OPTIMAL MESH COARSENING UNDER CONSTRAINTS

MICHAEL FEISCHL AND HUBERT HACKL

Abstract. In many non-stationary PDE problems, evolving singularities are a cause for inefficiency of finite element approximations. Without coarsening of the underlying triangulation after each time step, a moving singularity will lead to overrefinement and thus many unnecessary degrees of freedom. While coarsening of triangulations is well-understood for non-constrained problems since [1], we consider vector valued equations with non-convex constraints. Particularly, we are interested in problems where the solution is restricted pointwise to a given manifold. A relevant application is computational micro-magnetism, where the governing equation is the Landau-Lifshitz-Gilbert equation which enforces a pointwise length constraint on the solution vector field. Our main result shows that Binev's coarsening algorithm can be adapted to this setting and still delivers optimal coarsening while respecting the constraint. A by-product of the analysis in [2] shows that the coarsening algorithm can also be used to improve on the JPEG image compression algorithm.

Keywords: adaptive mesh-refinement, coarsening, quasi-optimal convergence

Mathematics Subject Classifications (2010): 65N30, 65N50, 15A23

References

[1] P. Binev and R. DeVore. Fast computation in adaptive tree approximation. *Numer. Math.*, 97:193-217, 2004.

[2] M. Feischl and H. Hackl. Adaptive Image Compression via Optimal Mesh Refinement. *arXiv E-print*, arXiv:2304.01640, 2023.

TU Wien - Institute of Analysis and Scientific Computing
Email address: michael.feischl@tuwien.ac.at

TU Wien - Institute of Analysis and Scientific Computing
Email address: hubert.hackl@tuwien.ac.at