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**A full Navier-Stokes solver on Irregular Domains coupled with a Poisson-Boltzmann solver with Neumann or Robin boundary conditions on Non-Graded Adaptive Grid** ASDIS HELGADOTTIR, FREDERIC GIBOU, University of California Santa Barbara — We introduce a second-order solver for the full Navier-Stokes equations coupled with the Poisson-Boltzmann equation on irregular domains. This simple fluid solver can be used for simulating fluid flow in microfluidic devices. The irregular domain is described implicitly and the grid needs not to conform to the domain's boundary, which makes grid generation straightforward and robust. Finite Volume approach is used for the Poisson-Boltzmann solver making it straightforward to enforce Neumann or Robin boundary conditions at the irregular domain. The linear system is symmetric, positive definite in the case where the grid is uniform, otherwise nonsymmetric but an invertible M-matrix. The fluid solver is based on the projection method where finite volume approach is used to easily enforce Neumann boundary conditions for pressure at the irregular domain. Extensions from two spatial dimensions to three are straightforward both for the Poisson-Boltzmann solver and the Navier-Stokes solver. The Poisson-Boltzmann solver is solved using Quadtee/Octree grids (in two and three spatial dimensions respectively). The fluid solver is solved on uniform grid and values are interpolated between the two grids using second order accurate interpolation.

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