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Performance evaluation of 3D printed miniature electromagnetic energy harvesters driven by air flow

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Highlights

- â€¢ Ten 3D printed energy harvesters are designed and experimentally tested.
- â€¢ Parametric measurements are conducted.
- â€¢ Maximum overall energy conversion efficiency is 6.59%.
- â€¢ Total electrical power is found to increase to 0.305Â W.
- â€¢ A more fast-prototyping and efficient miniature wind power harvester is

Abstract

As a renewable and non-polluting energy source, wind is used to produce electricity via large-diameter horizontal or vertical axis wind turbines. Such large wind turbines have been well designed and widely applied in industry. However, little attention has been paid to the design and development of miniature wind energy harvesters, which have great potential to be applied to the HVAC (heating, ventilating and air conditions) ventilation exhaust systems and household personal properties. In this work, 10 air-driven electromagnetic energy harvesters are fabricated using 3D printing technology. Parametric measurements are then conducted to study the effects of (1) the blade number, (2) its geometric size, (3) aspect ratio, presence or absence of (4) solid central shaft, (5) end plates, and (6) blade orientation. The maximum electrical power is 0.305Â W. To demonstrate its practical application, the electricity generated is used to power 4 LED (light-emitting diode) lights. The maximum overall efficiency Î·max is approximately 6.59%. The cut-in and minimum operating Reynolds numbers are measured. The present study reveals that the 3D printed miniature energy harvesters provide a more efficient platform for harnessing â€˜wind powerâ€™.

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Keywords

Energy harvesting; Wind energy; 3D printing; Energy conversion; Renewable energy; Wind power

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