Mechanical Engineering Thesis Defense

Development of a methodology for cilia-driven flow simulations with incompressible Navier-Stokes equations

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Abstract

This thesis presents a computational fluid dynamics (CFD) model of fluid flow driven by the motion of cilia, a cellular appendage found in organisms used to either move the fluid around them or to move themselves by propelling the fluid. Originating from an initial investigation to the flow patterns inside the third ventricle of a rat's brain, this project expanded to improve the inadequacies of existing models of ciliary motion in fluid. This model was developed using the actuator line model to include the cilia motion to get an accurate representation of the cilia motion and its effect of tn the flow. This model not only provides exciting potential in various fields including soft robotics, biomedical research, environmental engineering, but also holds promise for drug delivery systems, and enhancing microfluidic designs. This thesis investigates the effect of the phase difference, the spacing and the frequency of the cilia motion on the fluid flow and the formation of the metachronal waves.

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