DN2275 Advanced Computation in Fluid Mechanics 7.5 credits

Avancerade beräkningsmetoder i flödesmekanik

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for DN2275 valid from Autumn 2009

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Specific prerequisites

Single course students: 90 university credits including 45 university credits in Mathematics or Information Technology. English B, or equivalent.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

The goal is that the students should be able to analyze and use General GAlerkin (G2) adaptive finite element computational technology to model fluid flow at hogh Reynolds numbers. More precisely this means that the students should be able to:

- define the concepts weak solution and weak uniqueness
- derive energy estimates for the underlying equations and G2 approximations
- derive a posteriori output error estimates for G2 using duality
- analyze the gloal effect of friction boundary conditions in G2 computations
- use G2 software for adaptive flow computations with error control.

Based on a critical review of research literature and the students own G2 computations, the student should be able to compare state of the art fluid mechanics with G2 computation/analysis concerning the following fundamental problems:

·turbulence

·separation

·generation of drag and lift

with applications in a number of areas such as car-, ship- and aircraft industry and ball sports. The purpose is to develop a critical approach with the possibility to question established truths, and form new hypotheses.

Course contents

Navier-Stokes equations, Eulers equations, existence of exact solution, weak solution , weak uniqueness, General GAlerkin (G2) method, energy estimates, perturbation growth, stability, duality, a posteriori error estimate and adaptivity.

Friction boundary condition, separation, boundary layer, generation of drag and lift, Magnus effect, d'Alembert's paradox.

Course literature

J. Hoffman and C. Johnson (2007) "Computational Turbulent Incompressible Flow", and a number of scientific papers (to be handed out at course start).

Examination

- PRO1 - Project, 4.0 credits, grading scale: P, F
- TEN1 - Examination, 3.5 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

In this course all the regulations of the code of honor at the School of Computer science and Communication apply, see: http://www.kth.se/csc/student/hederskodex/1.17237?l=en_UK.

Other requirements for final grade

Mandatory participation at seminars including preparing short summary of preparatory literature. Assignements (4 hp). Project (3.5 hp).

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.