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Space-time adaptive multiresolution techniques with a gradient-augmented level set method for advection equations

Dmitry Kolomenskiy* Jean–Christophe Nave† Kai Schneider‡

Abstract

A space-time adaptive scheme is presented for solving advection equations in two space dimensions. Advection problems are encountered for example in moving fronts for a given velocity field, or in transport of passive scalars modeling pollution or mixing in chemical engineering. It can also be viewed as a simple model that partly describes other, more complex problems, such as advection-reaction-diffusion, fluid flow, elasticity, etc. The gradient-augmented level set method using a semi-Lagrangian formulation with backward time integration is coupled with a point value multiresolution analysis using Hermite interpolation. Thus locally refined dyadic spatial grids are introduced which are efficiently implemented with dynamic quad-tree data structures. For adaptive time integration, an embedded RungeKutta method is employed. The precision of the new fully adaptive method is analysed and speed up of CPU time and memory compression with respect to the uniform grid discretization are reported. Details can be found in [1]

Key words: Space-time adaptivity; Gradient augmented level-set method; Hermite multiresolution; Advection equation;

Mathematics subject classifications (2000): 35L65, 35Q35, 65M25, 65M50

References

[1] D. Kolomenskiy, J.C. Nave and K. Schneider. Adaptive gradient-augmented level set method with multiresolution error estimation. arXiv:1401.7294v2, submitted 08/2014.

*CRM and The Department of Mathematics and Statistics, McGill University, 805 Sherbrooke W. Street, Montreal, QC, Canada H3A 0B9, e-mail: dkolom@gmail.com

†The Department of Mathematics and Statistics, McGill University, 805 Sherbrooke W. Street, Montreal, QC, Canada H3A 0B9, e-mail: jcnave@mcgill.edu

‡M2P2CNRS, Aix-Marseille Université 39, rue Frédéric Joliot-Curie, 13453 Marseille Cedex 13, France, email: kschneid@cmi.univ-mrs.fr