

Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Flow energy harvesting – another application of the biomimetic flapping foils QIANG ZHU, ZHANGLI PENG, UC San Diego — Imitating fish fins and insect wings, flapping foils are usually used for biomimetic propulsion. Theoretical studies and experiments have demonstrated that through specific combinations of heaving and pitching motions, these foils can also extract energy from incoming wind or current. Compared with conventional flow energy harvesting devices based upon rotating turbines, this novel design promises mitigated impact upon the environment. To achieve the required motions, existing studies focus on hydrodynamic mode coupling, in which a periodic pitching motion is activated and a heaving motion is then generated by the oscillating lifting force. Energy extraction is achieved through a damper in the heaving direction (representing the generator). This design involves a complicated control and activation system. In addition, there is always the possibility that the energy required to activate the system exceeds the energy recovered by the generator. We have discovered that a much simpler device without activation, a 2DOF foil mounted on a rotational spring and a damper undergoing flow-induced motions can achieve stable flow energy harvesting. Using Navier-Stokes simulations we predicted different behaviors of the system during flow-induced vibrations and identified the specific requirements to achieve controllable periodic motions essential for stable energy harvesting. The energy harvesting capacity and efficiency were also determined.

Qiang Zhu
UC San Diego

Date submitted: 05 Aug 2009

Electronic form version 1.4