ECOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Prof. Annalisa Buffa
Institute of Mathematics - MNS

SEMINAR OF NUMERICAL ANALYSIS

➢ TUESDAY 08 MAY 2018 - ROOM MA A3 31 - 16:15

Prof. Josef KIENDL
(Norwegian University of Science and Technology, NO)

will present a seminar entitled:

« Isogeometric Methods in Structural Mechanics »

Abstract:

Isogeometric analysis is a novel method of computational analysis where functions used to describe geometries in Computer Aided Design (CAD) are adopted as basis for analysis. Due to this unified geometric representation, the model transfer from design to analysis, called mesh generation, is omitted providing a better integration of design and analysis. NURBS are the most widespread technology in today's CAD modeling tools and therefore are adopted as basis functions for analysis. Apart from the geometrical advantages, NURBS-based isogeometric analysis has proven superior approximation properties compared to standard finite element analysis for many different applications. Furthermore, the high continuity between elements also allows the discretization of higher order PDEs, which is especially useful in structural mechanics, where the classical plate and shell theories, based on Kirchhoff's kinematic assumption, can be implemented in a straightforward way.
We show an isogeometric shell analysis framework with formulations ranging from linear, geometrically nonlinear, and fully nonlinear shell models. All formulations are based on the Kirchhoff-Love shell theory and are rotation-free, i.e., using only displacement degrees of freedom. These formulations are then employed for the simulation of various problems of structural mechanics, including large deformations, buckling, elastoplasticity, and brittle fracture as well as for fluid-structure-interaction problems including high-fidelity FSI simulations of offshore wind turbine blades and bioprosthetic heart valves. Furthermore, we show how the continuity properties of IGA can be exploited to derive novel formulations for Reissner-Mindlin plates and shells, where shear locking is avoided ab initio.
Finally, we present isogeometric collocation methods (IGA-C), a novel approach where the partial differential equations are solved in the strong form. This avoids the need of computing integrals by numerical quadrature and, thus, reduces the computational costs by several orders. We show isogeometric collocation formulations for different problems in structural mechanics, like spatial beams, plates, and shells.

Lausanne, 2 May 2018/AB/rb
