Coupling Single-/Multi-Component Lattice Boltzmann and Material Point Method for Fluid-Solid Interaction Problems

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Abstract

To develop an effective numerical simulation method for the challenging fluid-deformable solid interaction problems involving solid dynamic massive deformation and fluid complex flow, a coupling lattice Boltzmann and material point method (LBMPM) is proposed. Briefly, the response of solid part is simulated by the convected particle domain interpolation based material point method with its superiority on handling dynamic massive deformation problems, and the lattice Boltzmann method is adopted for fluid part with the efficiency and reliability to simulate complex flow behaviors. Moreover, the connection between the two parts is accomplished by the compatibility conditions on the interface in a partitioned approach. The proposed method is capable to simulate the fluid-deformable solid interaction problems with no need for re-meshing operation for both domains. In addition, the multi-component multi-phase Shan-Chen pseudopotential model is further introduced into the present framework for exploring the multicomponent multiphase fluid-solid interaction problems. The supports from the National Natural Science Foundation of China (Nos. 11772082, 11672062 and 11672063) are gratefully acknowledged.

Reference

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