Programming Assignment 2: Sod's Shock Tube

Given Euler's Equation for an ideal, polytropic gas:

$$\begin{pmatrix} \rho \\ \rho u \\ E \end{pmatrix}_t + \begin{pmatrix} \rho u \\ \rho u^2 + p \\ \frac{\rho u}{\rho}(E+p) \end{pmatrix}_x = 0$$

with initial data

$$u_L = u_R = 0, \rho_L = 1.0, \rho_R = 0.125, p_L = 1.0, p_R = 0.1$$

where $f_L = f(x,0), x < 0$ and $f_R = f(x,0), x > 0$ and

$$p = (\gamma - 1)(E - \frac{1}{2}\rho u^2)$$

with the ratio of specific heats $\gamma = 1.4$. Use first order ENO-LLF to compute the solution at time $t = .25$. Plot your solutions on the domain $x \in [0,1]$.

I. Hints

A.

Boundary conditions will not be an issue because f_L and f_R are not affected in the time interval $t \in [0,1]$.

B.

The Jacobian and its eigensystem must be used to solve this problem. Details for how to compute these can be found in the solution to HW7, LeVeque chapter 5, Osher, Fedkiw chapter 14 and class notes.