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Handling Flux Boundary Conditions in an Immersed Boundary Method[1] RAMAKRISHNAN THIRUMALAISAMY, NISHANT NANGIA, AMNEET BHALLA, San Diego State University — Immersed boundary (IB) or fictitious domain (FD) methods allow for efficient modeling of moving domain problems, without requiring the computational mesh to conform to the geometrically complex interfaces. The volume penalization (VP) method is one such FD approach to solve complex moving domain problems. Most of the IB/FD methods in the literature have considered Dirichlet boundary conditions on the interfaces. In this presentation, we present a flux-based VP method to impose inhomogeneous Neumann boundary conditions. Applications include flux-driven thermal convection in an irregular domain or sedimentation of particles in thermally stratified flows, among others. The proposed approach modifies the diffusion coefficient and includes an additional forcing term in the governing equations to enforce flux boundary conditions on the surface that may also be spatially varying. As such, the flux-based VP method can be easily incorporated in existing codes. We assess the accuracy of this technique using the method of manufactured solutions. Several test problems involving irregular domains are considered to assess the order of accuracy of the solution for the Poisson equation, as well as for the scalar transport equation coupled to incompressible Navier Stokes solver.

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