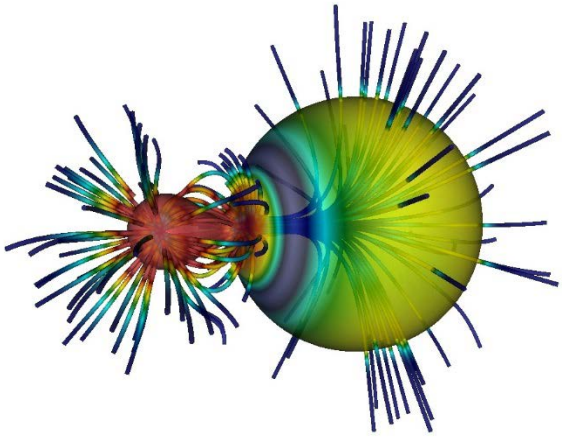
PURDUE
UNIVERSITY

ME614: COMPUTATIONAL FLUID DYNAMICS

Course Information: Fall 2019, MW 4:30-5:45 in Wang 2579



Instructor

Lead Instructor: **Prof. Hector Gomez**
Office: Wang 4560
Email: hectorgomez@purdue.edu
Office Hours: Right before the class
Instructor's Webpage: https://engineering.purdue.edu/gomez/

Teaching Assistant: TBD

Course objectives

The course will cover introductory aspects of Computational Fluid Dynamics (CFD) with focus on canonical flow problems, while providing exposure to the latest advancements in discretization methods for fluid flow problems. We will use programming languages (Octave or Matlab) and commercial software such as Fluent. The course will cover the following topics:

1. Classification of partial differential equations
2. The finite difference method
3. Review of control volume analysis, Navier-Stokes equations
4. The finite volume method
5. ANSYS Fluent tutorial on Purdue's supercomputers (Dr. Xiao Zhu)
6. Finite element methods for flow problems
7. The Lattice-Boltzmann method

Students will write their own solver for simple problems, and run ANSYS/Fluent for more complicated problems.

Prerequisites

Prerequisites for the course include basic knowledge of fluid mechanics, linear algebra, partial differential equations and average programming skills. Please take note of the following software/hardware requirements for the course:

- Octave Coding Language: Free Software (Same language as Matlab, but free)
- ANSYS: (1) ICEMCFD Mesher, (2) Fluent Flow Solver
- Working Laptop (bring it to class): for Windows only, procure SSH shell emulators, such as Putty.

The class content is structured in such a way to allow talented undergraduate students to successfully complete the coursework.

Learning outcomes

By the end of the course, you will be able to:

1. Design an adequate computational method to solve canonical flow problems.
2. Choose an adequate computational method to solve a fluid mechanics problem.
3. Evaluate the quality of a numerical solution to a fluid mechanics problem.
4. Recommend the use of a computational method or a theoretical approach for a fluid mechanics problem.
5. Understand scientific publications in the area of computational fluid dynamics

Methods of Evaluation: Homework, Midterm Exam, Final Project

Learning resources & texts

With the exception of programming tutorials, all of the lecture material will be explained at the blackboard to facilitate a dynamic discussion. Some of the course material will be based on selected pages from the following textbooks:

1. Ferziger, J., and M. Peric, Computational Methods for Fluid Dynamics, Third Edition, Springer, 2001
2. T.J.R. Hughes, The finite element method: Linear static and dynamic finite element analysis, Courier, 2012.
3. Pletcher, R. H., Tannehill, J. C., and Anderson, D., Computational Fluid Mechanics and Heat Transfer, CRC, 2011.
4. R. Leveque, Finite Volume Methods For Hyperbolic Problems, Cambridge, 2004
5. Lloyd N. Trefethen, Finite Difference and Spectral Methods for Ordinary and Partial Differential Equations, unpublished text, 1996, available at http://people.maths.ox.ac.uk/trefethen/pdetext.html

Grade distribution

Homework assignments and final reports turned in LATEX and/or with supporting images generated in vector graphics are strongly encouraged. The grade distribution is: 10% Homework 1, 10% Homework 2, 30% Midterm Exam (in class), 10% Homework 3, 10% Homework 4, 30% Final Project.

The grading scale for the course is:

$97 \leq \text{score} \Rightarrow$ A+	$80 \leq \text{score} < 83 \Rightarrow$ B-	$63 \leq \text{score} < 67 \Rightarrow$ D
$93 \leq \text{score} < 97 \Rightarrow$ A	$77 \leq \text{score} < 80 \Rightarrow$ C+	$60 \leq \text{score} < 63 \Rightarrow$ D-
$90 \leq \text{score} < 93 \Rightarrow$ A-	$73 \leq \text{score} < 77 \Rightarrow$ C	$\text{score} < 60 \Rightarrow$ F
$87 \leq \text{score} < 90 \Rightarrow$ B+	$70 \leq \text{score} < 73 \Rightarrow$ C-	
$83 \leq \text{score} < 87 \Rightarrow$ B	$67 \leq \text{score} < 70 \Rightarrow$ D+	

Academic Dishonesty

Sharing of ideas on the homework assignments is encouraged but submitted reports and source codes need to be individually prepared.

Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Part 5, Section III-B-2-a, University Regulations] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72-18, December 15, 1972]

Please review the following resource page on plagiarism:
http://www.education.purdue.edu/discovery/research_integrity.html.

You may also want to refer students to Purdue's student guide for academic integrity:
https://www.purdue.edu/odos/academic-integrity

The Purdue Honor Pledge:
“As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue"

Attendance

Students are expected to be present for every meeting of the classes in which they are enrolled. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts or absences can be anticipated, such as for many University sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible…For unanticipated or emergency absences when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email, or by contacting the main office that offers the course. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor’s department because of circumstances beyond the student’s control, and in cases of bereavement, the student or the student’s representative should contact the Office of the Dean of Students.

Disclaimer

This syllabus is subject to change.