Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

A moving control volume method for smooth computation of hydrodynamic forces and torques on immersed bodies[1] NISHANT NANGIA, Department of Engineering Sciences and Applied Mathematics, Northwestern University, NEELESH A. PATANKAR, Department of Mechanical Engineering, Northwestern University, AMNEET P. S. BHALLA, Applied Numerical Algorithms Group, Lawrence Berkeley National Laboratory — Fictitious domain methods for simulating fluid-structure interaction (FSI) have been gaining popularity in the past few decades because of their robustness in handling arbitrarily moving bodies. Often the transient net hydrodynamic forces and torques on the body are desired quantities for these types of simulations. In past studies using immersed boundary (IB) methods, force measurements are contaminated with spurious oscillations due to evaluation of possibly discontinuous spatial velocity of pressure gradients within or on the surface of the body. Based on an application of the Reynolds transport theorem, we present a moving control volume (CV) approach to computing the net forces and torques on a moving body immersed in a fluid. The approach is shown to be accurate for a wide array of FSI problems, including flow past stationary and moving objects, Stokes flow, and high Reynolds number free-swimming. The approach only requires far-field (smooth) velocity and pressure information, thereby suppressing spurious force oscillations and eliminating the need for any filtering. The proposed moving CV method is not limited to a specific IB method and is straightforward to implement within an existing parallel FSI simulation software.

[1]This work is supported by NSF (award numbers SI2-SSI-1450374, SI2-SSI-1450327, and DGE-1324585), the US Department of Energy, Office of Science, ASCR (award number DE-AC02-05CH11231), and NIH (award number HL117163)

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Date submitted: 28 Jul 2017 Electronic form version 1.4