Novel Technique to Smooth Power Output of a Wound Rotor Induction Generator based Wind Turbine

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Abstract

High penetration of wind power is hindered by the variability and uncontrollability of wind power output. Many research publications already proposed solutions using energy storage devices. However due to capital and maintenance cost, real applications of energy storage are limited. Wind turbines employing wound rotor induction generators where either rotor resistance is controlled or a voltage is injected to the rotor are already in existence. This paper investigates a novel method where external controllable impedance is added to the rotor of a wound rotor induction generator based wind turbines. Varying rotor impedance contributes to control the output power of the wind turbine, in four ways by changing (i) torque speed characteristic, (ii) power extraction from the wind, (iii) kinetic energy in the turbine inertia and (iv) electrical losses. The complete rotor impedance control was developed and studied using PSCAD/EMTDC and MATLAB simulation packages. Results confirmed that the controllability of the wind farm is increased using rotor impedance control technique. Finally a time domain study was performed in simulation and it showed that the output power of the wind farm was kept at constant while fluctuating natural wind speed input was given.