Diagonal-norm upwind SBP operators

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Abstract

I will present some new results concerning explicit high-order finite difference methods applied to hyperbolic systems. In particular I will present some new results that support the addition of appropriate artificial dissipation, even for linear problems.

Recently, high-order accurate first derivative finite difference operators are were derived that naturally introduce artificial dissipation. The boundary closures are based on the diagonal-norm summation-by-parts (SBP) framework and the boundary conditions are imposed using a penalty (SAT) technique, to guarantee linear stability for a large class of initial boundary value problems. These novel first derivative SBP operators have a non-central difference stencil in the interior, and come in pairs (for each order of accuracy). The accuracy and stability properties are demonstrated for linear first- and second-order hyperbolic problems in 1D, and for the compressible Euler equations in 2D. The newly derived first derivative SBP operators lead to significantly more robust and accurate numerical approximations, compared with the exclusive usage of (previously derived central) non-dissipative first derivative SBP operators.

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