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A geometry-adaptive IB–LBM for FSI problems at moderate and high Reynolds numbers[1] FANGBAO TIAN, LINCHENG XU, JOHN YOUNG, JOSEPH C. S. LAI, School of Engineering and Information Technology, University of New South Wales — An FSI framework combining the LBM and an improved IBM is introduced for FSI problems at moderate and high Reynolds numbers. In this framework, the fluid dynamics is obtained by the LBM. The FSI boundary conditions are handled by an improved IBM based on the feedback scheme where the feedback coefficient is mathematically derived and explicitly approximated. The Lagrangian force is divided into two parts: one is caused by the mismatching of the flow velocity and the boundary velocity at previous time step, and the other is caused by the boundary acceleration. Such treatment significantly enhances the numerical stability. A geometry-adaptive refinement is applied to provide fine resolution around the immersed geometries. The overlapping grids between two adjacent refinements consist of two layers. The movement of fluid-structure interfaces only causes adding or removing grids at the boundaries of refinements. Finally, the classic Smagorinsky large eddy simulation model is incorporated into the framework to model turbulent flows at relatively high Reynolds numbers. Several validation cases are conducted to verify the accuracy and fidelity of the present solver over a range of Reynolds numbers.

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