Computational Fluid Engineering

Special Subjects
Elective 2 credit

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1. Course Description

By the development of computer technology, large-scale fluid analysis has been performed. Conventionally, R&D (Research and Development) based on experiments has been performed, but now R&D is also performed using "Numerical Experiments" by computer simulation.
In this course, you will study the fundamental analytical methods and numerical calculation methods for performing numerical simulations of fluids engineering. And, in order to understand deeply, you actually perform fluid dynamics analysis by computer using open source fluid analysis software.
From 3rd to 9th classes, you will present your pre-surveyed research items for other students.
In the 10th and subsequent classes, you will use fluid analysis software and try computer simulation.
You will acquire knowledge and skills on DP1 and DP2 of diploma policies.

2. Course Objectives

The goal is to understand basic analysis methods and numerical calculation methods for performing CFD (Computational Fluid Dynamics), and to be able to actually perform simple fluid analysis on the computer.

3. Grading Policy

Your grade will be assessed based on the scores of reports of exercise problems (100%). You will be required to submit four reports.
LMS will provide feedback for submitted reports. Also, it may be provided in the class.

4. Textbook and Reference

Textbook
No text book, but reference materials and books are as follows:
Reference
Kevin McGrattan et al. Fire Dynamics Simulator User's Guide, Sixth Edition, NIST Special Publication 1019 http://dx.doi.org/10.6028/NIST.SP.1019
Kevin McGrattan et al. Fire Dynamics Simulator Technical Reference Guide, Volume 1 : Mathematical Model, Sixth Edition, NIST Special Publication 1018-1 http://dx.doi.org/10.6028/NIST.SP.1018
https://pages.nist.gov/fds-smv
一般社団法人オープンCAE学会(編) OpenFOAMによる熱移動と流れの数値解析 森北出版、ISBN-13: 978-4627691018
It is recommending that you collect information using library materials and internet.
And you can find class materials on LMS.

5. Requirements(Assignments)

For the preparation, you should study in advance for each class based on reference books, library materials, and materials collected via the Internet. (2 hours)
After the class, you should review and work on exercise for report in order to improve your understanding. (1 hour)

6. Note

In the 10th and subsequent classes, open source thermal-fluid analysis software (Fire Dynamics Simulator (FDS)) will be installed on your computer and calculations will be executed.

7. Schedule

[1] Overview of CFD
[2] Analysis method for Fluid Dynamics
[3] Governing equation for Fluid Dynamics
[4] Discretization of governing equations
[5] Solving partial differential equations
[6] von Neumann stability analysis, Courant number
[7] Boundary conditions
[8] Turbulence models
[9] Parallel computing
[10] Fire Dynamics Simulator (FDS) : Overview and setup
[11] Fire Dynamics Simulator (FDS) : How to create an input file
[12] Fire Dynamics Simulator (FDS) : Creating an input file and Execution of simulation
[13] Fire Dynamics Simulator (FDS) : Performing thermal-fluid analysis
[14] Fire Dynamics Simulator (FDS) : Performing thermal-fluid analysis advanced
[15] OpenFOAM: Overview