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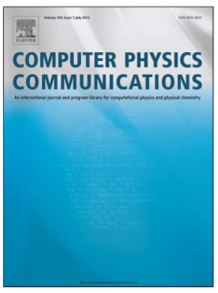

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A moving-grid approach for fluid-structure interaction problems with hybrid lattice Boltzmann method

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Abstract

In this paper, we propose a hybrid lattice Boltzmann method (HLBM) for solving fluid-structure interaction problems. The proposed numerical approach is applied to model the flow induced by a vibrating thin lamina submerged in a viscous quiescent fluid. The hydrodynamic force exerted by the fluid on the solid body is described by means of a complex hydrodynamic function, whose real and imaginary parts are determined via parametric analysis. Numerical results are validated by comparison with those from other numerical as well as experimental works available in literature. The proposed hybrid approach enhances the capability of lattice Boltzmann methods to solve fluid dynamic problems involving moving geometries.

Keywords: Hybrid lattice Boltzmann method; hydrodynamic function; fluid-structure interaction; moving grids.

1. Introduction

During the last decades an increasing attention has been addressed to model fluid-structure interaction (FSI) problems where the mutual actions played in between a viscous fluid and an immersed object determine the evolution of both fluid and solid motion. One of the most studied test-case is the oscillation of a lamina into a quiescent fluid, which may have practical applications in several technical branches, such as atomic force microscopy [1, 2],

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