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**A stabilized finite element method based on SGS models for compressible flows.** (English)

Zbl 1120.76331

Comput. Methods Appl. Mech. Eng. 196, No. 1-3, 652-664 (2006).

Summary: We present an appropriate extension of the stabilized finite element formulation, introduced in [A. Corsini, F. Rispoli, A. Santoriello, A variational multiscale high-order finite element formulation for turbomachinery flow computations, Comput. Methods Appl. Mech. Engrg. 194 (2005) 4797-4823] for the prediction of incompressible flows, aimed at compressible flows. The stabilized formulation is the so-called variable subgrid scale method (V-SGS) based on an approximation of the class of subgrid scale models (SGS) derived from the Hughes variational multiscale method (Hughes-VMS) introduced in [T.J.R. Hughes, Multiscale phenomena: Green's functions, the Dirichlet-to-Neumann formulation, subgrid scale models, bubbles and the origins of stabilized methods, Comput. Methods Appl. Mech. Engrg. 127 (1995) 387-401]. It is characterized by a variable stabilization parameter within the domain of element.

We also propose an innovative procedure for computing the stabilization parameter by using the one-dimensional element Green's functions corresponding to an advective-diffusive differential operator. The stabilization parameter is defined as the sum of two components, the first providing its mean value and the second its element-wise space dependency. On this basis the present work proposes the stabilization matrix for the multidimensional advective-diffusive system of equations governing compressible flows. The procedure developed for computing the stabilization parameter can be applied to other differential operators as it has been shown in [A. Corsini, F. Rispoli, A. Santoriello, A variational multiscale high-order finite element formulation for turbomachinery flow computations, Comput. Methods Appl. Mech. Engrg. 194 (2005) 4797-4823]. The proposed stabilization device is validated by simulation of inviscid and viscous supersonic flow configurations.

**MSC:**

76M10 Finite element methods applied to problems in fluid mechanics

76N15 Gas dynamics (general theory)

Cited in **15** Documents

**Keywords:**

Variational multiscale method; subgrid scale models; compressible flows; stabilized finite element method

**Full Text:** DOI

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