Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

The effects of flexibility on the performance of flapping airfoils[1]
MARCOS VANELLA, TIM FITZGERALD, SERGIO PREIDIKMAN, ELIAS BALARAS, BALAKUMAR BALACHANDRAN, University of Maryland, College Park, MD, 20742, USA — The majority of experimental and numerical studies related to flapping flight have been exploring the relation of the thrust coefficient and propulsive efficiency to the wing geometry and kinematics. Wing flexibility has received less attention and as of today it remains unclear if it can be exploited for better performance at low-Reynolds-number flapping flight. To bridge this gap we performed simulations of a two-dimensional, two-component wings connected by a hinge with a torsional spring. The motion of the lead body has prescribed kinematics, while the trailing body motion is passive. One of the primary outcomes of this work is that nonlinear resonances play an important role in the performance of a given flapping wing system, mainly by modifying the formation of leading and trailing edge vortices. For the flexible profile used, the mean values of lift and drag forces, and the ratio of lift to drag are enhanced when the system responds in the nonlinear resonance region.

[1]Work supported by NSF and AFOSR.

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Date submitted: 06 Aug 2007 Electronic form version 1.4