Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Harvesting energy via fluttering piezoelectric beams in viscous flow DENIZ TOLGA AKCABAY, YIN LU YOUNG, University of Michigan — This work explores the idea of harvesting energy from ambient flows using flexible piezoelectric beams. Beams lose their stability and flutter above a critical length or flow speed or below a critical stiffness. During flutter, beams oscillate in increasing amplitude until they enter a self-sustained limit cycle oscillation, which could be exploited to harvest energy. The objectives of this study are to: (i) identify the flutter boundary of a flexible beam in viscous flow; (ii) explore the energy harvesting potential; and (iii) identify critical non-dimensional parameters and parametric relations that govern the response and stability of thin composite beams vibrating in a viscous fluid. Two-dimensional Navier-Stokes equations are solved with a nonlinear beam model coupled with a linear piezoelectric material constitutive model. The harvested energy potential for various solid/fluid combinations is investigated by varying the critical non-dimensional parameters, which are defined in terms of beam length, density, thickness, and stiffness; fluid speed and density; and piezoelectric material properties.

Deniz Akcabay
University of Michigan

Date submitted: 11 Aug 2011 Electronic form version 1.4