Isogeometric Multiscale Modeling with Galerkin and Collocation Methods

M. Amin Ghaziani*, J. Kiendl† and L. De Lorenzis*

* Institute of Applied Mechanics
Technical University of Braunschweig
Bienroderweg 87, 38106 Braunschweig, Germany
e-mail: {m.amin-ghaziani, l.delorenzis}@tu-braunschweig.de

† Department of Marine Technology
Norwegian University of Science and Technology
Otto Nielsens veg 10, Trondheim, Norway
e-mail: josef.kiendl@ntnu.no

ABSTRACT

Computational homogenization in the framework of finite elements (FE^2) is well established but is known to be computationally demanding [1]. In this contribution, we apply computational homogenization by means of isogeometric analysis (IGA) and set this method as IGA^2. Despite more accuracy given by IGA, its efficient implementation especially in the context of a two-scale boundary value problem is an issue.

Aiming to optimize the computational efficiency of IGA, isogeometric collocation has been recently introduced [2, 3], which exploits the high continuity of the shape functions to solve the strong form of a boundary value problem (BVP). As the first step to solve a two-scale BVP more efficiently, we utilize isogeometric collocation at the global scale and IGA-Galerkin at the local scale. In this approach the number of evaluation points is dramatically reduced, thus a substantial gain in efficiency is obtained over the mentioned IGA^2 and FE^2 techniques. The efficiency of the method in terms of accuracy and computational cost is illustrated by numerical examples.

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