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3D Reduced-order modeling of flapping flight with heavy and highly articulated wings[1] XIAOZHOU FAN, KENNETH BREUER, Center for Fluid Mechanics, School of Engineering, Brown University — A three-dimensional reduced-order modeling technique is described for modelling and simulating inertial and aerodynamic forces associated with freely-flying flapping animals and robots. The model is then applied to previously-measured flights performed by different individuals of lesser-nosed dog-faced fruit bat. Both the inertial forces and torques of the flapping and folding of the wing, as well as the ensuing aerodynamic forces are considered. Quasi-steady Blade Element Momentum theory (BEMT) is used to model the aerodynamic forces on each segment of the highly articulated wing, and the center of mass and moment of inertia of the wing are computed and incorporated into the Lagrangian equation of motion for the overall animal dynamics. Comparisons between the predicted and observed body motions indicate that both thrust and weight support are captured well, although the model shows high sensitivity in the pitch axis. The origins of this sensitivity are also discussed.

[1]Hyundai Visionary Challenge, China Scholarship Council

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