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Lift and thrust generation by a butterfly-like 3D flapping wing model KOSUKE SUZUKI, TAKAJI INAMURO, Dept. Aeronautics and Astronautics, Kyoto University — The flapping flight of tiny insects such as a butterfly is of fundamental interest not only in biology itself but also in its practical use for the development of micro air vehicles. It is known that a butterfly flaps downward for generating lift force and backward for generating thrust force. In this study, we consider a simple butterfly-like 3D flapping wing model whose body is a thin rod, wings are rigid and rectangular, and wing motion is simplified. We investigate the lift and thrust generation by the butterfly-like flapping wing model by using the immersed boundary-lattice Boltzmann method. Firstly, we compute the lift and thrust forces when the body of the model is fixed for Reynolds numbers in the range of 50 - 1000. In addition, we evaluate the supportable mass for each Reynolds number by using the computed lift force. Secondly, we simulate the free flight where the body can move translationally but cannot rotate. As results, we find that the evaluated supportable mass can be supported even in the free flight, and the wing model with the mass and the Reynolds number of a fruit fly can go upward against the gravity. Finally, we simulate the effect of the rotation of the body. As results, we find that the body has a large pitching motion and consequently gets off-balance.

Kosuke Suzuki
Dept. Aeronautics and Astronautics, Kyoto University

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