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A Direct Forcing Immersed Boundary Method for Simulations of Heat and Mass Transport with Neumann Boundary Conditions JACOB JOHNSTON, JINCHENG LOU, NILS TILTON, Colorado School of Mines — The application of Dirichlet boundary conditions with direct-forcing immersed boundaries is well understood. There is less published work, however, on the application of Neumann conditions, particularly to second-order spatial accuracy in the context of finite volume and projection methods. This issue is important for the simulation of membrane filtration systems in which coupled heat and solute transport occur in the presence of complicated surfaces. Though linear interpolation of the forcing over the grid is sufficient to ensure second-order accuracy of Dirichlet conditions, we find that third-order interpolation is required for the implementation Neumann conditions to second-order accuracy. For semi-implicit simulations, this increases the local stencil such that matrices are no longer banded. We use the method to develop a 2D unsteady finite volume code that simulates heat, mass and momentum transport with the projection method of Choi and Moin (Journal of Computational Physics, 1994). We perform numerical experiments to confirm second-order spatial and temporal accuracy, and then use the method to simulate transport in a membrane filtration system.

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