Abstract Submitted
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On the aerodynamic forces of flapping finite-wings in forward flight: a numerical study[1] ALEJANDRO GONZALO, Universidad Carlos III de Madrid, MARKUS UHLMANN, Karlsruhe Institute of Technology, MANUEL GARCIA-VILLALBA, OSCAR FLORES, Universidad Carlos III de Madrid — We study the flow around two flapping wings in forward flight at a low Reynolds number, $Re = 500$, with 3D direct numerical simulations. The flow solver used is TUCAN, an in-house code which solves the Navier-Stokes equations for incompressible flow using an immersed boundary method to model the presence of the wings. The wings are rectangular with a NACA0012 airfoil of chord c as a cross-section. They are located side by side at a distance $0.5c$ between their inboard tips. The wings flap with respect to an axis parallel to the streamwise velocity, without pitching. The angle of rotation is defined using a sinusoidal function with a reduced frequency $k = 1$ and an amplitude such that the maximum height of the outboard tips is c in all cases. We perform several simulations varying the aspect ratio of the wings ($AR = 2$ and 4) and the distance between the inboard tip of the wings and the axis of rotation ($R = 0$, 2 and ∞), the latter case corresponding to wings in heaving motion. In this way we can study the variation of the fictitious forces on the wings and the induced spanwise flows, and their relation to the vortical structures on the wing (i.e. leading edge vortex, trailing edge votex, tip vortices) and the resulting aerodynamic forces.

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