Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Detached eddy simulation for turbulent fluid-structure interaction of moving bodies using the constraint-based immersed boundary method[1] NISHANT NANGIA, Department of Engineering Sciences and Applied Mathematics, Northwestern University, AMNEET P. S. BHALLA, BOYCE E. GRIFFITH, Department of Mathematics, University of North Carolina at Chapel Hill, NEELESH A. PATANKAR, Department of Mechanical Engineering, Northwestern University — Flows over bodies of industrial importance often contain both an attached boundary layer region near the structure and a region of massively separated flow near its trailing edge. When simulating these flows with turbulence modeling, the Reynolds–averaged Navier–Stokes (RANS) approach is more efficient in the former, whereas large–eddy simulation (LES) is more accurate in the latter. Detached-eddy simulation (DES), based on the Spalart–Allmaras model, is a hybrid method that switches from RANS mode of solution in attached boundary layers to LES in detached flow regions. Simulations of turbulent flows over moving structures on a body-fitted mesh incur an enormous remeshing cost every time step. The constraint–based immersed boundary (cIB) method eliminates this operation by placing the structure on a Cartesian mesh and enforcing a rigidity constraint as an additional forcing in the Navier–Stokes momentum equation. We outline the formulation and development of a parallel DES–cIB method using adaptive mesh refinement. We show preliminary validation results for flows past stationary bodies with both attached and separated boundary layers along with results for turbulent flows past moving bodies.

[1]This work is supported by the National Science Foundation Graduate Research Fellowship under Grant No. DGE-1324585.

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Date submitted: 22 Jul 2016 Electronic form version 1.4