Scaled Boundary Parametrizations in Isogeometric Analysis

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ABSTRACT

This contribution is concerned with a special class of parametrizations for Isogeometric Analysis (IGA). The so-called scaled boundary parametrizations are easy to construct and particularly attractive if only a boundary description of the computational domain is available. The idea goes back to the Scaled Boundary Finite Element Method [3], which has recently been extended to IGA. We take here a different viewpoint and study these parametrizations as bivariate or trivariate B-spline functions that are directly suitable for standard Galerkin-based IGA. Our results are first a general framework for this class of parametrizations, including aspects such as smoothness and regularity as well as generalizations to domains that are not star-shaped.

In the talk, the relation of this approach to the classical concept of Isogeometric Analysis is analyzed. In particular, focusing on a linear problem, we compare classical IGA with scaled boundary IGA where the weak form and Galerkin projection are used both in scaling and in circumferential direction. Using the Poisson equation as example, we explain the relation between these two methods by means of the Laplace-Beltrami operator. Further results concern the separation of integrals in both approaches, an analysis of the singularity in the scaling center, and a multipatch decomposition based on the art gallery problem.

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REFERENCES

[1] C. Arioli, A. Shamanskiy, S. Klinkel, B. Simeon, *Scaled Boundary Parametrizations in Isogeometric Analysis*. arXiv Preprint: 1711.05760 (2017)

[2] L. Chen, B. Simeon and S. Klinkel, *A NURBS based Galerkin approach for the analysis of solids in boundary representation*. Computer Methods in Applied Mechanics and Engineering 305, 777–805, 2016.

[3] C. Song, J.P. Wolf, *The scaled boundary finite-element method - alias consistent infinitesimal finite-element cell method - for elastodynamics.* Computer Methods in Applied Mechanics and Engineering 147, 329–355, 1997.