Course PM
1TD253: Finite element methods, 5.0 hp

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Course description

In this course you will learn the basic knowledge of the theory, practice and implementation of finite element methods to the partial differential equations of physics and engineering sciences. The main purpose is to give a balanced combination of theoretical and practical skills. The theory part gives you knowledge on the derivation of finite element formulations, a priori and a posteriori error estimates, methods and algorithms of adaptive mesh refinements, computer implementations of the finite element discretizations: element matrices, assembly process, numerical integration, local mesh refinement, etc.

Instructors

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Teaching plan

There will be 12 lectures, 6 exercise sessions and 3 labs.

Course homepage

http://www.it.uu.se/edu/course/homepage/fem/ht14

Course literature

Larson, M.G., Bengzon, F. The Finite Element Method: Theory, Implementation, and Practice. Department of Mathematics, Umea University 2009.

K. Eriksson, D. Estep, P. Hansbo, C. Johnson. Computational Differential Equations. Studentlitteratur, ISBN ISBN 91-44-49311-8.

C. Johnson. Numerical Solution of Partial Differential Equations by the Finite Element Method.

Alexandre Ern, Jean-Luc Guermond. Theory and Practice of Finite Elements. ISBN 978-0-387-20574-8.

Note: we will be using mainly the first book.

Prerequisites

Basic courses in scientific computing, some knowledge in programming and differential equations.

Homework

There will be a set of home exercises assigned after every lectures. Solving the homework problems in time helps you to understand the subject, get more learning experience and get prepared to the mandatory assignments and the final exam. The homeworks are not graded but it is highly recommended to solve them in time.

Programming assignments

There will be three mandatory programming assignments, where you can work in a group of two. You will have to write a report. The report must contain the title page including your name and contact info, introduction, problems statement, problems solution including some theory and result, summary. Then put the report in a folder together with the matlab codes. Email me a single arxiv of your results. If you want to get a feedback for your report, always submit the labs prior to the given deadlines.

Examinations

The course is graded with respect to your final examination. However, the course is completed only if you pass all your programming assignments and the exam.
Programming assignments: 2 points
Final: 3 points

Weekly plan

Week 1: Piecewise polynomial approximation in 1D
Week 2: Finite element methods in 1D
Week 3: Piecewise polynomial approximations in 2D
Week 4: Finite element methods in 2D
Week 5: Finite element methods for time-dependent problems
Week 6: Course review and repetition
Week 7: Final exam

Scholastic Dishonesty

Students may work together and discuss the homework problems with each other. Copying work done by others is an act of scholastic dishonesty and will be prosecuted to the full extent allowed by University policy. For more information on university policies regarding scholastic dishonesty, see the University of Uppsala's policy at http://www.it.uu.se/edu/fusk.pdf . The policy is in Swedish.

Students with Disabilities

According to the University regulation all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you need help or want to get more information about it please contact the University of Uppsala's services for students with disabilities.

Credits

This course is mainly adopted from the previous courses developed by Axel Målqvist. All credits go to him.