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Momentum distribution in the wake of a bio-inspired trapezoidal pitching panel. RAJEEV KUMAR[1], JUSTIN KING[2], MELISSA GREEN[3], Syracuse Univ — A trapezoidal pitching panel that models a fish caudal fin was used to study the distribution of streamwise momentum in its wake. The three-dimensional phase-averaged velocity fields were captured using stereoscopic PIV at Strouhal numbers (St) ranging from 0.17 to 0.56. The pitching trapezoidal panel wake consists of chains of interacting vortex rings that induce significant three-dimensional flows. With increasing Strouhal number, this wake structure induces flow with increasing non-dimensional downstream momentum, which is consistent with greater non-dimensional thrust production at higher St shown previously in the literature. Also at higher St, these chains of vortex rings split and diverge in the transverse direction, giving rise to a pair of downstream jets. At the highest St, a region of downstream momentum lower than the freestream is observed along the centerline between the jet pair. This loss of momentum surplus may be related to a previously described decline in propulsive efficiency at higher St. The momentum distribution is also studied in the time-averaged velocity fields to show how the average momentum is distributed over the same range of St.

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