Goal-Oriented Mesh Adaptation based on Optimization Approaches

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ABSTRACT

The talk will deal with the development and analysis of optimal approaches for mesh adaptation for the discretization of classical boundary-value problems. One can mathematically show that some greedy adaptive methods provide optimal rates of convergence with respect to the energy norm or some quantity of interest for simple problems such as those given in terms of symmetric positive-definite boundary-value problems [1, 5, 2]. Performance of the methods for general problems is far less clear. The objective of the talk will be to reformulate mesh adaptivity in terms of minimization problems with constraints, based either on classical optimization theories [4, 6] or on concepts from optimal transport [3]. The performance of the different formulations will be compared on classical model problems.

REFERENCES

[1] P. Binev, W. Dahmen, and R. DeVore. Adaptive finite element methods with convergence rates. *Numerische Mathematik*, 97:219–268, 2004.

[2] M. Feischl, D. Praetorius, and K. van der Zee. An abstract analysis of optimal goal-oriented adaptivity. *SIAM J. Numer. Anal.*, 54 (3):1423–1448, 2016.

[3] B. Lévy. A numerical algorithm for L2 semi-discrete optimal transport in 3D. *ESAIM: Mathematical Modelling and Numerical Analysis*, 49:1693–1715, 2015.

[4] G. McNeice and P. Marcal. Optimization of finite element grids based on minimum potential energy. *Journal of Engineering for Industry*, 95(1):186–190, 1973.

[5] M. Mommer and R. Stevenson. A goal-oriented adaptive finite element method with convergence rates. *SIAM J. Numer. Anal.*, 47 (2):861–886, 2009.

[6] M. Zahr, A. Shi, and P.-O. Persson. Implicit shock tracking using an optimization-based high-order discontinuous Galerkin method. *Journal of Computational Physics*, 410:109385, 2020.