Abstract:
Flow computations frequently require unfavourably meshes as for example highly stretched elements in regions of boundary layers or distorted elements in deforming arbitrary Lagrangian Eulerian (ALE) meshes. Thus the performance of a flow solver on such meshes is of great interest. The behaviour of finite elements with residual based stabilisation for incompressible Newtonian flow on distorted meshes is considered here. We investigate the influence of the stabilisation terms on the results obtained on distorted meshes by a number of numerical studies. The effect of different element length definitions within the elemental stabilisation parameter is considered. Further different variants of residual based stabilisation are compared indicating that dropping the second derivatives from the stabilisation operator, i.e. using a SUPG type of formulation yields better results in a variety of cases. A comparison of the performance of linear and quadratic elements reveals further that the inconsistency of linear elements equipped with residual based stabilisation introduces significant errors on distorted meshes while quadratic elements are almost unaffected by moderate mesh distortion.
stabilized finite elements, incompressible flow, distorted meshes, ALE methods, finite element methods, Petrov-Galerkin

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