Embedded structural entities in NURBS-based isogeometric analysis

The core idea of this article is nested parametrization in the context of isogeometric analysis. The method has been inspired by trimming procedures and can be applied to different applications like local modifications and enhancements of thin-walled structures or coupling of two overlying elements by embedding one in the other. A remodeling for an explicit representation of the boundaries is avoided, which would be contradictory to the aim of isogeometric analysis of using the original CAD model. The nested entity is directly linked to the super element, however its element formulation is independent of the super element formulation within this article. The derivation, implementation and application is shown in particular for one-dimensional entities embedded into 2D domains. Consequently, the definition of an embedded curve in the surface is required and realized by using NURBS curves in the parameter space of the corresponding surface. This curve with its respective predefined base vectors serves as the basis for new element formulations or adaptation of already developed element formulations, which are based on the geometric description of a curve. In detail, an adapted formulation of the recently developed nonlinear isogeometric
spatial Bernoulli Beam by the authors is presented in this paper. Furthermore, those embedded
curves are used for line supports and loads, as well as a mass manipulation. The accuracy of the
proposed element formulation is verified by several benchmark examples and the potential for
future applications is briefly revealed.

Stichworte:  Nonlinear isogeometric analysis; Nested parameterization; Embedded beam element; Trimming; NURBS

Zeitschriftentitel:  Computer Methods in Applied Mechanics and Engineering

Jahr:  2017
Band:  325
Jahr / Monat:  2017-10
Monat:  Oct
Seiten:  198-218
Reviewed:  ja
Sprache:  en

Volltext / DOI:  http://doi.org/10.1016/j.cma.2017.07.010

WWW:  Preprint: Embedded structural entities in NURBS-based isogeometric analysis

Verlag / Institution:  Elsevier BV

Status:  Verlagsversion / published

Publikationsdatum:  01.10.2017

TUM Einrichtung:  Lehrstuhl für Statik

Occurences:  · Einrichtungen > Fakultäten > Ingenieurfakultät Bau Geo Umwelt > Lehrstühle > Lehrstuhl für Statik (Prof. Bletzinger) > Journalbeiträge > 2017
    · Hochschulbibliographie > 2017 > Fakultäten > IngenieurBau Geo Umwelt > Lehrstuhl für Statik (Prof. Bletzinger)

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