Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Optimal feeding of ciliated microorganisms in concentration gradients. JINGYI LIU, YI MAN, EVA KANSO, Dept. of Aerospace and Mechanical Engineering, University of Southern California — The flow field generated by ciliated microorganisms in a viscous fluid can influence the microorganisms' nutrient environment, and the stirred concentration field can correspondingly influence the microorganisms' nutrients uptake. We consider a classic model of ciliated organisms consisting of a spherical body with continuous wave-like surface deformations. This model, known as Blake's spherical envelope model or a squirmer model, emulates the action of tightly-packed distribution of cilia on the organism's surface. Using the ideal solution for the flow field around this spherical body in Stokes flow and solving the advection-diffusion equation numerically using the Legendre polynomial spectral method, we compute the concentration field and nutrient uptake of the microorganism. We analyze the nutrient uptake in a uniform background concentration and in a background concentration with constant gradient. In each case, we discuss the optimal ciliary strokes that maximize nutrient uptake.

Jingyi Liu
Dept. of Aerospace and Mechanical Engineering, University of Southern California