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A Multiscale Approach for Particle Transport Simulation in Low Reynolds Number Flows

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In this paper, we study a nanoparticle suspended in water within a channel with a complex wall geometry in a laminar flow regime. We combine two independent iterative methods into one multiscale approach to compute the movement of the particle: a Lattice Boltzmann fluid-structure interaction code and a Navier-Stokes solver with the Faxén particle force estimation. A new switching strategy between these two methods is developed. On the one hand, the computationally expensive Lattice Boltzmann fluid-structure code is used in time intervals when short-time effects may yield a strong impact on the particle simulation. On the other hand, the Navier-Stokes solver with the Faxén correction is used to compute the particle movement when long-time predictions to the particle motion are possible and sufficient. We describe our coupling strategy, the mapping of unknowns between the two solvers and provide results for different particulate flow scenarios. Due to coupling of the two systems and the automatic switching we reduce the total computing time by magnitudes.