A new isogeometric approach for Kirchhoff-Love plates and shells

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ABSTRACT

A new approach is introduced for deriving a mixed variational formulation for Kirchhoff plate bending problems with mixed boundary conditions involving clamped, simply supported, and free boundary parts. Based on a regular decomposition of an appropriate nonstandard Sobolev space for the bending moments, the fourth-order problem can be equivalently written as a system of three (consecutively to solve) second-order problems in standard Sobolev spaces. This leads to the design of new discretization methods, which are flexible in the sense, that any existing and well-working discretization method and solution strategy for standard second-order problems can be used as a modular building block of the new method.

In particular, if a multi-patch isogeometric discretization of the plate bending problem is used, only C^0-continuity across patch boundaries for the spline approximation spaces are required.

Similar results for clamped plates have been obtained in [1]. The extension to more general boundary conditions encounters several difficulties including the construction of an appropriate nonstandard Sobolev space, the verification of Brezzi's conditions, and the adaptation of the regular decomposition, which all could be resolved, see [2].

Essential features of this approach can be extended to Kirchhoff-Love shells. On each single patch of a multi-patch representation of the shell the full potential of the isogeometric discretization can be exploited. Across patch boundaries only C^0-continuity for the spline approximation spaces are required.

REFERENCES

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[2] K. Rafetseder and W. Zulehner. A decomposition result for Kirchhoff plate bending problems and a new discretization approach. *ArXiv e-prints*, March 2017. arXiv:1703.07962.