Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Effect of aspect ratio in free-swimming plunging flexible plates PETER YEH, ALEXANDER ALEXEEV, Georgia Institute of Technology — Using three dimensional fully-coupled fluid-structure interaction simulations, we investigate the free swimming of plunging elastic rectangular plates with aspect ratios ranging from 0.5 to 5 in a viscous fluid with Reynolds number 250. We find that maximum velocity occurs near the first natural frequency regardless of aspect ratio, while the maximum swimming economy occurs away from the first natural frequency and corresponds to a specific swimmer bending pattern characterized by reduced displacement of the swimmer's center of mass. Furthermore, we find that swimmers with wider span are both faster and more economical than narrow swimmers. These faster speeds are due to decreased drag for low aspect ratio plunging swimmers, which is in agreement with a recently proposed vortex-induced drag model that suggests that the smaller relative size of side vortices in low aspect ratio swimmers creates less drag per unit width. Our results are useful for the design of small autonomous micro-swimming devices and also provide insights on the physics of aquatic locomotion using oscillating fins.

Peter Yeh
Georgia Institute of Technology

Date submitted: 01 Aug 2015 Electronic form version 1.4