

Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Investigation of Scaling Effects on Fish Pectoral Fin Performance

MELIHA BOZKURTTAS, HAIBO DONG, RAJAT MITTAL, The George Washington University, PETER MADDEN, GEORGE LAUDER, Harvard University, FLOW SIMULATION AND ANALYSIS GROUP TEAM, LAUDER LABORATORY TEAM — Reynolds and Strouhal numbers are two key parameters that can potentially affect the performance of rigid and deformable flapping foils. Flow past a deformable pectoral fin of a fish in steady forward motion (speed of 1 BL/s) is simulated using a Cartesian grid immersed boundary solver. Investigation of the scaling of the performance with these two parameters allows us to gain better insight into the fundamental mechanisms of the thrust production as well as address the practical question of how the performance of a fin is expected to change with changes in size, speed and frequency. It is found that the essential fluid dynamic mechanisms are unchanged with Reynolds number. We observe that although the vortex structures get more complicated with increasing Re, the key features (like the strong tip vortex, leading and trailing edge vortices) are similar in all the cases. On the other hand, the hydrodynamic performance of the fin is found to be quite sensitive to the Strouhal number. A set of numerical simulations of fin gaits synthesized from the POD modes are also carried out. This approach allows us to connect specific features in the fin gait with the observed vortex dynamics and hydrodynamic force production.

Meliha Bozkurttas
The George Washington University

Date submitted: 18 Sep 2006

Electronic form version 1.4