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How Insects Initiate Flight: Computational Analysis of a Damselfly in Takeoff Flight[1] AYODEJI BODE-OKE, SAMANE ZEYGHAMI, HAIBO DONG, Univ of Virginia, FLOW SIMULATION RESEARCH GROUP TEAM — Flight initiation is essential for survival in biological fliers and can be classified into jumping and non-jumping takeoffs. During jumping takeoffs, the legs generate most of the initial impulse. Whereas the wings generate most of the forces in non-jumping takeoffs, which are usually voluntary, slow, and stable. It is of interest to understand how non-jumping takeoffs occur and what strategies insects use to generate the required forces. Using a high fidelity computational fluid dynamics simulation, we identify the flow features and compute the wing aerodynamic forces to elucidate how flight forces are generated by a damselfly performing a non-jumping takeoff. Our results show that a damselfly generates about three times its bodyweight during the first half-stroke for liftoff while flapping through a steeply inclined stroke plane and slicing the air at high angles of attack. Consequently, a Leading Edge Vortex (LEV) is formed during both the downstroke and upstroke on all the four wings. The formation of the LEV, however, is inhibited in the subsequent upstrokes following takeoff. Accordingly, we observe a drastic reduction in the magnitude of the aerodynamic force, signifying the importance of LEV in augmenting force production.

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