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A Three-dimensional FVC scheme on non-uniform tetrahedron meshes: application to the 3D Euler equation

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In this study, we focus on the numerical solutions of the three-dimensional Euler equations on general meshes, extending an approach to spatial discretization recently proposed by [1, 2], as the authors have shown the effectiveness of this approach for shallow water equations. This is a new scheme that combines the method of characteristics and the finite volume method. This scheme uses the velocity component normal to the control volume interface as the characteristic velocity of the conservative variables of our equation system. The method is simple, accurate and avoids the resolution of Riemann problem in the time integration process.

The solutions obtained are monotonic and the normal shock wave profiles are sharp. Contact discontinuities and shock wave profiles are captured with a higher level of accuracy and robustness. The results are compared with the solutions presented by other approaches [3, 4, 5], as well as with several benchmark tests.

REFERENCES

[1] Benkhaldoun, F., Seaïd, M. A simple finite volume method for the shallow water equations. Journal of computational and applied mathematics, 234(1):5872, 2010.

[2] Ziggaf, M., Kissami, I., & Boubekeur, M. (2021). A well balanced FVC scheme for 2D shallow water flows on unstructured triangular meshes. arXiv preprint arXiv:2110.11457.

[3] Philip L Roe. Characteristic-based schemes for the Euler equations. Annual review of fluid mechanics, 18(1): 37365, 1986.

[4] Toro, E. F., Castro, C. E., & Lee, B. J. (2015). A novel numerical flux for the 3D Euler equations with general equation of state. Journal of Computational Physics, 303, 80-94.

[5] Pan, L., Li, J., & Xu, K. (2017). A few benchmarks test cases for higher-order Euler solvers. Numerical Mathematics: Theory, Methods and Applications, 10(4), 711-736.

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