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On the thrust performance of a 2D flapping foil in a forward flight condition SUNIL MANOHAR DASH, KIM BOON LUA, TEE TAI LIM, National University of Singapore — Past studies have shown that the thrust performance of a 2D airfoil undergoing simple harmonic motion in both pitch and heave in a forward flight condition is dependent on maximum effective angle of attack (α_o) and Strouhal number (S_T). For a given α_o, it is found that the thrust coefficient (C_T) increases with S_T until it reaches a peak value at the critical Strouhal number (S_{Tc}); beyond which C_T deteriorates considerably. In order to extend S_{Tc} and therefore increase the max.C_T, the airfoil must oscillate at a higher α_o. Further, it is found that, regardless of α_o thrust degeneration is accompanied by cessation of the induced effective angle of attack profile (α(t)) to exhibit simple harmonic function of time. As to why non simple harmonic function of α(t) is detrimental to thrust generation is not fully understood. In an attempt to better understand this phenomenon, both numerical simulations and comparative experiments are performed on a 2D flapping elliptic foil at Re of 5000. Our results show that the proximity of the leading edge vortex from the previous stroke to the oscillating foil plays a crucial role in the thrust generation. Detailed results will be discussed in the presentation.

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