Abstract

Nowadays, the most currently installed variable speed wind turbines are based on doubly fed induction generator (DFIG). In this thesis, a revision for the objectives and techniques used in the control of DFIG will be presented. A D-Q model for the simulation and the analysis of a double-fed induction generator is developed. A simulation for the stand alone DFIG with inverter controlled by 180° conduction will be considered. A comparison between the simulation and experimental results is performed to verify the output voltage and frequency. In order to improve the performance of the output waveform, the space vector pulse width modulation (SVPWM) technique is used for controlling the stand alone DFIG. A complete study and simulation for the self-excited DFIG using SVPWM will be presented. A grid-connected DFIG for wind-turbine system is also studied to control both active and reactive power under variable speed operation; this includes both sub-synchronous and super-synchronous speeds.

Table of contents

List of figures

List of tables

List of symbols

f_r: Rotor frequency,
f_s: Stator frequency,
P: Number of poles,
n_r: Rotor speed,
n_s : Synchronous rotating field speed (rpm);
S : Slip,
d: Direct axis,
q: Quadrature axis,
s: Stator variable,
r: Rotor variable,
F_{ij}: is the flux linkage (i =q or d and j=s or r),
v_{qs}, v_{ds}: q and d–axis stator voltages,
v_{qr}, v_{dr}: q and d–axis rotor voltages,
F_{mq}, F_{md}: q and d–axis magnetizing flux linkages,
R_r: Rotor resistance,
R_s: Stator resistance,
X_{ls}: Stator leakage reactance,
X_{lr}: Rotor leakage reactance,
i_{qs}, i_{ds}: q and d–axis stator currents,
i_{qr}, i_{dr}: q and d–axis rotor currents,
J: Moment of inertia,
T_e: Electrical output torque,
T_L: Load torque,
ω_e: Stator angular electrical frequency,
ω_b: Motor angular electrical base frequency, and
ω_r: Rotor angular electrical speed,
$T_z = \frac{T_s}{2}$;
T_s: Sample time;
M: Modulation index;
P_s: Stator active power –W,
Q_s: Stator reactive power –VAR,
V_s : Stator voltage –V,
I_s: Stator current –A,
$\emptyset$: Angle between stator voltage and current,
V_m: Magnetization branch voltage –V,
I_m : Magnetization branch current –V,
V_r : Rotor voltage –V,
I_r : Rotor current –A