6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

Recent progress on isogeometric reduced quadrature techniques

Frederik Fahrendorf[1], Laura De Lorenzis[1] and Hector Gomez[2]

[1] TU Braunschweig, Institute of Applied Mechanics, Pockelstr. 3, 38102 Braunschweig, f.fahrendorf@tu-braunschweig.de / l.delorenzis@tu-braunschweig.de, www.tu-braunschweig.de/iam

[3] Purdue University, School of Mechanical Engineering, 585 Purdue Mall, West Lafayette, IN 47907-2088, hectorgomez@purdue.edu and www.engineering.purdue.edu

Keywords: *Reduced Quadrature, Isogeometric Analysis, Variational Collocation, Superconvergent Points*

An efficient implementation of isogeometric analysis (IGA) requires non-standard quadrature techniques. Standard Gaussian rules are not well-suited for IGA, since they do not take advantage of the higher continuity of the shape functions. Therefore different quadrature strategies have been investigated. Bringing the concept of reduced quadrature to the extreme, collocation methods have been proposed and have recently gained increasing attention for linear as well as non-linear problems.

A recent important development in isogeometric collocation and, more generally, reduced quadrature techniques has emerged in the context of the so-called variational collocation method [1, 2]. The idea is that for isogeometric basis functions there exists a set of points, termed Cauchy-Galerkin points, such that collocation at these points reproduces the Galerkin solution exactly. Good estimates of these points have been found by means of superconvergence theory.

In this talk, we report on recent advancements made possible by the concept of variational collocation both in isogeometric collocation methods and in reduced quadrature rules for Galerkin schemes. In the former, significant advantages are obtained over classical collocation schemes in terms of spatial convergence rates. In the latter, new schemes can be proposed which can be seen as intermediate between the Galerkin variational formulation and the direct evaluation of the strong form in collocation approaches. The potential of the new methods in several research directions is also outlined.

REFERENCES

[1] H. Gomez and L. De Lorenzis, The variational collocation method. *Computer Methods in Applied Mechanics and Engineering*, Vol. **309**, pp. 152–181, 2016.

[2] F. Fahrendorf, L. De Lorenzis and H. Gomez, Reduced integration at superconvergent points in isogeometric analysis. *Computer Methods in Applied Mechanics and Engineering*, Vol. **328**, pp. 390–410, 2018.