Hovering and targeting flight simulations of a dragonfly-like flapping wing-body model by IB-LBM

TAKAJI INAMURO, KENSUKE HIRO-HASHI, Dept. Aeronautics and Astronautics, Kyoto University — Hovering and targeting flights of the dragonfly-like flapping wing-body model are numerically investigated by using the immersed boundary-lattice Boltzmann method (IB-LBM). The governing parameters of the problem are the Reynolds number $Re$, the Froude number $Fr$, and the non-dimensional mass $m$. We set the parameters at $Re = 200$, $Fr = 15$, and $m = 51$. First, we simulate free flights of the model for various values of the phase difference angle $\phi$ between the forewing and the hindwing motions and for various values of the stroke angle $\beta$ between the stroke plane and the horizontal plane. We find that the vertical motion of the model depends on the phase difference angle $\phi$, and the horizontal motion of the model depends on the stroke angle $\beta$. Secondly, using the above results we try to simulate the hovering flight by dynamically changing the phase difference angle $\phi$ and the stroke angle $\beta$. The hovering flight can be successfully simulated by a simple proportional controller of the phase difference angle and the stroke angle. Finally, we simulate targeting flight by dynamically changing the stroke angle $\beta$.

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