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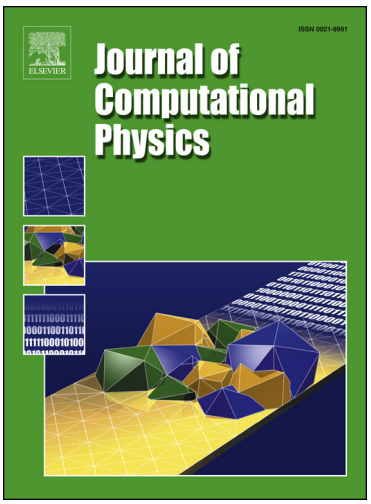

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Modeling Electrokinetic Flows by Consistent Implicit Incompressible Smoothed Particle Hydrodynamics

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Abstract

We present a consistent implicit incompressible smoothed particle hydrodynamics (I^2SPH) discretization of Navier-Stokes, Poisson-Boltzmann, and advection-diffusion equations subject to Dirichlet or Robin boundary conditions. It is applied to model various two and three dimensional electrokinetic flows in simple or complex geometries. The accuracy and convergence of the consistent I^2SPH are examined via comparison with analytical solutions, grid-based numerical solutions, or empirical models. The new method provides a framework to explore broader applications of SPH in microfluidics and complex fluids with charged objects, such as colloids and biomolecules, in arbitrary complex geometries.

Keywords: smoothed particle hydrodynamics, electrokinetic flow, boundary condition, implicit scheme

1. Introduction

Smoothed particle hydrodynamics (SPH) is a Lagrangian particle-based method for solving partial differential equations (PDEs) describing momentum, mass, and energy conservation laws [1]. In Lagrangian particle-based methods, advection is modeled exactly by advecting degrees of freedom with the streamlines of

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