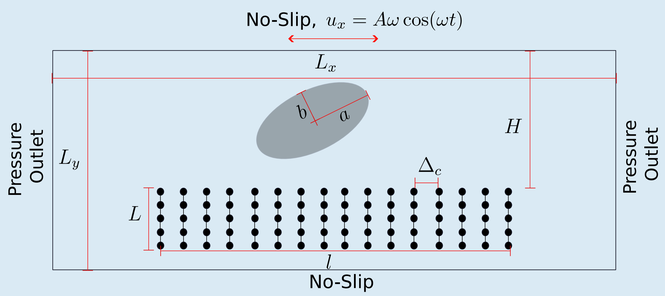
Cilia as Particle Sensors: From 2D Numerical Models to 3D with preCICE

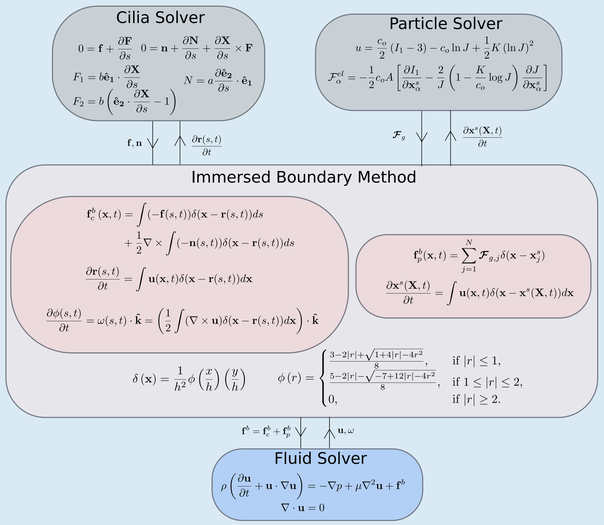
Divyaprakash

Amitabh Bhattacharya

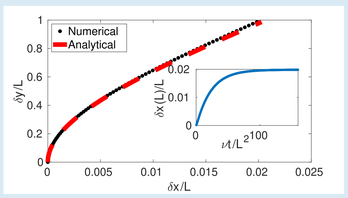
2D Cilia-Particle Simulations

Methodology



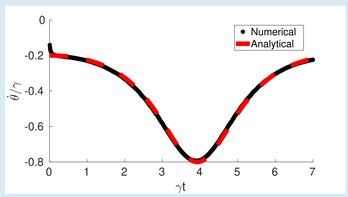


Validation



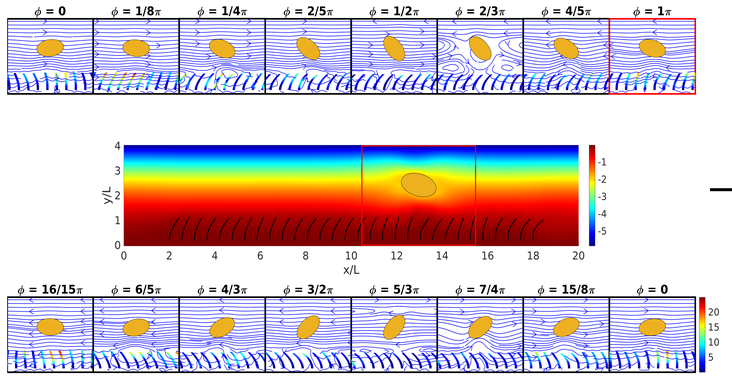
Deflection of cantilever cilium subjected to a point load it's free-end

The angular velocity of the particle in shear flow is validated against the analytical results

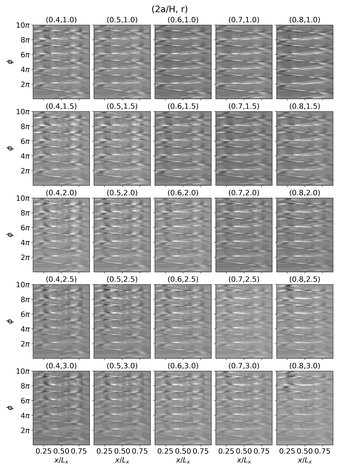


Detecting particle characteristics using perturbation in cilia tip deflections

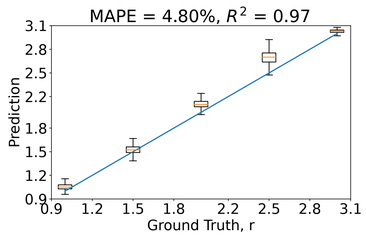
Simulations



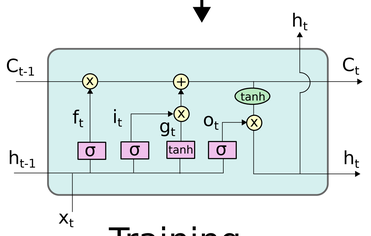
ML Data



Predictions



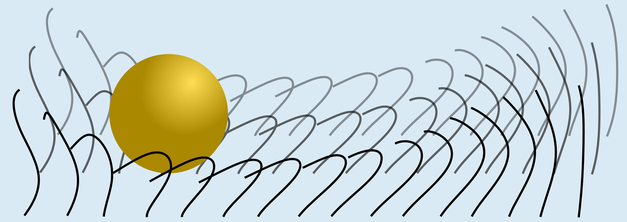
Training



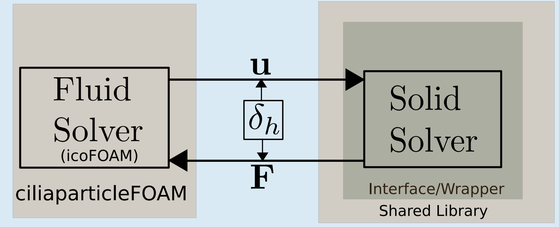
1.) Current approach is limited to 2D simulations.
2.) 3D simulations allow capturing the full six degrees of freedom for particle motion.
3.) 3D models capture more realistic spatial dynamics of cilia, including coordinated movements like metachronal waves
.
A comprehensive 3D approach is therefoe crucial for understanding complex biological processes in realistic settings. We are planning to tacke this problem with the help of preCICE

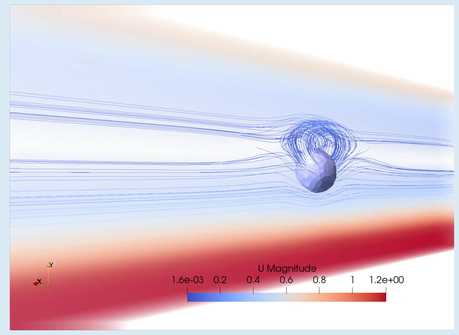
Coupling with OpenFOAM and preCICE

Moving towards 3D



IBM Implementation in OpenFoam





Proposed preCICE Coupling

