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Unsteady Performance of Finite-Span Pitching Propulsors in Mixtures of Side-by-Side and In-Line Arrangements MELIKE KURT, KEITH MOORED, Lehigh Univ — Birds, insects, and fish propel themselves by flapping their wings or oscillating their fins in unsteady motions. Many of these animals fly or swim in groups or collectives, typically described as flocks, swarms and schools. The three-dimensional steady flow interactions and the two dimensional unsteady flow interactions that occur in collectives are well characterized. However, the interactions that occur among three-dimensional unsteady propulsors remain relatively unexplored. The aim of the current study is to measure the forces acting on and the energetics of two finite-span pitching wings. The wings are arranged in mixtures of canonical in-line and side-by-side configurations while the phase delay between the pitching wings is varied. The thrust force, fluid-mediated interaction force between the wings and the propulsive efficiency are quantified. The three-dimensional interaction mechanisms are compared and contrasted with previously examined two-dimensional mechanisms. Stereoscopic particle image velocimetry is employed to characterize the three-dimensional flow structures along the span of the pitching wings.

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