

Design of a pitch angle control system for a horizontal axis small wind turbine

Wind energy has proven to be an important source of clean and renewable energy. In order to take advantage of wind turbines, design of efficient control system is required not only to improve wind turbines behavior and make the turbines more reliable and efficient, but also to operate the wind turbine in a safe condition. There are two main control systems on the mechanical part of wind turbines; yaw control and pitch angle control systems. Yaw control is used to adjust the wind turbine to face wind direction. Pitch angle control system is used to adjust the blade attack angle according to wind velocity by changing the pitch angle and rotating the blades about their axis with respect to the hub. The present work focuses on pitch angle control system for small scale wind turbines. These turbines may work at high range of wind velocities. So an appropriate control system is required for the purpose of generating the maximum possible power from wind during low wind velocity. Also to make the wind turbine work in safe operation in high wind speed to avoid undesirable operating conditions. In the present study, a small pitch-controlled wind turbine model with 0.8 m rotor diameter has been designed, constructed and tested in the wind tunnel. The present thesis covers two main tasks. First, careful characterization of the small wind turbine was carried out at different wind velocities and pitch setting angles. Second, a pitch control system is implemented to control the power output of the turbine at wind speeds above the rated speed. A linkage mechanism was implemented for controlling the pitch angle by a servo motor. This proved to be efficient and convenient for small wind turbines and worked perfectly. All measurements and control actions were achieved by using Arduino Mega board supported with MATLAB SIMULINK. It was found that using of neural network control system to regulate pitch angle has properly provided a suitable and good controlling action in pitch angle control system which can be achieve wind turbine the required power curve. The proposed system was not only valid for small wind turbine, but also can be implemented to be used for medium and large wind turbines.