IGA Based on Extraction of (Truncated) Hierarchical B-Splines

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ABSTRACT

One of the fundamental topics of research on Isogeometric Analysis (IGA) is local refinement, where various techniques are being currently developed. One approach, denoted by hierarchical B-spline (HB) [1], is to define a suitable set of basis functions on different hierarchical levels. This strategy has been recently improved under the name of truncated hierarchical B-spline (THB) [2]. Despite its conceptual simplicity, implementing the hierarchical definition of shape functions into an existing code can be rather involved.

In this work we present a simple way to bring the hierarchical concept closer to a standard Finite Element formulation. Practically speaking, the hierarchy of functions and knot spans is flattened into a sequence of elements being equipped with a standard single-level basis. In fact, the proposed multi-level extraction is a generalization of the classical Bézier extraction [3] and analogously offers a standard element structure to the hierarchical overlay of functions. Moreover, this approach is suitable for an extension to non-linear problems and for a parallel implementation. The multi-level extraction is presented as a general concept that can be applied to different kinds of refinements and basis functions.

In conclusion, the multi-level extraction is proposed for transforming an existing finite element software into an adaptive isogeometric code being able to tackle local refinement and adaptivity efficiently.

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