

POLYGONAL STAGGERED DISCONTINUOUS GALERKIN METHODS

EUN-JAE PARK*, ERIC CHUNG, DOHYUN KIM, LINA ZHAO

ABSTRACT

In this talk, we first present the staggered discontinuous Galerkin method on general meshes for the Poisson equation [1]. Adaptive mesh refinement is an attractive tool for general meshes due to their flexibility and simplicity in handling hanging nodes. We derive a simple residual-type error estimator. Numerical results indicate that optimal convergence can be achieved for both the potential and vector variables, and the singularity can be well-captured by the proposed error estimator. Then, some applications [2, 3, 4, 5] to interface problems are considered such as coupling of Darcy-Forchheimer and Stokes equations, and a single-phase flow in porous media with a fracture. In the case of a fractured porous media [5], the bulk variables are solved using staggered DG method and an interface variable is solved using the continuous Galerkin method. We derive optimal convergence for both pressure and velocity fields. Numerical experiments suggest that our method is more accurate when polygonal meshes are used among various mesh configurations; moreover, our method is robust to mesh distortion. These observations allow us to consider unfitted methods without any special treatment. With background meshes generated independent of fracture, numerical solutions converge in optimal order.

REFERENCES

- [1] L Zhao and E-J Park, A staggered DG method of minimal dimension on quadrilateral and polygonal meshes, *SIAM J. Sci. Computing* 40(4) 2018, A2543-A2567.
- [2] L Zhao and E-J Park, A staggered cell-centered DG method for linear elasticity on polygonal meshes, *SIAM J. Sci. Comput.* 42 (2020), no. 4, A2158-A2181.
- [3] Dohyun Kim, L Zhao and E-J Park, Staggered DG Methods for the Pseudostress-Velocity Formulation of the Stokes Equations on General Meshes. *SIAM J. Sci. Comput.* 42 (2020), no. 4, A2537-A2560.
- [4] L Zhao, E. Chung, E-J Park, and G. Zhou, Staggered DG method for coupling of the Stokes and Darcy-Forchheimer problems, *SIAM J. Numer. Anal.* 59 (1), 1–31, (2021).

- [5] L Zhao, Dohyun Kim, E-J Park, E. Chung, Staggered DG Method with Small Edges for Darcy Flows in Fractured Porous Media, *Journal of Scientific Computing* (2022).

* YONSEI UNIVERSITY, EJPARK@YONSEI.AC.KR