Analysis of Mechanical Suspension Pressure on Energy Efficiency Piezoelectric Harvesting Using Simulink

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ABSTRACT

This study aims to analyze the effect of mechanical pressure in a suspension system on the efficiency of piezoelectric-based energy harvesting through modeling and simulation using MATLAB Simulink. The background of this research is driven by the increasing demand for electrical energy and the importance of utilizing alternative energy sources that can harvest mechanical energy from the environment, such as pressure and vibration. The method used is a quantitative simulation-based approach by modeling a piezoelectric system integrated with a rectifier circuit, buck converter, and energy storage system. Mechanical pressure variations were applied through loading conditions of 60 kg, 70 kg, and 80 kg to evaluate their effect on electrical output in terms of voltage, current, and power. The simulation results indicate that the mechanical energy increases with higher loading, reaching 1.4715 J, 1.7168 J, and 1.9620 J, respectively, while the corresponding electrical energy outputs are 0,02056 J, 0,02399 J, and 0,02793 J. The system efficiencies obtained are 1,39%, 1,40%, and 1,42%, demonstrating that higher mechanical pressure leads to increased electrical energy generation and improved system efficiency. Overall, the piezoelectric energy harvesting system shows good capability in converting mechanical energy into electrical energy; however, the high efficiency values are influenced by ideal simulation assumptions, indicating the need for experimental validation to obtain more realistic results.

Keywords*: Piezoelectric, Energy Harvesting, Mechanical Pressure, Suspension System, MATLAB Simulink, Energy Efficiency*