Project Proposal

WENO High-Resolution Finite Volume Methods

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Essentially non-oscillatory or ENO methods have historically proven successful at capturing shock discontinuities by choosing the smoothest interpolating polynomial at several neighboring stencils. Weighted ENO or WENO methods use a convex combination of the interpolating polynomial at all stencils and hence preserve both the high-resolution for shocks and high-order accuracy for smooth data.

We propose the implementation of finite-volume and finite-difference WENO methods as investigated in [1, 2, 3]. WENO methods preserve high-order accuracy in regions where the solution is smooth and resolve discontinuities without introducing spurious oscillations. We will implement and test these schemes on one-dimensional hyperbolic equations such as the advection and burgers equations with shocks. We will also include comparisons with `clawpack`'s results for non-WENO schemes. We also plan to investigate the benefits of using Total Variation Diminishing (TVD) Runge-Kutta schemes versus traditional non-TVD integrators. If there is time, we will extend our analysis to more complicated systems of hyberbolic equations including shallow water wave equations.

References

[1] Jiang, G.-S., and Shu, C.-W. Efficient implementation of weighted eno schemes. Tech. rep., DTIC Document, 1995.

[2] Ketcheson, D. I., Parsani, M., and LeVeque, R. J. High-order wave propagation algorithms for hyperbolic systems. *SIAM Journal on Scientific Computing 35*, 1 (2013), A351–A377.

[3] Shu, C.-W. High order weighted essentially nonoscillatory schemes for convection dominated problems. *SIAM review 51*, 1 (2009), 82–126.