Propulsive characteristics of an oscillating flexible foil in a fluid

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Abstract

The work presented here investigates the effect of structural dynamic terms and inertia loads on a flexible foil undergoing large amplitude rigid body harmonic 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 propulsion of the aeroelastic system is studied in terms of the mass ratio of the foil and the fluid, as well as its 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.

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