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ACCEPTED MANUSCRIPT

Inertial Dilute Particulate Fluid Flow Simulations with an Euler–Euler Lattice Boltzmann Method

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Abstract

Systems of dilute particulates, affected by inertia, with sizes in the range of $1\mu m$ to 1mm are of great interest in the design of many mechanical devices. For the simulation of such particle-laden flows most often Euler-Lagrange approaches are applied, that yield massive computational costs, if a high accuracy e.g. in the deposition pattern is desired. In contrast to that, Euler-Euler approaches scale only with the resolution of the chosen discretization in computational effort. However, the stabilization required for the considered convection-dominated regime and in general the formulation of boundary conditions on this macroscopic scale are more challenging. In this article a stabilized extension to the Euler–Euler approach is proposed, together with appropriate boundary conditions, to also account for drag forces and yield viable results for a wide range of Péclet and Reynolds numbers. The two-component system is solved using a lattice Boltzmann method and the resulting scheme is applied to a simplified geometry of a human lungs bifurcation. The numerical results are validated by comparison to other works, that apply an Euler-Lagrange approach, regarding the deposition and its dependency on the Stokes number. After consideration of the effect of artificial diffusion, the results are found to be in excellent agreement. Keywords: lattice Boltzmann method, microparticle deposition,

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