Introducing Dynamic Walls into Integer Lattice Gas Simulations

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Introduction

- Explore interactions between gas and rigid shapes
- Build off of existing Lattice Gas Simulation Code

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- Build off of existing Lattice Gas Simulation Code

initial goals

- Non leaking dynamic walls
- Make complex shapes out of these dynamic walls
- reproduce the Feynman tube experiment.

Method 1

Expected value of flow

$$< \mathit{flow} >= \text{particle density} * \text{wall velocity}$$

$$0 < \mathit{flow} < \text{min particle density}$$

Results

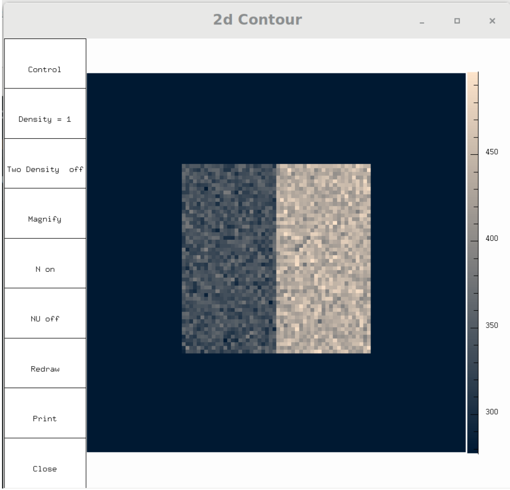

Figure 1:

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Results

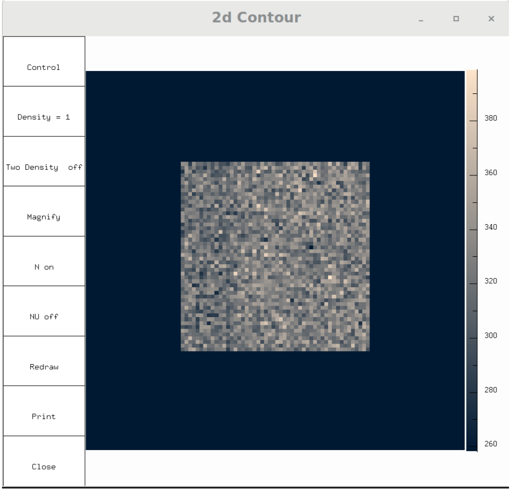

Figure 2:

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Results

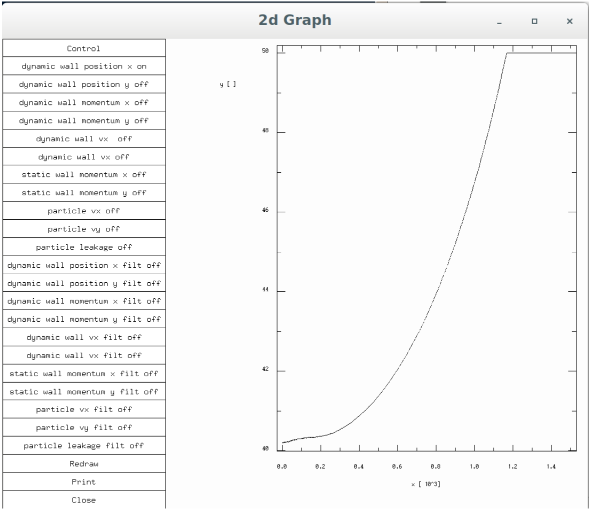

Figure 3:

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Results

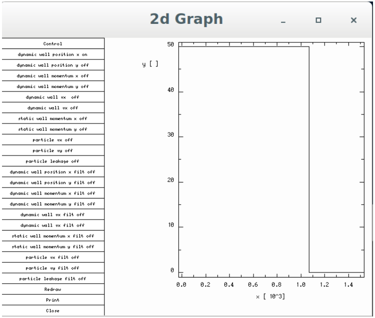

Figure 4:

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Results

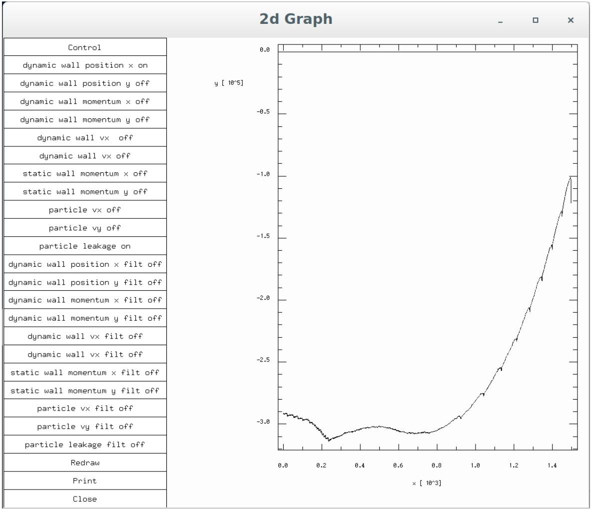

Figure 5:

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Method 2

In more detail, the probability that

$$pr * \text{particle density}$$

number of particles will be moved is

$$pr = \frac{\text{Wall Vx}}{1 - \left(\text{real(Wall x) - int(Wall x)}\right)}$$

.

Results

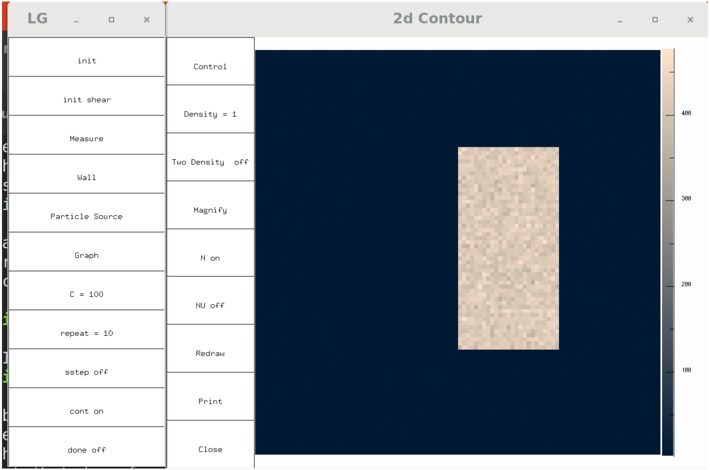

Figure 6:

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Results

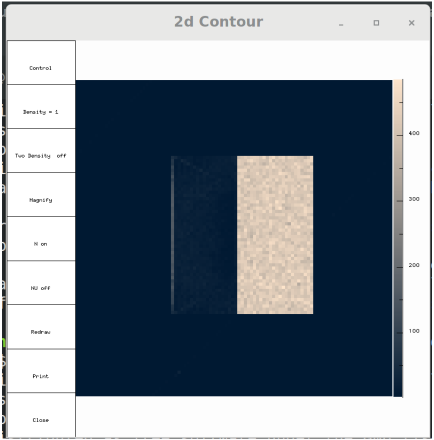

Figure 7:

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Results

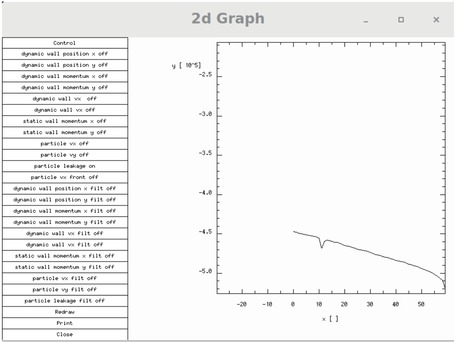

Figure 8:

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Results

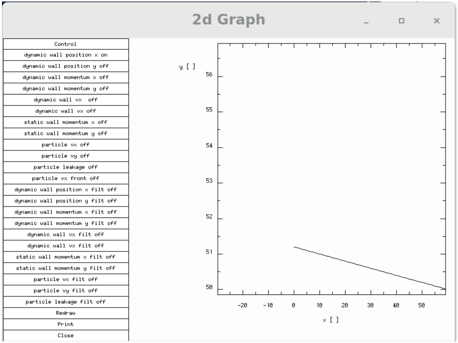

Figure 9:

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Method 3

$$\frac{\partial \rho}{\partial t} + \frac{\partial(\rho u_i)}{\partial x_i} = \nabla(\rho) + \upsilon * \nabla(\nabla(U) + (\nabla(U)T)) \tag{1}$$

The partial for ρ and ρu_i can be set to zero. This gives us:

$$0 = \nabla(\rho) + \upsilon * \nabla(\nabla(U) + (\nabla(U)T)) \tag{2}$$

$$\nabla(\rho) = F$$

$$0 = F + \upsilon * \nabla(\nabla(U_x)) \tag{3}$$

Solving the differential equation for

$$U_x$$

(mean velocity) above gives us:

$$U_x = \frac{F}{2 * \upsilon} * (x(x - L))\text{Where L is the length of the tube in Lattice sites} \tag{4}$$

Results

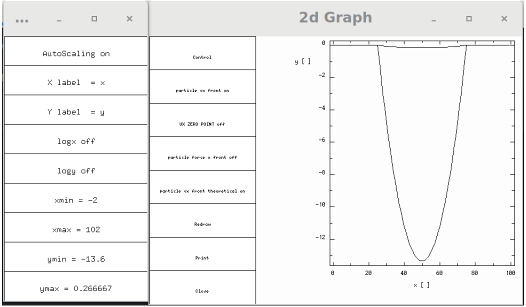

Figure 10:

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Results

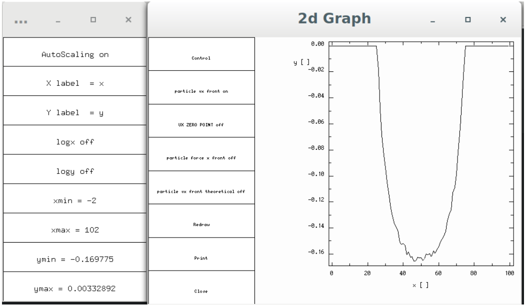

Figure 11:

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Results

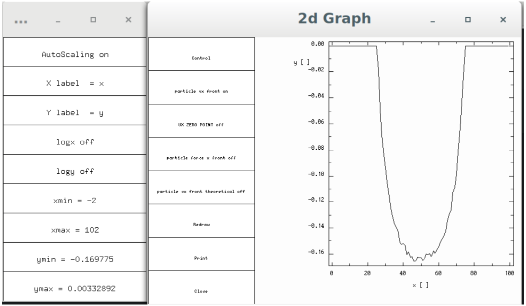

Figure 12:

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Conclusions and Final thoughts

- significant leakage for most walls
- partially working
- problem depth and complexity
- Approach 3 Issue might be solvable