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Schooling of flapping wings: Simulations HASSAN MASOUD, Courant Institute, NYU and Princeton University, ALEXANDER BECKER, LEIF RISTROPH, MICHAEL SHELLEY, Courant Institute, NYU — We examine the locomotion of an infinite array of wings that heave vertically with a prescribed sinusoidal motion and are free to translate in the horizontal direction. To do this, we simulate the motion of a freely translating flapping airfoil in a domain with periodic horizontal boundary conditions. These simulations indicate that the wings can "take advantage" of their collectively generated wake flows. In agreement with our experiments in a rotational geometry, we find ranges of flapping frequency over which there are multiple stable states of locomotion, with one of these swimming states having both higher speeds and efficiencies than an isolated flapping and locomoting wing. A simple mathematical model, which emphasizes the importance of history dependence in vortical flows, explains this multi-stability. These results may be important to understanding the role of hydrodynamic interactions in fish schooling and bird flocking.

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