ABSTRACT

The need for studies of control strategies for induction motor drives is justified with the proliferation of application of these drives in industries and production plants where materials have to be both processed and transported and where a high productivity is one of the key factors. This work is focused on developing effective control strategies and configurations for control scheme of industrial induction motor drives. The work is extended to harmonics and reactive power control of the industrial induction motor drive with a PWM converter. The proposed control strategy is analyzed and confirmed by the simulation studies of the mathematical models used.

The complete mathematical model of field orientation control (FOC) and direct torque control (DTC) of induction motor is described and simulated in MATLAB for studies of 200 hp cage type induction motor drives. The indirect vector controlled induction motor drives involve decoupling of the stator current in to torque and flux producing components. PI control is used for the estimation of the instantaneous magnitude of the rotor speed, current and torque. The direct torque control employs direct control of stator flux linkages and the electromagnetic torque by the selection of an optimum voltage vector.

The pulse width modulated (PWM) converter designed as controllable switching pulses generator offers a flexible solution to the problem of current harmonics and reactive power requirement of the designed industrial drives. The dissertation successfully demonstrates the field oriented control and direct torque control fed with a PWM converter topology. Both motor control strategies are compared to decide the performance of the motor.

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LIST OF SYMBOLS

Symbols	**Description**
d^s-q^s	Stationary reference frame direct and quadrature axis
d^e-q^e	Synchronously rotating reference frame direct and quadrature axis
i_{qs}	q^e-axis stator current
i_{qr}	q^e-axis rotor current
i_{dr}	d^e-axis rotor current
i_{ds}	d^e-axis stator current
i_{qs}	q^e-axis stator current
L_m	Magnetizing inductance
L_{ls}	Stator leakage inductance
L_{lr}	Rotor leakage inductance
v_{qs}	q^e -axis stator voltage
v_{ds}	d^e -axis stator voltage
v_{qr}	q^e-axis rotor voltage
v_{dr}	d^e-axis rotor voltage
R_s	Stator resistance
R_r	Rotor resistance
L_s	Stator inductance
L_r	Rotor inductance
ω_e	Stator or line frequency
ω_r	Rotor electrical speed
ω_{sl}	Slip frequency
s	Laplace operator
p	Number of pole
θ_e	Angle of synchronously rotating frame
θ_r	Rotor angle
θ_{sl}	Slip angle
v_{qs}^s	q^s-axis stator voltage
v_{ds}^s	d^s-axis stator voltage
i_{qs}^s	q^s-axis stator current
i_{ds}^s	d^s-axis stator current
K_s	Slip gain
Q	Reactive power
Q*	Reactive power reference
i_a*, i_b*, and i_c*	Stator current reference
i_{qs}*	Stator quadrature-axis reference current
i_{ds}*	Stator direct-axis reference current
$\mid \psi_r \mid^*$	Sotor flux reference input
T_e*	Torque reference
$\mid \psi_r \mid_{est}$	Estimated rotor flux linkage