Adaptive *hp*-Finite Element Method for Low Mach Number Flows

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Abstract

Flow configurations in the low-Mach number regime usually lead locally to large gradients in the velocity field as well as in the temperature variable. Such structures including boundary layers are typical in the study of e.g. heat transfer problems or more generally in situations where compression effects are mainly due to thermodynamical effects (see e.g. [1]). We propose a method based on *hp*-FEM which allows the simultaneous adaptation of the mesh size h and the polynomial degree p of FEM ansatz in the context of a Low Mach number model. A duality-based a posteriori error analysis is developed for the conforming *hp* Galerkin finite element approximation. Duality arguments combined with Galerkin orthogonality yield representations of the error in arbitrary quantities of interest and depending on the regularity of the solution leads locally to an h or p refinement. Applications for 2D and 3D low Mach number flows are presented and demonstrate the high effectivity of the proposed approach.

References

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