Master Thesis Experiment Report VII : Looping System

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Abstract

Changing the system into a loop

1 Context

After adding an acceleration field instead of a constant imposing of velocity given by Zou-He, we want to make the system cyclic.

2 Description

We changed the system so that the fluid goes into a closed loop as illustrated in Figure 1. The acceleration field (illustrated by the yellow box) adds at every iteration a constant force $F = [Fx, Fy]$ to the PDFs. All walls of the system are bounceback nodes as is the central obstacle.

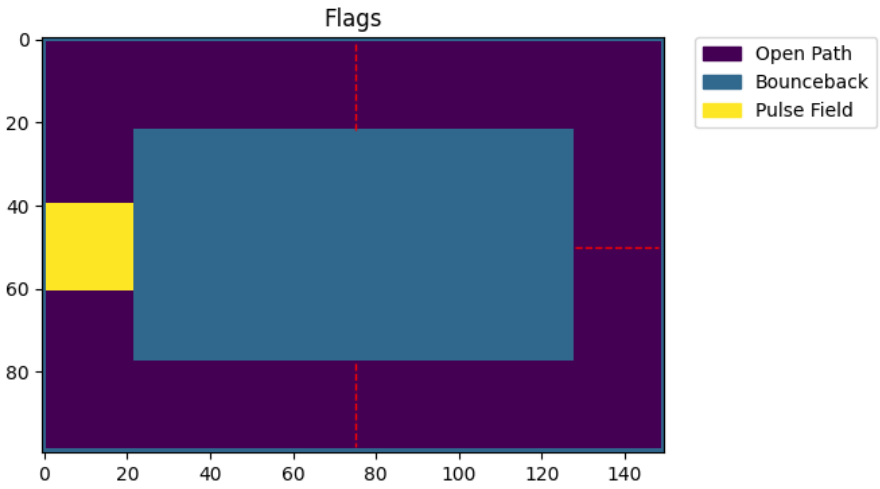

Figure 1: Looping system. Note : the red dotted lines are the sites were we will measure the velocity profiles

3 Experiments

3.1 Experiment 1

3.1.1 Description

We implemented the new geometry on a small 150x100 system, with each tube diameter being 21. F is set as $F = [0, 0.0001]$, which implies that only a vertical acceleration is applied to the PDFs. We set the viscosity as $\nu = 0.01$ and the initial density as $\rho = 2.5$ and let the simulation run for 50'000 iterations.

3.1.2 Results

The results are illustrated in Figure 2. As shown in Figure 1 the three velocity profiles have been taken in order from : the top horizontal tube, the right vertical tube and the bottom horizontal tube.

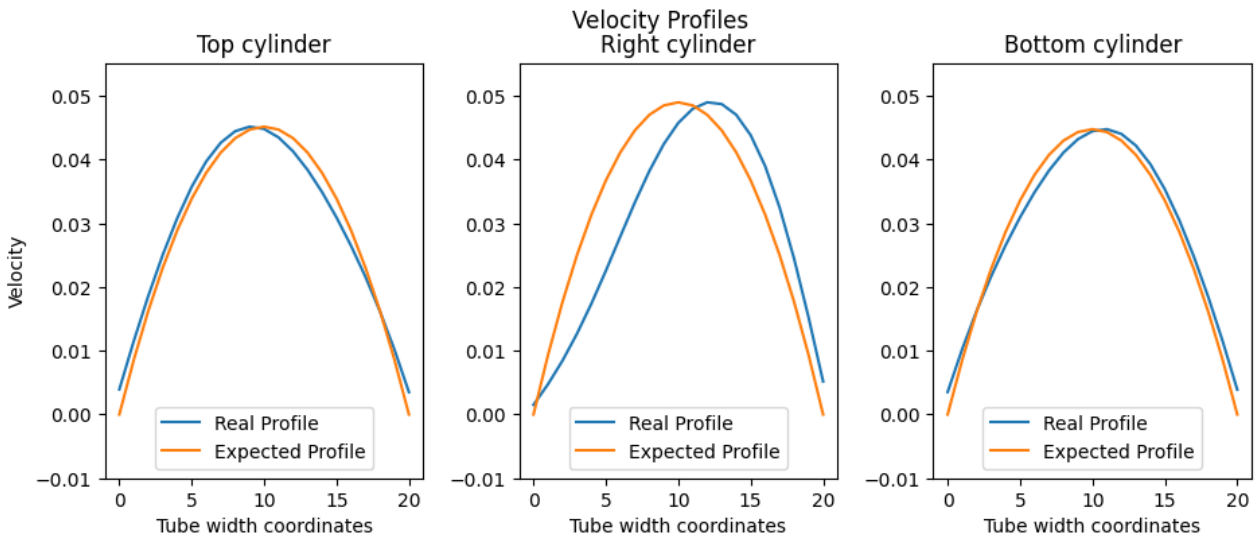

Figure 2: Velocity profiles of the top, right and bottom cylinder

As expected, the three profiles converge to Poiseuille's form. The right cylinder is however slightly shifted and has a bit more velocity as compared with the two others : this could be a side effect of the geometry taken with the chosen dimension of 150x100. We will tst this theory in the next experiment.

3.2 Experiment 2

3.2.1 Description

We tested the same method using this time a bigger square system of dimension 200x200 as illustrated in Figure 3. The simulation runs for 30'000 iterations with the exact same parameters as before. The velocity profiles are measures in the same places as the previous system as Figure 3 shows.

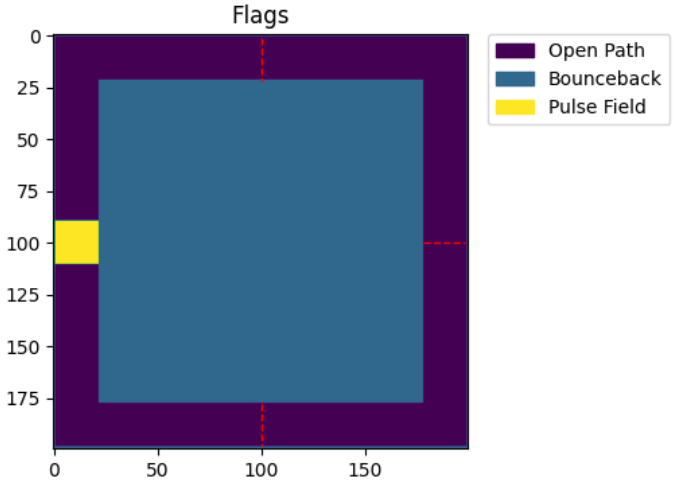

Figure 3: Square system

3.2.2 Results

Figure 4 shows the results. As we expected, all the velocity profiles now converge to a correct Poiseuille flow. This implies that for the fluid to flow correctly, some precautions on the size and shape of the system have to be taken.

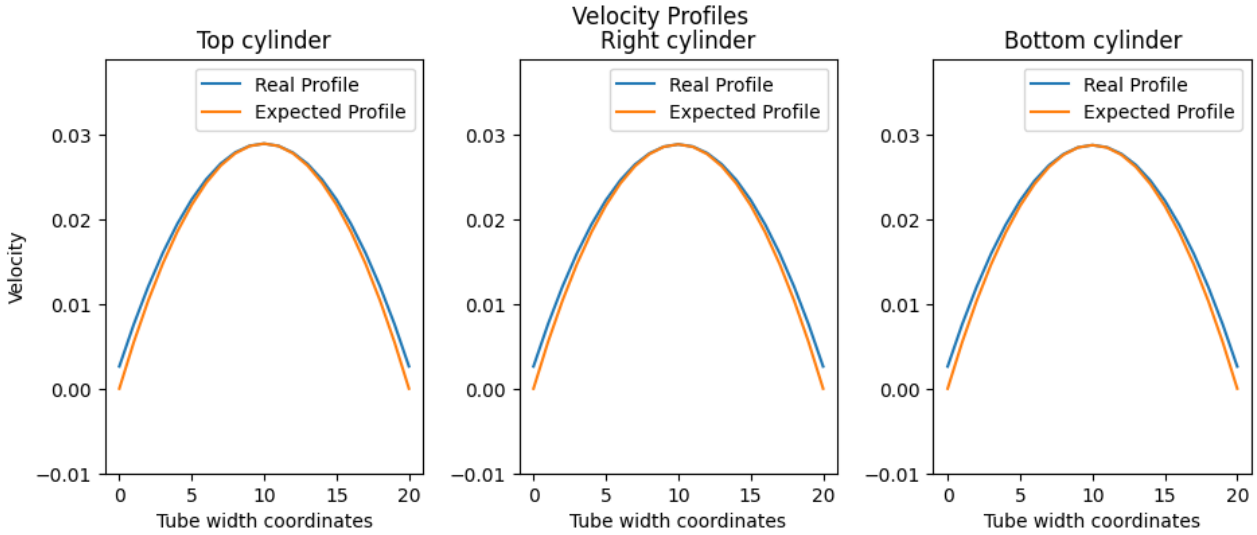

Figure 4: Velocity profiles of the top, right and bottom cylinder

4 Conclusion

5 References