ADVANTAGES OF SPLINE-BASED INTERFACES FOR FLUID-STRUCTURE INTERACTION IN BALLOON-TYPE PROBLEMS

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Abstract. Inflating Balloon-type problems are characterized by two numerical challenges: First, a deviation of the geometry, e.g., caused by discretization, can have a dramatic influence on the numerical result. Second, the composition of the boundary by an inflow and a moving but impermeable wall typically results in a problem with Dirichlet boundaries only. This leads to difficulties for partitioned fluid-structure interaction approaches, if incompressible fluids are involved. In the presented work, the first problem is handled by using a geometrically matching interface based on Non-Uniform Rational B-Spline (NURBS) interface [1]. On the solid side a shell model is solved with isogeometric analysis (IGA) [2]. Following the idea of the NURBS-enhanced finite element method [3], the spline-based interface is considered on the fluid side only at the boundary. The second problem is treated by enforcing the coupling condition at the interface through a Robin-Neumann-type coupling scheme. The accuracy of the partitioned FSI approach is demonstrated with two- and three-dimensional benchmark problems.

REFERENCES

- [1] N. HoVsters, J. Helmig, A. Stavrev, M. Behr and S. Elgeti, Fluid-Structure Interaction with NURBS-based Coupling, *Comput. Methods Appl. Mech. Engrg.*, **Vol 332**, pp. 520-539, 2018.
- [2] T.J.R. Hughes, J.A. Cottrell and Y. Bazilevs, Isogeometric analysis: CAD, Finite Elements, NURBS, exact geometry and mesh refinement. *Comput. Methods Appl. Mech. Engrg.* **Vol 194**: pp. 4135-4195, 2005.
- [3] R. Sevilla; S. Fernandez-Mendez and A. Huerta, NURBS-Enhanced Finite Element Method (NEFEM): A Seamless Bridge Between CAD and FEM. *Arch of Computat. Methods Eng.* **Vol 18**: pp. 441-484, 2011.