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Titel des Beitrags: Integrated design and analysis of structural membranes using the Isogeometric B-Rep Analysis

Abstract: The recently developed Analysis in Computer Aided Design (AiCAD) concept is applied to the integrated design and analysis of structural membranes. This concept allows for a consistent design-through-analysis workflow based on the Isogeometric B-Rep Analysis (IBRA) applied to complete trimmed NURBS surfaces, i.e. unmodified CAD geometry. Structural membranes show very particular characteristics concerning their numerical design and analysis. The arising computational challenges – namely the form-finding of NURBS surfaces, the assembly of trimmed multipatch NURBS geometries, and the application of cable elements along trimming edges – are treated within this contribution. Formulating a structural membrane element for trimmed NURBS surfaces as well as a cable element that is consistently embedded within the trimmed multi-patch NURBS surface as a B-Rep edge element, these challenges are met. The proposed element formulations are applied to selected numerical examples. In a non-linear structural analysis of untrimmed and trimmed multi-patch geometries, the accuracy, robustness and applicability of the developed element formulations is demonstrated. The example of a minimal surface illustrates
form-finding with the formulated elements and is assessed against analytical solutions. Additionally, the "exactness" of NURBS for geometry representation in the context of mechanically motivated structural shapes is discussed with this example.

Stichworte: Analysis in Computer Aided Design (AiCAD); Isogeometric B-Rep Analysis (IBRA); Trimmed multi-patch geometries; Prestressed membrane element; Embedded cable element; Form-finding

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