Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Simplified hovering flight analyzed by a theory of force decomposition CHIN-CHOU CHU, Institute of Applied Mechanics, National Taiwan University, CHIEN-CHENG CHANG, Division of Mechanics, Research Center for Applied Sciences, Academia Sinica, CHENG-TA HSIEH, Institute of Applied Mechanics, National Taiwan University — It has been of great interest to learn how an insect flight gains lift from its aerodynamics. In this study, we examine a simplified model of hovering motion for fruit fly from the perspective of force decomposition. The force components from the decomposition include one from the vorticity within the flow, one from the surface vorticity, and two contributions credited to the motion of the insect wing. The phase difference in the models gives three types of motion: symmetric, advanced and delayed rotations. It is shown that the symmetric rotation has the maximum vorticity lift, but the optimal average lift is attained for an advanced rotation, which, compared to the symmetric rotation, increases the force contribution due to the unsteady surface motion at the expense of sacrificing contribution from the vorticity. By identifying the variations of the vorticity lift with flow characteristics, we may further explore the detailed mechanisms associated with the unsteady aerodynamics at different phases of hovering motion. Moreover, it is shown that the insect wing shares the same mechanism of gaining lift when in the phase of driving with a fuller speed, but exhibits different mechanisms at turning from one phase of motion to another.

Chin-Chou Chu
Institute of Applied Mechanics, National Taiwan University

Date submitted: 04 Aug 2008 Electronic form version 1.4