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Exact solutions for the unsteady motion of multiple wings in an inviscid fluid PETER J. BADDOO, DARREN CROWDY, Imperial College London, NICK MOORE, United States Naval Academy, ANAND OZA, New Jersey Institute of Technology (NJIT) — When two or more fliers or swimmers move together, their interactions can significantly affect the characteristics of the surrounding flow. Indeed, it is well known that many natural swimmers exploit these effects to enhance their propulsive efficiency. This raises the question of when these swimmers are operating in co-operation or competition; i.e. do the interaction effects help or hinder the swimmers. We use conformal maps and multiply connected function theory to build a model for these interactions. Our model is based on thin aerofoil theory and requires equivalent assumptions such as attached flow, small-amplitude motions and linearised wakes. Accordingly, our approach is very general and permits consideration of a range of wing motions (pitching, heaving, undulatory) and configurations (tandem, in-line, periodic, ground effect). Unlike previous approaches, our model is not based on the assumption that the swimmers are far apart and thus interact only weakly. We focus on the (doubly connected) case where there are two interacting swimmers and find that our results show excellent agreement with experimental data. Specifically, our model recovers the equilibrium configurations observed in recent experiments and suggests the existence of new stable configurations.

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