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VARIATIONAL MULTISCALE STABILIZATION METHOD FOR COMPRESSIBLE FLOWS

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Abstract. This paper describes a Variational Multiscale method for Compressible flows, VMS-C, firstly presented in [1,2,6]. While the VMS method was introduced by Hughes and co-workers [3] in the context of incompressible flows, it is not until very recently that compressible flow has being addressed to be stabilized following these ideas. A version for mixed Finite Volumes method is proposed in [4] and a first version for supersonic flow is presented in [5]. In the present paper, we derive a totally new formulation for a wide range of Mach numbers, analyzing different linearization strategies and stabilization parameter tau, modeled as a "non- diagonal" stabilization parameter matrix. The wide range of Mach numbers is tested with examples ranging from transient atmospheric flows benchmarks up to hypersonic flows. For the case of supersonic flows, an anisotropic shock-capturing diffusion is added. Viscous problems are addressed, particularly supersonic ones with temperature dependent viscosities. In this paper, the explicit version of the VMC-C algorithm is addressed, parallelized with almost linear scalability up to thousands of processors, extending the tests of [1,2,6] and focusing mainly in implementation issues.

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