Adaptive Multiresolution Discontinuous Galerkin Schemes for Conservation Laws

Nune Hovhannisyan*† Siegfried Müller‡ Roland Schäfer‡

September 16, 2010

A multiresolution-based adaptation concept is proposed that aims at accelerating Discontinuous Galerkin schemes applied to nonlinear hyperbolic conservation laws. Opposite to standard adaptation concepts no error estimates are needed to tag mesh elements for refinement. Instead of this, a multiresolution analysis is performed on a hierarchy of nested grids for the data given on a uniformly refined mesh. This provides difference information between successive refinement levels, that may become negligibly small in regions where the solution is locally smooth. Applying hard thresholding the data are highly compressed and local grid adaptation is triggered by the remaining significant coefficients. A central mathematical problem addressed in this work is then to show that the adaptive solution is of the same accuracy as the reference solution on a uniformly refined mesh. Numerical comparisons demonstrate the efficiency of the concept and provide reliable estimates of the actual error in the numerical solution.

Conservation laws, Discontinuous Galerkin schemes, grid adaptation, multiwavelets.
35L65, 65M12, 65M60, 65T60, 74S05

*Faculty of Informatics and Applied Mathematics, Alex Manoogian 1, Yerevan 0044, Armenia (alnune03@yahoo.com)

†This work has been performed with funding by the Deutsche Forschungsgemeinschaft in the Collaborative Research Center SFB 401 "Flow Modulation and Fluid-Structure Interaction at Airplane Wings" of RWTH Aachen University, Germany.

‡Institut für Geometrie und Praktische Mathematik, RWTH Aachen University, Templergraben 55, 52056 Aachen, Germany (mueller,schaefer@igpm.rwth-aachen.de)