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Effects of wing-wake interactions on the aerodynamic performances of a hovering rhinoceros beetle.[1] SEHYEONG OH, BOOGEON LEE, HYUNGMIN PARK, HAECHEON CHOI, Seoul National University — We investigate the aerodynamic performance of a hovering rhinoceros beetle using numerical simulation and a quasi-steady aerodynamic model. The simulation shows that the wing-wake interactions significantly affect the aerodynamic performance. To examine the wake characteristics behind the wing, we obtain the temporal and spatial distributions of downwash motion from numerical simulation, and show that the downwash motion is non-uniform along the wing spanwise direction, of which magnitude is large immediately after the stroke reversal and small at the end of half stroke. Therefore, we model the wake behind the wing as a non-uniform (in spanwise direction) and sawtooth-type (in time) downwash motion. Also, we combine a quasi-steady aerodynamic model and a momentum theory, together with unsteady and non-uniform downwash motion. The aerodynamic performance predicted by the present aerodynamic model is in good agreement with that of the present numerical simulation.

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