Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Cilia-driven mixing and transport in complex geometries HANLIANG GUO, HAI ZHU, SHRAVAN VEERAPANENI, University of Michigan, Ann Arbor — Cilia and flagella are self-actuated microtubule-based structures that are present on many cell surfaces, ranging from the outer surface of single-cell organisms to the internal epithelial surfaces in larger animals. A novel and exciting research direction in *in vitro* cell cultures is the development of engineered tissues in microfluidic chips, so called 'organs-on-chips'. A fast and reliable numerical method that simulates the coupled hydrodynamics of cilia and the constituent particles in the fluid such as rigid particles, drops or cells would be useful to not only understand several disease and developmental pathologies due to ciliary dysfunction but also to design microfluidic chips with ciliated cultures for some targeted functionality, e.g., maximizing fluid transport or particle mixing. Here we propose a hybrid numerical scheme that employs the boundary integral method for handling the channel and particle boundaries and the method of regularized Stokeslets for handling the cilia. The algorithm is efficient, easy to implement and scales linearly with the problem size. We provide several examples demonstrating the effects of complex geometries on cilia-generated fluid mixing as well as the cilia-particle hydrodynamics.

Hanliang Guo
University of Michigan, Ann Arbor

Date submitted: 31 Jul 2019 Electronic form version 1.4