Ay190 – Worksheet 15
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Date: February 27, 2014

1 SPH Shock

We implement a 1D SPH Code for a Shock Tube with the following parameters on a domain of $[-0.5, 0.5]$ with $r = 0$, $\rho_L = 1.0$, $\epsilon_L = 2.5$, $v_L = 0$, and on the right side $\rho_R = 0.25$, $\epsilon_R = 1.795$, $v_R = 0$ and the adiabatic exponent of $\gamma = 1.4$.

1.1 Shock Develops

We implement the code in python and run it to a final time of $t = 0.2$.

We can see in figure 1 that the initial density in the left and right region are different densities and have a discontinuity.

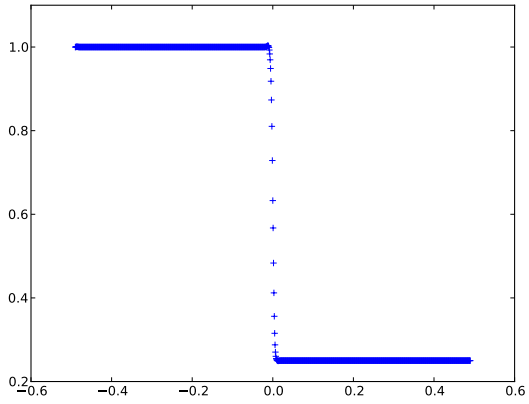

Figure 1: Graph of density with respect to space on the domain $[-0.5, 0.5]$. At time $t = 0$.

1.1.1 Plateau Devleops

As it evolves in time we can see the constant density plataus develope over time. See figures 2, 3.

1.1.2 Rarefraction Develops

As time progresses further we can see the rarefraction is more visible in 4 and at the final time 5.

1.2 Fortran Comparison

We use the fortran code to run an exact Riemann Solver and compare the solutions to our SPH code.

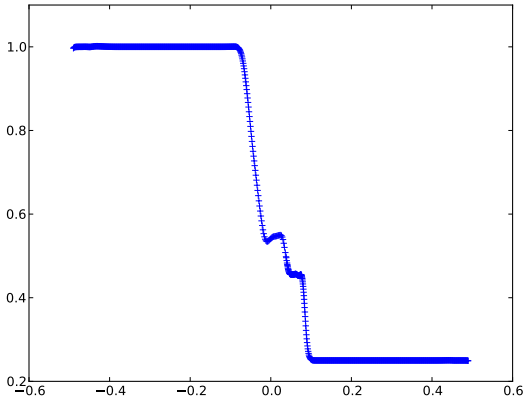

Figure 2: Graph of density with respect to space on the domain $[-0.5, 0.5]$. At time $t = 0.05$.

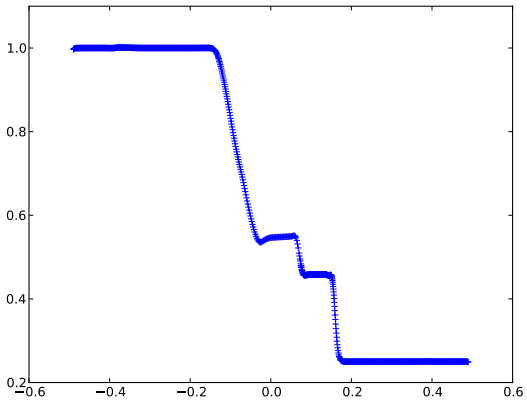

Figure 3: Graph of density with respect to space on the domain $[-0.5, 0.5]$. At time $t = 0.1$.

We can see that at small time $t = 0.05$ the two solutions are relatively close in 6.

As time goes on our numerical solution differs from the exact solution, as we would expect. At $t = 0.105$ the numerical simulation has over done the rarefraction as well as extended moved the shock to far to the right 7.

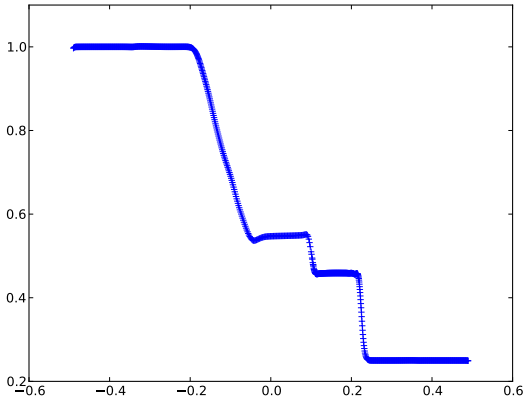

Figure 4: Graph of density with respect to space on the domain $[-0.5, 0.5]$. At time $t = 0.15$.

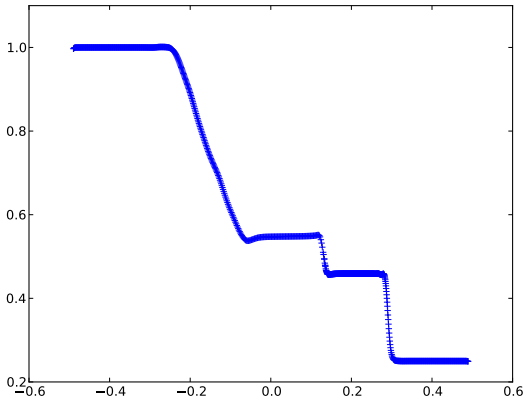

Figure 5: Graph of density with respect to space on the domain $[-0.5, 0.5]$. At time $t = 0.2$.

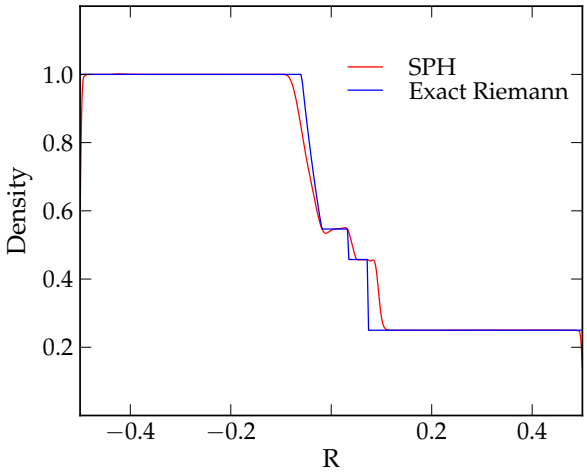

Figure 6: Graph of density with respect to space on the domain $[-0.5, 0.5]$ at $t = 0.05$. SPH solution in red, exact Riemann Solver in blue.

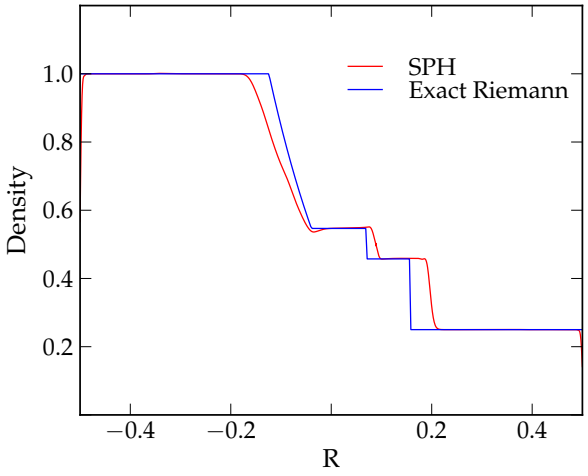

Figure 7: Graph of density with respect to space on the domain $[-0.5, 0.5]$ at $t = 0.105$. SPH solution in red, exact Riemann Solver in blue.