Coupling of patches for isogeometric analysis of solids in boundary representation

Margarita Chasapi*, Wolfgang Dornisch† and Sven Klinkel*

* Chair of Structural Analysis and Dynamics (LBB)
RWTH Aachen University
Mies-van-der-Rohe-Str. 1, 52074 Aachen, Germany
e-mail: {chasapi,klinkel}@lbb.rwth-aachen.de, web page: http://www.lbb.rwth-aachen.de/

† Chair of Structural Analysis and Dynamics
BTU Cottbus - Senftenberg
Konrad-Wachsmann-Allee 2, 03046 Cottbus, Germany
e-mail: wolfgang.dornisch@b-tu.de - web page: https://www.b-tu.de/fg-statik-dynamik/

ABSTRACT

In this contribution we present a coupling approach for non-conforming NURBS patches in the framework of an isogeometric formulation in boundary representation [1]. In order to fit the boundary representation modeling technique in CAD, we follow the idea of the scaled boundary finite element method [2] for the parameterization of the solid. Thus, two-dimensional solid surfaces are partitioned into sections in relation to a central point, the scaling center. Each section is parameterized with a circumferential parameter along the boundary and a radial scaling parameter in the interior of the domain. We employ NURBS basis functions for the approximation of the solution in both parametric directions. The approximation in scaling direction is flexible and allows for local refinement within the computational domain. For the coupling of non-conforming sections we employ a mortar approach as presented in [3]. We establish a master-slave relation for the interface control points between adjacent sections based on the equality of mutual deformations along the interface. The coupling is realized in a weak manner by constraining the basis functions, which means that the NURBS basis functions of the slave side are related to those of the master side so that the solution of both sections along the interface is equal in a weak sense. This approach is derived numerically and its application to nonlinear problems is straightforward. We study several numerical examples of linear and nonlinear problems in solid mechanics and compare the results with conforming computations.

REFERENCES

[1] Chasapi, M. and Klinkel, S. A scaled boundary isogeometric formulation for the elasto-plastic analysis of solids in boundary representation. *Comput. Methods Appl. Mech. Engrg.* (2018) **333**:475–496.

[2] Song, C. and Wolf, J.P. The scaled boundary finite-element method−alias consistent infinitesimal finite-element cell method−for elastodynamics. *Comput. Methods Appl. Mech. Engrg.* (1997) **148**:329–355.

[3] Dornisch, W., Vitucci, G. and Klinkel, S. The weak substitution method − an application of the mortar method for patch coupling in NURBS-based isogeometric analysis. *Int. J. Numer. Meth. Engng.* (2015) **103**:205–234.