Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

A Boundary Element Simulation of Flapping Foils with Leading-Edge Separations QIANG ZHU, Dept. of Structural Engr., UCSD, XIAOXIA DONG, MICHAEL S. TRIANTAFYLLOU, DICK K.P. YUE, Dept. of Mechanical Engr., MIT — We develop a three-dimensional numerical model based on potential-flow theory and boundary-integral formulations to investigate the dynamics of a flapping foil with vortex generation at both the trailing and the leading edges. The shedding at the trailing edge is denoted by a single shear layer originated from the sharp edge itself, while the vorticity generation near the leading edge is modeled as a group of shear layers, each of them starting from a prescribed separation line. With a boundary-element algorithm the problem is solved numerically. We find that without taking into account the effect of leading-edge separations, the predictions of the hydrodynamic forces and propulsion efficiency of a heaving-pitching foil match the experimental measurements only in the regime of small Strouhal number or small angle of attack, while the agreement between numerical results and experiments is significantly improved over a large range of kinematic parameters by including the leading-edge separation model.

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Date submitted: 02 Aug 2005 Electronic form version 1.4