

Immersed Boundary Methods for Simulation of Flows with Moving Boundaries and Structural Interactions

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Abstract: Mesh generation in flow problems with complex boundaries and/or moving surfaces often consume a significant fraction of the overall computational effort. The computational effort can be quite significant if body-fitted grids have to be used in problems with rapidly evolving surfaces since this often requires re-generation of the mesh at frequent intervals. Immersed Boundary Methods (IBM) represent one approach by which complex-surfaces can be represented at each time-step without body-fitting the mesh. With IBM grid points adjacent to the moving surfaces are tagged and forcing terms or interpolations used to drive the solution at these points to values that are consistent with boundary conditions on the curved or deforming surface. However, IBM can potentially be a source of lower accuracy, mass-conservation errors, and resolution difficulties for boundary layers along the surfaces.

In this talk, the IBM is reviewed and a specific implementation of the IBM is described. The application of the IBM to problems involving moving boundaries and flow-structural interactions are presented. Several validation examples will be presented. Two specific examples discussed in some detail will include incompressible stirred-tank mixing and compressible flow past ballutes. Issues pertaining to accuracy and mass conservation errors will be discussed.

Bio: Sumanta Acharya is the L. R. Daniel Professor in mechanical engineering at Louisiana State University (LSU) and the Director of the Turbine Innovation Energy Research (TIER) Center. He joined LSU after receiving his PhD from the University of Minnesota in 1982. His primary research interests are in computational fluid dynamics and gas turbine heat transfer and combustion.

