Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Tuning Bacterial Hydrodynamics with Magnetic Fields: A Path to Bacterial Robotics CHRISTOPHER PIERCE, ERIC MUMPER, JACK BRANGHAM, HIRAN WIJESINGHE, STEPHEN LOWER, BRIAN LOWER, FENGYUAN YANG, RATNASINGHAM SOORYAKUMAR, The Ohio State University — Magnetotactic Bacteria (MTB) are a group of motile prokaryotes that synthesize chains of lipid-bound, magnetic nano-particles. In this study, the innate magnetism of these flagellated swimmers is exploited to explore their hydrodynamics near confining surfaces, using the magnetic field as a tuning parameter. With weak (Gauss), uniform, external, magnetic ?elds and the field gradients arising from micro-magnetic surface patterns, the relative strength of hydrodynamic, magnetic and ?agellar force components is tuned through magnetic control of the bacteria's orientation and position. In addition to direct measurement of several hydrodynamic quantities related to the motility of individual cells, their tunable dynamics reveal a number of novel, highly controllable swimming behaviors with potential value in micro-robotics applications. Specifically, the experiments permit the MTB cells to be directed along parallel or divergent trajectories, suppress their flagellar forces through magnetic means, and induce transitions between planar, circulating trajectories and drifting, vertically oriented "top-like" motion. The implications of the work for fundamental hydrodynamics research as well as bacterially driven robotics applications will be discussed.

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Date submitted: 11 Nov 2016 Electronic form version 1.4