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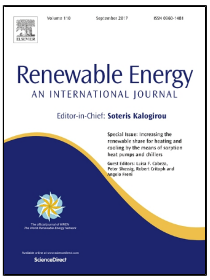

An experimental and numerical investigation on the power performance of 150kW horizontal axis wind turbine

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An experimental and numerical investigation on the power performance of 150kW horizontal axis wind turbine

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Abstract

In this paper, the computational fluid dynamics (CFD) based blade design simulations is performed to study the 150 kW horizontal axis wind turbine. Reynolds-averaged Navier–Stokes equations and RNG k-ε turbulence model are applied for computational fluid dynamics (CFD) simulations to predict turbulent flow. The predicted results show that under the 12 m/s rated wind speed, the output power are 180 kW, 82 kW and 56 kW on the pitch angle of 5, 15 and 30 degrees, respectively. The maximum aerodynamic performance of 0.42 can be achieved on the pitch angle of 5 with TSR of 3.6. In order to validate the design, output of torque and power performance of the wind turbine under various wind speed have been measured. The comparisons demonstrate the reasonable agreements between experimental and numerical data under the pitch angle of 5 degrees and 6-10m/s wind speed.

Keywords: Computational fluid dynamics, horizontal axis wind turbine, experimental measurements

1. Introduction

Wind energy is a one of renewable sources and can be captured by turbines, which convert aerodynamic power into mechanical energy that is then converted to electricity via electrical generator. The horizontal-axis wind turbine (HAWT) has been widely implemented for commercial application [1] due to its high efficiency compared to vertical axis and other types of wind turbines. In general, the efficiency of wind turbine system is directly related to electrical generator, power inverter, manipulate strategy and blade geometry. Therefore, for development of more reliable and energy conversion efficiency, accurately predicting aerodynamic phenomena is significant, because it determines annual energy production (AEP) and affects the loads of main shaft, gear box, blade structure etc.