A stencil penalty method for improving accuracy of constraint immersed boundary method RAHUL BALE, AICS, RIKEN, NICLAS JANSSON, Department of High Performance Computing and Visualization, KTH , KEIJI ONISHI, MAKOTO TSUBOKURA, AICS, RIKEN, NEELESH PATANKAR, Department of Mechanical Engineering, Northwestern University — The constraint based immersed boundary (cIB) method is known to be accurate for low and moderate Reynolds number (Re) flows. At high Re, we found that cIB is not able produce accurate results. High Re flows typically result in large pressure gradient across fluid-IB interface. This is especially pronounced when the IB is an interface with "zero-thickness." There is also a jump in pressure which leads to incorrect evaluation of pressure gradients near the fluid-IB interface. This error leads to inaccuracies in the boundary layer around the IB and can also lead to leakage of flow across the interface. We propose a novel IB formulation with a modified pressure gradient operator that calculates one-sided gradients on either side of the interface. This removes spurious gradients in pressure across the interface. The pressure gradient operator is modified using a WENO based stencil penalization scheme.

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