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Modes of thrust generation in flying animals¹ HAOXIANG LUO, Vanderbilt University, JIALEI SONG, Beijing Computational Science Research Center, BRET TOBALSKE, University of Montana, LUO TEAM, TOBALSKE TEAM — For flying animals in forward flight, thrust is usually much smaller as compared with weight support and has not been given the same amount of attention. Several modes of thrust generation are discussed in this presentation. For insects performing slow flight that is characterized by low advance ratios (i.e., the ratio between flight speed and wing speed), thrust is usually generated by a “backward flick” mode, in which the wings moves upward and backward at a faster speed than the flight speed. Paddling mode is another mode used by some insects like fruit flies who row their wings backward during upstroke like paddles (Ristroph et al, PRL, 2011). Birds wings have high advance ratios and produce thrust during downstroke by directing aerodynamic lift forward. At intermediate advance ratios around one (e.g., hummingbirds and bats), the animal wings generate thrust during both downstroke and upstroke, and thrust generation during upstroke may come at cost of negative weight support. These conclusions are supported by previous experiment studies of insects, birds, and bats, as well as our recent computational modeling of hummingbirds.

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