Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Globally shed wakes for three distinct retracting foil geometries
STEPHANIE STEELE, MICHAEL TRIANTAFYLLOU, MIT — In quickly retracting foils at an angle of attack, the boundary layer vorticity along with the added mass energy is immediately and globally shed from the body into the surrounding fluid. The deposited vorticity quickly reforms into lasting vortex structures, which could be used for purposes such as manipulating or exploiting the produced flow structures by additional bodies in the fluid. The globally shed wake thus entrains the added mass energy provided by the initially moving body, reflected by the value of the circulation left in the wake. In studying experimentally as well as numerically this phenomenon, we find that the three different tested geometries leave behind distinct wakes. Retracting a square-ended foil is undesirable because the deposited wake is complicated by three-dimensional ring vorticity effects. Retracting a tapered, streamlined-tipped foil is also undesirable because the shape-changing aspect of the foil geometry actually induces energy recovery back to the retracting foil, leaving a less energetic globally shed wake. Finally, a retracting hollow foil geometry avoids both of these detrimental effects, leaving relatively simple, yet energetic, vortex structures in the wake.

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Date submitted: 29 Jul 2015 Electronic form version 1.4