Isogeometric analysis for overlapping multi-patch domains

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ABSTRACT

Isogeometric analysis (IGA) is a recent computational approach, which connects computer aided design (CAD) and numerical simulation methods. In IGA the same function spaces (typically tensor-product B-splines) are used both for the geometry representation and numerical analysis. In order to avoid trimming, complicated domains can be constructed as a union of simple overlapping subdomains. However, numerical simulation on such domains is a serious challenge. There are three approaches, which can be employed to solve PDEs on such domains. One can split and reparameterize the patches to obtain a non-overlapping multi-patch structure, one can trim some of the subdomains to remove the overlaps (see [1]), or one can reformulate the model problem to be able to handle overlaps directly.

A global reparameterization is usually costly and should be avoided. On the other hand, trimming results in a collection of non-overlapping, but trimmed patches with (generally) non-matching intefaces. However, the numerical integration as well as imposing the coupling and boundary conditions are complicated.

To avoid these difficulties, we employ methods that can handle overlapping subdomains directly. One possibility is to use iterative methods, such as the *Additive Schwarz* domain decomposition method, see [2]. Here the PDE is solved on each subdomain in each interation step. The coupling between sub-problems is achieved by imposing boundary conditions at the coupling boundaries. The method becomes inefficient for a large number of overlapping subdomains or for small overlaps, as the number of iterations increases.

In this talk we show that PDEs on overlapping multi-patch domains can be solved directly, without reparameterizations or trimming. We set up one global system which can be solved directly without using a Schwarz-type iteration. The proposed approach, presented in [3], reduces the computational cost significantly and is robust for small sizes of overlaps or large numbers of subdomains.

REFERENCES

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