

Modeling the Flow of PCL Fluid due to the Movement of Lung Cilia

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ABSTRACT: Cilia in the human lungs are moving hairs that aid in the movement of mucus. The layer that contains the cilia is called the periciliary layer, PCL, and the liquid in that layer the PCL fluid. In this talk, we discuss a three-dimensional mathematical model of the PCL fluid flowing slowly due to the movement of the cilia. We model the PCL fluid as an incompressible viscous fluid, and we consider the cilia as a periodic array of cylinders that rotate about their base with height varying as a function of the angle. We use homogenization to determine a system of equations that are then solved numerically to calculate the permeability in term of the radius of the cilia, the distance between two adjacent cilia, and the angle the cilia make with their base. Numerical results are obtained using the mixed finite element Method of Taylor-Hood type. For an initial model of the fluid flow in the PCL, the Stokes-Brinkman equations are applied with a fixed PCL height. The numerical results are validated by comparing them with an analytic solution.