1D CU & CURH Scheme results summarised

(Fortran and C++ Code results)

Moving Contact Wave

We consider the initial conditions

$$(\rho(x,0), u(x,0), p(x,0)) = \begin{cases} (1.4, 0.1, 1), x < 0.3 \\ (1.0, 0.1, 1), x > 0.3 \end{cases} \tag{1.2}$$

Where the computational domain is $x \in [0,1]$ and solution is evolved till $t = 2$sec on a uniform grid, for a second-order scheme we take $\Delta x = \frac{1}{100}$ for both CU and CURH Schemes. Free boundary conditions are imposed.

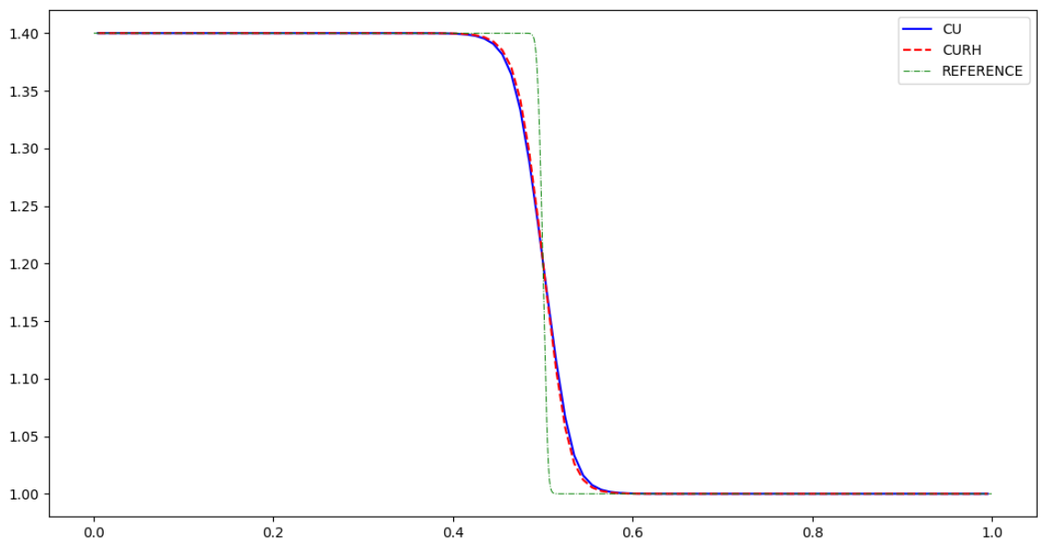

Figure 1 Moving Contact Wave (Fortran)

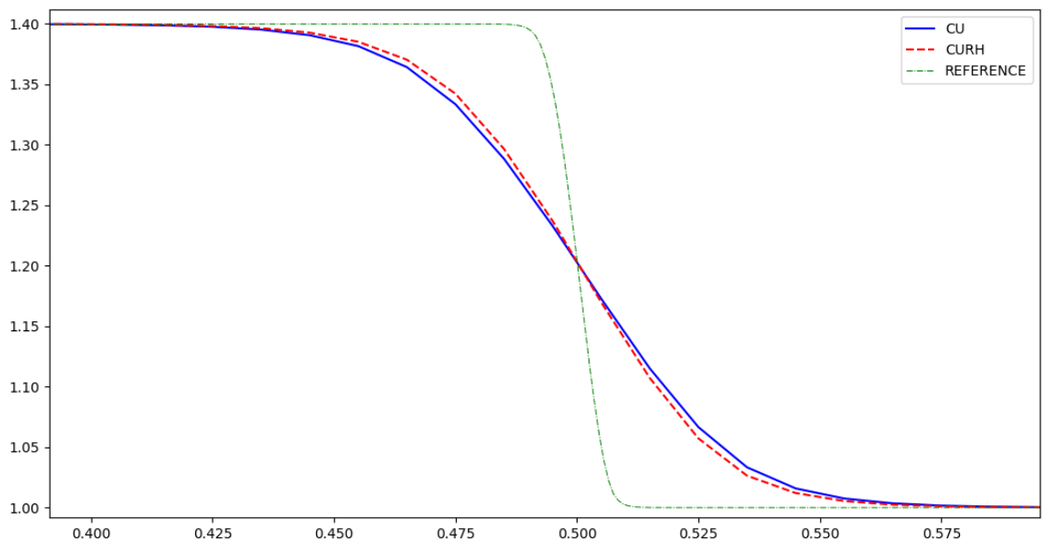

Figure 2Moving Contact Wave Zoomed (Fortran)

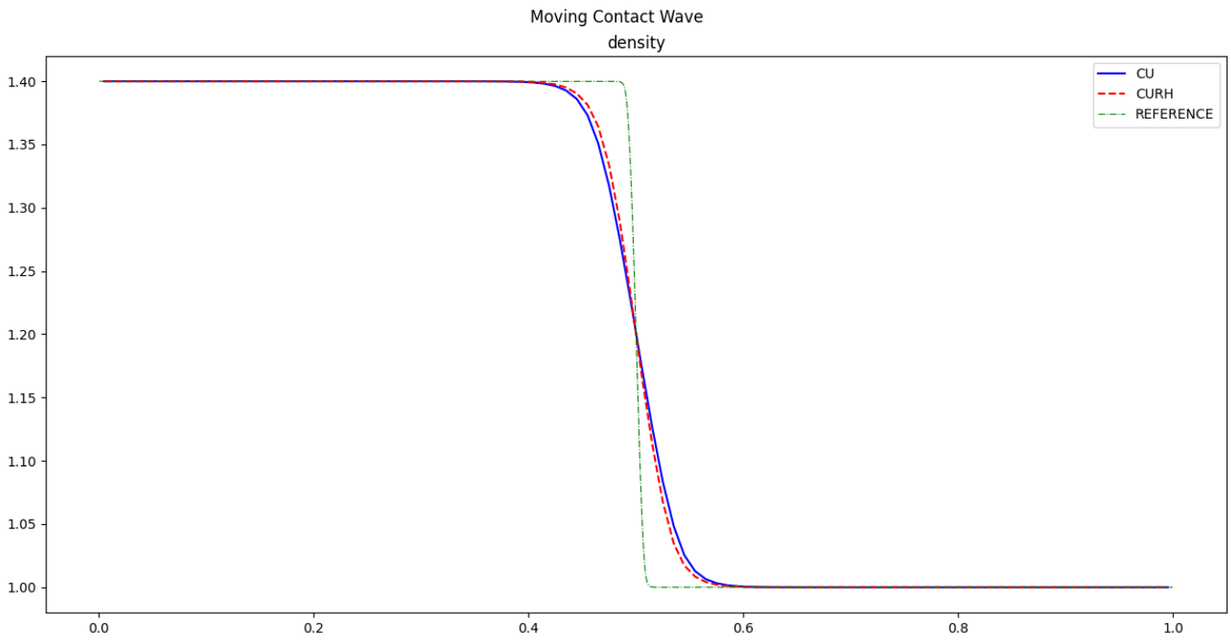

Figure 3 Moving Contact Wave (C++)

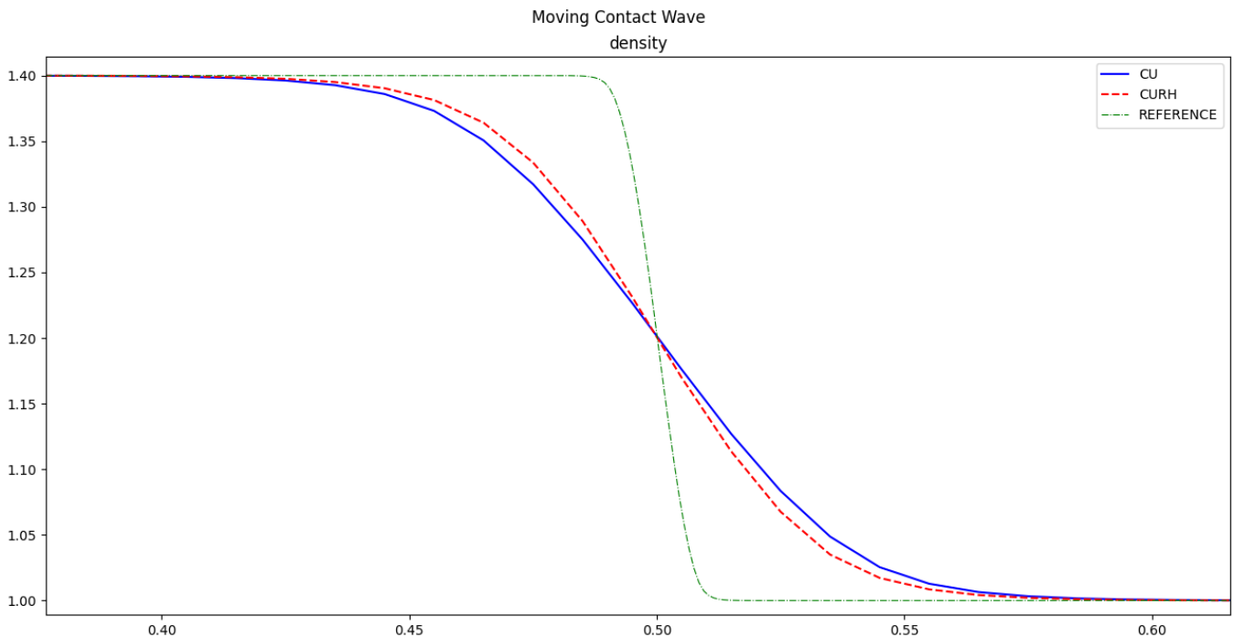

Figure 4 Moving Contact Wave Zoomed (C++)

Blastwave Problem

We consider the initial conditions

$$(\rho(x,0), u(x,0), p(x,0)) = \begin{cases} (1, 0, 1000), x < 0.1 \\ (1, 0, 0.01), 0.1 \leq x \leq 0.9 \\ (1, 0, 100), x > 0.9 \end{cases} \tag{1.3}$$

Where the computational domain is $x \in [0, 1]$ and solution is evolved till $t = 0.038$sec on a uniform grid, for a second-order scheme we take $\Delta x = \frac{1}{400}$ for both CU and CURH Schemes. Reflective boundary conditions are imposed.

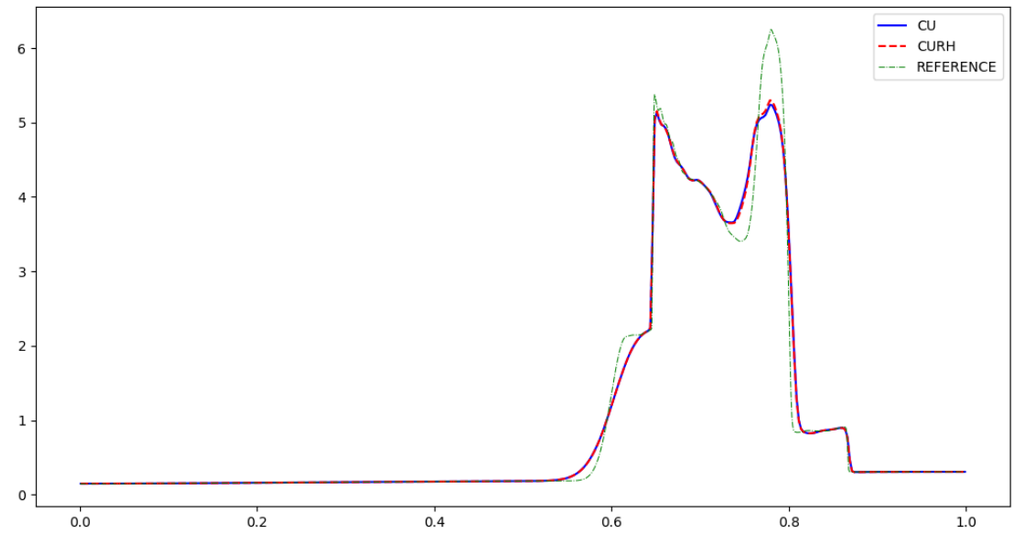

Figure 5 Blastwave Problem (Fortran)

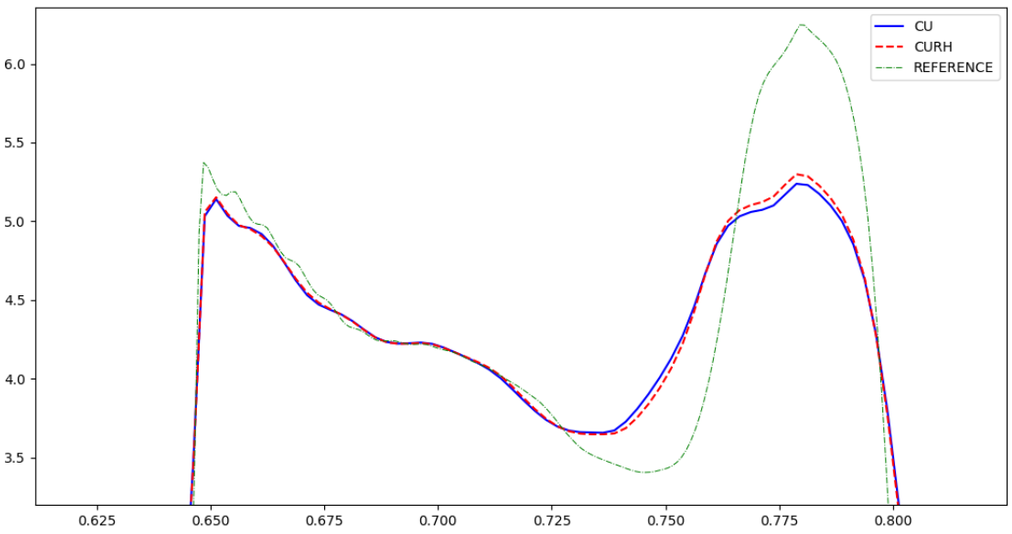

Figure 6 Blastwave Problem Zoomed (Fortran)

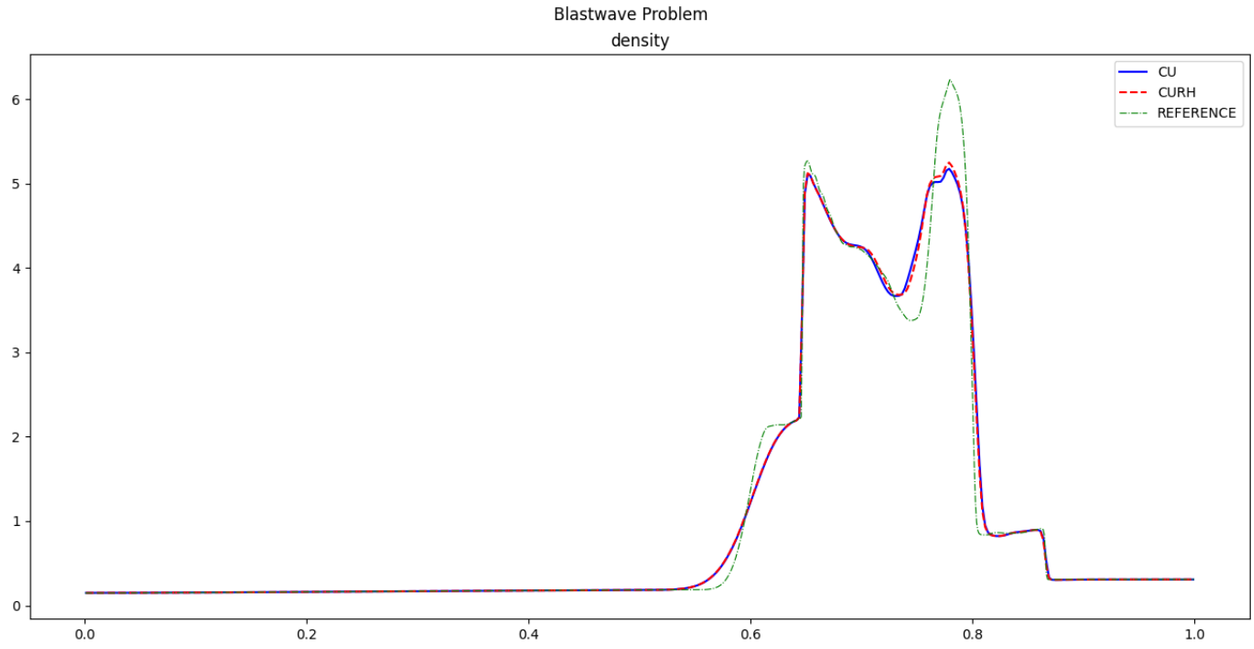

Figure 7 Blastwave Problem (C++)

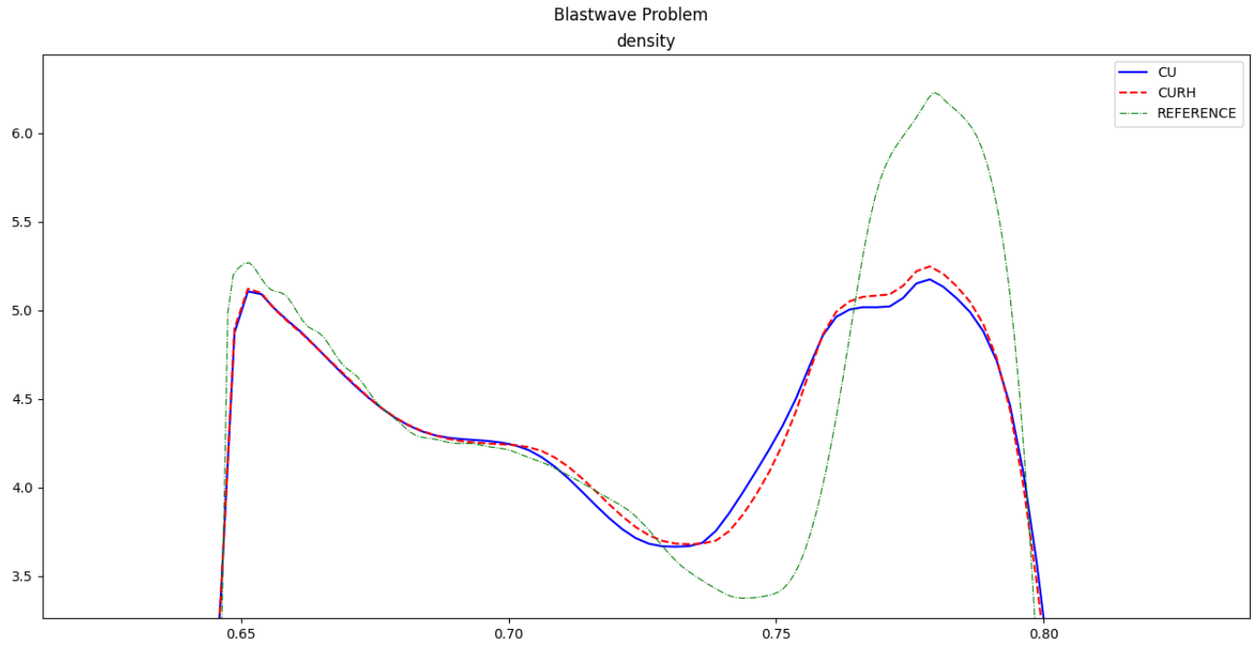

Figure 8 Blastwave Problem Zoomed (C++)

Shu Osher Problem

We consider the initial conditions

$$(\rho(x,0), u(x,0), p(x,0)) = \begin{cases} (3.857143, 2.629369, 10.3333), x < -4.0 \\ (1 + 0.2 * \sin(5x), 0, 1), x > -4.0 \end{cases} \quad (1.6)$$

Where the computational domain is $x \in [-4.5, 4.5]$ and solution is evolved till $t = 1.8$sec on a uniform grid, for a second-order scheme we take $\Delta x = \frac{1}{256}$ for both CU and CURH Schemes. Free boundary conditions are imposed.

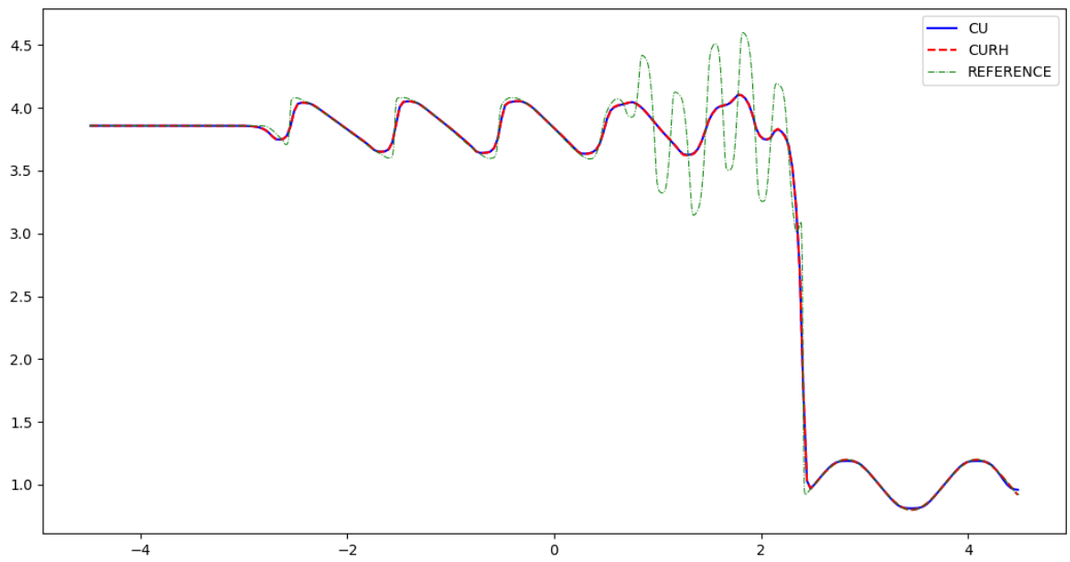

Figure 9 Shu Osher Problem (Fortran)

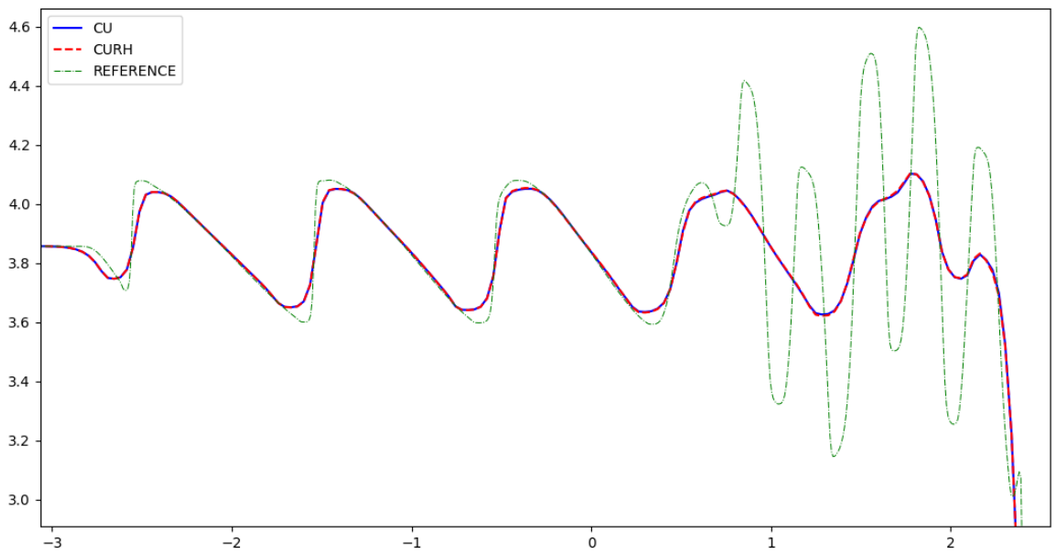

Figure 10 Shu Osher Problem Zoomed (Fortran)

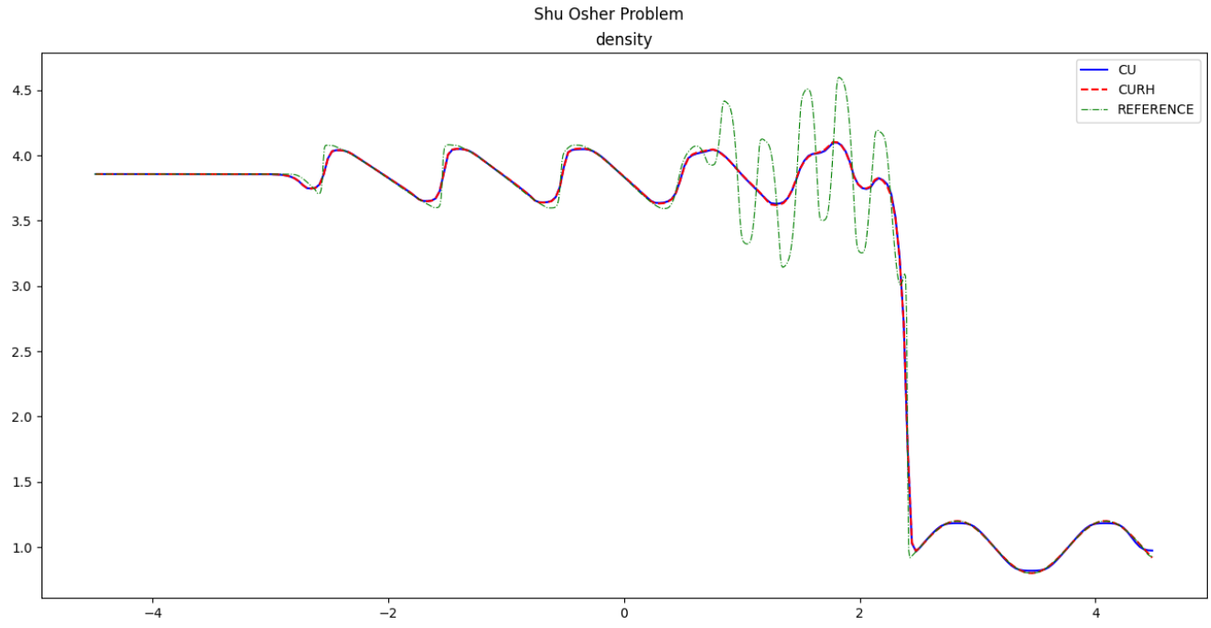

Figure 11 Shu Osher Problem (C++)

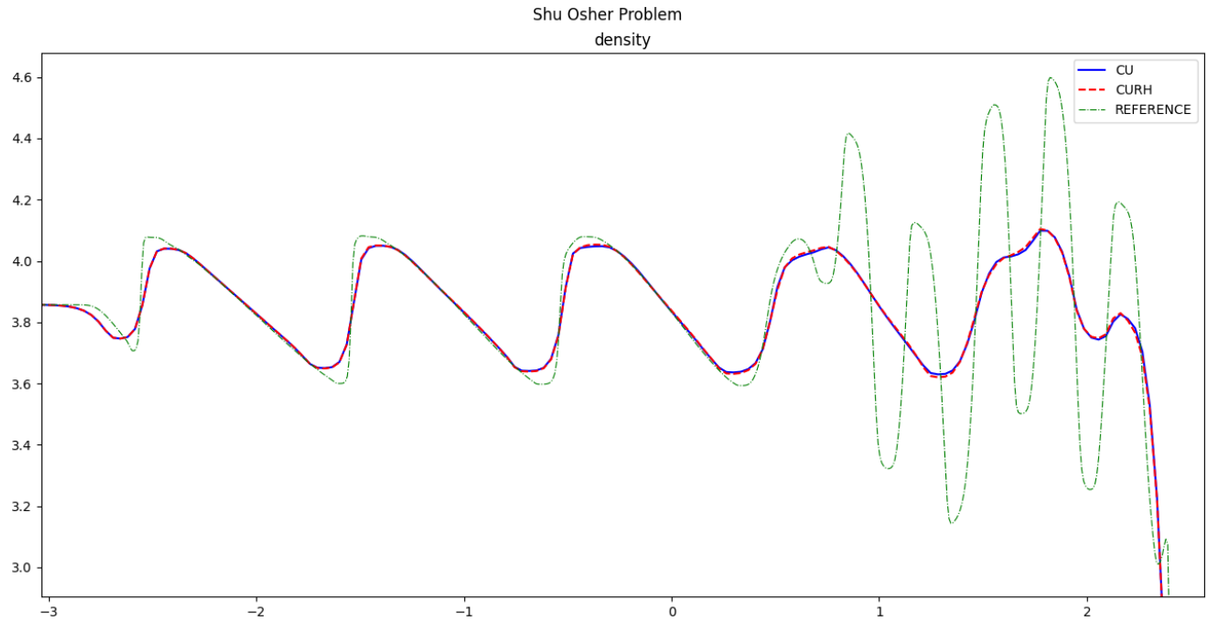

Figure 12 Shu Osher Problem Zoomed (C++)

Lax Problem

We consider the initial conditions

$$(\rho(x,0), u(x,0), p(x,0)) = \begin{cases} (0.445, 0.698, 3.528), x < 0 \\ (0.500, 0.000, 0.571), x > 0 \end{cases} \tag{1.3}$$

Where the computational domain is $x \in [-5, 5]$ and solution is evolved till $t = 1.3$sec on a uniform grid, for a second-order scheme we take $\Delta x = \frac{1}{200}$. Free boundary conditions are imposed.

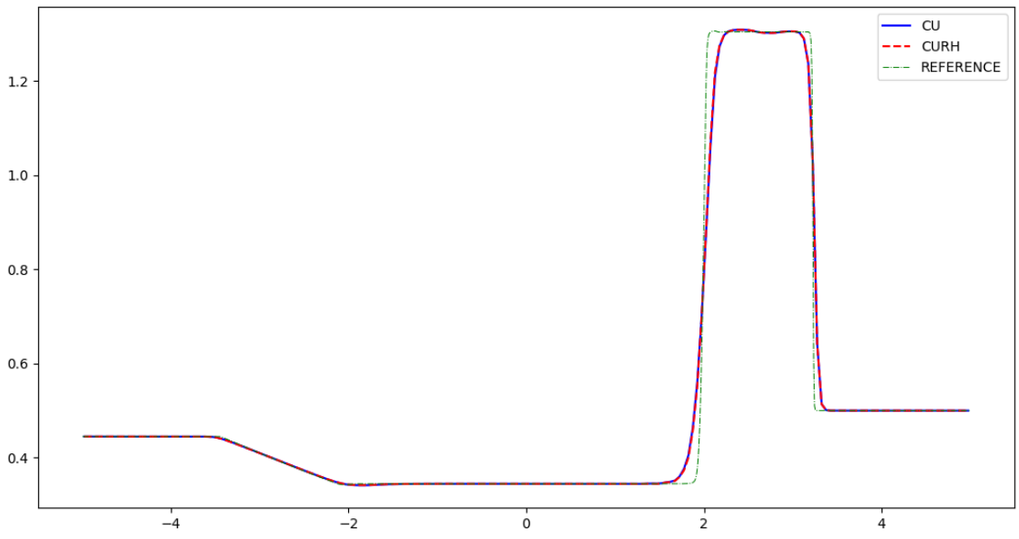

Figure 13 Lax Problem (Fortran)

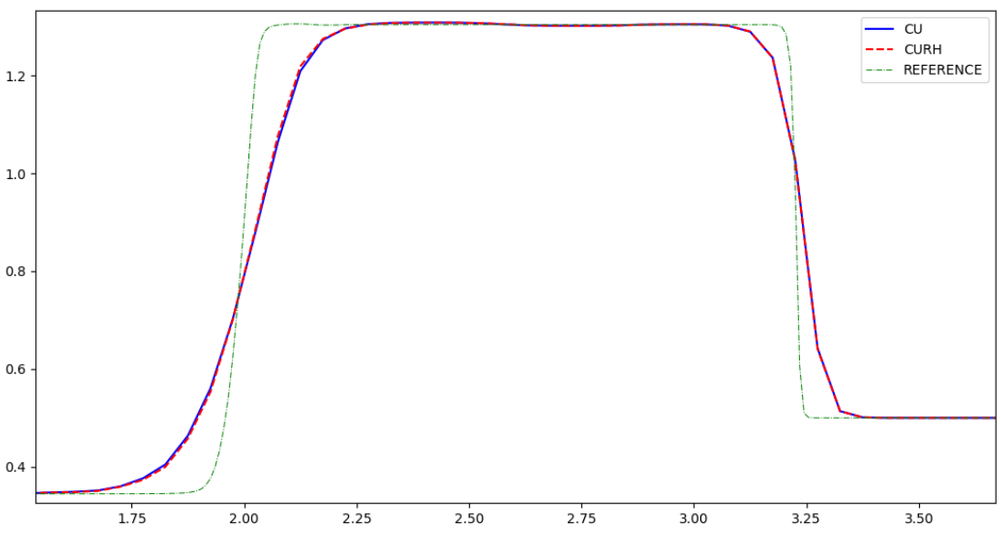

Figure 14 Lax Problem Zoomed (Fortran)

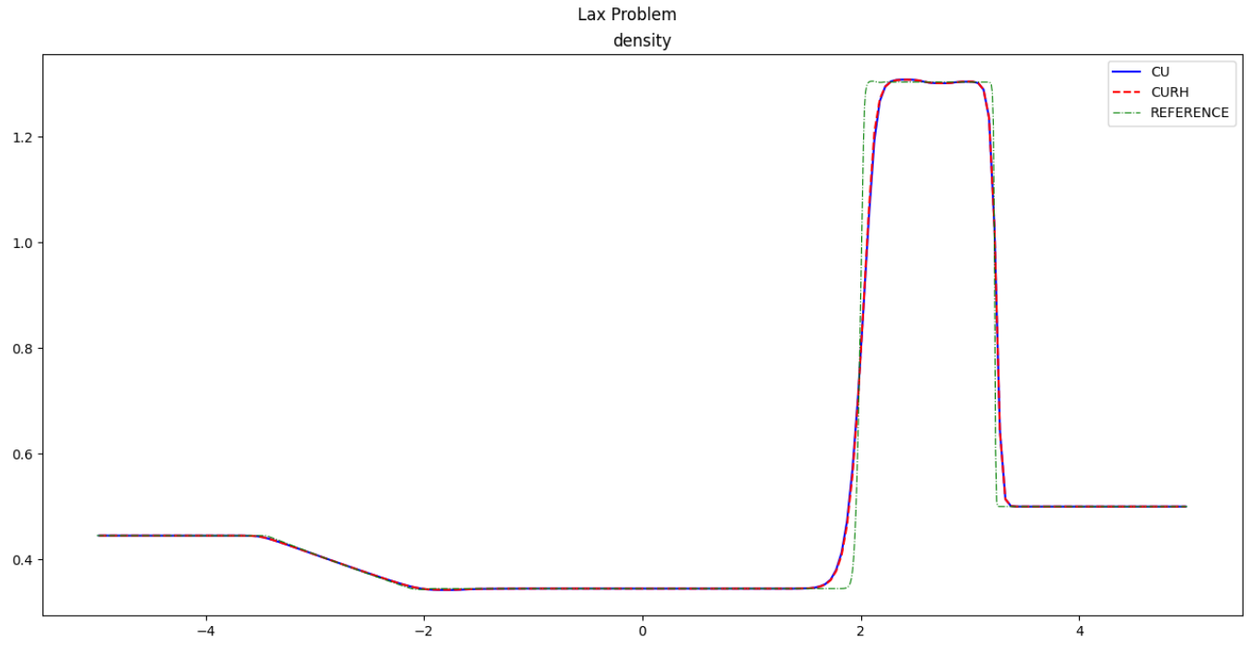

Figure 15 Lax Problem (C++)

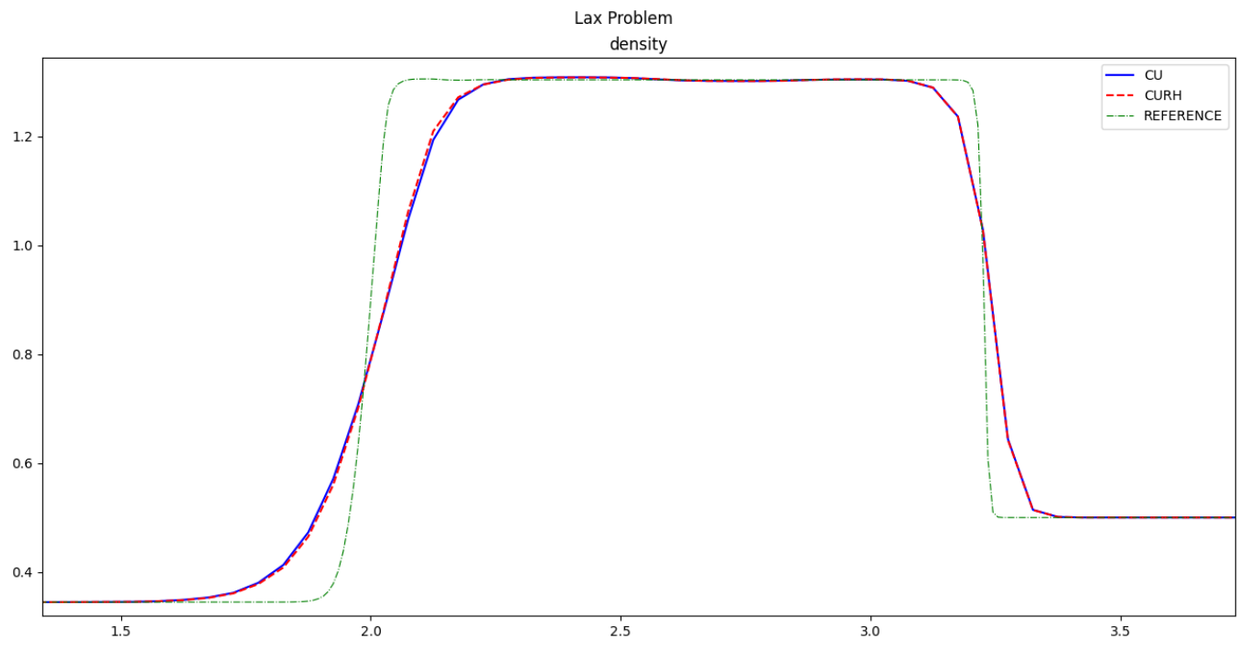

Figure 16 Lax Problem Zoomed (C++)

Sod's shock tube problem

We consider the initial conditions

$$(\rho(x,0), u(x,0), p(x,0)) = \begin{cases} (1.0, 0, 1.0), x < 0.5 \\ (0.125, 0, 0.1), x > 0.5 \end{cases} \tag{1.4}$$

Where the computational domain is $x \in [-1, 1]$ and solution is evolved till $t = 0.2$sec on a uniform grid, for a second-order scheme we take $\Delta x = \frac{1}{200}$. Free boundary conditions are imposed.

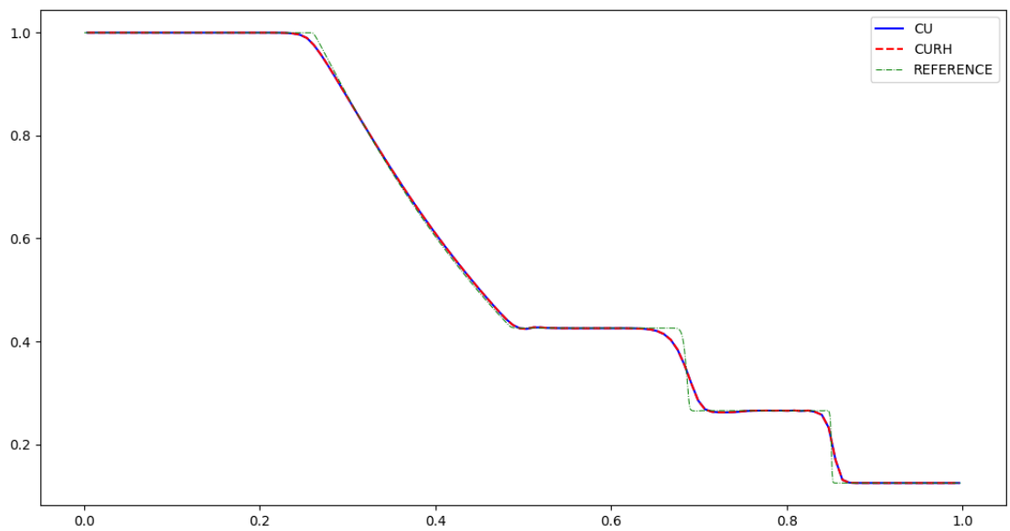

Figure 17 Sod's Shock Tube Problem (Fortran)

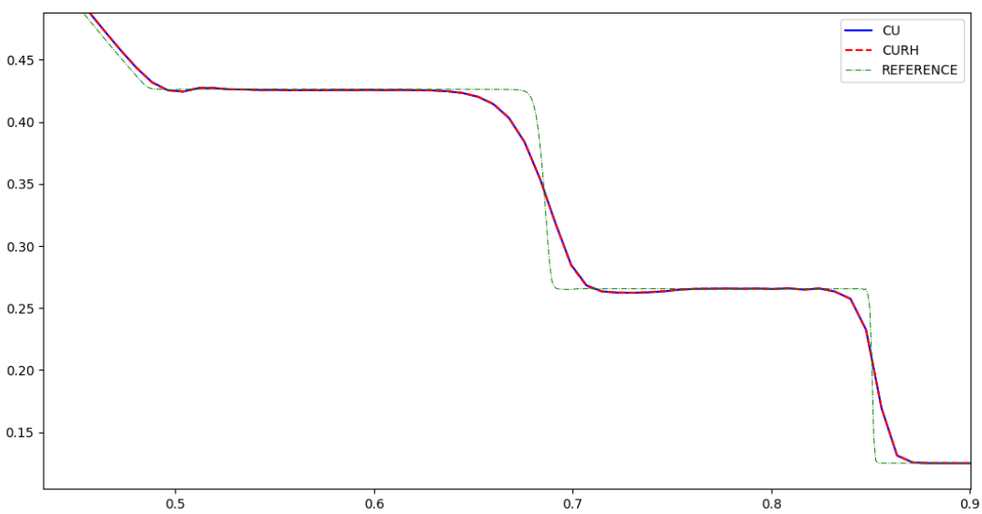

Figure 18 Sod's Shock Tube Problem Zoomed (Fortran)

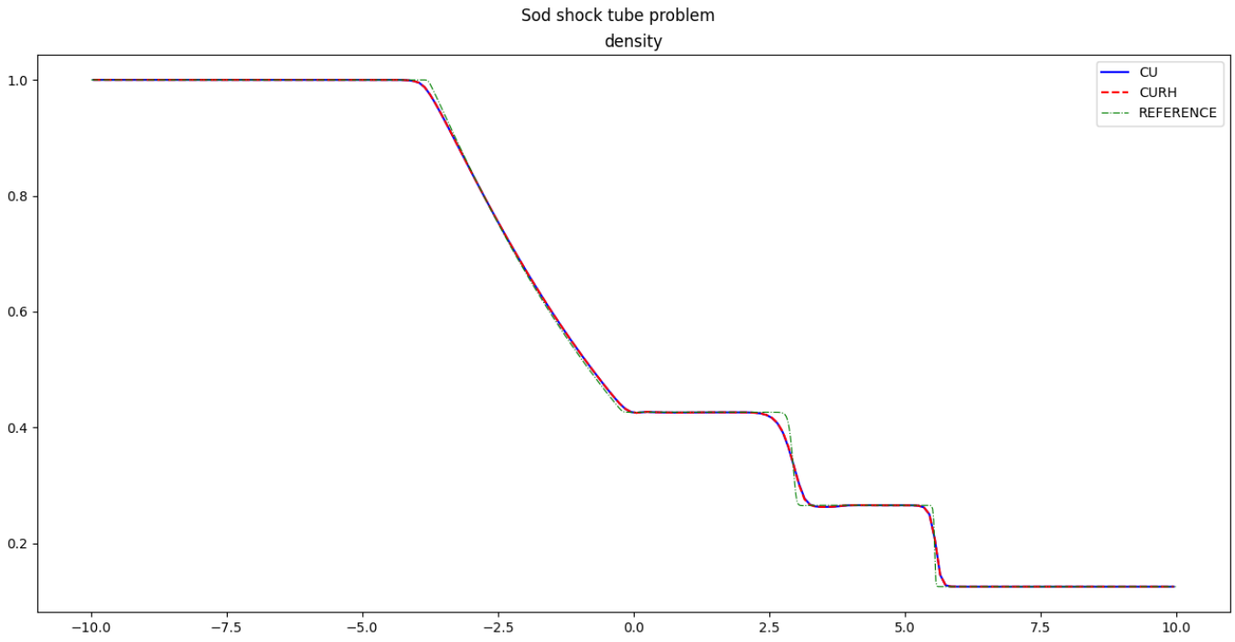

Figure 19 Sod's Shock Tube (C++)

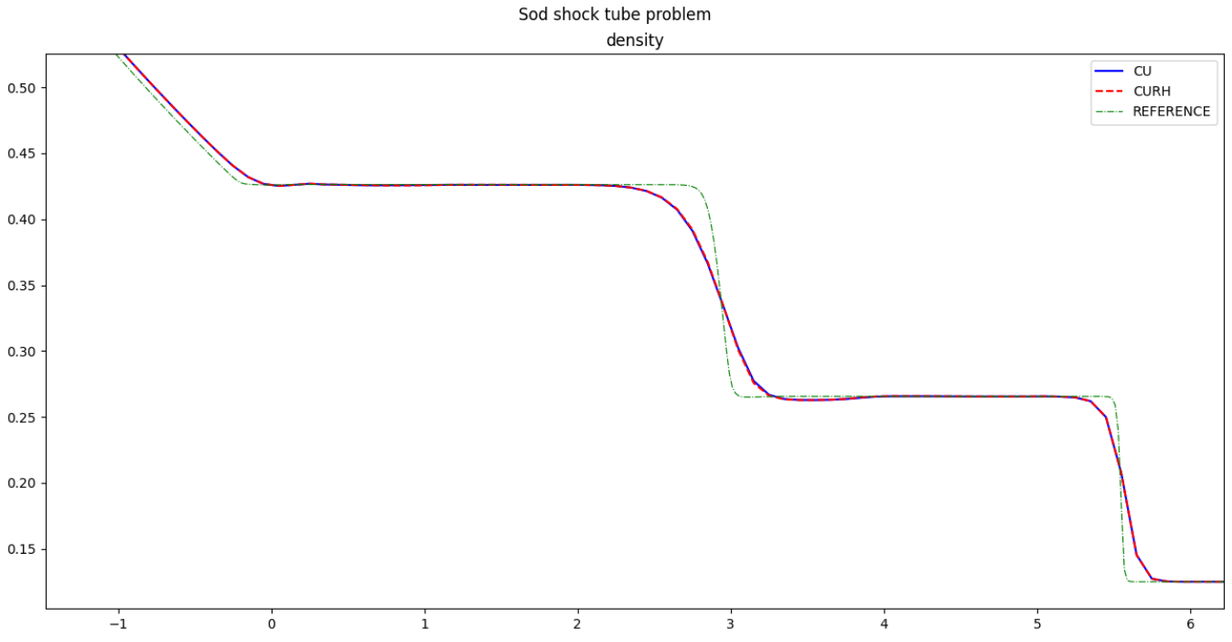

Figure 20 Sod's Shock Tube Zoomed (C++)