1 Saltzman's problem

Completely taken from [2].

"This is a difficult test case to validate numerical schemes with moving boundary and has been extensively studied in the literature [1]. The set-up of the problem is the following. On a computational domain 1.0×0.1, 100×10 grid points are distributed in the following (x, y) locations,

$$\begin{cases} x_{ij} = (i-1)\Delta x + (11-j)sin(\frac{\pi(i-1)}{100})\Delta y \\ y_{ij} = (j-1)\Delta y \end{cases}$$

where $\Delta x = \Delta y = 0.01$.

A gas with specific heat ratio $\gamma = 5/3$ is filled stationarily inside the computational domain initially. Then, the left boundary, such as a piston, is moving into the gas with constant velocity 1.0. Thus, a strong shock wave is generated from the moving piston. On the upper and lower boundaries, a reflection boundary condition is used. This problem has the exact solution. At $t = 0.6$, the shock is expected to be located at $x = 0.8$ with the post-shock density $\rho = 0.6$, velocity $u = 1.0$, and pressure $p = 1.333$.

In this case, we simply take $U_{g,y} = 0$. The numerical results by the current moving mesh method are shown in Figs. 8-13. The initial mesh is given in Figs. 8 and 9 is the mesh at time $t = 0.6$. The computed pressure, velocity and density are presented in Figs. 12 and 11 along the line y = 0.05. We find that the current numerical results are more accurate in comparison with other scheme, such as in [36,37].In Fig. 13, the mesh and density contour at time $t = 0.9$ are shown."

So we have following problem parameter values for ideal gas inside the domain:

$$\begin{cases} \rho_0 = 1 \\ u_0 = 0 \\ e_0 = 10^-4 \end{cases}$$

and left border velocity is set to be $u_L = 1.0$.

References

[1] J K Dukowicz and B J a Meltz. "Vorticity Errors in Multidimensional Lagrangian Codes". In: *Journal of Computational Physics* 99 (1992), pp. 115–134. ISSN: 00219991. DOI: 10.1016/0021-9991(92)90280-C.

[2] Guoxi Ni, Song Jiang, and Shuanghu Wang. "A remapping-free, efficient Riemann-solvers based, ALE method for multi-material fluids with general EOS". In: *Computers and Fluids* 71 (2013), pp. 19–27. ISSN: 00457930. DOI: 10.1016/j.compfluid.2012.10.005. URL: http://dx.doi.org/10.1016/j.compfluid.2012.10.005.