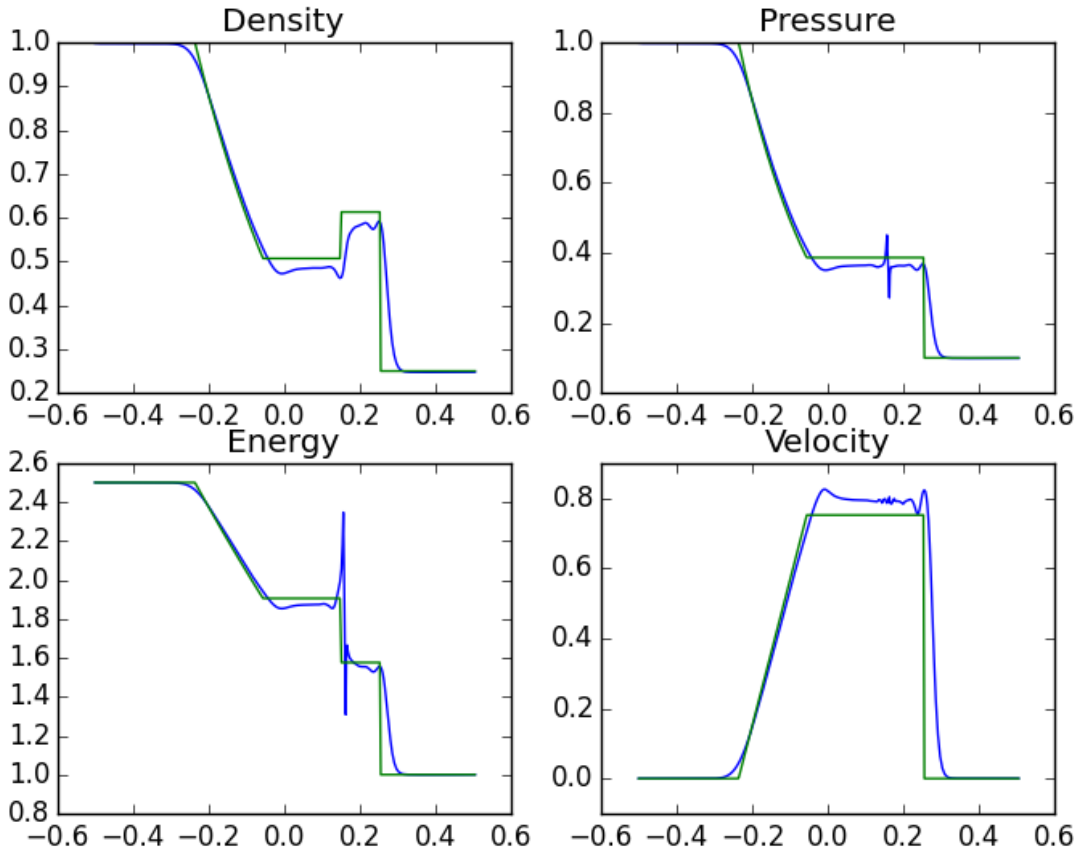
Sod's shock tube using SPH

Parameters:

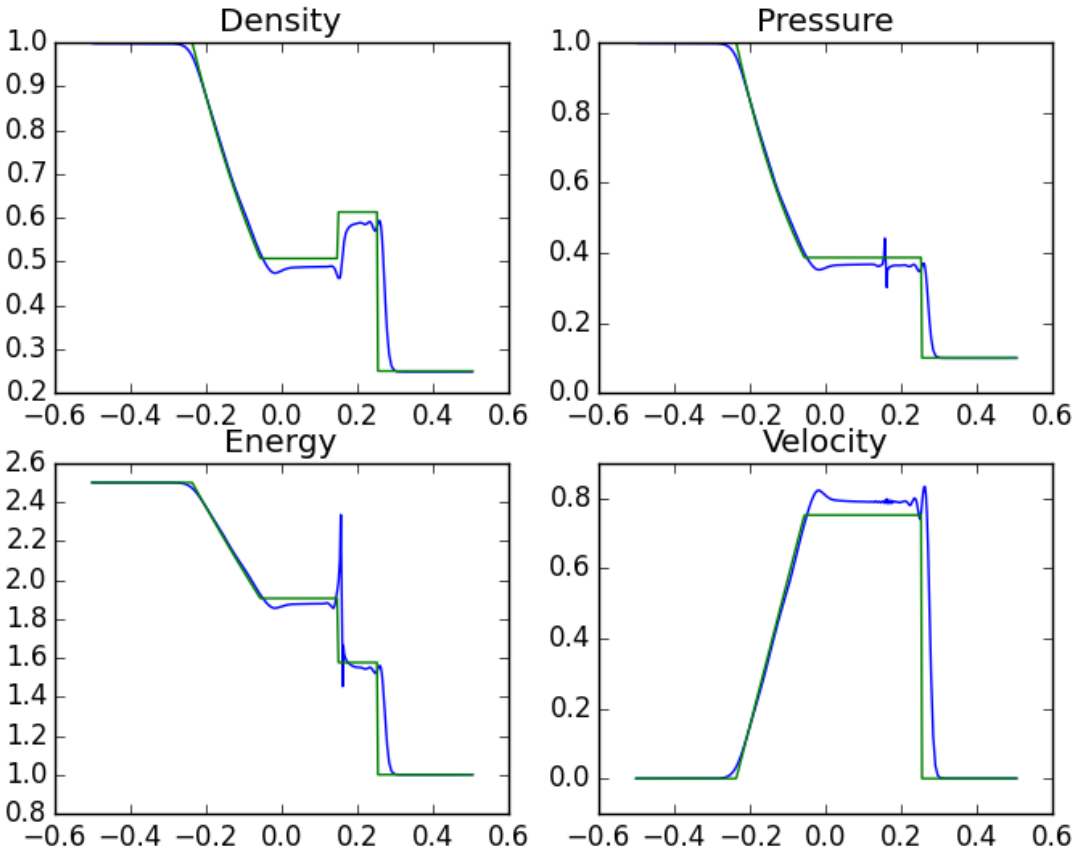
- Number of points in the physical domain = 401
- Physical Domain = [-0.5, 0.5]
- Extension using ghost points = upto 0.6 on each side
- time step = [1e-2, 1e-3, 1e-4, 0.5e-4]
- Final time = 0.2 seconds
- h_factor = [0.6, 1, 1.4, 2]

Results:

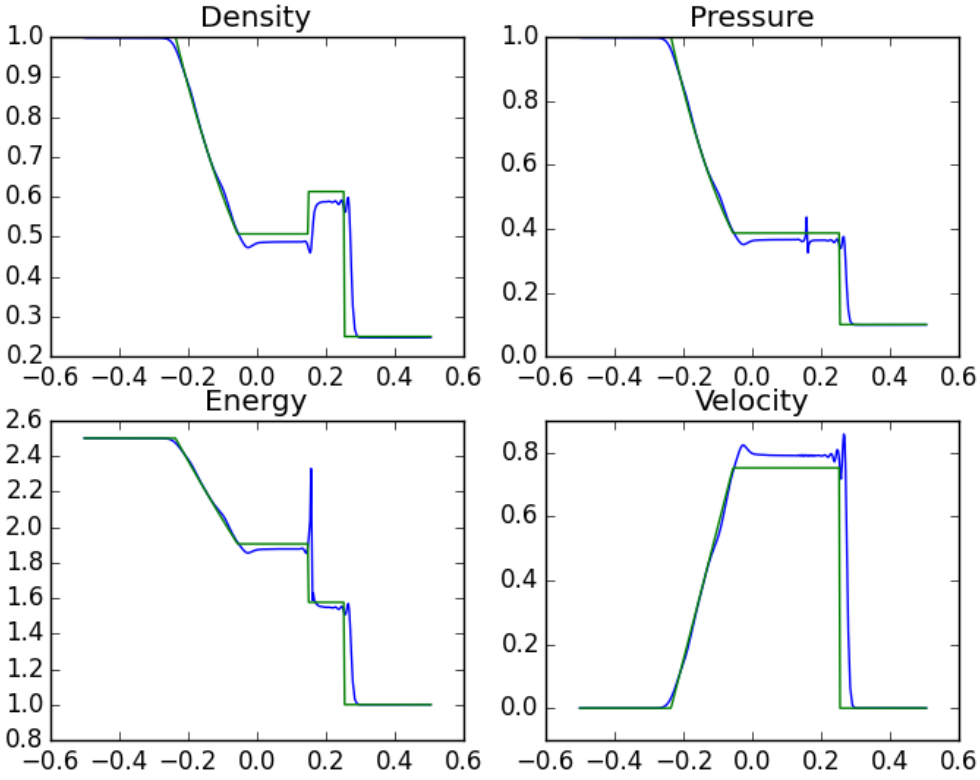
- Case 1: h_factor = 2; time step = 1e-4 sec (default case given by Sir)



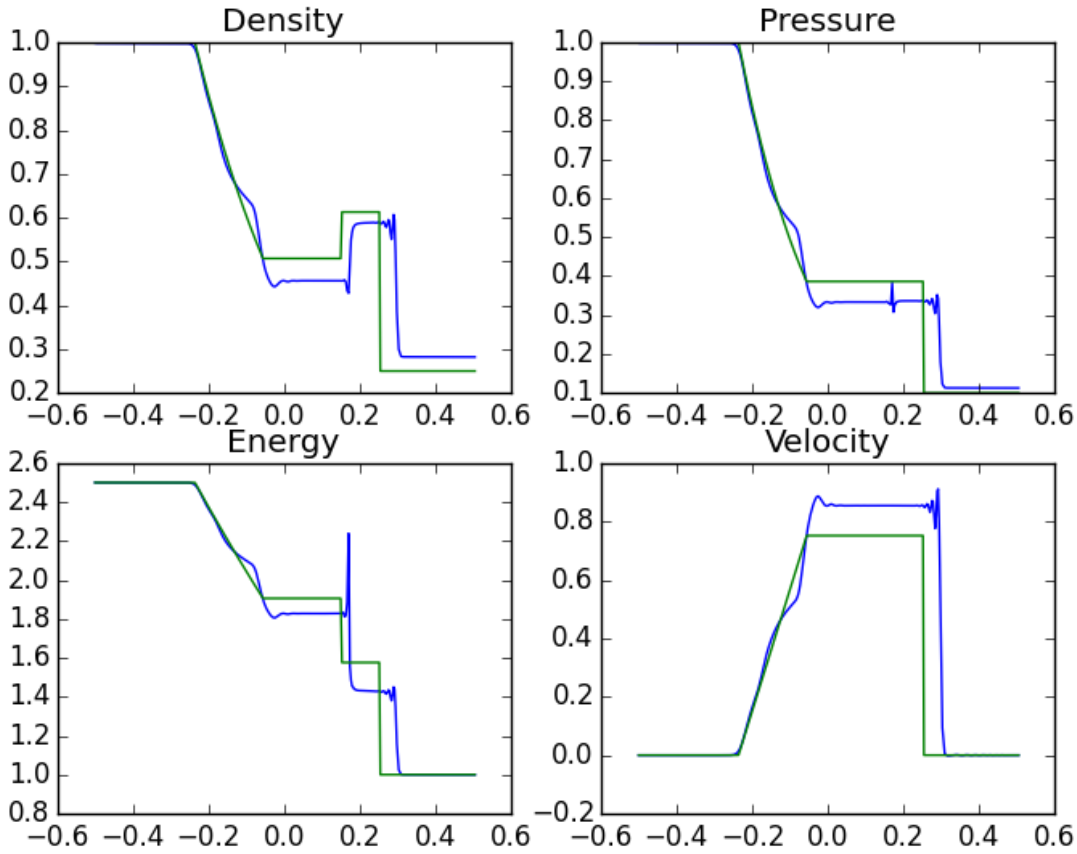
- Case 2: h_factor = 1.4; time step = 1e-4 sec



- Case 3: h_factor = 1; time step = 1e-4 sec



- Case 4: h_factor = 0.6; time step = 1e-4 sec



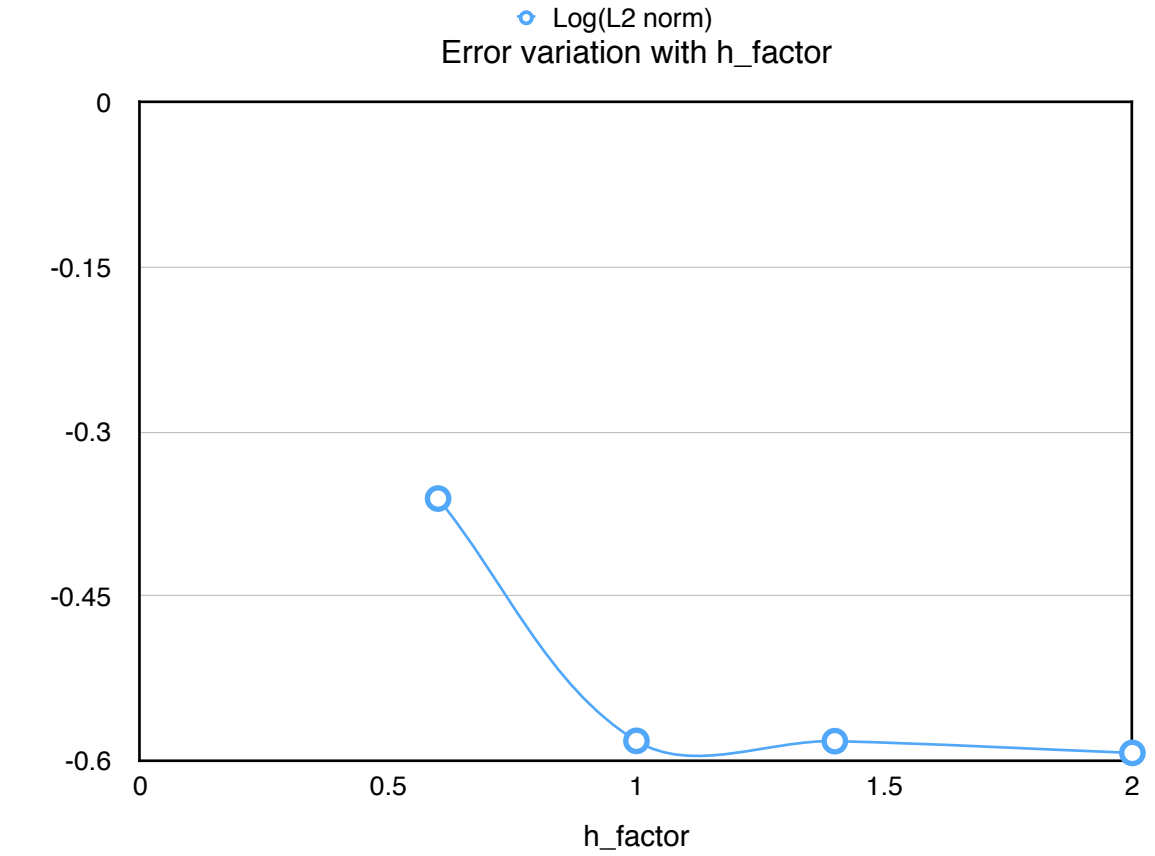
Error Plots:

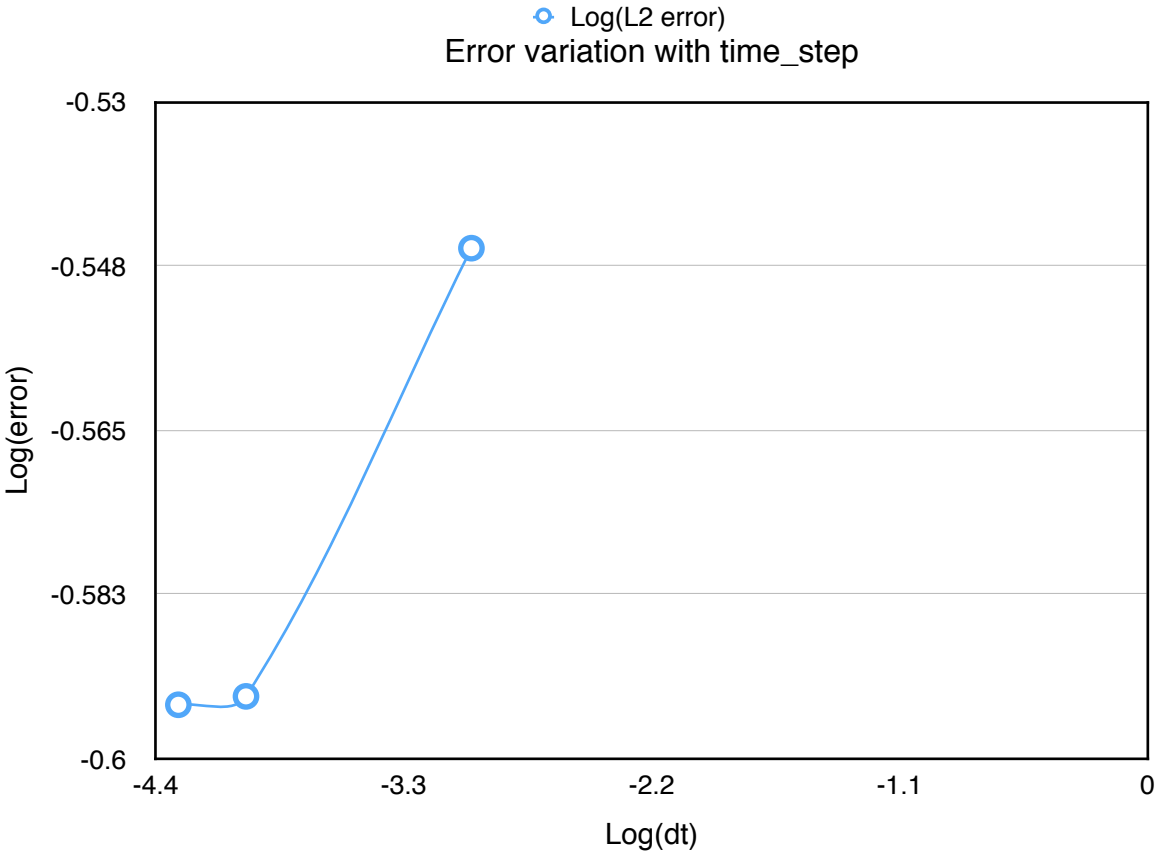
- Variation with time step

time step (h_factor = 2)	Max L2 error	Log(dt)	Log(L2 error)
1E-02	nan	-2E+00	
1E-03	0.284689424467	-3E+00	-0.545628665557406
1E-04	0.255072247645	-4E+00	-0.593336790901346
5.0E-05	0.254548249742	-4.3E+00	-0.594229884798336

- Variation with h_factor

h_factor (time step = 1e-4)	Max L2 error	Log(L2 norm)
0.6	0.435259472964	-0.361251768145788
1	0.261628686617	-0.582314638954683
1.4	0.261453150566	-0.582606120462038
2	0.255072247645	-0.593336790901346


Log(L2 norm)
Error variation with h_factor
0
-0.15
-0.3
-0.45
-0.6
0
0.5
1
1.5
2
h_factor


Log(L2 error)
Error variation with time_step
-0.53
-0.548
-0.565
-0.583
-0.6
Log(error)
-4.4
-3.3
-2.2
-1.1
0
Log(dt)

Observations & Conclusions:

- We observe kinks in the plots of energy and pressure, mainly because h was kept constant throughout the domain and time stepping, it might be one of the many problems.
- when we increase the denominator (term which is used to take care of singularity) of the numerical viscosity term, we observe high oscillations in the plots. this is why it is kept low.
- Very good match is observed in the rarefaction region and in the shock region the graph is a bit shifted, may be the shock speed is not captured properly by the scheme
- Some oscillations are also seen near the shock region on the left side the reason for which is unknown
- Ghost particles are added on the edge to take care of the edge effect. They are not touched while integration