R-adaptation for unsteady compressible flow simulations in two and three dimensions

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ABSTRACT

We present an algorithm to perform PDE-based r-adaptation in two- and three-dimensional numerical simulations of unsteady compressible flows on unstructured meshes. A Laplacian-based model for the moving mesh is used to follow the evolving shock-wave patterns in the fluid flow, while the finite volume ALE formulation of the flow solver is employed to implicitly perform a conservative remapping of the solution from the previous to the current mesh, at each time step of the simulation.

First, we show the application of the method to classical two-dimensional test cases. Then, we show its extension and application to compressible flows on three-dimensional geometries. To this aim, an improved relaxation scheme has been developed in order to preserve the validity of the mesh throughout the time simulation in three dimensions, where the geometrical constraints typically restrict the allowable mesh motion.

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