AE 625 - Particles Methods for Fluid Flow Simulation
SPH function and derivative approximation

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Consider Laney's problems and solve them using SPH.

The report is generated through the command ¨ sh a8-140010042.sh ¨

1 Solve $u_t + u_x = 0$ with $u(x, 0) = sin(\pi x)$, periodic in [1,1], find $u(x, 40)$ using 40 points for discretization.

Results:

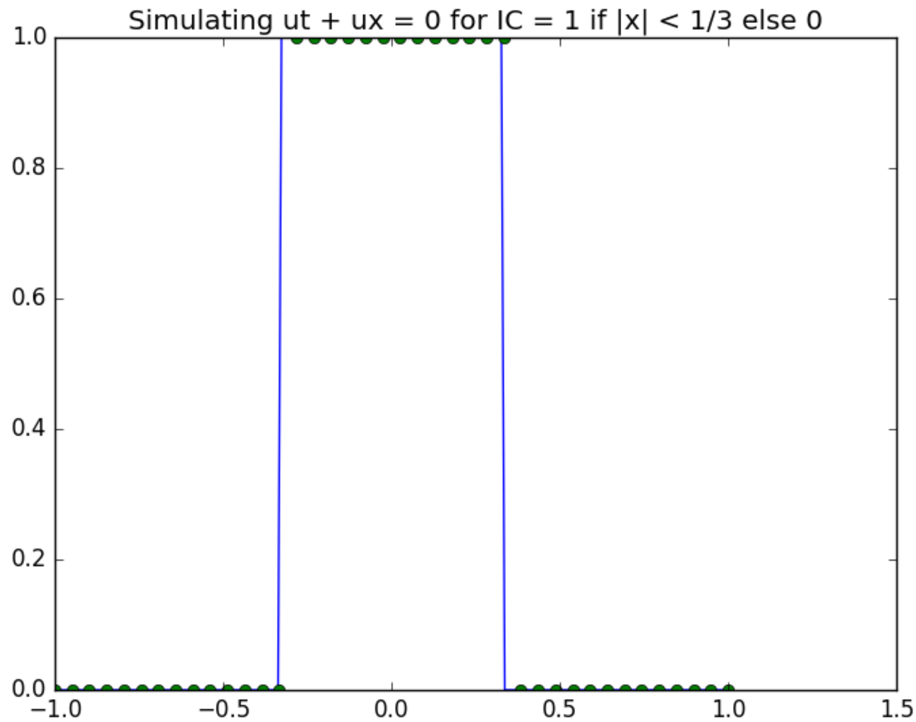

Figure 1: Q1 40 points

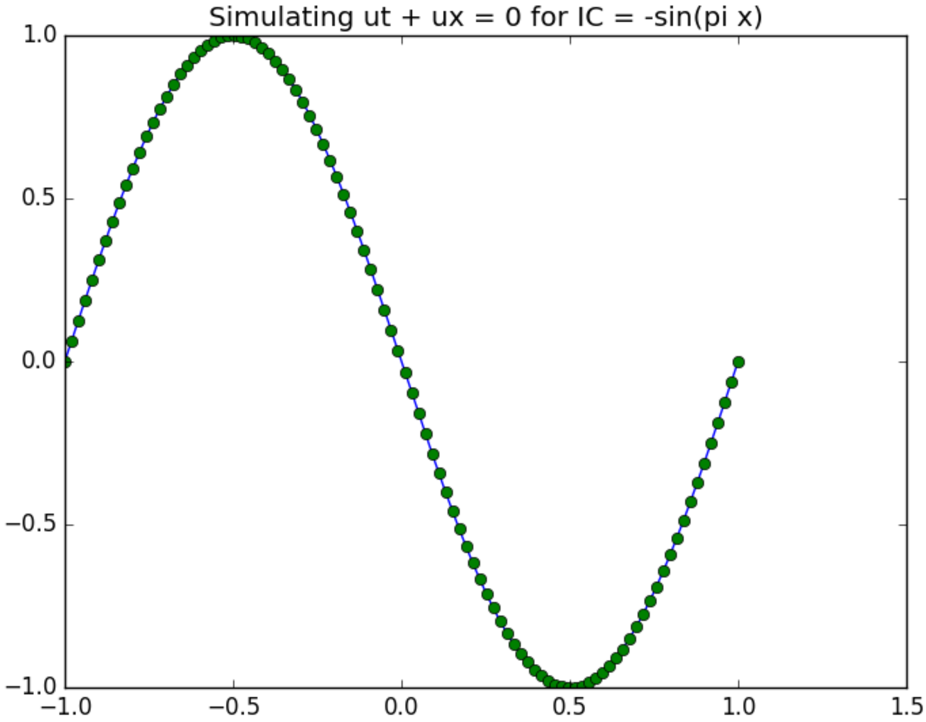

Figure 2: Q1 100 points

2 Solve $u_t + u_x = 0$ with $u(x, 0) = 1 when |x| < 1/3 and 0 otherwise$, periodic in [1,1], find $u(x, 40)$ using 40 points for discretization.

Results:

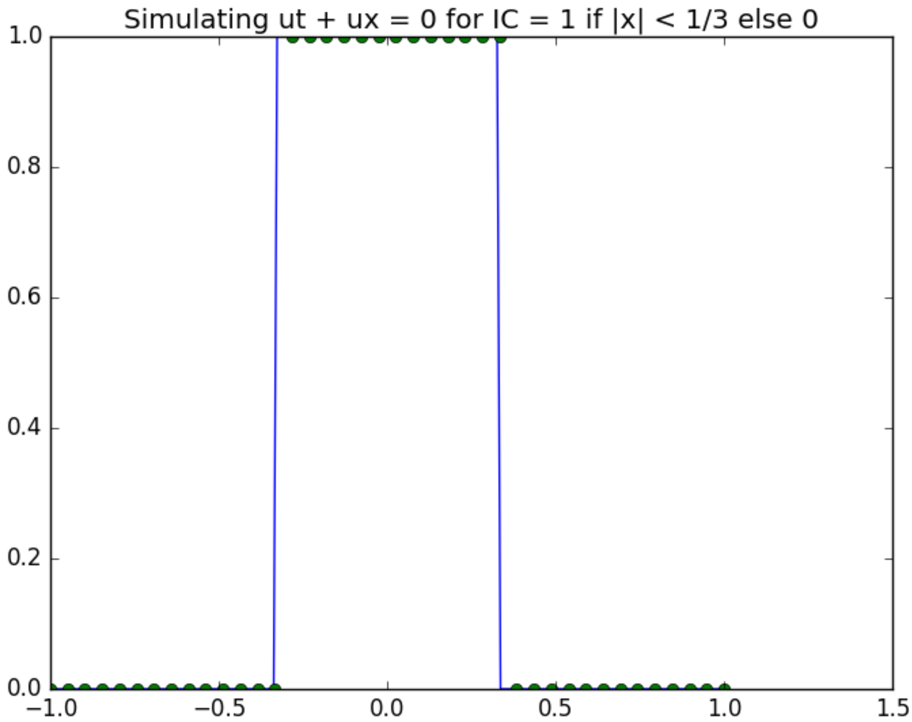

Figure 3: Q2 40 points

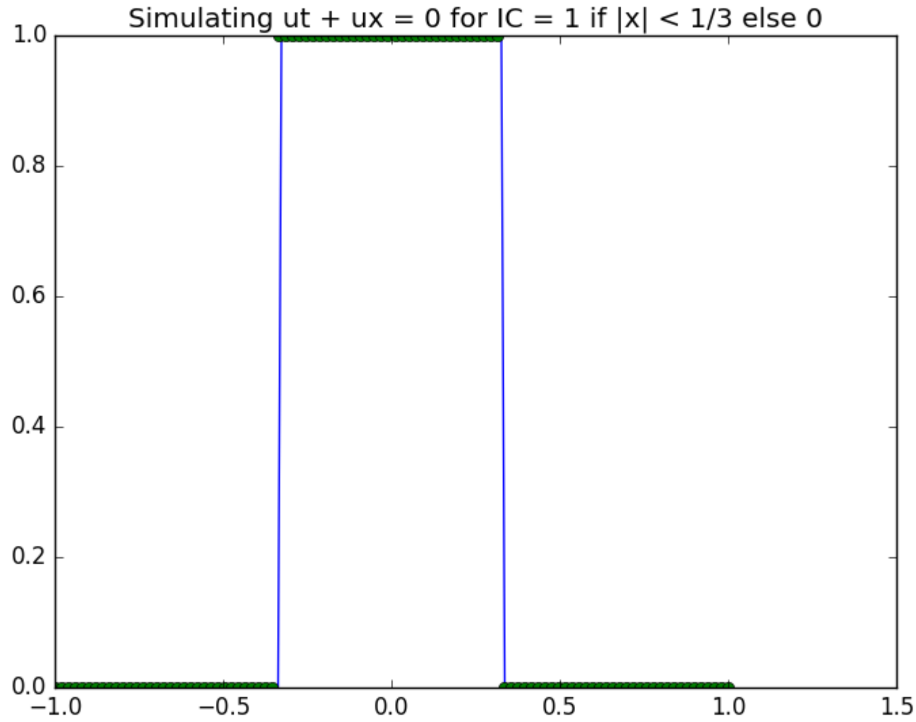

Figure 4: Q2 100 points

3 Solve $u_t + u_x = 0$ with $u(x,0) = 1 when |x| < 1/3 and 0 otherwise$, periodic in [1,1], find $u(x,0.6)$ using 40 points for discretization.

Results:

e = 0.5

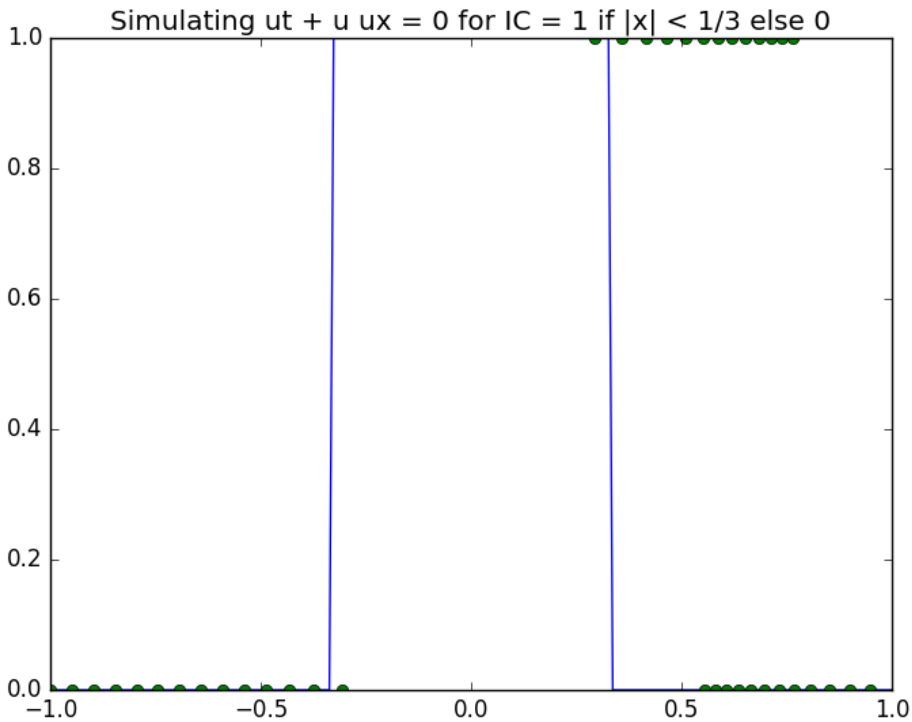

Figure 5: Q3 40 e 0.5

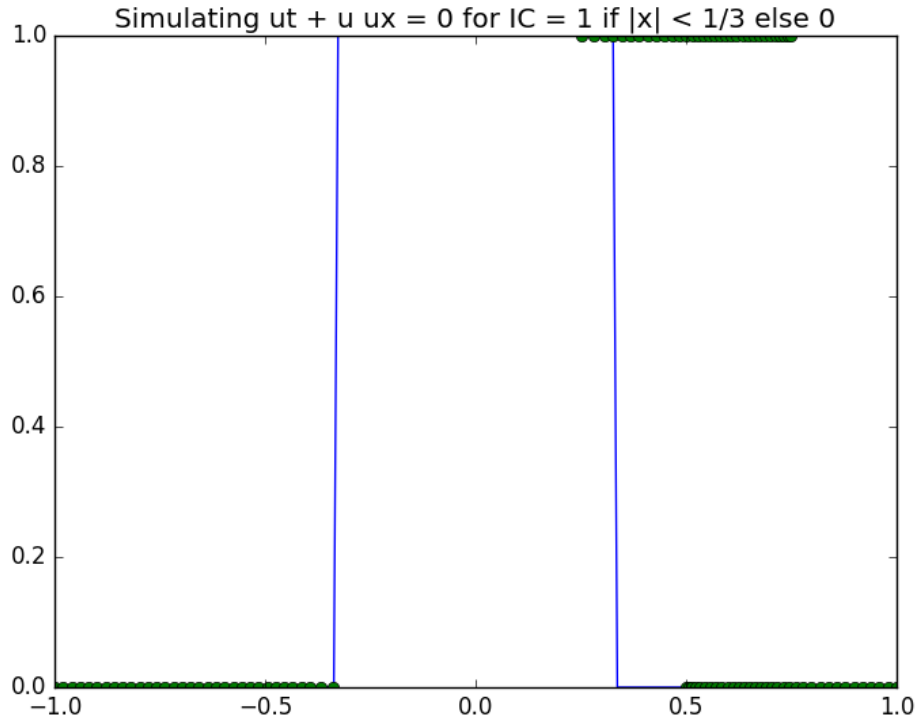

Figure 6: Q3 100 e 0.5

e = 1.0

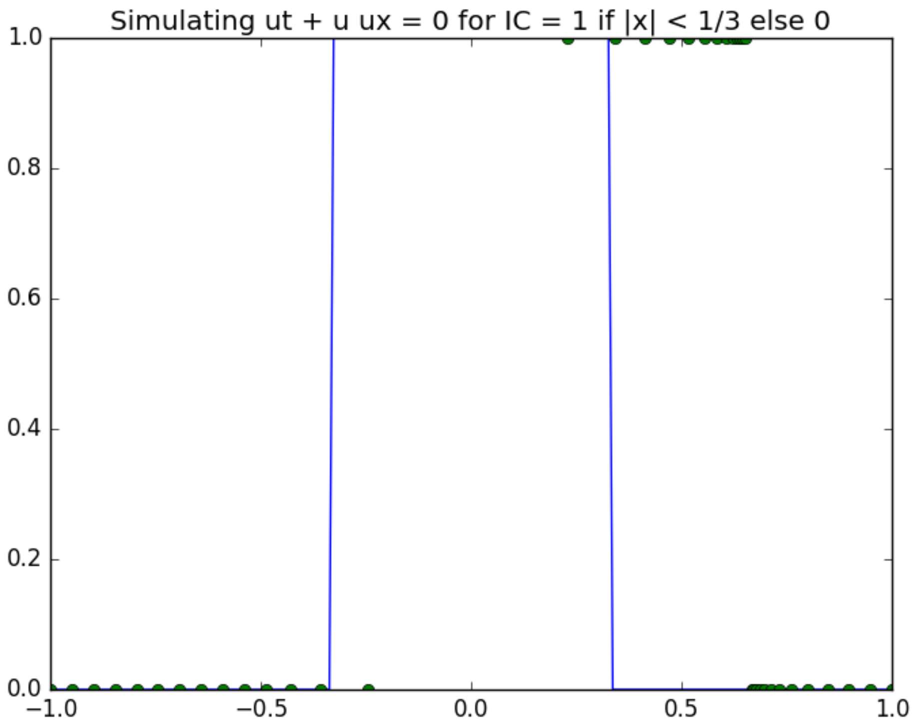

Figure 7: Q3 40 e 1.0

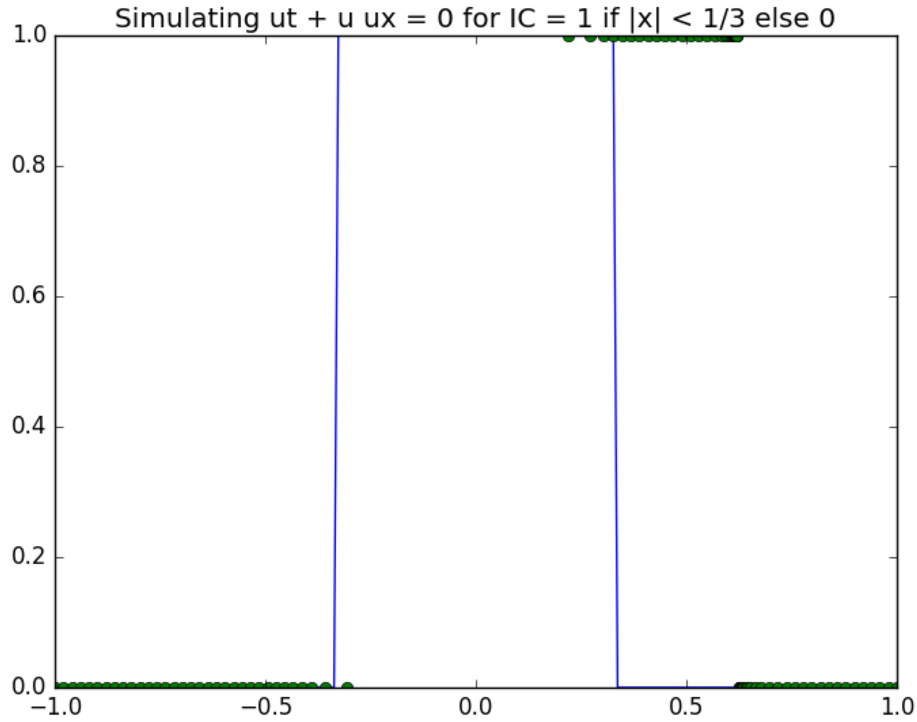

Figure 8: Q3 100 e 1.0

4 Solve $u_t + u_x = 0$ with $u(x,0) = 1 when |x| < 1/3 and - 1 otherwise$, periodic in [1,1], find $u(x, 0.3)$ using 40 points for discretization.

Results:

e = 0.5

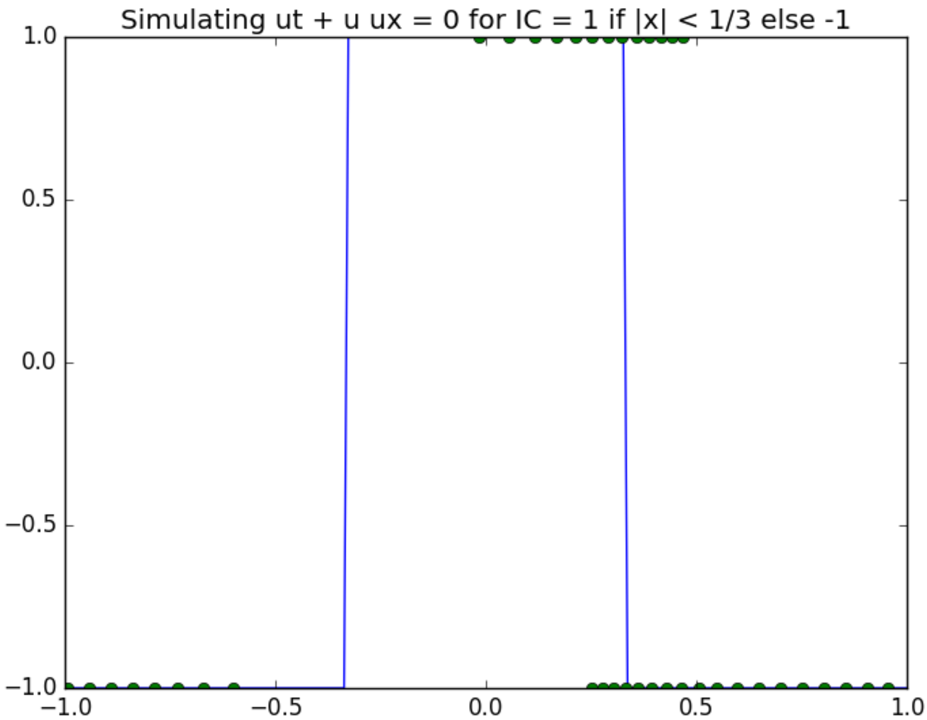

Figure 9: Q4 40 e 0.5

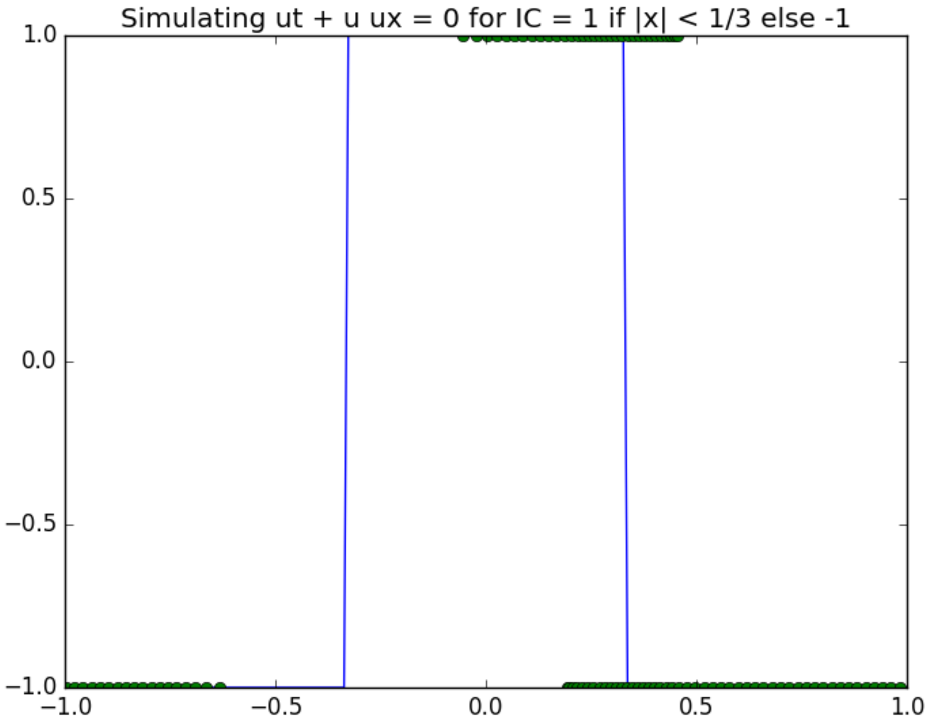

Figure 10: Q4 100 e 0.5

e = 1.0

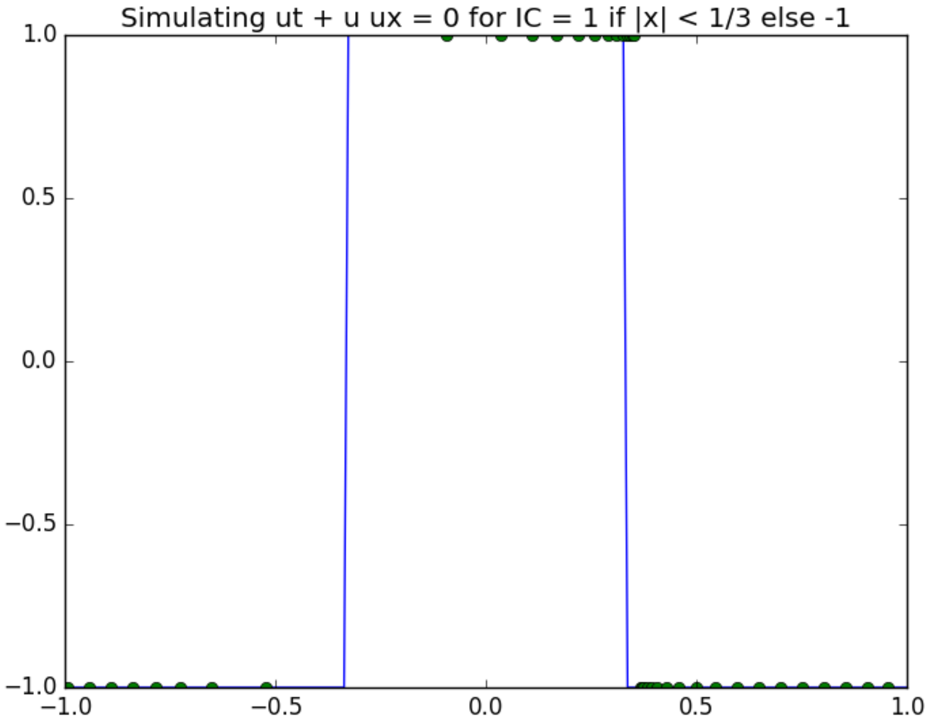

Figure 11: Q4 40 e 1.0

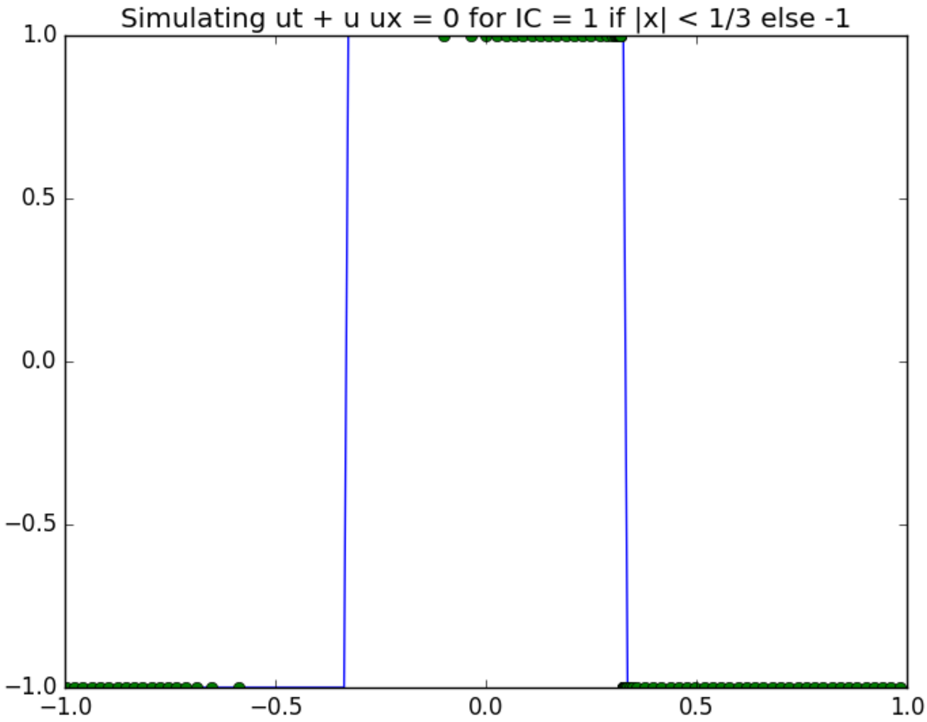

Figure 12: Q4 100 e 1.0

Inference: The XSPH velocity for e = 1.0 is nothing weighted average of velocity in the neighbourhood of x, So particles having same position will tend to move with same velocity as opposed to the case with e = 0.5 where particles retain a part of their original velocity