Numerical Simulation for Optimization of Unsteady Rotating Wind Turbine

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In many cases, the basic characteristics can be measured by rotating only one wind turbine at a constant angular velocity.[1] Recently, some researches propose to install multiple wind turbines close together. The interaction between the flow of wind turbines increases the power coefficient.[2] In most studies, in order to investigate the basic characteristics of the wind turbine, it is necessary to make the wind turbine rotate at a constant angular speed. Nevertheless, it is also important to investigate the response characteristics of wind speed changes.

In this study, we performed numerical simulations for time-varying rotations to investigate the characteristics when the wind turbine starts to rotate and find the optimum blade shape. A drag-type vertical axis wind turbine and its one cross-sectional view are shown in Fig.1 and Fig.2, respectivelly. Many parameters have to be decided, even if limited to related to one cross-section. "Overlap" and "gap" are optimized in this study. The graph in Fig.3 is the result of the simulation. The vertical axis shows the torque coefficient (power of the wind turbine) . The horizontal axis shows the size of the overlap or gap when the wind turbine radius is 1.0. And simulating the eight different windturbines which have different gaps and zero overlap. The results are indicated by broken lines. And simulating the eight different windturbines which have different overlaps and zero gap. The results are indicated by solid lines. Compared with other wind turbines, the wind turbine showed in Fig. 4 has the highest torque coefficient. When the gap is large, the torque coefficient is bad.

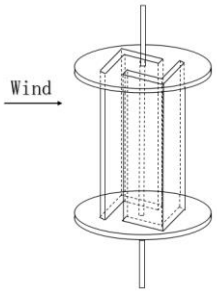

Fig.1. Drag-type vertical axis wind turbine

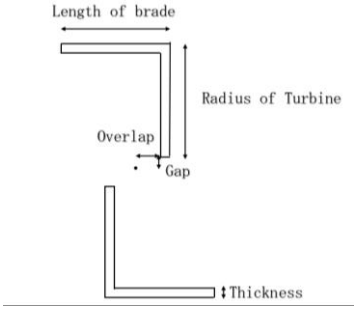

Fig.2. A cross-sectional view of Fig.1

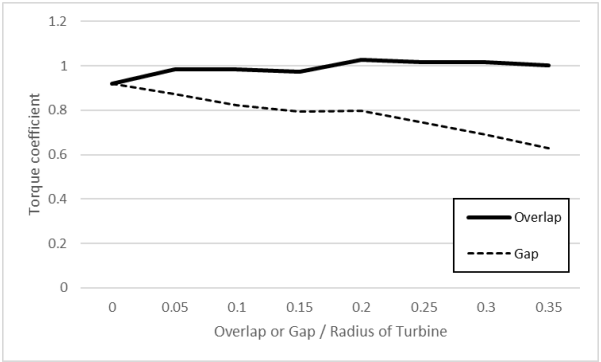

Fig.3 Output characteristics for 16 different wind turbines.

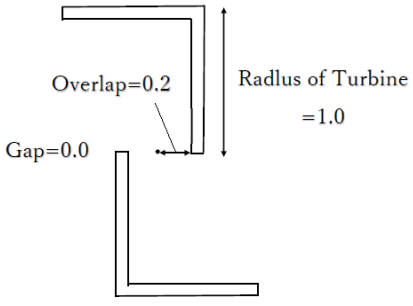

Fig.4 Windturbine with the highest torque coefficient.

[1] I. Ushiyama, H Nanagi and J Shinoda, "Experimentally Determining the Optimum Design Configuration for Savonius Rotors", Bulletin of JSME, 29(258), pp.4130-4138, (1986). [2] A.R.El-Bazac, K.Youssef, M.H.Mohamed, "Innovative improvement of a drag wind turbine performance", Renewable Energy, 86, pp. 89-98, (2016).