Interaction of Microparticles in a Miniaturized Vacuum-Cleaner

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Introduction: The complexity of samples nowadays demands higher efficiencies of analytical techniques, e.g. Liquid Chromatography (LC). We propose a method to achieve perfectly ordered microparticles in LC columns using a miniaturized vacuum-cleaner.

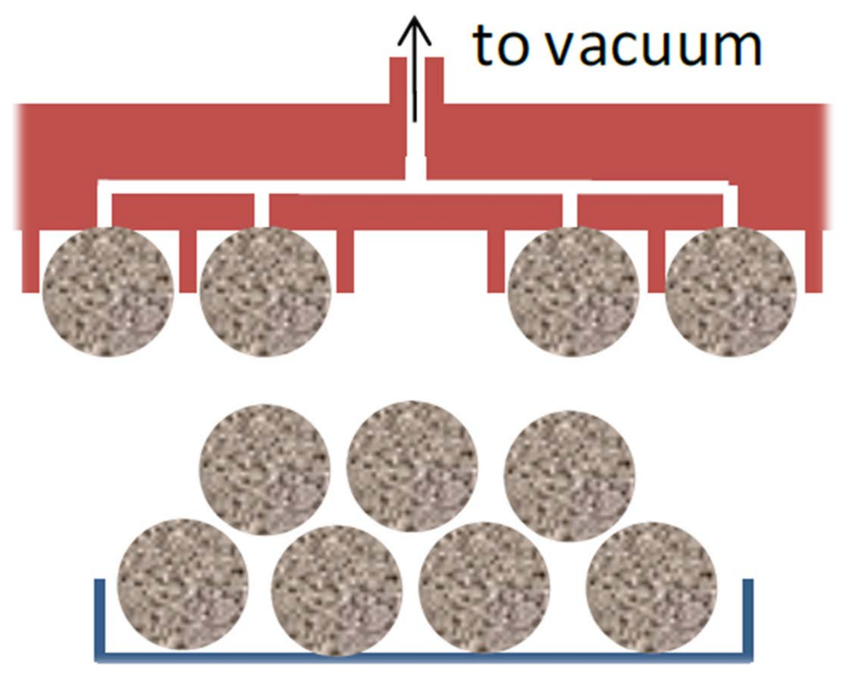

Figure 1. Miniaturized Vacuum-Cleaner

Computational Methods: The trajectory of the particles from the bottom plate to the suction holes is influenced by the movement of neighbouring particles and the fluid flow in the system. Using the fluid interface of COMSOL Multiphysics® we simulate a channel with two 10 micron sized particles, which are set at rest during the simulation and determine the total force that is induced on these particles by the air flow. We vary the height *h* and width *w* of the channel.

To date, we also simulated the movement of these particles. To this end we have employed the fluid-structure interaction module with moving mesh.

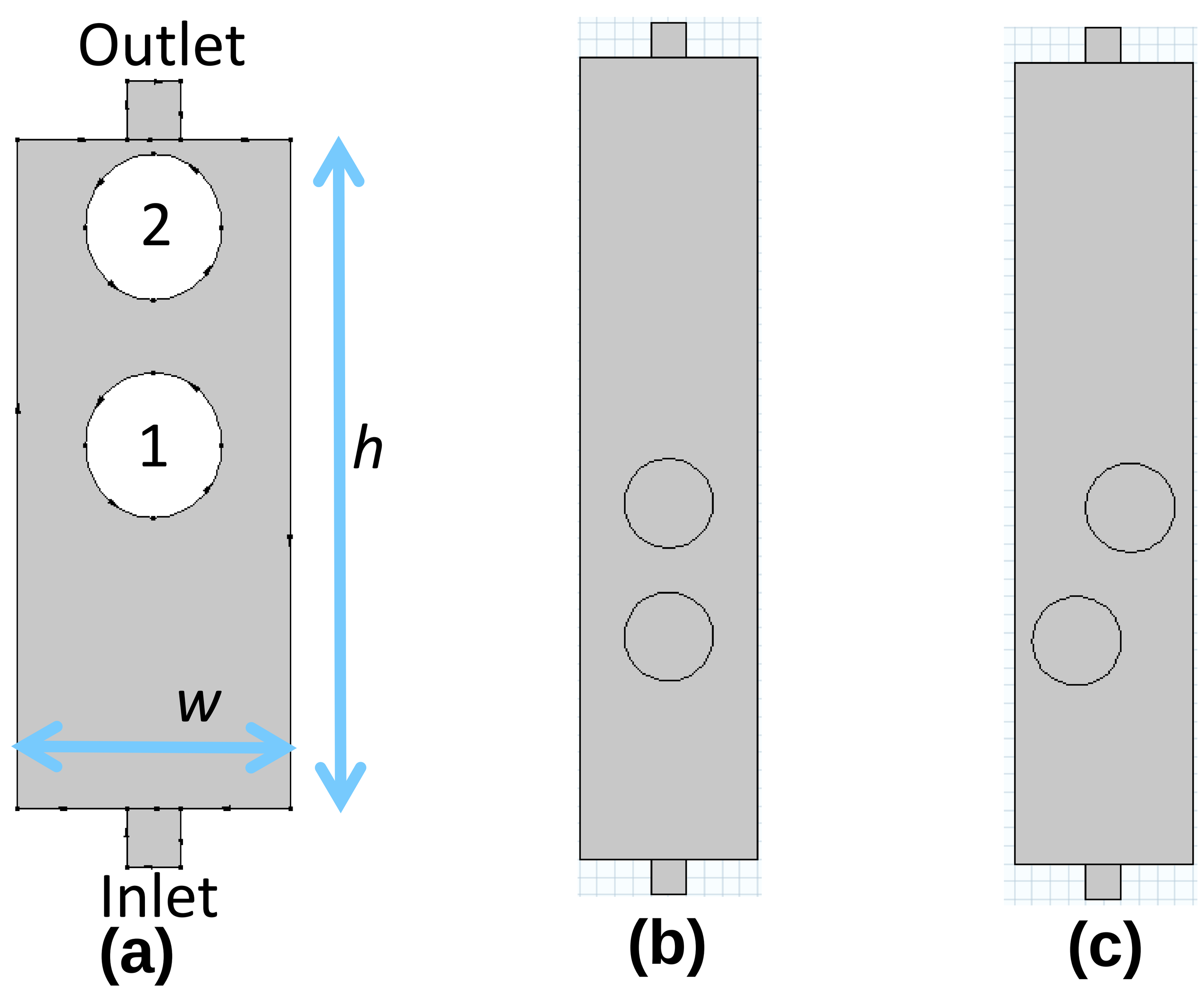

Figure 2. **(a)** Geometry of the channel (with height *h* and width *w*) with particle 1 and 2 for the fluid interface simulations, **(b)** symmetric, **(c)** asymmetric configurations of the particles for the fluid-structure interface module with moving mesh simulations.

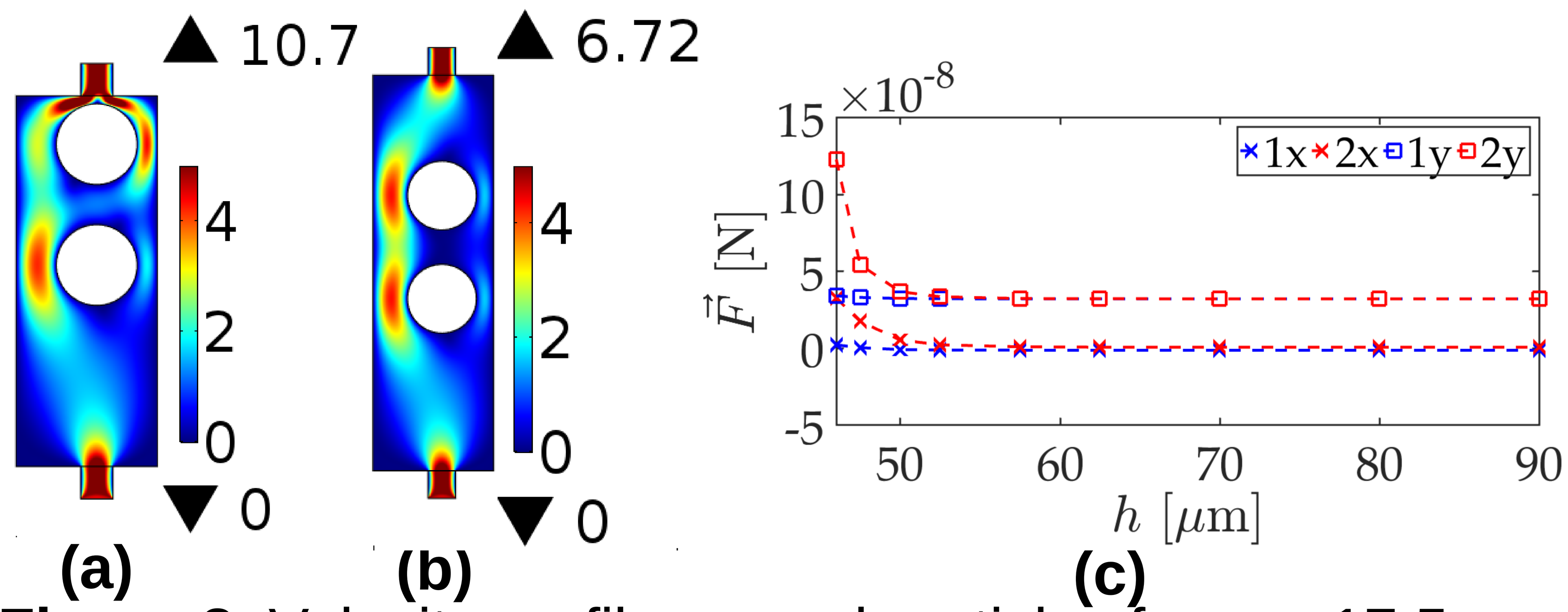

Figure 3. Velocity profile around particles for *w* = 17.5 μm And **(a)** *h* = 46 μm, **(b)** *h* = 57.5 μm, **(c) the** total force on both particles.

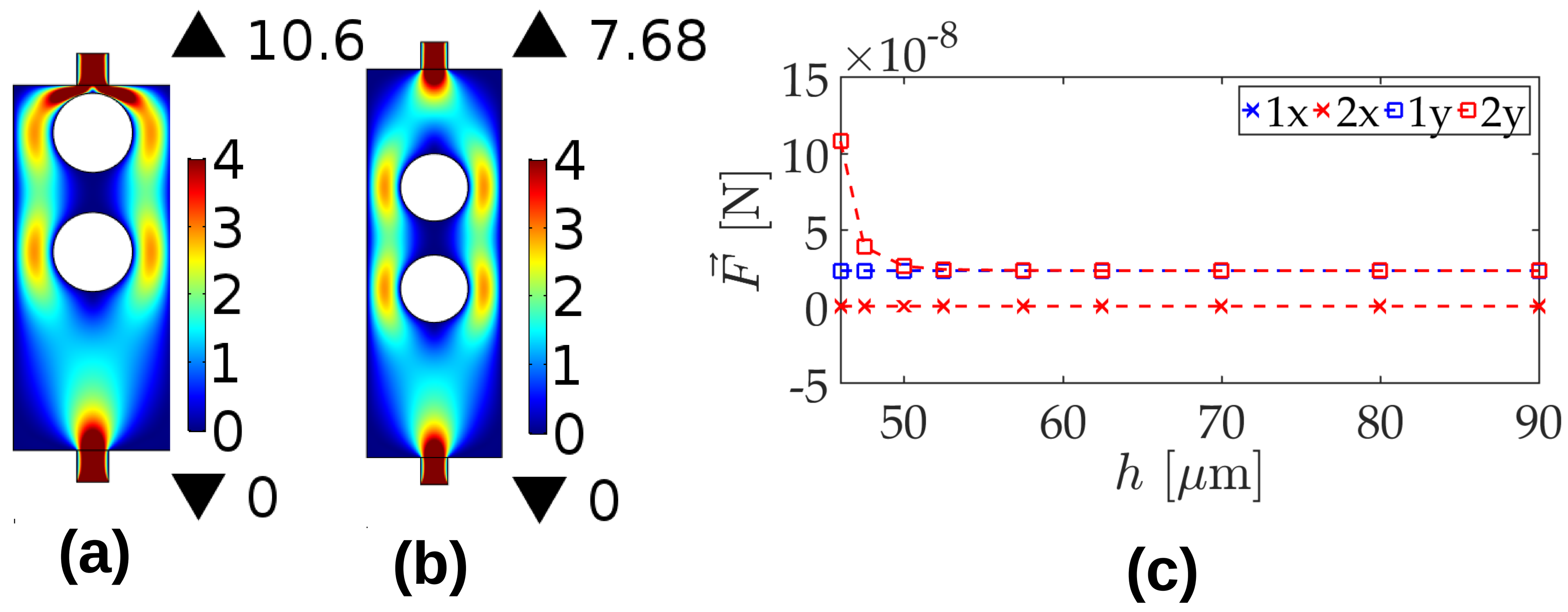

Figure 4. Velocity profile around particles for *w* = 20 μm and **(a)** *h* = 46 μm, **(b)** *h* = 57.5 μm, **(c)** the total force on both particles.

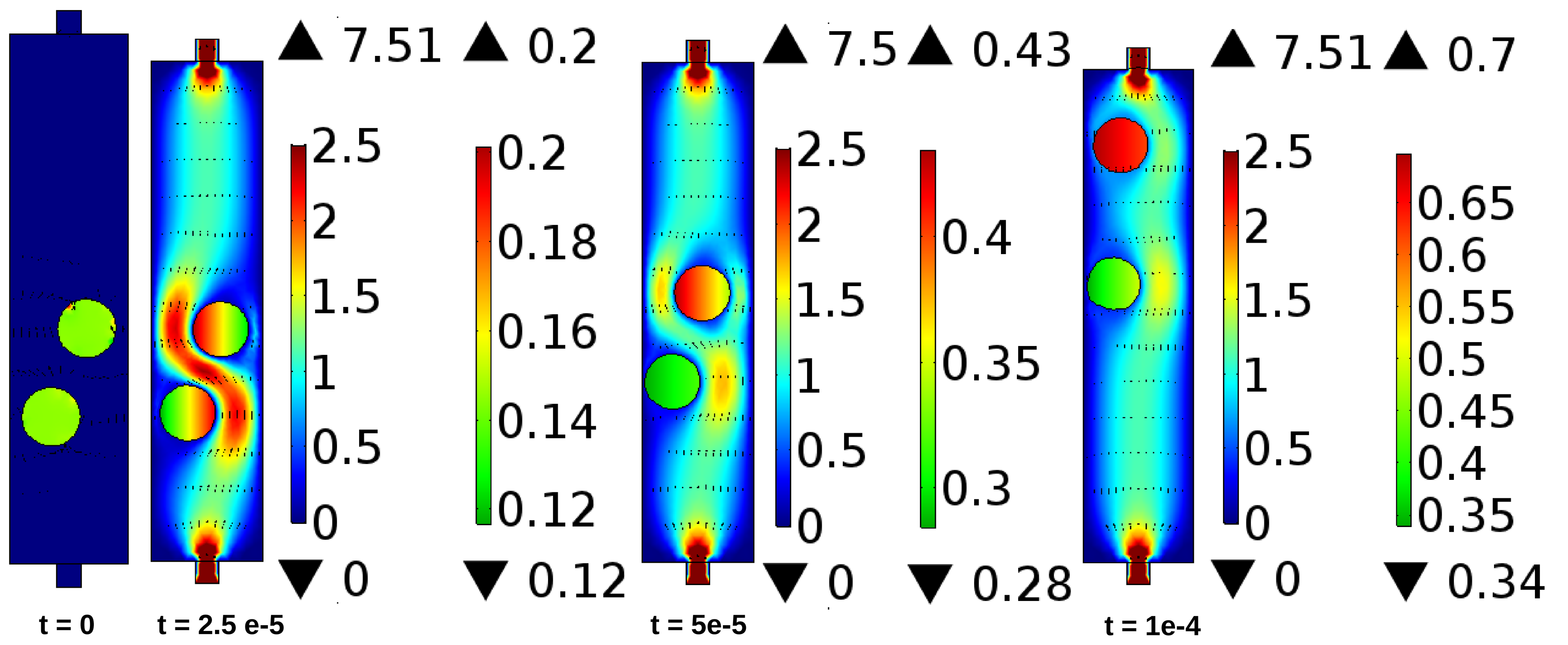

Figure 5 Velocity profile of simulations with moving mesh for the asymmetric configuration.

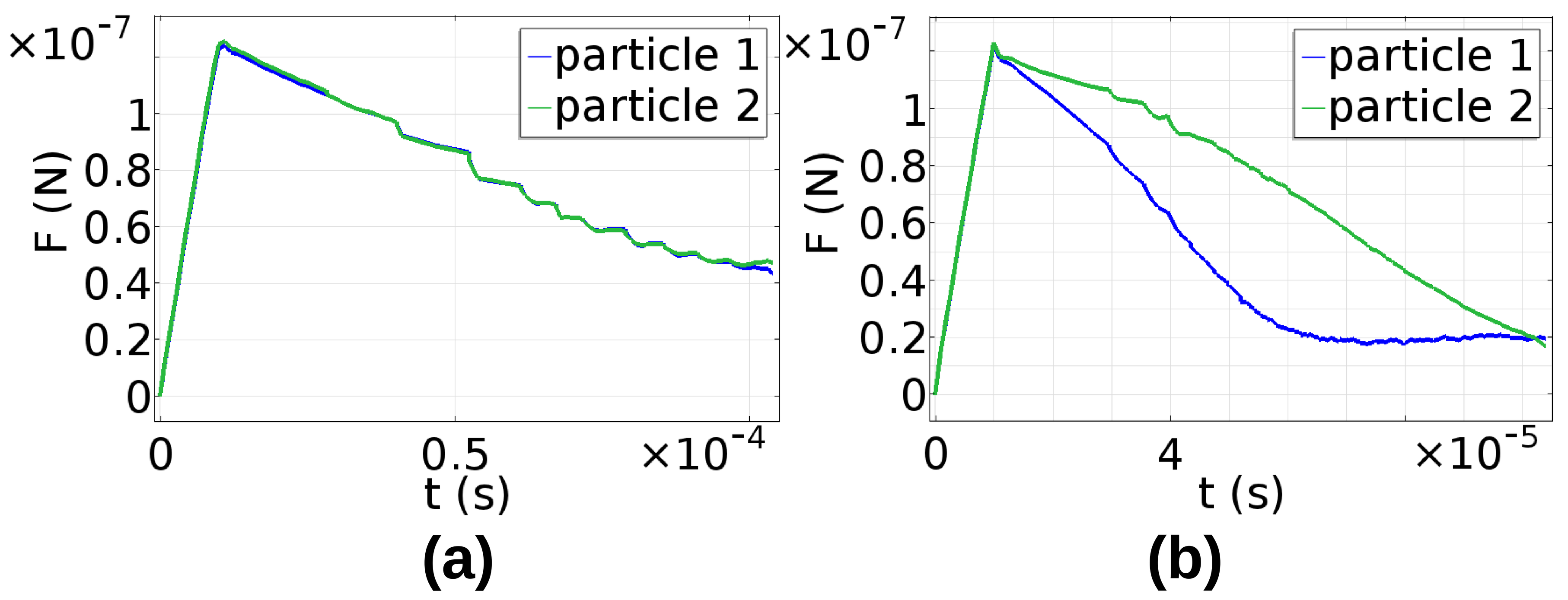

Figure 6. Total force in y-direction for both particles for the **(a)** symmetric and **(b)** asymmetric configuration.

Conclusions: The movement of particles in a miniaturized vacuum-cleaner has been characterized. The total force has been analyzed for different values of *h* and *w*. By using a moving mesh, the exact propagation of these microparticles can be identified.

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