EFFICIENT OBJECT-ORIENTED IMPLEMENTATION OF A FINITE VOLUME FLOW SOLVER

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This project is mainly focused on the CFD simulation of steady, inviscid, compressible air flow without heat transfer, heat generation, external forces and sources for various test cases, by using time-marching approach. The objective was to efficiently implement state-of-the-art cell-centered finite volume numerical methods for Euler equations on 2D and 3D unstructured grids in the object-oriented framework COOLFluiD under development at the von Karman Institute for Fluid Dynamics.

Roe's scheme was implemented first for 2D and 3D, followed by mirror, subsonic inlet and subsonic outlet boundary conditions for 2D and 3D cell-centered finite volume approach. Linear least squares reconstruction for 2D, Venkatakrishnan's and Barth-Jespersen's limiters for 2D and 3D and linear least squares reconstruction for 3D were implemented next. Afterwards, $AUSM^+$-up scheme was implemented for 2D and 3D. The last development was a far-field boundary condition for 2D. The test cases solved are Burger's equation, interaction of two supersonic jets for 2D and 3D, supersonic flow inside a channel over a compression corner, subsonic flow inside a channel over a sinus bump, transonic flow over a NACA0012 airfoil and hypersonic flow over a sphere.

Finally, a comparison was made between the time efficiencies of the COOLFluiD, NSC2KE and THOR codes for transonic flow over a NACA0012 airfoil test case. As a result, COOLFluiD came out to have similar efficiency with THOR; but it was less efficient than NSC2KE for 2D.

Figures 1 and 2 show the Mach number isolines over a compression corner and a NACA0012 airfoil, respectively, for 2nd order results obtained with both schemes.

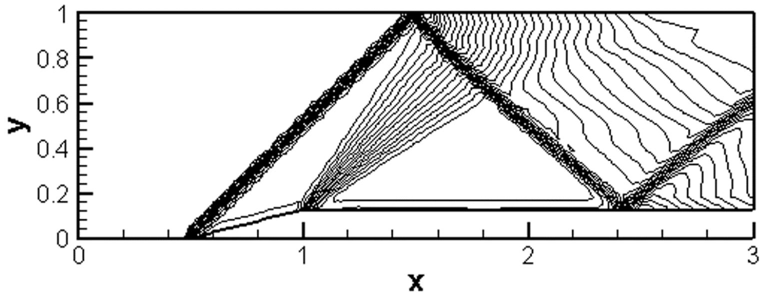

Figure 1: Mach number isolines over a compression corner, Roe's scheme with Barth-Jespersen's limiter

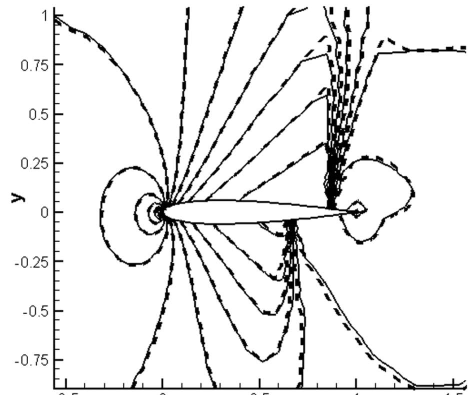

Figure 2: Mach number isolines over a NACA0012 airfoil, Roe's scheme with Barth-Jespersen's limiter (solid), $AUSM^+$-up scheme with Venkatakrishnan's limiter (dashed)