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Investigation of Body-involved Lift Enhancement in Bio-inspired Flapping Flight[1] JUNSHI WANG, GENG LIU, YAN REN, HAIBO DONG, University of Virginia — Previous studies found that insects and birds are capable of using many unsteady aerodynamic mechanisms to augment the lift production. These include leading edge vortices, delayed stall, wake capture, clap-and-fling, etc. Yet the body-involved lift augmentation has not been paid enough attention. In this work, the aerodynamic effects of the wing-body interaction on the lift production in cicada and hummingbird forward flight are computationally investigated. 3D wing-body systems and wing flapping kinematics are reconstructed from the high-speed videos or literatures to keep their complexity. Vortex structures and associated aerodynamic performance are numerically studied by an in-house immersed-boundary-method-based flow solver. The results show that the wing-body interaction enhances the overall lift production by about 20% in the cicada flight and about 28% in the hummingbird flight, respectively. Further investigation on the vortex dynamics has shown that this enhancement is attributed to the interactions between the body-generated vortices and the flapping wings. The output from this work has revealed a new lift enhancement mechanism in the flapping flight.

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