

AE 720- Numerical Methods for compressible flows

Assignment 2: Report

Exact Solution of General Riemann Problem

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Introduction

Exact Solution for general Riemann Problem was simulated in Python. The initial conditions were as follows:

$$\begin{bmatrix} \rho_l \\ u_l \\ p_l \end{bmatrix} = \begin{bmatrix} 1.0 \\ 0.0 \\ 1.0 \end{bmatrix}$$
$$\begin{bmatrix} \rho_r \\ u_r \\ p_r \end{bmatrix} = \begin{bmatrix} 0.125 \\ 0 \\ 0.1 \end{bmatrix}$$

Initial Discontinuity is assumed to be present at $x=0$. Plots for velocity, density, pressure and Temperature with x in range $[-0.5, 0.5]$.

Dependencies

Python

Matplotlib

Numpy

Latex

Results

Expansion fan on the Left side ($x < 0$) and Normal Shock on the right side ($x > 0$) is obtained for the given conditions. $p^* = 0.303132bar$

$$u^* = 0.9273623m/s$$

$$\rho_{L^*} = 0.4262903kg/m^3$$

$$\rho_{R^*} = 0.265558kg/m^3$$

Plots

Following Plots were obtained for the given Initial Conditions. All the plots are non dimensionalized.

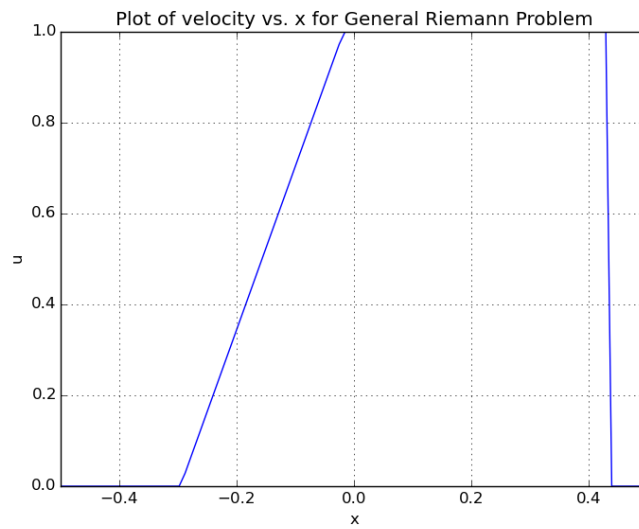


Figure 1: Velocity vs. x

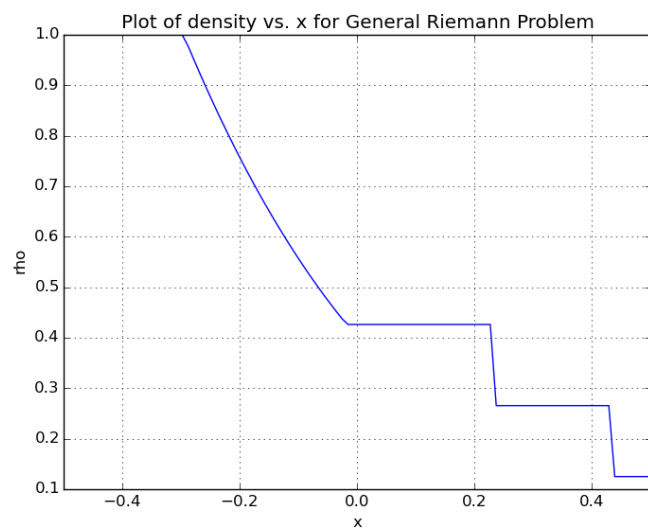


Figure 2: Density vs. x

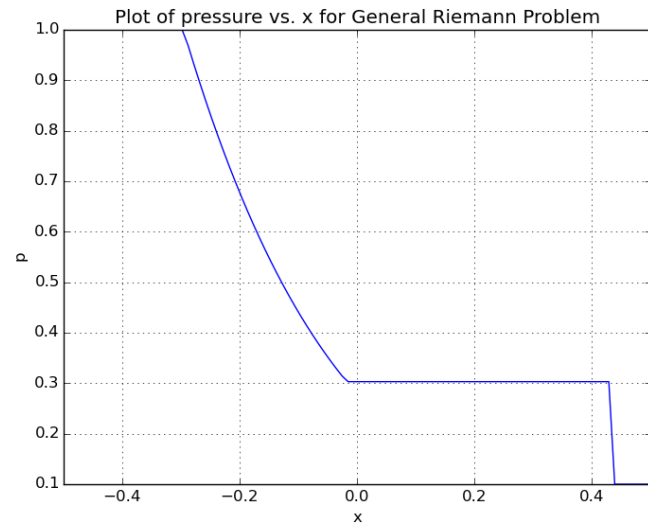


Figure 3: pressure vs. x

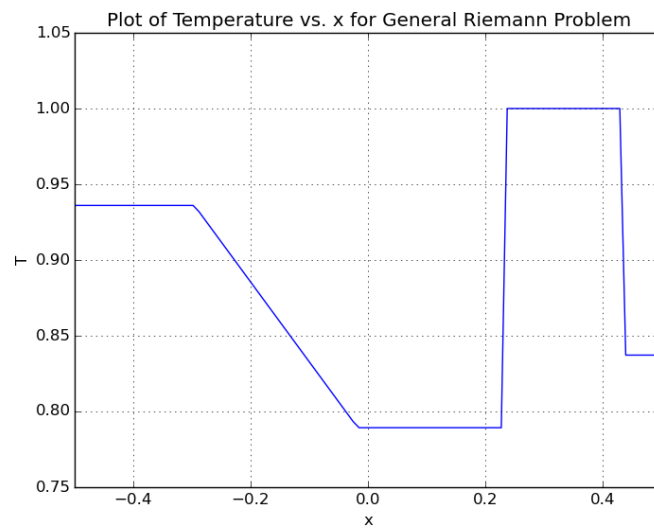


Figure 4: Temperature vs. x