Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Numerical Analysis of a Heaving flexible Airfoil in a Viscous Flow[1] JEAN-NOEL PEDERZANI, HOSSEIN HAJ-HARIRI, University of Virginia — A numerical model for two-dimensional unsteady viscous fluid flow around flexible bodies is used to analyze the effect of chordwise flexibility on heaving airfoils. Flexible airfoils proved to be more efficient than the rigid ones. Both the output power and the input power increase in the flexible cases. The gain in efficiency is realized as a result of the output power increasing more than the input power. The density of the airfoils was shown to be a key factor in determining efficiency and power. In the parameter range analyzed, heavier airfoils are shown to generate less output power and to require proportionately less input power. Thus, heavier airfoils are more efficient than lighter airfoils. In the numerical model the bodies are represented by a distributed body force in the Navier-Stokes equations. The body force density is found at every time-step so as to adjust the velocity within the computational cells occupied by the bodies to a prescribed value. The main advantage of this method is that the computations can be effected on a Cartesian grid, without having to fit the grid to the body surface. This approach is particularly useful when applied to the case of multiple bodies moving relatively to each other, as well as flexible bodies, in which case the surface of the object changes dynamically.

[1]supported by NASA Grant NAG1-01120; J.G. Batterson.

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Date submitted: 03 Aug 2006 Electronic form version 1.4