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Abbreviations

FSIG	Fixed-speed induction generator
DFIG	Doubly-fed induction generator
AC	Alternator current
DC	Direct current
PWM	Pulse width modulation
RSC	Rotor side converter
GSC	Grid side converter
MSC	Machine side converter
WECS	Wind energy conversion system
WTS	Wind turbines system
VC	Vector control
STATCOM	Static synchronous compensator

List of Symbols

R_r	Rotor resistance
X_r	Rotor reactance
E_{si}	Stator induced voltage
E_r	Rotor induced voltage
a_{eff}	Turn ratio
P_{sw}, P_{sQ}	Real and reactive power of stator
P_{rw}, P_{rQ}	Real and reactive power of rotor
V_s	Stator voltage
V_R	Rotor voltage
I_s	Stator current
I_R	Rotor current
Ψ_s	Stator flux
Ψ_R	Rotor flux
R_s	Stator resistance
ω_1	Synchronous frequency
ω_2	Slip frequency
L_M	Magnetizing inductance
$L\sigma$	Leakage inductance
np	Number of pole pairs
J	Inertia
T_s	Shaft torque
E_g	Grid voltage
i_f	Grid-filter current
V_f	Grid-filter voltage
W_{dc}	Energy stored in the dc-link capacitor
V_{dc}	DC-link voltage
T_e	Electromechanical torque
K_p	Proportional gain of PI-controllers
K_i	Integration gain of PI-controllers

Abstract

In recent years, wind energy has become one of the most important and promising sources of renewable energy. In order to meet power needs, taking into account economical and environmental factor, wind energy conversion is gradually gaining interests as a suitable source of renewable energy. This dissertation deals with the analysis, modeling, and control of the doubly-fed induction generator (DFIG) for wind turbines. The stator of the generator is directly connected to the grid while the rotor is fed at variable frequency through the AC-CD-AC converter and a mathematical model of the machine is written in appropriate d-q reference frame is established to investigate simulation. This dissertation also presents the simulation of wind turbine drives doubly-fed induction generator. Two voltage source converters are used to extract maximum power from variable wind speed. The grid-side converter controls the power flow between the DC bus and the AC side. The rotor-side converter control the output power generated. Matlab/Simulink software is used to simulate the system. The results of three wind speed are obtained and compared.

المستخلص

في السنوات الأخيرة أصبحت طاقة الرياح واحدة من أهم وأكثر مصادر الطاقة المتجددة الواعدة. بسبب الطلب لمقابلة الحاجة للطاقة يجب الأخذ في الاعتبار العوامل الاقتصادية والبيئية لذلك نجد أن طاقة الرياح إكتسبت بشكل تدريجي الإهتمام باعتبارها مصدر مناسب للطاقة المتجددة. هذه الأطروحة تتناول التحليل والنمذجة والتحكم في المولد الحثي مزدوج التغذية المستعمل في توربينات الرياح حيث نجد أن العضو الثابت للمولد يوصل مباشرة للشبكة والعضو الدوار يغذى من مصدر متغير السرعة. أيضا تم تناول النموذج الرياضي للماكينة. في هذه الأطروحة تم عمل محاكاة لتوربينة الرياح التي بها مولد حثي مزدوج التغذية كما تم إستخدام مصدرين للجهد للحصول على أقصى قدرة من الرياح. المحول في جانب الشبكة للتحكم في القدرة المناسبة بينما المحول في جانب العضو الدوار للتحكم في قدرة الخرج. أيضا تم إستخدام برنامج Matlab/Simulink لمحاكاة النظام وذلك بإستخدام ثلاث قيم لسرعة الرياح ومن ثم عرضت النتائج وتم التعليق عليها ومقارنتها مع بعضها.