

HIGH ORDER PARALLEL WENO-WAVE-PROPAGATION ALGORITHMS FOR HYPERBOLIC PDES IN THREE DIMENSIONS

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Recently, the wave propagation finite volume methods¹ of LeVeque's Clawpack code² have been adapted to a method-of-lines framework and combined with high order time integration (using strong stability preserving (SSP) Runge-Kutta methods) and high order spatial discretization (using weighted essentially non-oscillatory (WENO) reconstruction)^{4,6}. The resulting algorithms, in one and two dimensions, are available with a convenient Python interface and can be run in parallel with excellent scaling^{3,5}. The parallel implementation relies on PETSc through the petsc4py package⁷. We present the extension of these algorithms to three spatial dimensions and their application to problems in fluid dynamics and electromagnetism. We also present the first scaling studies for the high-order WENO-wave-propagation code.

REFERENCES

- [1] R. J. LeVeque. Wave Propagation Algorithms for Multidimensional Hyperbolic Systems. *Journal of Computational Physics*, 131:327–353, 1997.
- [2] <http://clawpack.org>
- [3] D. I. Ketcheson, K. T. Mandli, A. J. Ahmadi, A. Alghamdi, M. Quezada de Luna, M. Parsani, M. G. Knepley, and M. Emmett. PyClaw: Accessible, Extensible, Scalable Tools for Wave Propagation Problems. *SIAM Journal on Scientific Computing*, 34(4):C210–C231, 2012.
- [4] D. I. Ketcheson, M. Parsani, and R. J. LeVeque. High-order Wave Propagation Algorithms for Hyperbolic Systems. *SIAM Journal on Scientific Computing*, 35(1):A351–A377, 2013.
- [5] K. T. Mandli and D. I. Ketcheson. PyClaw software, 2011.
- [6] M. Emmett, PyWENO Software Package, <http://memmett.github.com/PyWENO>, 2011.
- [7] S. Balay, J. Brown, K. Buschelman, V. Eijkhout, W. D. Gropp, D. Kaushik, M. G. Knepley, L. C. McInnes, B. F. Smith, and H. Zhang. PETSc Users Manual. Technical Report ANL-95/11 - Revision 3.1, Argonne National Laboratory, 2010.