A priori and a posteriori error analysis of an augmented mixed finite element method for incompressible fluid flows

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Abstract

In this paper we extend recent results on the a priori and a posteriori error analysis of an augmented mixed finite element method for the linear elasticity problem, to the case of incompressible fluid flows with symmetric stress tensor. Similarly as before, the present approach is based on the introduction of the Galerkin least-squares type terms arising from the constitutive and equilibrium equations, and from the relations defining the pressure in terms of the stress tensor and the rotation in terms of the displacement, all of them multiplied by stabilization parameters. We show that these parameters can be suitably chosen so that the resulting augmented variational formulation is defined by a strongly coercive bilinear form, whence the associated Galerkin scheme becomes wellposed for any choice of finite element subspaces. Next, we present a reliable and efficient residualbased a posteriori error estimator for the augmented mixed finite element scheme. Finally, several numerical results confirming the theoretical properties of this estimator, and illustrating the capability of the corresponding adaptive algorithm to localize the singularities and the large stress regions of the solution, are reported.