Abstract Submitted
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Free Surface and Flapping Foil Interactions[1] PALANISWAMY ANANTHAKRISHNAN, Florida Atlantic University — Flapping foils for station-keeping of a near-surface body in a current is analyzed using a finite-difference method based on boundary-fitted coordinates. The foils are hinge-connected to the aft of the body and subject to pitch oscillation. Results are obtained for a range of Strouhal number, Froude number, unsteady frequency parameter τ, Reynolds number and the depth of foil submergence. Results show that at low Strouhal number ($St < 0.1$) and sub-critical unsteady parameter $\tau < 0.25$, the flapping generates drag instead of thrust. At high Strouhal number and super-critical value of the unsteady parameter ($\tau > 0.25$) flapping generates high thrust with low efficiency. Thrust and efficiency are found to decrease with decreasing submergence depth of the foil. At the critical $\tau = 0.25$ and shallow submergence of the foil, the standing wave generated above the foil continues to grow until breaking; both the thrust and efficiency of the foil are reduced at the critical τ. The necessary conditions for optimal thrust generation by a flapping foil underneath the free surface are found to be (i) Strouhal number in the range from 0.25 to 0.35, (ii) unsteady parameter $\tau > 0.25$ and (iii) the maximum angle of attack less than 15^o for the flat-plate foil.

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