SEMINAR

Università degli Studi di Pavia

Dipartimento di Ingegneria Civile e Architettura

Recent progress in the framework of higher order approximation

Isogeometric analysis (IGA) intends to bridge the gap between computer aided design (CAD) and finite element analysis. The core idea of IGA is to use the same smooth and higher-order basis functions, in particular non-uniform rational B-splines (NURBS), for the representation of both, geometry and solution fields. The potential of this paradigm and its advantages have been documented in a large number of benchmark problems and proof-of-concept studies. However, CAD derived models rarely consist of single or matching NURBS patches. They are typically built from a number of trimmed patches that are connected along matching and non-matching trimming curves that arbitrarily cut through NURBS elements.

In the first part of this talk an isogeometric analysis concept for NURBS geometries that are assembled from multiple trimmed patches is presented. Its main component is an extended Nitsche-based formulation that can be used to weakly enforce essential boundary conditions and kinematic compatibility conditions along coupling interfaces. It is combined with a fictitious domain concept based on the finite cell method that is used to effectively mitigate the influence of trimmed parts of a NURBS patch. The resulting IGA technology allows the analysis of trimmed and overlapping multi-patch NURBS geometries with non-matching patch interfaces including linear and geometrically nonlinear models and the coupling of different mathematical models for thin-walled structures.

In the second part of this talk a p-FEM-based simulation framework is presented which has been developed for the analysis of voxel-based data models derived from medical imaging technologies. Both ideas, the weak enforcement of boundary conditions and the fictitious domain approach, build the core concepts of the developed framework. The method pursued exploits the properties of Cartesian grids for an efficient analysis of the elastic properties of patient-specific femora to support the pre-planning phase of a hip-joint replacement in the clinical routines of orthopedic surgeons.

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