CFD Application
to Ship Hydrodynamics

Course number: 464.711

Fall 2008

Instructor: Prof. Shin Hyung Rhee

Time: 1:00PM – 2:15PM Tue. & Thu.

Place: 34-119

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Course Objectives

- This is the first graduate-level course in computational fluid dynamics (CFD) for the naval architecture and ocean engineering program.

- As such, its principal objective is to provide basic knowledge on CFD, such as mathematical modeling of physical phenomena and numerical solution methods for the mathematical equations.

- Secondly, apply the knowledge to some of most basic, yet practical, problems.

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Course Description

- Basics of fluid flow
- Mathematical modeling
  - Time integration for unsteady problems
  - Navier-Stoke equation solutions
  - Complex geometries
  - Turbulent flows
- Numerical method
  - Fundamentals of numerical methods
  - Finite difference methods
  - Finite volume methods
  - Linear equation solutions
- Solution improvement
- Case studies

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Course Materials

- Text
  - *Computational Methods for Fluid Dynamics* by Ferziger & Peric, Springer
- References
  - *Computational Fluid Mechanics for Engineers* by Hoffman, EES
  - *Numerical Computation of Internal and External Flows* by Hirsch, John Wiley & Sons

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Approach

- Two pronged approach
  - Basics of CFD
  - Ability to carry out CFD projects
- For fundamentals of CFD, courses are available at MAE.
- Evaluation
  - Term project: 40%
  - Tests: 40%
  - Homework assignments: 20%

Term Project

- Choose your problem
  - HRIC discretization for volume fraction
  - Realizable k-ε turbulence model
  - Vortex induced vibration
- Literature review
- CFD tool
  - OpenFOAM (http://www.opencfd.co.uk/openfoam/)
- Run and analyze results
- Write a technical paper (ASME format)
- Present in front of class
- Defend your work

Schedule

Date	Subjects	Date	Subjects
Tue., Sep. 02, 2008	Introduction	Thu., Sep. 04, 2008	Basics of fluid flow
Tue., Sep. 09, 2008	Numerical methods	Thu., Sep. 11, 2008	Finite difference method
Tue., Sep. 16, 2008	Finite difference method	Thu., Sep. 18, 2008	Finite volume method
Tue., Sep. 23, 2008	Finite volume method	Thu., Sep. 25, 2008	Solution of discretized equations
Tue., Sep. 30, 2008	Solution of discretized equations	Thu., Oct. 02, 2008	Solution of discretized equations
Tue., Oct. 07, 2008	Substituted by 27th Sympo. on Naval Hydrodynamics	Thu., Oct. 09, 2008	Substituted by 27th Sympo. on Naval Hydrodynamics
Tue., Oct. 14, 2008	Invited lecture (Speaker TBA)	Thu., Oct. 16, 2008	Mid-term test
Tue., Oct. 21, 2008	Term project progress report	Thu., Oct. 23, 2008	Unsteady problems
Tue., Oct. 28, 2008	Unsteady problems	Thu., Oct. 30, 2008	Solution of Navier-Stokes equations
Tue., Nov. 04, 2008	Solution of Navier-Stokes equations	Thu., Nov. 06, 2008	Solution of Navier-Stokes equations
Tue., Nov. 11, 2008	Solution of Navier-Stokes equations	Thu., Nov. 13, 2008	Complex geometries
Tue., Nov. 18, 2008	Term project progress report	Thu., Nov. 20, 2008	Turbulent flows
Tue., Nov. 25, 2008	Turbulent flows	Thu., Nov. 27, 2008	Special topics
Tue., Dec. 02, 2008	Solution improvement	Thu., Dec. 04, 2008	Final test
Tue., Dec. 09, 2008	Term project presentation	Thu., Dec. 11, 2008	Term project presentation

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Get to Know Class

- Introduce yourself
  - Name
  - Lab
  - Pursuing degree
  - Background (home, history, …)
  - Reason taking this course
  - Interested problem
  - Thesis topic

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