Isogeometric Shell Analysis with Nonlocal Contact in TIGAR

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ABSTRACT

Isogeometric analysis (IGA) has proven to be a powerful technology for shell structure analysis. However, the rate of technological progress in isogeometric shell analysis is often limited by the pace at which new formulations can be tediously linearized and translated into software implementations, which must subsequently be carefully debugged. The FENICS Project [1] introduced a flexible Unified Form Language (UFL) for specificying high-level descriptions of weak partial differential equation systems, which can be automatically linearized and compiled into C++ routines for efficient (optionally parallel) computations using traditional finite elements. The recent open-source library TIGAR [2, 3] uses the concept of Bézier extraction to make this functionality available for IGA. We demonstrate how TIGAR can greatly accelerate the process of implementing complicated shell structure formulations that rely on smooth isogeometric spline spaces. We also show how this automated approach to assembling shell structure formulation residuals and Jacobians can be combined with manual implementation of a recent nonlocal contact formulation [4], to rapidly apply isogeometric shell formulations in challenging scenarios involving complex (self-)contact, including an isogeometric model of a heart valve immersed in a finite element discretization of blood flow.

REFERENCES

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[3] https://github.com/david-kamensky/tIGAr

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