Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

A reduced model for unsteady laminar flow past a solid body using matched asymptotics[1] PONNULAKSHMI VADIVELNADAR KARTHEESWARAN, XINJUN GUO, SHREYAS MANDRE, School of Engineering, Brown university — We present a reduced order method for unsteady, laminar flow past a smooth but otherwise arbitrarily shaped body at high Reynolds number. Inspired by matched asymptotic expansion of Navier-Stokes equation, the flow domain is divided into two regimes: (i) an outer inviscid region where the flow field is represented using potential flow and point vortices, and (ii) a boundary layer around the body where the flow field obeys Prandtl's boundary layer equations. Since both representations of the flow field are governed by identical process (viscous effects becoming negligible sufficiently away from the solid body), it is possible to match the flow field at the interface between the two domains. Matching the flow field at the interface dictates the strength and location of vorticity shed from the boundary layer to the outer region. An approximately 100-fold increase in computational speed may be achieved using this method. In this talk, we present results for the flow surrounding a 2D oscillating elliptic hydrofoil, a configuration employed for energy extraction from tides. Simulations are performed for various pitching and heaving parameters in an effort to optimize the stroke for maximum energy extraction.

[1]A reduced model for unsteady laminar flow past a solid body using matched asymptotics

Ponnulakshmi Vadivelnadar Kartheeswaran
School of Engineering, Brown university

Date submitted: 01 Aug 2014 Electronic form version 1.4