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Coupling biochemistry, mechanics, and hydrodynamics to model sperm motility

Calcium (Ca2+) dynamics in mammalian sperm are directly linked to motility. These dynamics depend on diffusion, nonlinear fluxes, Ca2+ channels specific to the sperm flagellum, and other signaling molecules. The goal of this work is to couple Ca2+ dynamics to a mechanical model of a motile sperm within a viscous, incompressible fluid. We will first discuss a model of the CatSper mediated Ca2+ dynamics relevant to hyperactivated motility. The method of regularized Stokeslets is used to investigate the hydrodynamics of swimming sperm. Results showing emergent waveforms, swimming speeds, and trajectories will be compared to experimental data.