Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

**Effect of torsional stiffness on passive wing pitch and its aerodynamic performance in hovering flight**[1] MENGLONG LEI, CHENGYU LI, Villanova University — Insect's wings are able to passively maintain a high angle of attack due to the torsional flexibility of wing basal region without the aid of the active pitching motion. However, there is no clear understanding of how torsional wing flexibility should be designed to achieve optimal aerodynamic performance. In this work, a computational study was conducted to investigate the passive pitching mechanism of a fruit fly wing in hovering flight using a torsional spring model. The torsional wing flexibility was characterized by Cauchy number. Different flapping patterns including zero-deviation, figure-8, oval-shaped stroke kinematics were evaluated. The aerodynamic forces and associated unsteady flow structures were simulated using an in-house immersed-boundary-method based computational fluid dynamic solver. Our simulations revealed that the optimal lift and lift-to-power ratio can be achieved in a particular range of Cauchy number (0.16˜0.30) regardless of its stroke kinematics. This range is consistent with the Cauchy number calculated based on the fruit fly data from literature. The findings of this work could provide important implications for designing more efficient flapping-wing micro air vehicles.

[1]This study is supported by 2019 Villanova University Summer Grant Program and 2019 ORAU Ralph E. Powe Junior Faculty Enhancement Award to CL.

Chengyu Li
Villanova University

Date submitted: 24 Jul 2019 Electronic form version 1.4