Abstract Submitted
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Numerical simulation of insect flight with flexible wings using a mass-spring fluid-interaction solver[1] KAI SCHNEIDER, HUNG TRUONG, Aix-Marseille Univ, THOMAS ENGELS, LMD-IPSL, Ecole Normale Superieure-PSL, DMITRY KOLOMENSKIY, Japan Agency for Marine-Earth Sci and Tech (JAMSTEC), THE AIFIT TEAM — Fundamental characteristics of insect flight are flexible wings, which play an important role for their aerodynamics. Real wings are delicate structures, composed of veins and membranes, and can undergo significant deformation. Here we present detailed numerical simulations of such deformable wings modeled by a mass-spring network. The mass-spring model uses a functional approach, thus modeling the veins and the membranes of the wing. Results are obtained with a fluid-structure interaction solver, coupling a mass-spring model for the flexible wing with the pseudo-spectral code FLUSI solving the incompressible Navier-Stokes equations. We impose the no-slip boundary condition through the volume penalization method; the time-dependent complex geometry is then completely described by a mask function. We perform a series of numerical simulations of a flexible revolving bumblebee wing at a Reynolds number Re=1800. In order to assess the influence of wing flexibility on the aerodynamics, we vary the elasticity parameters and study rigid, flexible and highly flexible wing models. A better aerodynamic performance of the flexible wing, characterized by the increase of the lift-to-drag ratio, is found while the highly flexible wing appears to be less efficient than the rigid wing.

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