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THE EFFECTS OF ELECTROMECHANICAL COUPLING ON TRANSIENT CHARGING BEHAVIOR IN PIEZOELECTRIC POWER HARVESTING

A. Wickenheiser[1], T. Reissman[2], and E. Garcia[3]

[1]Sibley School of Mechanical & Aerospace Engineering, Cornell University
amw30@cornell.edu
[2]Sibley School of Mechanical & Aerospace Engineering, Cornell University
tr34@cornell.edu
[3]Sibley School of Mechanical & Aerospace Engineering, Cornell University
eg84@cornell.edu

W. Wu[4]

[4]Department of Engineering Science and Ocean Engineering, National Taiwan University
wjwu@ntu.edu.tw

ABSTRACT

This paper focuses on comparing weakly to strongly coupled electromechanical systems for harvesting energy from ambient vibrations to charge a storage capacitor. This coupling is characterized by the amount of energy extracted from the mechanical vibrations and converted into electrical energy. The system in question is a cantilevered piezoelectric beam undergoing base excitation whose extracted electrical energy is used to charge a storage capacitor. A strongly coupled beam and a weakly coupled beam are compared to highlight the impact of energy extraction on the vibrations, in the former case. The transient dynamics of the coupled system are studied in detail with an emphasis on the time to charge to a specified voltage. Analytic models of these dynamics are developed in order to illuminate the effects of coupling and the errors introduced by simplified modeling assumptions. These theoretical results are compared to experimental results for these two beams. Finally, some of the challenges inherent in designing for a highly coupled energy harvesting system are discussed.

***Keywords**:* Power harvesting, Piezoelectric, Electromechanical Coupling.