Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Dynamics and stability of low Reynolds number swimming near a plane wall[1] YIZHAR OR, RICHARD M. MURRAY, Dept. of Control and Dynamical Systems, Caltech — Low Reynolds number swimming of microorganisms or tiny robotic swimmers in confined environments poses open questions on the existence of steady swimming parallel to the boundary, as well as the stability of such solutions under perturbations. In this work we formulate the dynamics of a simple swimmer near a plane wall. The swimmer is modeled as an assemblage of spheres attached to a rigid frame and being actively rotated about their attachment points. Using the model developed by Swan and Brady (Physics of Fluids 19, 113306, 2007) to account for the far-field hydrodynamic interactions between the spheres and the wall, we formulate the dynamic equations of swimming. We prove that steady solution of parallel swimming exists for a swimmer with two rotating spheres. We then discuss the interplay between symmetry and stability, and show that one must break the symmetry in order to obtain passive stabilization. Next, we show that parallel swimming with three spheres can be passively stable in a wide range of orientations, and present numeric simulation results. Finally, we discuss the existence and stability of periodic orbits, and the relation to effects of attraction and alignment of swimming bacteria near a plane boundary.

[1]Y. Or is supported by Fulbright and Bikura postdoctoral scholarships

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Date submitted: 01 Aug 2008 Electronic form version 1.4