Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Simulation of a prescribed fruitfly flapping motion by the ALE-GFD method on a hybrid Cartesian-meshfree grid N.T. TRONG, T.T. LIM, K.S. YEO, National University of Singapore — The flapping-wing aerodynamics of insects has been a subject of immense interest for many years. The Arbitrary Lagrangian-Eulerian – Generalized Finite Difference (ALE-GFD) computational scheme on hybrid convecting Cartesian-meshfree grid systems represents a viable alternative to existing mesh-based and immersed boundary approaches for simulating the highly complex and unsteady flows generated by the flapping wings of insects. The three-dimensional flapping-wing flows of a fruitfly (Drosophila) are simulated in the present study. As the forces generated are very sensitive to the acceleration of the wings, a smoothing process was applied on the flapping kinematics to suppress non-physical fluctuations and spikes from the force outcome. The resulting lift and drag forces are then validated with the experimental results, obtained from a parallel experimental study conducted by the research group, measured on a fruitfly-like wing profile executing the identical motion. The excellent agreement between the results demonstrates the feasibility and efficacy of the ALE-GFD numerical approach.

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Date submitted: 27 Jul 2011 Electronic form version 1.4