

Numerical Methods for Conservation Laws

Assignment 3 (system of nonlinear equations), October 2021

Solve the following nonlinear system of equations using ^{both} (1) first-order Roe solver in finite difference/finite volume form (2) second-order flux difference splitting.

1. **Shallow water equations**; Dam break problem with initial discontinuity at $x = 0$.

$$h_l = 3, u_l = 0 \quad (1)$$

$$h_r = 1, u_r = 0 \quad (2)$$

Plot h and hu at $t = 0, 0.5, 2$.

Domain is $[-5, 5]$ with initial discontinuity at $x = 0$, $g=1$.

2. **Inviscid Euler equations**; shock tube problem (Sod).

$$\rho_l = 1, u_l = 0, p_l = 1 \quad (3)$$

$$\rho_r = 0.125, u_r = 0, p_r = 0.1 \quad (4)$$

Plot ρ , u , p at $t = 0.25$.

Domain is $[0, 1]$ with initial discontinuity at $x = 0.5$.

Number of points 101, 201, **CFL** ~ 0.6 .

The code(s) submitted for the previous assignment is expected to serve as a template for starting the current assignment and this needs to be verifiable in style/logic used. Any radical departures need to be informed with justifications