High-order central-upwind schemes for hyperbolic conservation laws

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Abstract

We study central-upwind schemes for systems of hyperbolic conservation laws, recently introduced in [A. Kurganov, S. Noelle and G. Petrova, SIAM J. Sci. Comput., 23 (2001), pp. 707–740]. Similarly to the staggered central schemes, these schemes are central Godunov-type projection-evolution methods that enjoy the advantages of high resolution, simplicity, universality, and robustness. At the same time, the central-upwind framework allows one to decrease a relatively large amount of numerical dissipation present at the staggered central schemes.

In this talk, we first present a modification of the one-dimensional fully- and semi-discrete central-upwind schemes, in which the numerical dissipation is reduced even further. The goal is achieved by a more accurate projection of the evolved quantities onto the original grid. In the semi-discrete case, the reduction of dissipation procedure leads to a new, less dissipative numerical flux. We also extend the new semi-discrete scheme to the two-dimensional case via the rigorous, genuinely multidimensional derivation. The new semi-discrete schemes are tested on a number of numerical examples, where one can observe an improved resolution, especially of the contact waves.

On the second part, we like to illustrate general principle for construct high-order central-upwind schemes for one- or multi-dimensional hyperbolic conservation laws. The main concept is the use of convex ENO reconstruction for numerical flux.