A CONTINUOUS $hp-$MESH MODEL FOR DPG FINITE ELEMENT SCHEMES WITH OPTIMAL TEST FUNCTIONS

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ABSTRACT

In many industrial and academic applications, certain quantities of interest, such as flux across a specific boundary or solution in a particular sub-domain, are subject to more interest than the solution variable itself. In these cases, adapting the mesh for resolving the governing PDE's solution features may result in an unwanted increase in the number of degrees of freedom. In this context, goal-oriented mesh adaptation techniques have been critical for producing meshes that only focus on resolving the target functional. Typically, these adaptation techniques often compute the element size distribution by solving a compatible dual problem. However, this can be complemented by selecting a correct local polynomial order for approximating the primal variables.

In terms of meshing techniques, it has already been shown that metric-based mesh generation can produce anisotropic meshes having substantial advantage while resolving anisotropic flow features such as sharp boundary layers and singularities [2]. In this work, we present a goal-oriented metric-based mesh adaptation scheme where we employ the recently proposed DPG-star method for solving the compatible dual problem and the associated a posteriori error estimate for computing element size distribution. Also, we solve certain local problems and utilize the well-established energy norm error estimator [1] to obtain an appropriate polynomial order of approximation for the primal variables and anisotropy of the elements in the mesh.

References

[1] Leszek Demkowicz and Jay Gopalakrishnan,*A class of discontinuous Petrov–Galerkin methods. II. Optimal test functions*,Numerical Methods for Partial Differential Equations.2011

[2] Ankit Chakraborty, Ajay Mandyam Rangarajan, Georg May, *An anisotropic h-adaptive strategy for discontinuous Petrov-Galerkin schemes using a continuous mesh model*, Computers & Mathematics with Application. 2022

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