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An Inviscid Compressible Flow Solver Based on Unstructured OpenFOAM Mesh Format

Authors : Utkan Caliskan

Abstract : Two types of numerical codes based on finite volume method are developed in order to solve compressible Euler equations to simulate the flow through forward facing step channel. Both algorithms have AUSM+- up (Advection Upstream Splitting Method) scheme for flux splitting and two-stage Runge-Kutta scheme for time stepping. In this study, the flux calculations differentiate between the algorithm based on OpenFOAM mesh format which is called 'face-based' algorithm and the basic algorithm which is called 'element-based' algorithm. The face-based algorithm avoids redundant flux computations and also is more flexible with hybrid grids. Moreover, some of OpenFOAM's preprocessing utilities can be used on the mesh. Parallelization of the face based algorithm for which atomic operations are needed due to the shared memory model, is also presented. For several mesh sizes, 2.13x speed up is obtained with face-based approach over the element-based approach.

Keywords : cell centered finite volume method, compressible Euler equations, OpenFOAM mesh format, OpenMP
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