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Modeling and Simulation of Biofilm Fragmentation in Fluid Flow

In this talk we use the immersed boundary method to simulate the interaction of fluid flowing in a tube with an attached biofilm on the inner surface of the tube. We use the incompressible viscous Navier-Stokes (N-S) equations to describe the motion of the flowing fluid. In this simulation we can assign different density and viscosity values to the biofilm than that of the surrounding fluid. We look specifically at the adaptations in the simulation which arise as a result of a highly viscous biofilm compared to the surrounding fluid. Also included in this simulation are breakable linear springs connecting the particles in the biofilm which allow us to include biofilm fragmentation and detachment into the model. We discretize the fluid equations using finite differences and use a projection method with an iterative multigrid scheme to solve at each time step. Multigrid is used because the biofilm has a different density and viscosity than the surrounding fluid which causes the coefficients in the N-S equations to be non-constant in space and time. We apply this model in both two and three dimensions.