Abstract

Direct Torque Control (DTC) is a control technique used in AC drive systems to obtain high performance torque control. The conventional DTC drive contains a pair of hysteresis comparators, a flux and torque estimator and a voltage vector selection table. The torque and flux are controlled simultaneously by applying suitable voltage vectors, and by limiting these quantities within their hysteresis bands, de-coupled control of torque and flux can be achieved. Conventional DTC drives utilizing hysteresis comparators suffer from high torque ripple and variable switching frequency.

Several techniques have been developed to improve the torque performance. In this thesis, Proportional-Integral (PI) controller has been presented to improve the system performance which gives better torque and flux response and also reduces the undesirable torque ripple. The most common solution to high torque ripple and variable switching frequency is to use the space vector pulse width modulation (SV-PWM) that depends on the reference torque and flux. The reference voltage vector is then realized by using a voltage vector modulator.

The conventional DTC and DTC with PI controller are implemented using Xilinx System Generator (XSG) for MATLAB/Simulink environment through Xilinx blocks. The design was achieved in VHDL, based on a MATLAB/Simulink simulation model.

The Hardware-in-the-Loop (HIL) method is used to verify the functionality of the Xilinx FPGA estimator. The results are obtained and compared with MATLAB/ Simulink results considering the implementation of the proposed model on the Xilinx NEXYS2 Spartan 3E1200 FG320 Kit. The simulations of the DTC-SV PWM were carried out using MATLAB/Simulink simulation package. The design, implementation and simulation of the overall drive system is performed using MATLAB/Simulink program version 7.13.0.564 (R2011ba) and Xilinx ISE Design Suite 14.2.