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Experimental and Numerical Study of the Role of Elytra on Beetles Flapping Flight TUYEN QUANG LE, DOYOUNG BYUN, YONGHOON YOO, JINHWAN KO, WON-KAP KIM, HOON CHEOL PARK, Konkuk University — The effect of flapping elytra of a beetle on aerodynamic force is investigated by particle image velocimetry (PIV) experiment and a two-dimensional numerical analysis. During the transition period from the up-stroke to the down-stroke, the positions of the hind and elytrum wings become close to each other and then the elytrum strongly affects on the aerodynamic forces. Through experimentally method, the quantitative velocity, vorticity, and pressure fields around the both wings are measured. A big leading edge vortex (LEV) is observed on the upper surfaces of the elytrum and the hind wings from the measured quantities at the initial instance of the down-stroke. Numerical result shows that the at first, elytrum hinders vortex generation on the hind wing due to its position is ahead along the streamline direction, then it contributes for vortex generation as the hind wing goes down. The elytrum itself generates big vertical force and small horizontal force during flapping due to that its curved geometry interacts with flow around. Conclusively, the total aerodynamic force by the both wings is lager than that by the hind wing without the elytrum considered.

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