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Propulsion of a flexible foil in a fluid KARTIK VENKATRAMAN, RAVI CHAITHANYA, Indian Institute of Science — The dynamic properties such as time dependent pressure loading, free stream velocity, and local acceleration of the hydrofoil determine the instantaneous deformation of a flexible foil. The present work is concerned with the effect of structural dynamic terms and inertia loads on a flexible foil undergoing large amplitude rigid body harmonic wave-like motion in an unsteady potential flow. The hydrofoil structural dynamics is modeled as an Euler-Bernoulli beam finite element. The unsteady fluid dynamic force is evaluated using a numerical discrete vortex implementation of an unsteady incompressible potential flow model. The hydrofoil is fixed at its leading edge and it moves with velocity parallel to its length in the undeformed state. The propulsion of the hydro-elastic system is studied in terms of the mass ratio of the foil and the fluid, as well as its structural flexibility. It is shown that the thrust coefficient and propulsive efficiency of the flexible foil decreases with increase in structural flexibility. We made a comparison of the effect of structural flexibility on the thrust coefficient and propulsive efficiency considering models of the oscillating foil with inertia and without inertia effects present. Detailed parametric studies of the effect of different parameters on propulsion of the foil were made. Including inertia loads and structural dynamic terms significantly affect the propulsive efficiency and thrust coefficient.

Kartik Venkatraman
Indian Institute of Science

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