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Three-dimensional vortical structures around a flapping wing in hovering motion[1] JIHOON KWEON, HAECHEON CHOI, Seoul National University — In this study, we investigate three-dimensional vortical structures around a flapping wing in hovering motion using numerical simulation. The three-dimensional wing shape and kinematics are based on the data of the Drosophila model by Dickinson et al. (Science 1999) and realized using an immersed boundary method (Kim & Choi, JCP 2006). The Reynolds number is 136 based on the maximum translational velocity and mean chord length. During the translational motion, a strong wing-tip vortex is generated and stays in the wake. In the following stroke, the wing passes through a region of high momentum fluids induced by this wing-tip vortex, and has a high-pressure region on the pressure surface. On the other hand, leading- and trailing-edge vortices are generated during the translational motion and shed at the stroke reversal. These shed vortices interact with the wing in the following stroke. This interaction process is similar to that discussed in two-dimensional mechanism of hovering motion (Birch & Dickinson, JEB 2003). However, the interaction between the wing and wing-tip vortex is completely three-dimensional. To further investigate the issue on 2D and 3D mechanisms, we vary the Reynolds number. The results of these computations will be discussed in the presentation.

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