

AE 320/706 Computational Fluid Dynamics

Assignment 5

Due on 21 April 2019

Assignment 05

10 marks

Write a code that can simulate the 1–D Euler Equations using Lax–Friedrichs and Rusanov schemes.

Simulate the Sod Shock tube problem (Toro's version) upto a time of 0.2 s . The initial conditions are as follows:

$$\text{Primitive Variables: } q_p = \begin{cases} (1, 0.75, 1) & \text{for } 0 < x < 0.3 \\ (0.125, 0, 0.1) & \text{for } 0.3 \leq x < 1 \end{cases}$$

You can assume zero gradient boundary condition at $x = 0, 1$ for the present simulations.

Your report should contain the plots of density, velocity and pressure at $t = 0.2 \text{ s}$. Discuss the errors in your results.

Compare your results with the exact solutions given in the attached reference (Liska & Wendroff) and at Liska's Webpage

Consider 100, 200, 400 and 800 cells for your simulations. Comment on the convergence of the results.

Bonus Assignment

10 marks

The Bonus Assignment can be used to compensate for the lost marks in other assignments.

Use your 1–D Euler solver to simulate the following additional test cases (from the paper by Liska & Wendroff):

- Test Case 2
- Noh Problem
- Shu-Osher Problem

Once again, perform a grid convergence study, and plot all variables and analyse the errors obtained by comparing with references.