Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Adjoint-based optimization for the understanding of the aerodynamics of a flapping plate[1] MINGJUN WEI, MIN XU, New Mexico State University — An adjoint-based optimization is applied on a rigid flapping plate and a flexible flapping plate for drag reduction and for propulsive efficiency. Non-cylindrical calculus is introduced to handle the moving boundary. The rigid plate has a combined plunging and pitching motion with incoming flow, the control parameter is the phase delay which is considered first as a constant then as an arbitrary time-varying function. The optimal controls with different cost functions provide different strategies to reach maximum drag reduction or propulsive efficiency. The flexible plate has plunging, pitching, and deformation which is defined by the first two natural modes. With the same optimization goals, the control is instead the amplitude and phase delay of the pitching, the first eigen mode, and the second eigen mode. Similar analyses are taken to understand the conditions for drag reduction and propulsive efficiency when flexibility is involved. It is also shown that the flexibility plays a more important role at lower Reynolds number.

[1]Supported by AFOSR

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Date submitted: 30 Jul 2015 Electronic form version 1.4