

Adaptive Multimesh hp -FEM for Coupled Problems with Boundary Layers

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ABSTRACT

Multiphysics coupled problems pose a true challenge to adaptive numerical methods due to the accumulation of many difficulties – the lack of analytical a-posteriori error estimates, presence of strong nonlinearities, and multiscale behavior to mention just a few. The former can be tackled using robust computational error estimates [1]. The latter is often dealt with via operator splitting and using different meshes for various solution components. This, however, can lead to a significant loss of accuracy and sometimes even stability of the numerical method [1]. We introduce a novel adaptive multimesh hp -FEM that approximates various physical fields on different meshes *without operator splitting* [3]. The resulting discretization is *monolithic* and it can be very efficient especially when some solution components contain a boundary or internal layer while others do not. We begin the presentation by showing the advantage of hp -FEM over low-order FEM in the context of singularly perturbed problems, and of using both spatially and polynomially anisotropic refinements. Then we describe the multimesh hp -FEM and show its application to selected coupled PDE systems where only some solution components contain boundary layers.

References

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