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ABSTRACT

This thesis adopted the idea of Wind Energy Conversion System (WECS). Most commonly wind turbines are classified into two major categories, namely Fixed Speed Wind Turbines, FSWT, and Variable Speed Wind Turbines, VSWT. As a consequence of using fixed speed generators, wind turbines had to work at a certain speed. The benefits of FSWT are the simplicity of the system. Its disadvantage, however, is that it constrains rotor speed so that the turbine cannot operate at its peak efficiency in all wind speeds. For this reason the wind turbine industry has moved to using VSWTs that can maximize below-rated power production.

VSWTs have two main regions of operation. The First Region encompasses wind speeds below the rated value and the objective is to maximize wind energy capture. The other one encompasses high wind speeds in which the turbine must limit the captured wind power so that safe electrical and mechanical loads are not exceeded. There are different types of control are proposed. The first is blade pitch control which is typically used to limit power and speed for turbines operating in wind speeds above the rated value. The second is generator torque control which is usually used for maximizing the captured power. The third is the gearbox ratio control to maintain the resultant angular rotor speed of the generator constant at its rated value throughout different speeds. The fourth is the control on the excitation capacitor value to obtain constant angular rotor speed.

The wind speed represents the main exogenous signal for producing the power. A method for generating realistic wind speed is introduced. The models for real wind speed, the wind turbine, the proposed generator and different control strategies are simulated using the MATLAB program. Simulation results show that the proposed methods ensure increasing the stability under different situations. The controllers can extract maximum power and regulate the voltage and frequency under various wind and load. The control system proved that the overall system is stable and reliable for different wind speeds up to 25m/s and capable of delivering various loads.

The summary not more than 500 words