Title: CAT schemes with good MOOD

Authors: R. Loubere[1], E. Macca[2], C. Parés[3], G. Russo[4]

ABSTRACT: A new family of high-order shock-capturing finite difference numerical methods for systems of conservation law is presented. In this paper we blend high-order Compact Approximate Taylor (CAT) numerical methods [1, 2, 3] with the *a posteriori* Multi-dimensional Optimal Order Detection (MOOD) paradigm [4]. These methods, named CATMOOD [5], use centered (2p + 1)-point stencils, where p may take values in 1, 2, . . . , P, and some detectors resulting: highly accurate for smooth solutions; essentially non-oscillatory for discontinuous ones; and almost fail-safe positivity preserving.

Some numerical results for scalar conservation laws and systems are presented to show the appropriate behavior of CAT-MOOD methods in 1D and 2D. In particular, we will focus on scalar linear case and 2D isentropic vortex in motion; Burgers equation and 2D Sedov Blast wave; 1D and 2D Riemann problems; and 2D Astrophysical jet Mach2000 problem.

Keywords: High order fully-discrete schemes; High order reconstruction techniques; Finite difference schemes; MOOD detector; 2D Riemann problems; 2D Astrophysical jet Mach2000 problem.

References

[1] H. Carrillo and C. Parés *Compact approximate Taylor methods for systems of conservation laws* , Journal of Scientific Computing, 80 (2019), pp. 1832-1866.

[2] H. Carrillo, E. M., C. Parés, G. Russo and D. Zorío, *An order-adaptive Compact Approximate Taylor method for systems of conservation law*, Journal of Computation Scientific, 438 (2021) pp.31.

[3] H. Carrillo, E. M., C. Parés and G. Russo, *An order-adaptive well-balanced Compact Approximate Taylor method for systems of balance law*, Journal of Computation Scientific, 478 (2023).

[4] S. Clain, S. Diot and R. Loubère, *A high-order finite volume method for systems of conservation laws – Multi-dimensional Optimal Order Detection (MOOD)*,Journal of Computation Scientific 230 (10), (2011).

[5] R. Loubère, E. M., C. Parés and G. Russo, *CAT-MOOD methods for conservation laws in one space dimension*, proceeding submitted (2023).

[1]Université de Bordeaux, CNRS, Bordeaux INP, IMB, UMR 5251, F-33400 Talence, France (raphael.loubere@math.u-bordeaux.fr)

[2]Department of Mathematics and Computer Science, University of Catania, Italy, (emanuele.macca@unict.it)

[3]Departamento de Análisis Matemático, Universidad de Malága, Spain, (pares@uma.es)

[4]Department of Mathematics and Computer Science, University of Catania, Italy, (russo@dmi.unict.it)