

ME EN 541 – Modeling Project 3

Due Apr. 18th at 11:59 pm in Learning Suite (firm deadline)

Overview

For this project you will write and validate a basic 2D flow solver.

Activities

1. Write a steady Navier-Stokes-based solver for flow through a 2D rectangular channel. Use the following parameters:
 - I. Geometry
 - a. Rectangular channel
 - b. Height = 1 cm
 - c. Length = 5 cm
 - II. Boundary conditions
 - a. Inlet: specified uniform velocity of 0.001 m/s
 - b. Top & bottom: no-slip walls
 - c. Outlet: zero pressure
 - III. Fluid
 - a. Water: density = 1000 kg/m³, viscosity = 0.001 Pa·s
 - IV. Code
 - a. SIMPLE pressure-velocity coupling
 - b. Upwind scheme
 - c. Any solver (iterative or direct)
2. Submit a PDF with the following:
 - I. Contour plot of pressure field with colorbar.
 - II. Contour or vector plot showing velocity field. If contour plot, submit two plots: one showing x-velocity, the other showing y-velocity. If vector plot, just one plot is sufficient. In order for scale to be determined, include a colorbar (if contour plot) or a reference arrow with magnitude (if vector plot).
 - III. Evidence of verification:
 - a. Grid independence
 - b. Convergence criteria
 - IV. Summary of numerical parameters:
 - a. Relaxation criteria
 - b. Number of nodes
 - c. Any other essential parameters
 - V. For validation, comparison of your results with:
 - a. Theoretical data, or
 - b. Commercial code (STAR-CCM+ or ADINA) model that you have verified, along with verification details
 - VI. Copy of your code at the end.