DPG FOR PLATE BENDING, PART I

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ABSTRACT. The discontinuous Petrov–Galerkin method with optimal test functions (DPG method) is a family of schemes that combine the use of product test spaces with so-called optimal test functions to automatically satisfy the discrete inf-sup condition. In this form it has been proposed by Demkowicz and Gopalakrishnan [2], initially for transport problems. Since then, DPG settings have been developed for several problems of different types. An important class of models is that of plate bending. Two linear cases are the Kirchhoff–Love and the Reissner–Mindlin models. A first DPG approximation for the latter one has been proposed in [1]. The Reissner–Mindlin model can be interpreted as a singularly perturbed case of the Kirchhoff–Love formulation. There are many numerical schemes for the Reissner–Mindlin case, and the holy grail is to obtain robust approximations with respect to the plate thickness. The setup from [1] does not consider this perturbation.

Our aim is to use DPG techniques to approximate model variables that are less regular than the deflection or rotation. Specifically, we have developed DPG schemes that include the approximation of bending moments, also in the case of non-convex polygonal plates [3, 4].

In our presentations, we will report on these DPG schemes and their analysis. We specifically include fully discrete variants that take into account the approximation of optimal test functions.

REFERENCES

[1] V. M. Calo, N. O. Collier, and A. H. Niemi. Analysis of the discontinuous Petrov–Galerkin method with optimal test functions for the Reissner–Mindlin plate bending model. *Comput. Math. Appl.*, 66 (12):2570–2586, 2014.

[2] L. F. Demkowicz and J. Gopalakrishnan. A class of discontinuous Petrov-Galerkin methods. Part I: the transport equation. *Comput. Methods Appl. Mech. Engrg.*, 199 (23–24):1558–1572, 2010.

[3] T. Führer, N. Heuer, and A. H. Niemi. An ultraweak formulation of the Kirchhoff–Love plate bending model and DPG approximation. *Math. Comp.* (appeared online, DOI:10.1090/mcom/3381).

[4] 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.

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