

Accepted Manuscript

A Nitsche-based non-intrusive coupling strategy for global/local isogeometric structural analysis

Robin Bouclier, Jean-Charles Passieux

PII: S0045-7825(18)30267-6
DOI: <https://doi.org/10.1016/j.cma.2018.05.022>
Reference: CMA 11923

To appear in: *Comput. Methods Appl. Mech. Engrg.*

Received date: 22 February 2018
Revised date: 11 May 2018
Accepted date: 20 May 2018

Please cite this article as: R. Bouclier, J.-C. Passieux, A Nitsche-based non-intrusive coupling strategy for global/local isogeometric structural analysis, *Comput. Methods Appl. Mech. Engrg.* (2018), <https://doi.org/10.1016/j.cma.2018.05.022>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



A Nitsche-based non-intrusive coupling strategy for global/local isogeometric structural analysis

Robin Bouclier^{a,*}, Jean-Charles Passieux^b

^a IMT, Université de Toulouse, UPS, UT1, UT2, INSA, CNRS,
135 avenue de Rangueil, F-31077 Toulouse Cedex 04, France

^b ICA, Université de Toulouse, UPS, INSA, ISAE-SUPAERO, MINES-ALBI, CNRS,
3 rue Caroline Aigle, 31400 Toulouse, France

Abstract

In this work, we propose a new non-intrusive coupling algorithm for global/local isogeometric structural analysis. In contrast to the existing non-intrusive strategies that rely on a Lagrange multiplier coupling, the algorithm makes use of the non-symmetric Nitsche method. It results in an accurate and efficient tool to compute any evolution of a local model within a fixed global NURBS one. The reason for this is the robustness and simplicity of the coupling (no auxiliary fields, no dual space approximation, no stabilization parameters), which enables to directly handle all the non-conforming coupling scenarios encountered through the global/local multiresolution process. The performance of the methodology is numerically demonstrated through a series of two-dimensional elastic benchmarks involving conforming and non-conforming couplings, along straight, curved, and bi-material interfaces. In all examined problems, the proposed Nitsche algorithm provides optimal accuracy. **Conversely, reaching the same accuracy with Lagrange multipliers would imply to use a difficult to implement dual space. It is shown that using a practical choice for the dual space leads to less robustness for the Lagrange multiplier version.** Finally, to illustrate both the efficiency in a multiple query context and the robustness of the method to arbitrary non-conforming scenarios, a simple structural optimization problem is carried out using the developed non-intrusive solver, which simplifies the process and ensures computational time saving.

Keywords: Isogeometric analysis, **Discontinuous Galerkin method**, Non-symmetric Nitsche method, Non-intrusive coupling, Non-conforming geometries, Multiresolution

1. Introduction

The IsoGeometric Analysis (IGA) concept, which was first introduced in Hughes *et al.* [1] and later formalized in the book by Cottrell *et al.* [2], relies on the use of the same basis functions for the representation of both the geometry in Computer-Aided Design (CAD) and the numerical approximations in Finite Element Analysis (FEA). As a consequence, typical Lagrange polynomials are replaced in the computations by smooth and higher-order functions such as Non-Uniform-Rational-B-Splines (NURBS) [3, 4], which constitute the most commonly used technology in CAD. Other geometry descriptions include T-splines [5] and subdivision surfaces [6]. Within this work NURBS are used. Beyond the reinforced link between CAD and analysis, IGA turned out to be a superior computational mechanics technology, which on a per-degree-of-freedom basis exhibits increased accuracy and robustness in comparison to standard FEA [7]. The reason for this is the higher order of regularity of spline-based functions, namely $C^{(p-1)}$ through the knot-span elements of the mesh for a polynomial degree p , whereas only C^0 continuity is available for Lagrange polynomials. However, in contrast to the standard nodal basis, a multivariate NURBS basis comprises a rigid tensor

*Corresponding author

Email addresses: bouclier@insa-toulouse.fr (Robin Bouclier), passieux@insa-toulouse.fr (Jean-Charles Passieux)

Download English Version:

<https://daneshyari.com/en/article/6915309>

Download Persian Version:

<https://daneshyari.com/article/6915309>

[Daneshyari.com](https://daneshyari.com)