Università degli Studi di Pavia

Dipartimento di Meccanica Strutturale

in collaboration with

Centro di Simulazione Numerica Avanzata – CeSNA

Istituto Universitario di Studi Superiori

SEMINAR

The B-spline version of the finite cell method

The Finite Cell Method (FCM) is a high-order immersed boundary method, which combines the fictitious domain approach with the p-version of the FEM and adaptive integration. For linear elastic problems with a smooth solution, FCM has been shown to achieve exponential rates of convergence, while its structured cell grid guarantees simple mesh generation irrespective of the geometric complexity involved.

In a first step, we give a concise overview of the finite cell method for small and large deformation of porous and foam-like materials. In particular, we show that the FCM concept can also be applied to geometrically nonlinear problems by a modified FCM formulation, which uses repeated deformation resetting in the fictitious domain. We also combine the FCM concept with high-order and high-continuity B-spline approximations, called the B-spline version of the FCM, which exhibits equivalent benefits as the p-version of the FCM.

In a second step, we demonstrate the potential of the B-spline version of the finite cell method as a seamless IGA design-through-analysis procedure for complex engineering parts and assemblies. We use the principle of B-spline subdivision and ideas of the hp-d adaptive approach to derive a hierarchical approach for local refinement of B-splines, which combines full analysis suitability of the basis with straightforward implementation in tree data structures and simple generalization to higher dimensions. We demonstrate with the examples of a ship propeller and a rim of a car wheel that hierarchical refinement considerably increases the flexibility of the B-spline version of the FCM by adaptively resolving local features.

Finally, we show that with a few modifications, our hierarchical approach for local refinement can be applied in NURBS based isogeometric analysis, which is illustrated with some elementary fluid and structural analysis problems in two and three dimensions.

Ing. Dominik Schillinger
Computation in Engineering,
Faculty of Civil Engineering and Surveying,
Technische Universität München

Wednesday 30 November, 14.30
MS1 Conference Room,
Department of Structural Mechanics,
Via Ferrata, 1 – Pavia

The support of the European Community through the 2010 ERC Starting Grant project "ISOBIO: Isogeometric Methods for Biomechanics" is gratefully acknowledged