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Efficient flapping flight using flexible wings oscillating at resonance[1] ALEXANDER ALEXEEV, HASSAN MASOUD, Georgia Institute of Technology — Using a fully-coupled computational approach that integrates the lattice Boltzmann and lattice spring models, we investigate the three-dimensional aerodynamics of flexible flapping wings at resonance. The wings are tilted from the horizontal and oscillate vertically driven by a force applied at the wing root. Our simulations reveal that resonance oscillations drastically enhance the aerodynamic efficiency of low-Reynolds-number plunging, and yield lift and lift-to-weight ratio comparable to the values typical for small insects. Within the resonance band, we identify two flapping regimes leading to the maximum lift and the maximum efficiency, which are characterized by different bending modes of flexible flapping wings. Our results indicate the feasibility of using flexible wings driven by a simple harmonic stroke for designing efficient microscale flying machines.

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