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Talk title: *Modeling Biologically Inspired Fluid Flow Using Regularized Singularities and Spectral Deferred Correction Methods*

Abstract: The motion of primary nodal cilia present in embryonic development resembles that of a precessing rod. Implementing regularized singularities to model this fluid flow numerically simulates a situation for which colleagues have exact mathematical solutions and experimentalists have corresponding laboratory studies on both the micro- and macro-scales. Stokeslets are fundamental solutions to the Stokes equations, which act as external point forces when placed in a fluid. By strategically distributing regularized Stokeslets in a fluid domain to mimic an immersed boundary (e.g. cilium), one can compute the velocity and trajectory of the fluid at any point of interest. The simulation can be adapted to a variety of situations including passive tracers, rigid bodies, and numerous rod structures in a fluid flow generated by a rod either rotating around its center or its tip near a plane. The exact solution allows for careful error analysis and the experimental studies provide new applications for the numerical model. Spectral deferred correction methods are used to alleviate time stepping restrictions in trajectory calculations. Quantitative and qualitative comparisons to theory and experiment have shown that a numerical simulation of this nature can generate insight into fluid systems that are too complicated to fully understand via experiment or exact numerical solution independently.