Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Dynamics of wake structure in clapping propulsion DAEGYOUM KIM, MORTEZA GHARIB, California Institute of Technology — Some animals such as insects and frogs use a pair of symmetric flaps for locomotion. In some cases, these flappers operate in close proximity or even touch each other. In order to understand the underlying physics of these kinds of motion, we have studied the wake structures induced by clapping and their associated thrust performance. A simple mechanical model with two acrylic plates was used to simulate the power stroke of the clapping motion and three-dimensional flow fields were obtained using defocusing digital particle image velocimetry. Our studies show that the process of vortex connection plays a critical role in forming a downstream closed vortex loop. Under some kinematic conditions, this vortex loop changes its shape dynamically, which is analogous to the process of an elliptical vortex ring switching its minor and major axis. As the length of the plate along the rotating shaft decreases to change an aspect ratio, the downstream motion of the vortex is retarded due to the outward motion of side edge vortices and less propulsive force is generated per the surface area of the plate. The impact of compliance and stroke angle of the plate on wake structures and thrust magnitudes are also presented.

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Date submitted: 07 Aug 2009 Electronic form version 1.4