MAE/CSE 557
M.E. Mueller
Fall 2025

MAE/CSE 557: Simulation and Modeling of Fluid Flows

Final Project

Deadlines

Topic/Group Selection: Monday, November 10
Reports/Code: Friday, December 19

Instructions

The final culmination of the course will be a final project of your choosing. The projects can be completed individually or in groups two students; expectations for group projects will be proportionally higher. Deliverables for your project will include a written report and your source code.

Your project topic should be selected in consultation with the instructor in order to ensure that the scope is tractable. Each individual/group should either (a) send an email with a brief proposal or (b) schedule a time with the instructor to briefly discuss the project idea, and a short abstract must be submitted by the date indicated above. These abstracts will be shared with the class. Your topic could be directly related to your research, or you could use this as an opportunity to explore other areas of fluid mechanics.

Your projects should follow one of two prototypes: (1) implementation, verification, and application of advanced numerical methods[1] briefly discussed or not discussed in the course to simple flows or (2) implementation, verification, and application of numerical methods to complex fluid flows (multi-phase flows, reacting flows, magnetohydrodynamics, etc.). Enhancements and improvements to existing methods are obviously encouraged. In either case, your project will consist of five components: (1) a thorough literature review and discussion of the advantages and disadvantages of your methods compared to other methods; (2) a complete detailing of the method including any analysis of convergence, stability, conservation, etc.; (3) implementation of your method; (4) verification of your method; and (5) application of your method to a canonical flow problem relevant to your chosen topic.

The written report should follow the basic outline given above. For individuals, the written report should be no more than ten pages, and, for groups, the written report should be approximately fifteen pages.

Your source code must be submitted with your written reports. For groups, the sophistication of your source code should be proportionally higher than for individuals. The compute portion of your project must be completed in a compiled language (C, C++, or Fortran) or another performative language (e.g., Julia). However, scripting languages can be used to manage a program as long the compute components are in a compiled language. Obviously, good programming practice (comments, etc.) are highly encouraged, and your source code must be submitted electronically with your written report. Along with your code, you ***must*** submit instructions for compiling and running your code on Nobel or Adroit, Linux

[1] An "advanced numerical method" goes beyond finite difference or finite volume methods on structured grids. Examples include any methods applied to unstructured grids or spectral, finite element, spectral element, or other methods applied to structured grids.

clusters administered by Research Computing[2]; information for obtaining an account on Nobel or Adroit can be found on the Research Computing website.

Grading

Code:	50%
Report:	50%

For the code, the majority of the grade will be based on success of implementation and its sophistication, which should be discussed with the instructor during project selection. A lesser portion of the code grade (25%) will be based on adequate commenting, compilation instructions, and good software engineering practice. For the report, the five components mentioned above will be equally weighted in addition to the quality of your writing. Detailed written feedback for all deliverables will be provided.

[2] There is no expectation that your code run in parallel, but parallel computing can be utilized if desired.