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Vortical structures around a gliding swallowtail butterfly[1]
HYUNGMIN PARK, BYOUNGDO LEE, JONGKOOK SEONG, HAECHEON CHOI, Seoul National University — In the present study, we aim at understanding the flow characteristics around a low-aspect-ratio wing at low Reynolds number. As a model of this wing, we select a swallowtail butterfly in gliding posture because it is known to be one of the versatile flyers using gliding and flapping efficiently. We perform a numerical simulation of flow behind a gliding swallowtail butterfly using an immersed boundary method (Kim et al., JCP 2001). We consider the Reynolds numbers of $1,000 - 3,000$ based on the free-stream velocity and average wing chord length, which is close to that of real butterfly in gliding flight, and various attack angles between 2° and 30°. We identify the existence of four vortical structures around a gliding butterfly: the wing-tip, leading-edge, trailing-edge and hairpin vortices. Interestingly, at the attack angles larger than 10°, hairpin vortices are generated above the center of the butterfly and travel downstream. We will describe the effect of these vortices on the lift and drag forces and their interaction in detail in the presentation.

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Haecheon Choi
Seoul National University

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