

Abstract Submitted  
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**Interaction of the elytra and hind wing of a rhinoceros beetle (*Trypoxylus dichotomus*) during a take-off mode**<sup>1</sup> SEUNGYOUNG OH, SEHYEONG OH, HAECHON CHOI, BOOGEON LEE, HYUNGMIN PARK, Seoul National University, SUN-TAE KIM, Agency for Defense Development — The elytra are a pair of hardened wings that cover the abdomen of a beetle to protect beetles hind wings. During the take-off, these elytra open and flap in phase with the hind wings. We investigate the effect of the elytra flapping on beetles aerodynamic performance. Numerical simulations are performed at  $Re=10,000$  (based on the wingtip mean velocity and mean chord length of the hind wing) using an immersed boundary method. The simulations are focused on a take-off, and the wing kinematics used is directly obtained from the experimental observations using high speed cameras. The simulation result shows three-dimensional vortical structures generated by the hind wing of the beetle and their interaction with the elytra. The presence of elytra has a negative effect on the lift generation by the hind wings, but the lift force on the elytra themselves is negligible. Further discussions on the elytra - hind wing interaction will be provided during the presentation.

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Seungyoung Oh  
Seoul National University

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