MATH-650

Advanced Topics in Computational Science for Multiphysics Problems (2018)

Quarteroni Alfio

Cursus	Sem.	Type
Mathematics		Obl.

Language of teaching	English
Credits	2
Session	
Exam	Oral presentation
Workload	60h
Hours	**28**
Courses	20
Exercises	8
Number of positions	**20**

Remark

Next time: Fall 2017

Summary

Numerical solution of parametrized Partial Differential Equations (PDEs) based on domain decomposition, reduced basis methods, control problems, fluid structure interaction problems. Application to physiological and environmental flows. Basic knowledge of numerical solution of PDEs requested.

Content

After recalling the finite element formulation for flow equations, we will introduce advanced domain decomposition methods for parallel computing. Then we will discuss their generalization to heterogeneous and multiphysics problems. In particular we will discuss the case of nonconforming approximations, the use of the ICDD (interface Control Domain Decomposition) method, and that of efficient parallel preconditioners for fluid structure problems and, more generally, multiphysics problems. Then we will consider Reduced Basis Methods for the efficient solution of parametrized partial differential equations. Forward, inverse, and optimal control problems will be analyzed. Applications will be concerned with the modeling of the cardiovascular system and the interaction of Navier-Stokes and Darcy equations for environmental flows.

Keywords

Partial differential equations, Scientific Computingm Finite Elements, Multiphysics Problems

Learning Prerequisites

Required courses

Analysis 1 and 2, Numerical Analysis