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Power Performance Improvement of 500W Vertical Axis Wind Turbine with Salient Design Parameters

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Abstract : This paper presents the performance characteristics of Darrieus-type vertical axis wind turbine (VAWT) with NACA airfoil blades. The performance of Darrieus-type VAWT can be characterized by torque and power. There are various parameters affecting the performance such as chord length, helical angle, pitch angle and rotor diameter. To estimate the optimum shape of Darrieustype wind turbine in accordance with various design parameters, we examined aerodynamic characteristics and separated flow occurring in the vicinity of blade, interaction between flow and blade, and torque and power characteristics derived from it. For flow analysis, flow variations were investigated based on the unsteady RANS (Reynolds-averaged Navier-Stokes) equation. Sliding mesh algorithm was employed in order to consider rotational effect of blade. To obtain more realistic results we conducted experiment and numerical analysis at the same time for three-dimensional shape. In addition, several parameters (chord length, rotor diameter, pitch angle, and helical angle) were considered to find out optimum shape design and characteristics of interaction with ambient flow. Since the NACA airfoil used in this study showed significant changes in magnitude of lift and drag depending on an angle of attack, the rotor with low drag, long cord length and short diameter shows high power coefficient in low tip speed ratio (TSR) range. On the contrary, in high TSR range, drag becomes high. Hence, the short-chord and long-diameter rotor produces high power coefficient. When a pitch angle at which airfoil directs toward inside equals to -2° and helical angle equals to 0°, Darrieus-type VAWT generates maximum power.

Keywords : darrieus wind turbine, VAWT, NACA airfoil, performance
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