Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Aerodynamic role of dynamic wing morphing in hummingbird maneuvering flight[1] YAN REN, GREGORY SHALLCROSS, HAIBO DONG, University of Virginia, XINYAN DENG, Purdue University, BRET TOBALSKE, Montana State University, FLOW SIMULATION RESEARCH GROUP TEAM, BIO-ROBOTICS LAB COLLABORATION, UNIVERSITY OF MONTANA FLIGHT LABORATORY COLLABORATION — The flexibility and deformation of hummingbird wing gives hummingbird a great degree of control over fluid forces in flapping flight. Unlike insect wing's passive deformation, hummingbird wing employs a more complicated wing morphing mechanism through both active muscle control and passive feather-air interaction, which results in highly complex 3D wing topology variations during the unsteady flight. Three camera high speed (1000 fps) high resolution digital video was taken and digitized to measure 3D wing conformation in all its complexity during steady flying and maneuvering. Results have shown that the dynamic wing morphing is more prominent in maneuvering flight. Complicated cambering and twisting patterns are observed along the wing pitching axis. A newly developed immersed boundary method which realistically models wing-joint-body of the hummingbird is then employed to simulate the flow associated with dynamic morphing. The simulations provide a first of its kind glimpse of the fluid and vortex dynamics associated with dynamic wing morphing and aerodynamic force computations allow us to gain a better understanding of force producing mechanisms in hummingbird maneuvering flight.

[1]This work is supported by AFOSR FA9550-12-1-007 and NSF CEBT-1313217

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Date submitted: 01 Aug 2014 Electronic form version 1.4