Computational Methods for Fluid Mechanics and Heat Transfer
MEC 524, Spring 2017

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Abstract
Computational fluid dynamics (CFD) has been widely employed in both academia and industry for the design and optimization of fluid flow systems. This course offers an introduction to CFD with an emphasis on the finite-difference method. It covers the classification of (partial differential equations) PDEs, finite-difference approximations of derivatives, applications to model equations, the Euler equations for inviscid flow, and the incompressible and compressible Navier-Stokes equations, and the basics of grid generation. A brief introduction to the immersed boundary methods, which are very powerful for simulating flows with arbitrarily complex geometries, will be given in the end of this course. The Midterm exam will be about some basics of the computational techniques. In the final project, the students will be asked to write a code to solve some two-dimensional flow or heat transfer problems. Upon completion of this course, the students should be able to:
1. Classify partial differential equations into elliptic, parabolic and hyperbolic types;
2. Develop basic discretization techniques;
3. Understand the consistency, stability, convergence, and error analysis of numerical schemes;
4. Understand the grid generation process;
5. Develop CFD codes for two-dimensional flow and heat transfer problems.

Lecture: 10:00AM - 11:20AM Tuesday Thursday (Chemistry 126, West Campus).

Text Books:

Required

1. Computational Fluid Mechanics and Heat Transfer, Third Edition. Authors: Richard H. Pletcher, John C. Tannehill, Dale Anderson. Publisher: CRC Press.

Recommended

1. Fundamentals of Computational Fluid Dynamics. Authors: H. Lomax, Thomas H. Pulliam, David W. Zingg. Publisher: Springer.
2. Computational Techniques for Fluid Dynamics, Vol. 1: Fundamental and General Techniques. Author: C.A.J. Fletcher. Publisher: Springer.
3. Computational Methods for Fluid Dynamics, Third Edition. Authors: Joel H. Ferziger, Milovan Peric. Publisher: Springer.

Website: https://blackboard.stonybrook.edu/

Grading: Homework 40%; Midterm exam (Thursday, March 23) 30%; Final Project 30%.

Homework:
Homework will be either assigned in the class or posted at blackboard. You would submit assignments and projects electronically at the university provided Blackboard services.

Software:
1. Matlab;

2. MS Visual Studio for programming using C or C++;
3. Excel, Gnuplot, VisIt or ParaView for visualization.

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