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Interaction between the fore- and hind-wings in hovering flight of modelled dragonfly[1] JIHOON KWEON, HAECHEON CHOI, Seoul National University — In the present study, we investigate the interaction between the fore- and hind-wings in hovering flight of modelled dragonfly using 3D numerical simulation. The three-dimensional wing shape is based on that of *Aeschna juncea* (Norberg 1972) and numerically realized using an immersed boundary method (Kim et al. 2001). The wing flapping motion is modelled using a sinusoidal function and the stroke plane angle is 60°. We consider 12 different phase differences between the fore- and hind-wings ($\phi = 0° \sim 330°$). The Reynolds number is 1,000 based on the maximum translational velocity and mean chord length. In counter stroke ($\phi = 180°$), the wing-tip vortices from both wings are connected, generating an entangled wing-tip vortex (e-WTV). A strong downward motion induced by this vortex decreases the vertical force in the following stroke (Kweon & Choi 2008). In parallel stroke ($\phi = 0°$), both wings meet e-WTV during the upstroke and thus the decrease of vertical force is small. At $\phi = 270°$, although e-WTV is generated on a relatively narrow region, the hind-wing moves downward along with e-WTV, resulting in a significant reduction of vertical force on the hind-wing. Therefore, the sum of vertical forces on both wings is maximum with parallel stroke and minimum at $\phi = 270°$. The power required has a similar trend to the vertical force and thus the efficiency does not show a large variation with the phase difference.

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