A Mixed Order of Galerkin Discretization for Steady Compressible Navier-Stokes Equations in Lid-Driven Flows

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Abstract

In this paper, we propose a blend of high ordera Galerkin discretization schemes for solving steady compressible Navier-Stokes equations. The pointwise numerical fluxes are separated into convective fluxes, acoustic fluxes, and viscous fluxes. Several combinations of discretization order on these fluxes are investigated. The overall residual is integrated using fourth-order Runge-Kutta scheme with a preconditioning matrix. The spurious numerical oscillations are reduced by using a high collocation points to calculate the viscous stresses and temperature gradient. Using a high order discretization on all the fluxes, the solution is smooth, but the resolution does not improve. To resolve the corner vortices more closely, a second order of discretization for convective flux, a eighth order of discretization on acoustic flux and a fourth order of discretization on viscous fluxes are suggested. Numerical experiments for several Reynolds number in lid-driven problem confirm the high resolution and good quality of our scheme to resolve the flow field.

Keyword：Galerkin discretization, aliasing errors, lid-driven problem, precondition matrix