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Effect of Eliminating Trailing Edge Vortices on Thrust Coefficient in a Plunging Flat Plate AEVELINA RAHMAN, PhD Student, DANESH TAFTI, Professor — Plunging motion, characterized by frequency and amplitude is a key component in the kinematics of many flying and swimming organisms. We studied plunging of a flat plate with a broad range of reduced frequencies $0.25 \leq k \leq 16$ and plunge amplitudes $0.03125 \leq h \leq 8$ giving plunge velocities of $0.25 \leq kh \leq 4$ at Re=100. This study observed that, unlike previous investigations for small plunge amplitudes, thrust does not increase monotonically with kh but reaches a maximum and then decreases. It is shown that Leading Edge Vortices (LEVs) are responsible for thrust production whereas Trailing Edge Vortices (TEVs) induce drag on the plate. At higher kh, vortex induced velocities dominate the flow with strong nonlinear vortex-vortex interactions (VVI). Three main VVI mechanisms are identified; in two of them TEVs adversely affect thrust production. It is shown that by introducing a splitter plate that eliminates the formation of TEVs, the thrust coefficient (C_T) increases monotonically with kh. A parametrization of thrust coefficient is done with frequency (k) and amplitude (h) [$C_T = A.k^{1.4}h - B$ where A and B are constants, with a R^2 =0.96 for the proposed equation]. Additionally, a scaling analysis is done between C_T and circulation to see the effect of eliminating TEV on LEV dynamics.

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