High-Order Semi-Discrete Central-Upwind Schemes for Multi-Dimensional Hamilton-Jacobi Equations

Steve Bryson, Doron Levy

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We present the first fifth order, semi-discrete central upwind method for approximating solutions of multi-dimensional Hamilton-Jacobi equations. Unlike most of the commonly used high order upwind schemes, our scheme is formulated as a Godunov-type scheme. The scheme is based on the fluxes of Kurganov-Tadmor and Kurganov-Tadmor-Petrova, and is derived for an arbitrary number of space dimensions. A theorem establishing the monotonicity of these fluxes is provided. The spacial discretization is based on a weighted essentially non-oscillatory reconstruction of the derivative. The accuracy and stability properties of our scheme are demonstrated in a variety of examples. A comparison between our method and other fifth-order schemes for Hamilton-Jacobi equations shows that our method exhibits smaller errors without any increase in the complexity of the computations.

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