Inverse Lax-Wendroff Procedure for Numerical Boundary Conditions

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We discuss a recent development of a high order finite difference numerical boundary condition for solving hyperbolic Hamilton-Jacobi equations, hyperbolic conservation laws, and convection-diffusion equations on complex geometry using a Cartesian mesh. The challenge results from the wide stencil of the interior high order scheme and the fact that the boundary may not be aligned with the mesh. Our method is based on an inverse Lax-Wendroff procedure for the inflow boundary conditions coupled with traditional extrapolation or weighted essentially non-oscillatory (WENO) extrapolation for outflow boundary conditions. The schemes are shown to be high order and stable, under the standard CFL condition for the inner schemes, regardless of the distance of the first grid point to the physical boundary, that is, the "cut-cell" difficulty is overcome by this procedure. Numerical examples are provided to illustrate the good performance of our method. This is a joint work with Jinwei Fang, Ling Huang, Tingting Li, Jianfang Lu, Jianguo Ning, Sirui Tan, Francois Vilar, Cheng Wang and Mengping Zhang.