Fast Multipatch Isogeometric Analysis Solvers

(Poster)

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In this contribution, we construct and investigate fast solvers for large-scale linear systems of algebraic equations arising from isogeometric analysis (IgA) of diffusion problems with heterogeneous diffusion coefficients on multipatch domains. In particular, we investigate the adaption of the Dual-Primal Finite Element Tearing and Interconnecting (FETI-DP) method to IgA, called Dual-Primal IsogEometric Tearing and Interconnecting (IETI-DP) method. We consider the cases of matching and non-matching meshes on the interfaces. In the latter case, we use a discontinuous Galerkin (dG) method to couple the different patches. This requires a special extension of the IETI-DP method to the dG-IgA formulation.

We use ideas from the finite element case in order to formulate the corresponding IETI-DP method, called dG-IETI-DP. Furthermore, the method is extended to the case of non-matching interfaces due to incorrect segmentation, which produces gaps and overlaps in the domain decomposition. Numerical experiments show that the condition number κ behaves like $O((1+\log(H/h))^2)$, and is robust with respect to jumping diffusion coefficients and changing mesh-sizes across patch interfaces.

We also study the dependence of κ on the underlying polynomial degree p of the NURBS used. In terms of p, we observe a logarithmic dependence. Moreover, we investigate the scaling behaviour of the classical IETI-DP method up to 1024 cores and present numerical results for complicated two and three dimensional domains. We investigate inexact versions utilizing multigrid methods for the solution of the patch-local problems. The advantage is a smaller memory footprint of the algorithm, hence, the possibility to solve larger systems. Finally, we present fast parallel solvers for the huge system arizing from stable space-time IgA approximations to parabolic diffusion problems. The solvers are based on time-parallel multigrid methods. Here the IETI-DP method is used as a part of the smoother.

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