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

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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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Abstract

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

28 **Keywords:** Wind energy; Wind tunnel experiment; Aerodynamic; Cross-Axis Wind
29 Turbine (CAWT); Vertical Axis Wind Turbine (VAWT); Power coefficient

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