Innovative CAD-integrated Isogeometric Simulation of Sliding Edge Cables in Lightweight Structures

The focus of the paper is twofold: About the practical structural problem of membrane structures mechanically prestressed by edge cables, which are allowed to slide tangentially, and about an innovative CAD-integrated simulation technique. The structural problem is well recognized but the new technique most elegantly resolves the challenges of standard discretization approaches when dealing with the formulation and solution of the sliding contact of two bodies discretized by individual, non-matching meshes moving relatively to each other. The proposed formulation takes advantage of the parameter space of NURBS patches and extends the weak coupling formulation by adding a degree of freedom in the parameter space and thus inherently satisfies the sliding constraints. Indeed, the presented contact formulation is of most general importance and may be applied to many other contact problems of structural mechanics. The special case of an edge supported membrane structure, however, is a most illustrative case to demonstrate how this technique is embedded into CAD and the sliding contact can immediately be considered in the early stages of architectural design. As a consequence, the effect to the stresses and displacements can immediately be studied and controlled. The contribution briefly presents and verifies the newly proposed approach with some
examples and demonstrates the applicability in different real-world problems.

Stichworte:
Isogeometric analysis, embedding, sliding cable, contact, NURBS, construction process, membrane structures, CAD integration

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