A Study on the Significance of Exact Geometry in Stability Analyses of Shells and Membranes

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ABSTRACT

In recent years, an increased activity in the scientific field of formulations and discretization methods for shell structures can be observed, see for instance [2], [3], [4], among many others. The topic has received a major boost due to the popularity of the isogeometric concept [1], along with finite element methods using NURBS or B-splines as shape functions. Smooth splines are particularly attractive in problems for which the weak form has a variational index of 2 or larger, for instance, the classical Kirchhoff-Love thin shell model. Another frequently mentioned key feature of isogeometric analysis (IGA) is the use of “exact” geometry representation from CAD for computation.

Own preliminary studies for buckling and wrinkling analyses of shells and membranes show that isogeometric shell formulations may provide superior accuracy compared to standard shell finite elements in detecting both critical load levels and physical buckling or wrinkling patterns. That is, isogeometric shell formulations may require only a fractional amount of degrees of freedom for the same level of accuracy obtained with a fine finite element mesh. But: What is the reason for the superior results? Is it due to a better approximation of the solution by smooth splines compared to Lagrange/Hermite polynomials? Or is the better, i.e. “exact”, geometry representation within IGA the key factor for the superior results? The aim of this contribution is to answer these questions systematically, i.e., we study the influence of several parameters on the accuracy of results.

REFERENCES


