On the discretization of convective fluxes for aeroacoustic Large Eddy Simulations

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Abstract A high order finite difference solver is implemented in order to test the accuracy and effectiveness of several numerical schemes for the aeroacoustic Large Eddy Simulations of compressible flows. The sharp gradients that are present in compressible flows and the low-dissipation required for aeroacoustics using LES can impose contradictory requirements for the discretization of the convective terms. The present solver uses multiple discretization strategies for the convective terms such as the Roe-Pike scheme, the Kurganov-Tadmor scheme or the explicit 4-th order centered difference, with high order filtering. Variable reconstruction is done via the 3-rd order Monotone Upstream-centered Scheme for Conservation Laws, with multiple limiters. A new model that blends the centered discretization with an upwind scheme tries to reconcile the contradictory requirements. The blending parameter is defined as a continuous function based on the variation of the gradient of the density field. The diffusive terms are discretized using the explicit 4-th order centered difference with geometrical averaging. The accuracy, fidelity and efficiency of the solver are examined by comparing against other established results. The solver is parallelized for distributed memory platforms using domain decomposition and Message Passing Interface and salient features of the parallel algorithm are presented.

References

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