DD2365 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 DD2365 valid from Spring 2019

Grading scale

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

Education cycle

Second cycle

Main field of study

Computer Science and Engineering

Specific prerequisites

For non-program students, 90 credits are required, of which 45 credits have to be within mathematics or information technology. Furthermore, English B or the equivalent is required.

Language of instruction

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

Intended learning outcomes

The General aim is that the students should be able to analyse and use general Galerkin (G2) adaptive finite elements calculation methodology to model movement at high Reynolds numbers. Concretely, it implies that the students should be able to:

- account for the concepts of weak solution and weak uniqueness
- derive energy estimates for underlying equations and G2 approximations
- derive a posteriori error estimates for output in G2 by means of duality
- analyse the global effect of friction boundary in G2 calculations
- use G2 software for adaptive flow computations with error control.

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

- turbulence

- separation

- generation of drag and lift in aerodynamics

with applications within a lot of fields, such as car, ship and aircraft industry and ball sports. The intention is to develop a critical approach with possibility to be able to question established truths and shape own hypotheses.

Course contents

Navier-Stoke's equations, Euler's 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 and d'Alembert's paradox.

Course literature

J. Hoffman and C. Johnson (2007) "Computational Turbulent Incompressible Flow", samt ett antal vetenskapliga artiklar (utdelas vid kursstart).

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.

Other requirements for final grade

Compulsory attendance in seminars including preparation of literature review. A take-home problem solving exam (4 credits). Project assignment (3.5 credits).

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.