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SciVerse ScienceDirect
Energy Procedia 18 (2012) 339 – 348
Energy
Procedia

Sensorless MPPT fuzzy controller for DFIG wind turbine

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Abstract :

In this work, a maximum power point tracking method, is developed for the DFIG wind turbine system under study to control the rotor side converter by fuzzy controller in order to capture the maximum wind energy without measuring the wind velocity.
Simulations results, are given and discussed with MATLAB /SIMULINK to validate the proposed control strategy for 10KW DFIG wind generator.
Keywords :

Windturbine, Doubly fed induction generator, Maximum power track, Fuzzy logic controller.

1-Introduction

In the last decades, Renewable Energy Sources have attracted special attention in Europe and all over the world, in order to reach Increasing the security of energy supply and Reducing the emission of greenhouse gases[1] Among the different renewable energy generators, the wind generator is technically and economically the most developed one[2]
Much of the wind turbines installed today are equipped with machine double-fed asynchronous (DFIG). This generator allows the production of electricity has variable speed, this allows then to better exploit the wind resources for different wind velocities. [3] Under optimal control conditions, the variable speed wind system can extract a maximum wind power for a wide range of wind [4]

A DFIG consists of a wound rotor induction generator with the stator windings directly connected to a three-phase power grid and with the rotor winding mounted to a bidirectional back-to-back IGBT frequency converter . A schematic diagram of a variable-speed wind turbine system with a DFIG is shown in Fig. 1.Rotor side converter RSC and the grid side converter GSC are in 20-30% apparent power size The controller of the utility side converter regulates the voltage across the DC link for power transmission to the gird, The RSC regulates the electro-magnetic torque or active power and supplies some of the reactive power[5].

 doi:10.1016/j.egypro.2012.05.045

The scheme of the DFIG wind energy conversion system is presented in figure1.

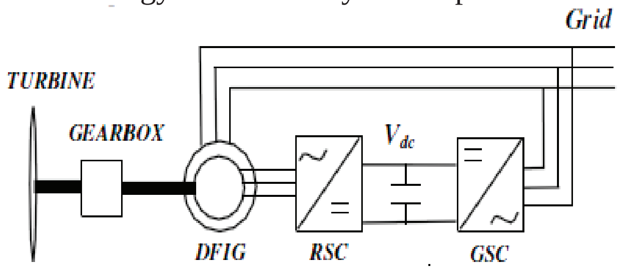

Fig1 Scheme of DFIG based wind system

In this paper, a fuzzy logic controller is proposed to control the speed of the DFIG in order to track the maximum power operating point for a wide range of wind speed. This controller is applied to control the rotor side converter (RSC) by using a stator flux oriented strategy and an optimal speed reference which is estimated from the wind speed.
The aim of controlling the GSC is to guarantee a smooth DC voltage and ensure sinusoidal currents in the grid side.But the GSC control is not study in this work.

2-Modelling of the turbine

The wind power or wind power is defined as follows:

$$P_w = \frac{1}{2}\rho S V_w^3 \qquad (1)$$

ρ Is the density of the air
S is the circular area swept.
V_w is wind speed
The aerodynamic power appearing at the turbine rotor is written:

$$P_{aer} = C_p P_w = C_p(\lambda).\frac{\rho S V_w^3}{2} \qquad (2)$$

The power coefficient *Cp* is the aerodynamic performance of wind turbine. It depends on the characteristic of the turbine. The variation of this coefficient as a function of tip speed ratio λ, TSR

The TSR is defined as the ratio between the linear speed of the blades and the wind speed**.**

$$\lambda = \frac{\Omega_{tur} R}{V_w} \qquad (3)$$

The expression of the power coefficient was obtained by interpolation of measured points for a 10KW wind turbine[6]

$$C_p = 7.9563.10^{-5}\lambda^5 - 17.375.10^{-4}\lambda^4 + 9.86.10^{-3}\lambda^3 - 9.4.10^{-3}\lambda^2 + 6.38.10^{-2}\lambda + 0.001 \qquad (4)$$