MATH-652

Isogeometric Analysis for the approximation of PDEs (2017)

Vazquez Hernandez Rafael

Cursus	Sem.	Type
Mathematics		Obl.

Language of teaching	English
Credits	2
Session	
Exam	Project report
Workload	60h
Hours	**28**
Courses	16
TP	12
Number of positions	

Remark

Next time: Spring semester 2019

Summary

The course focuses on the approximation of Partial Differential Equations with Isogeometric Analysis. Theoretical and computational aspects of the method will be studied. Basic knowledge of Finite Element Methods is requested.

Content

Isogeometric Analysis (IGA) is a numerical method based on splines for the approximation of Partial Differential Equations (PDEs), introduced with the aim of improving the interoperability between Computer Aided Design (CAD) and Finite Element Method (FEM) software. The main idea of the method is to use the same basis functions utilized for the geometry representation in CAD as the basis of the discrete space for the approximation of the PDE. This permits to use the exact geometry representation given by CAD during the analysis, without approximating the geometry by a mesh, as it is done in standard FEM. Additionally, the spline functions used in CAD are smoother than basis functions traditionally used in FEM, and they have shown to be superior in terms of accuracy and robustness.

This course covers both the theoretical and the computational aspects of IGA. We will start with the introduction of B-splines and Non-Uniform Rational B-splines (NURBS), their use in CAD and their mathematical properties. We will then introduce the main concepts of IGA and apply the method to a model linear problem, that will serve us to analyze the similarities and the differences between IGA and FEM. Then, we will discuss the application of IGA to the solution of high order PDEs, such as the bilaplacian, taking advantage of the continuity of NURBS to deal with the direct formulation. We will also consider the approximation of vector fields, with applications in computational mechanics.

The Octave/Matlab library GeoPDEs will be provided for the practical work and the laboratory activities.

Keywords

Isogeometric Analysis
Finite Element Methods
Partial Differential Equations

Learning Prerequisites

Required courses

Numerical approximation of PDE's I
Numerical Analysis