Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Traction reveals mechanisms of wall-effects for microswimmers near boundaries XINHUI SHEN, - MARCOS, Nanyang Technological University, Singapore, HENRY C. FU, University of Nevada, Reno — Swimming of microorganism near solid boundaries plays an important role in various biological processes, such as biofilm formation and the early stage of infection. The influence of a plane boundary on low-Reynolds number swimmers has frequently been studied using image systems for flow singularities. However, the effect of a boundary can also be expressed in terms of the flow caused by the force or traction exerted by the boundary on the fluid. Here we show that examining the traction pattern on the boundary caused by a nearby swimmer can yield physical insight into the effect of the boundary on swimming velocities. To illustrate this point, we investigate a three-sphere swimmer initially placed parallel to a solid planar wall. The three spheres are modelled as three stokeslets and the method of images for a stokeslet is employed to solve for the traction on the wall. When the swimmer is close to the boundary, the middle sphere and end spheres produce a quadrupolar and dipolar time-averaged traction, respectively, reflecting the internal structure of the swimmer. Far away from the boundary, the time-averaged traction of the swimmer is similar to that of a pure far-field quadrupole. Thus the traction patterns reveal how close the swimmer must be to the boundary for the internal structure of the swimmer to influence the boundary effects.

Xinhui Shen
Nanyang Technological University, Singapore

Date submitted: 28 Jul 2015 Electronic form version 1.4