into regular quadrilateral subgrids shaping an adaptive global grid, traverses these subgrids autonomously, calls PDE-specific routines on each subgrid, and preserves the data consistency between the subgrids. Each subgrid is autonomously allowed to advance in time based on the local CFL condition, yielding a speedup in several cases compared to global time stepping. The AMR memory footprint is small due to the use of nonoverlapping grids. Subroutines written for regular Cartesian grids are used on adaptive meshes without modification. Furthermore, the framework provides a very simple programming interface to specify dynamic refinement criteria. We thus lower the implementation threshold for domain specialists who want to extend existing code with AMR features without introducing complexity into their own applications. Our framework is a merger of the spacetime mesh management and traversal code Peano and Clawpack’s PyClaw, an explicit finite volume solver for general PDEs.

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