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An improved wall model based on immersed boundary method for large eddy simulation of turbulent flow over complex/moving boundaries MING MA, WEI-XI HUANG, CHUN-XIAO XU, Tsinghua University — A hybrid immersed boundary/wall-model based large eddy simulation method is developed to simulate high Reynolds number turbulent flow with complex/moving boundaries. The no-slip boundary condition is imposed by continuous forcing of the immersed boundary (IB) method, so that the filter Navier-Stokes equations can be solved on a regular Cartesian grid. Wall shear on the boundary is obtained by solving thin boundary layer equation on an embedded mesh. Subgrid viscosity near the wall is modified to maintain the viscosity flux at the face adjacent to the wall equal to the modeled wall shear stress. Non-physical correlation caused by IB force oscillation is eliminated by applying viscosity buffer under the wall. This method has been validated by simulating turbulent channel and pipe flows at high Reynolds numbers, up to $\mathrm{Re}_\tau = 10^5$. Furthermore, flows past a circular cylinder at $\mathrm{Re}_\mathrm{D} = 10^4$ and 1.4×10^5 have also been simulated. The numerical results are shown to be in good agreements with previous numerical and experiment data.

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