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A Posteriori Error Estimate Techniques for Coupled Navier-Stokes Equations and Energy Equation

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Abstract

The compressible viscous fluid flow can be modeled by coupling the Navier-Stokes Equations for a compressible fluid and an energy equation describing the accompanying heat transfer phenomena. Accurate compressible Navier-Stokes flow simulation can be achieved through adaptive finite element strategy oriented by *a posteriori* error estimation. Due to the presence of several complicated nonlinear terms in the coupled Navier-Stokes equation and energy equation, it is rather difficult to directly compute an error estimator for the whole coupled system. In this work, we numerically establish two separate *a posteriori* error estimate frameworks corresponding to the Navier-Stokes equations and the energy equation, respectively. In practice, we alternatively use these two resulting error estimation systems as criterion for mesh adaptation to ensure a minimization of errors of finite elementsolution for all involved variables. Numerical experiments on simulation of compressible flows around NACA0012 airfoil are implemented to demonstrate the efficiency of our new *a posteriori* error estimate techniques.