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Geometric Multilevel Methods for Isogeometric Analysis

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SUMMARY

Isogeometric discretizations (IGA) are based on the use of spline-type basis functions for numerical approximations of partial differential equations (PDEs). This idea leads to the same type of parametrizations appearing in the computer aided design (CAD), that allows to capture more accurately the geometry of any computational domain. Then, IGA involves an important improvement over the classical finite element method (FEM). On the other hand, the search of an efficient solver is nowadays an important issue and multilevel methods seem to be a good choice, given that they are among the fastest solvers for FEM discretizations. However, they have to be carefully designed. For example, in multigrid methods for IGA, standard smoothers such as Gauss-Seidel do not provide a robust solver with respect to the spline degree and the convergence is seriously deteriorated. In order to find out the reason why this takes place, local Fourier analysis (LFA) is a useful tool. Moreover, it will be used for the design of adequate smoothers and then a robust solver with respect to the polynomial degree will be obtained. At this point, we propose to apply overlapping multiplicative Schwarz methods as relaxation procedures. For these geometric multilevel methods, LFA yields a prediction of a nice asymptotic convergence factor. Finally, numerical experiments will be presented to confirm the theoretical results provided by the analysis.

Keywords: Multilevel methods, Multigrid solver, Isogeometric Analysis, Local Fourier Analysis

AMS Classification: 65F10, 65M22, 65M55

References

[1] Alvaro Pe de la Riva, Carmen Rodrigo, Francisco J. Gaspar. "An efficient multigrid solver for isogeometric analysis", *submitted*. Preprint available in: arXiv:1806.05848v1 [math.NA].

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