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Adiabatic shock capturing in perfect gas hypersonic flows. (English) Zbl 1427.76133

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Summary: This paper considers the streamline-upwind Petrov/Galerkin (SUPG) method applied to the compressible Euler and Navier-Stokes equations in conservation-variable form. The spatial discretization, including a modified approach for interpolating the inviscid flux terms in the SUPG finite element formulation, is briefly reviewed. Of particular interest is the behavior of the shock-capturing operator, which is required to regularize the scheme in the presence of strong, shock-induced gradients. A standard shock-capturing operator that has been widely used in previous studies by several authors is presented and discussed. Specific modifications are then made to this standard operator that is designed to produce a more physically consistent discretization in the presence of strong shock waves. The actual implementation of the term in a finite-dimensional approximation is also discussed. The behavior of the standard and modified scheme is then compared for several supersonic/hypersonic flows. The modified shock-capturing operator is found to preserve enthalpy in the inviscid portion of the flowfield substantially better than the standard operator.

MSC:

76M10	Finite element methods applied to problems in fluid mechanics
76L05	Shock waves and blast waves in fluid mechanics
76K05	Hypersonic flows
76N15	Gas dynamics (general theory)
35Q30	Navier-Stokes equations
35Q31	Euler equations

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