Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Fluid-Structure Interaction Study on a Pre-Buckled Deformable Flat Ribbon[1] LAUREN FOVARGUE, EHSAN SHAMS, AMY WATTERSON, Rensselaer Polytech Inst, DAVE CORSON, Altair Engineering, Inc., BENJAMIN FILARDO, DANIEL ZIMMERMAN, BOB SHAN, Pliant Energy Systems LLC, ASSAD OBERAI, Rensselaer Polytech Inst — A Fluid-Structure Interaction study is conducted for the flow over a deformable flat ribbon. This mechanism, which is called ribbon frond, maybe used as a device for pumping water and/or harvesting energy in rivers. We use a lower dimensional mathematical model, which represents the ribbon as a pre-buckled structure. The surface forces from the fluid flow, dictate the deformation of the ribbon, and the ribbon in turn imposes boundary conditions for the incompressible Navier-Stokes equations. The mesh motion is handled using an Arbitrary Lagrangian-Eulerian (ALE) scheme and the fluid-structure coupling is handled by iterating over the staggered governing equations for the structure, the fluid and the mesh. Simulations are conducted at three different free stream velocities. The results, including the frequency of oscillations, show agreement with experimental data. The vortical structures near the surface of the ribbon and its deformation are highly correlated. It is observed that the ribbon motion exhibits deviation from a harmonic motion, especially at lower free stream velocities. The behavior of the ribbon is compared to swimming animals, such as eels, in order to better understand its performance.

[1]The authors acknowledge support from ONR SBIR Phase II, contract No. N0001412C0604 and USDA, NIFA SBIR Phase I, contract No. 2013-33610-20836 and NYSERDA PON 2569, contract No. 30364.

Ehsan Shams
Rensselaer Polytech Inst

Date submitted: 01 Aug 2015 Electronic form version 1.4