Conceptual design and center-point force dynamic simulation of a new horizontal axis semi-exposed wind turbine

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Abstract

Renewable energy sources are fast growing. Nowadays much effort has been made by inventors to devise new and more efficient configurations of wind turbines. This paper describes mechanical design and resultant-force dynamic simulation of innovative horizontal axis semi-exposed wind turbine structure. The innovation in wind turbine structure includes flat shape of its blades and their orientation towards the wind that minimizes the axial component of wind force on the shaft bearings. As a result, the wind power is fully utilized to generate a useful rotary force that drives the generator rotor. This enhances the efficiency of the turbine as compared to complex shape blades in traditional horizontal axis wind turbines. The distinctive feature of the system is also an oscillating shield that automatically protects the generator shaft from over speeding at extreme wind speeds, and therefore, from generating power above its nominal capacity. The over speeding may even cause a physical damage to the generator. The center-point force dynamic load models on the rotor blades have been derived for various wind conditions. The simulation algorithms have been tested in MATLAB Simulink environment. The results of simulation show the efficacy of the system and an advantage of using this system with the over speed shield protection.

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