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The effects of unsteady wind on the performances of a newly developed cross-axis wind turbine: A wind tunnel study

Wei-Cheng Wang, Jheng-Jie Wang, Wen Tong Chong

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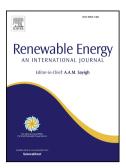
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ACCEPTED MANUSCRIPT

1 The Effects of Unsteady Wind on the Performances of a Newly

2 Developed Cross-Axis Wind Turbine: a Wind Tunnel Study

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4 Wei-Cheng Wang^{1,*}, Jheng-Jie Wang¹, Wen Tong Chong²

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- 6 ¹Department of Aeronautics and Astronautics, National Cheng Kung University, Tainan,
- 7 Taiwan, 70101
- 8 ²Department of Mechanical Engineering, Faculty of Engineering, University of Malaya,
- 9 Kuala Lumpur, Malaysia, 50603

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- *Corresponding author:
- Wei-Cheng Wang
- Email: wilsonwang@mail.ncku.edu.tw

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Abstract

For the purpose of meeting the wind field in urban area, the performances of a newly

invented cross-axis wind turbine (CAWT), which consists of the advantages of horizontal and vertical axis wind turbines (HAWTs and VAWTs), was examined in a calibrated open-circuit low speed wind tunnel. Firstly, to ensure the quality of the wind tunnel, the evaluations in accordance with the flow uniformity, turbulent intensity and pressure gradient along the test section were conducted within the wind tunnel, based on the IEC61400-12 standard. Furthermore, the CAWT was tested with and without the artificial turbulence generator for examining the static and dynamic performances within the steady/unsteady wind conditions at various Reynolds numbers, and the blockage inside the wind tunnel was additionally taken into account. The results showed that both the static and dynamic performances were improved with the addition of turbulence generator. Moreover, the payback period of the CAWT was calculated associated with its power performance.

Keywords: Wind energy; Wind tunnel experiment; Aerodynamic; Cross-Axis Wind

Turbine (CAWT); Vertical Axis Wind Turbine (VAWT); Power coefficient

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