Well-Balanced Finite Difference Schemes for the Euler Equations Under Gravitational Fields

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Euler equations under gravitational field admit hydrostatic equilibrium state where the flux produced by the pressure is exactly balanced by the gravitational source term. In this talk, we present high order well-balanced finite difference WENO schemes, which can preserve the isentropic hydrostatic balance state exactly and maintain genuine high order accuracy for general solutions. To obtain the well-balanced property, we firstly rewrite the source into an equivalent form, and construct the numerical flux by means of a flux modification technique. Rigorous theoretical analysis as well as extensive numerical examples all suggest that the present schemes preserve the well-balanced property. Moreover, one- and two-dimensional simulations are performed to test the ability to capture small perturbation of such steady state, and the genuine high order accuracy in smooth regions.