

Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Do hummingbirds use a different mechanism than insects to flip and twist their wings?¹ JIALEI SONG, HAOXIANG LUO, Vanderbilt University, TYSON HEDRICK, The University of North Carolina at Chapel Hill — Hovering hummingbirds flap their wings in an almost horizontal stroke plane and flip the wings to invert the angle of attack after stroke reversal, a strategy also utilized by many hovering insects such as fruit flies. However, unlike insects whose wing actuation mechanism is only located at the base, hummingbirds have a vertebrate musculoskeletal system and their wings contain bones and muscles and thus, they may be capable of both actively flipping and twisting their wings. To investigate this issue, we constructed a hummingbird wing model and study its pitching dynamics. The wing kinematics are reconstructed from high-speed imaging data, and the inertial torques are calculated in a rotating frame of reference using mass distribution data measured from dissections of hummingbird wings. Pressure data from a previous CFD study of the same wing kinematics are used to calculate the aerodynamic torque. The results show that like insect wings, the hummingbird wing pitching is driven by its own inertia during reversal, and the aerodynamic torque is responsible for wing twist during mid-stroke. In conclusion, our study suggests that their wing dynamics are very similar even though their actuation systems are entirely different.

¹This research was supported by the NSF

Haoxiang Luo
Vanderbilt University

Date submitted: 30 Jul 2014

Electronic form version 1.4