ON THE DEVELOPMENT OF A NON-INTRUSIVE COUPLING STRATEGY FOR NURBS LOCAL MODELING

R. Bouclier[1], J.C. Passieux[2], and M. Salaün[2]

[1] Université de Toulouse, INSA-Toulouse, IMT UMR CNRS 5219,
135 avenue de Rangueil, F-31077 Toulouse Cedex 04, France
bouclier@insa-toulouse.fr

[2] Université de Toulouse, INSA/UPS/ISAE/Mines Albi, ICA UMR CNRS 5312,
3 rue Caroline Aigle, 31400 Toulouse, France
passieux@insa-toulouse.fr,michel.salaun@isae.fr

ABSTRACT

Due to an exact representation of the geometry and to the use of smoother functions, the concept of isogeometric analysis [1], based on NURBS functions, enables to compute structures with an improved per-degree-of-freedom accuracy.

Although the global accuracy of NURBS is now proved, difficulties are still encountered to model localized phenomena within a NURBS patch. This is inherent to the tensor product nature of NURBS which necessarily implies a structured quadrangular mesh in a NURBS patch. As an example, the introduction of a geometric detail (hole, crack) may involve a costly re-parametrization of the NURBS model, including the treatment of trimmed NURBS objects. To address the issue, the combination of fictitious domain approaches with coupling methods may constitute an interesting option [2]. However, it has to be noted that such strategies still suffer from some intrusiveness: if the local region is expected to evolve (shape optimization of the hole, crack propagation), several re-constructions and re-computations of the whole problem have to be performed.

The alternative purpose of this work is to develop a non-intrusive coupling strategy for NURBS [3]. The method involves the definition of two models: a global, coarse NURBS (multi-)patch model of the whole structure and a local, more detailed (NURBS or classical) finite element "sub-model" meant to replace the global model in the area of interest. An iterative coupling technique is used to perform the substitution in an exact but non-intrusive way. It results in a simple, flexible strategy: first, the global NURBS patch remains unchanged, which completely eliminates the need for costly re-parametrization procedures; then, easy merging of a linear NURBS code with any other existing robust codes suitable for the modeling of complex local behavior is possible. A range of numerical examples in two-dimensional linear elasticity are carried out to demonstrate the performance of the methodology for NURBS local modeling. In particular, the developed non-intrusive strategy is used for crack modeling and shape optimization of geometric details in a NURBS patch.

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