Abstract Submitted for the DFD17 Meeting of The American Physical Society

Fluidic Energy Harvester Optimization in Grid Turbulence¹ AMIR DANESH-YAZDI, Penn State Univ, Erie, NIELL ELVIN, YIANNIS AN-DREOPOULOS, City College of New York — Even though it is omnipresent in nature, there has not been a great deal of research in the literature involving turbulence as an energy source for piezoelectric fluidic harvesters. In the present work, a grid-generated turbulence forcing function model which we derived previously is employed in the single degree-of-freedom electromechanical equations to find the power output and tip displacement of piezoelectric cantilever beams. Additionally, we utilize simplified, deterministic models of the turbulence forcing function to obtain closed-form expressions for the power output. These theoretical models are studied using experiments that involve separately placing a hot-wire anemometer probe and a short PVDF beam in flows where turbulence is generated by means of passive and semi-passive grids. From a parametric study on the deterministic models, we show that the white noise forcing function best mimics the experimental data. Furthermore, our parametric study of the response spectrum of a generic fluidic harvester in grid-generated turbulent flow shows that optimum power output is attained for beams placed closer to the grid with a low natural frequency and damping ratio and a large electromechanical coupling coefficient.

¹NSF Grant No. CBET 1033117

Amir Danesh-Yazdi Penn State Univ, Erie

Date submitted: 02 Aug 2017

Electronic form version 1.4