

Accepted Manuscript

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PII: S0924-4247(17)31763-6
DOI: <https://doi.org/10.1016/j.sna.2018.02.023>
Reference: SNA 10645

To appear in: *Sensors and Actuators A*

Received date: 2-10-2017
Revised date: 9-1-2018
Accepted date: 15-2-2018

Please cite this article as: Bouzelata Y, Kurt E, Uzun Y, Chenni R, MITIGATION OF HIGH HARMONICITY AND DESIGN OF A BATTERY CHARGER FOR A NEW PIEZOELECTRIC WIND ENERGY HARVESTER, *Sensors and Actuators: A Physical* (2010), <https://doi.org/10.1016/j.sna.2018.02.023>

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MITIGATION OF HIGH HARMONICITY AND DESIGN OF A BATTERY CHARGER FOR A NEW PIEZOELECTRIC WIND ENERGY HARVESTER

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HIGHLIGHTS

- A new power conversion strategy has been implemented for a wind energy harvester system.
- Extremely high THD values have been annihilated by the proposed technique for the triple piezoelectric system.
- An effective control strategy for the voltage - mode control method (VMC) has been improved to control the dc – dc buck converter.

Abstract

A new piezoelectric wind energy harvester (PWEH) implementation and its power conversion system design have been studied. The new PWEH is a portable, economic, easy-mounted, and contactless machine exerting the elastic piezoelectric layers with permanent magnets (PMs). Although a single piezoelectric layer has an ideal sinusoidal waveform from its output terminals, the combined rotating system having multiple layers give complicated responses due to the electromechanical damping, high frequency mechanical vibrations and electromagnetic nonlinearities. In the current work, for instance, three layers generate three different waveforms with high harmonics. Thus, the output waveforms of such multiple layer low power-scale systems require special attention to gain the maximal power from such low-scale harvesters. Indeed, electrical power generation from complicated voltage waveforms and charging efficiency have become main tasks for those low power systems. The proposed rectifier is joined to a capacitor-inductor output filter to ensure high quality DC - bus voltage by ripple mitigation function. An effective control strategy is also carried out for the voltage - mode control (VMC) method in order to control the DC – DC buck converter in such a way that it may guarantee a smooth output DC voltage. Then the later can be applied to charge storage unit such as a lead-acid type electrochemical battery for the future numerous low power applications. The proposed circuitry is successful to mitigate the harmonics of the voltage waveforms from the terminals of three piezoelectric layers with high THD values (i.e. 169.16%, 51.75% and 42.64%). In addition, the proposed PWEH has an ability to charge the battery with a stable output rectified voltage at 40 V by enabling a linear increase in the State-Of-Charge (SOC) from 0 % to 18 % after 4 seconds till the battery is fully charged.

Abstract

In the present paper, a new piezoelectric wind energy harvester (PWEH) implementation and its power conversion system have been studied. The new PWEH is a portable, economic, easy-mounted, and contactless

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