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Rotational inertial effects on flexible wing DEWEI QI, Western Michigan University, RAYMOND GORDNIER, AFRL/RBAC, Wright Patterson AFB OH 45435 — To understand rotational inertial effects on aerodynamic force, the lattice Boltzmann flexible particle method (LBFPM) is employed to simulate interaction between fluid flows and flapping motion of a chord-wise flexible wing in a 3D space at two levels of pitching or rotational rates corresponding to two rotational Reynolds numbers of Rer=356 and 107 while the translation Reynolds number is kept at the same level of Re=136. At each rotational Reynolds number, flexibility and mass ratio of wing to fluid are systematically varied at different levels and lift, drag, deformation and power efficiency are computed and compared. It is found that the lift force and power efficiency increase non-linearly up to maximum values as chord-wise flexibility increases, then fall down as flexibility continuously increases for the larger rotational Reynolds number of Rer=356. As the mass ratio increases the inertial force and the lift force increase while the input power increases. The flexibility should be optimized by the lift force and the power efficiency. The simulation results indicate that rotational inertia is an important factor for flexibility to enhance lift and power efficiency. However, the case with a lower rotational Reynolds number of Rer=107 does not have this behavior. It is also found that the deflection angle and the sweeping distance in the vertical direction are much larger for trailing edge than leading edge.

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