Abstract

Direct Torque Control (DTC) is one of the most effective and modern methods for speed control of three phase induction motor, but it suffers from the following drawbacks:

(a) It needs to an estimator for the electromagnetic torque and stator flux.

(b) The existence of inherent ripples in the output torque.

So it needs a rapid estimator for stator flux and torque, and an accurate hysteresis comparator to furnish the suitable triggering pulses for the inverter in order to reduce torque ripples of the induction motor.

In this thesis, a proposed DTC system supported by Radial Basis Function Neural Network (RBFNN) and Fuzzy Control (FC) technique is constructed in order to avoid the above drawbacks.

The (RBFNN) is used as an estimator for the electromagnetic torque and stator flux instead of the conventional one in order to achieve an accurate and rapid estimation. During design and construction of this network the independent outputs case is considered during training and simulation, also the spread constant of different values is considered for each torque, stator flux and flux position sector (S_k) to obtain accurate results.

Fuzzy Control (FC) technique is used instead of the hysteresis comparator for torque and flux errors in order to organize the switching state selector. This is done by using the membership function to have four linguistic variables for error of torque and error of flux. The inputs of controller are torque errors and flux errors as well as sectors and the outputs are pulses which supply the inverter to drive the motor in the most regular way. The construction of fuzzy controller is achieved by using a Matlab/m-file and S-function to work with the proposed DTC system.

The simulation of the proposed DTC system is done by using (Matlab/Simulink) program. The proposed DTC system shows a considerable reduction in torque ripples, and fast starting time. This improvement leads to the ability of increasing the sampling time four times

over the conventional used time to reduce the switching losses of the driver.

An educational program has been prepared depending on instructional design concepts and using simulation method, in the form of instructional modules, to present the fundamental principles identification, features, advantages and drawbacks of the control techniques, especially, direct torque control of induction motor by using RBFNN and FC techniques. This program helps in saving time and effort of the learner and overcome the individual differences among learners.