A DPG METHOD FOR THE QUAD-CURL PROBLEM

THOMAS FÜHRER, PABLO HERRERA, AND NORBERT HEUER

Abstract. In this talk we present an ultra-weak formulation for the quad-curl problem in two and three dimensions. We provide a discontinuous Petrov–Galerkin (DPG) method [4] and prove its quasi-optimal convergence. The quad-curl problem is related with many applications of science and engineering. For example, we can find some applications in the fields of magneto-hydrodynamics, electromagnetic inverse scattering theory, and fluid dynamics. For instance, we show an application of the quad-curl problem for the Stokes problem in two dimensions. We eliminate the pressure variable involved in the Stokes equations, via the application operator, and apply the DPG techniques for the Kirchoff–Love plate bending problem [2, 3]. Also, we provide a fully discrete DPG method in two dimensions. We show an a priori error estimate which also improves past error estimation for effective shear forces using a less restrictive regularity assumption. Finally, we show numerical experiments that confirm our findings.

Keywords: DPG, quad-curl, Stokes, Kirchhoff–Love

Mathematics Subject Classifications (2010): 35J35, 65N30, 74K20, 35J67

Acknowledgment: Support by ANID-Chile through FONDECYT projects 1190009 and 1210391 is gratefully acknowledged.

References

[1] T. Führer, P. Herrera and N. Heuer. A DPG method for the quad-curl problem. *Comput. Math. Appl.* (in press), 2023.

[2] T. Führer, N. Heuer, and A. H. Niemi. An ultraweak formulation of the Kirchhoff–Love plate bending model and DPG approximation. *Math. Comp.*, 88:1587–1619, 2019.

[3] T. Führer and N. Heuer. Fully discrete DPG methods for the Kirchhoff–Love plate bending model. *Comput. Methods Appl. Mech. Engrg.*, 343:550–571, 2019.

[4] L. F. Demkowicz and J. Gopalakrishnan. A class of discontinuous Petrov–Galerkin methods. Part ii. optimal test functions. *Numer. Methods Partial Differential Equations.*, 27 (1):70–105, 2011.

Facultad de Matematicas, Pontificia Universidad Católica de Chile, Avenida Vicuña Mackenna 4860, Santiago, Chile

Email address: {tofuhrer,pcherrera,nheuer}@mat.uc.cl