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Evaluation of two schemes for power control of DFIG for wind energy generation

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Over the last few years, there has been a growing interest in the use of wind energy as environmental and, in many cases, also economical concerns are on the rise. The wind-powered electricity generation growth rapidly because of the advantages of the active and reactive power regulate independently capacity and excitation converters requires small capacity, the doubly fed induction generator (DFIG) has been widely used in the wind power system. Due to an increase in the separate unit and total power of wind turbine installations, the utilities and the local network dispatchers request that wind supplied generators support the grid following different kind of disturbances.

Wind energy systems, generally, are based on variable-speed turbines. From among different alternatives to work with variable speed, the system based on the DFIG has been commonly employed for the recently build wind farms. In such a system the machine stator is directly connected to the grid and the rotor is connected via slip rings to an variable frequency inverter. To cover a wide range rotor speed - from subsynchronous to supersynchronous - the power converter needs to operate with power flowing in both directions (back-to-back inverter). For analyzing the mutual interaction between aforementioned wind generator and the utility network a simulation and modeling technique may be used.

Traditionally, DFIG control is achieved by vector control (VC) [1], [2], which decouples the rotor currents into active power (or torque) and reactive power (or flux) components, and adjusts them separately in a reference frame fixed to either the rotor flux [4], the stator flux [5], [6], magnetizing flux [3] or voltage [2]. The rotor flux reference is calculated using the reactive power/power factor reference. Since the rotor supply frequency, can become very low, rotor flux estimation is significantly affected by the machine parameter variations. Recently, a direct power control strategy based on the estimated stator flux was proposed. Since the stator (network) voltage

is relatively harmonic-free with fixed frequency, a DFIG's estimated stator flux accuracy can be guaranteed. The control system is very simple, and the machine parameters' impact on system performance was found to be negligible [5], [6]. The controller directly calculates the required rotor control voltage within each fixed time period based on the stator flux, the rotor position, and the values of active and reactive powers and their errors. The very similar scheme based on the stator flux reference frame was proposed in [3]. The rotor current in x-y coordinates is used to control the stator reactive and active powers, respectively. The resulting control chain is composed of two control loops with two pairs of independent PI regulators: the inner one stabilizes the rotor current and the outer loop controls the value of active and reactive power.

In the paper the last two proposed schemes for DFIG control are investigated by using of MATLAB-SIMULINK models. Details of the used procedures are presented in the paper. Some results of simulations are also included.

References

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