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Aerodynamics of a beetle in take-off flights[1] BOOGEON LEE, HYUNGMIN PARK, Seoul National University, SUN-TAE KIM, Agency for Defense Development — In the present study, we investigate the aerodynamics of a beetle in its take-off flights based on the three-dimensional kinematics of inner (hindwing) and outer (elytron) wings, and body postures, which are measured with three high-speed cameras at 2000 fps. To track the highly deformable wing motions, we distribute 21 morphological markers and use the modified direct linear transform algorithm for the reconstruction of measured wing motions. To realize different take-off conditions, we consider two types of take-off flights; that is, one is the take-off from a flat ground and the other is from a vertical rod mimicking a branch of a tree. It is first found that the elytron which is flapped passively due to the motion of hindwing also has non-negligible wing-kinematic parameters. With the ground, the flapping amplitude of elytron is reduced and the hindwing changes its flapping angular velocity during up and downstrokes. On the other hand, the angle of attack on the elytron and hindwing increases and decreases, respectively, due to the ground. These changes in the wing motion are critically related to the aerodynamic force generation, which will be discussed in detail.

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