CHAPTER-6

CONCLUSION AND FUTURE WORK

6.1 Conclusion

This chapter clearly describes the concluded work of this research. The work presented in this thesis constitutes the following contributions to the research on DSP based control of direct torque control of induction motor drive.

Direct torque controller is supposed to be the one of the best controllers for driving any induction motor. Its main principles have been clearly explained. It is also demonstrated in this thesis that the method of DTC allows the independent and decoupled control of motor torque and stator flux linkage. Two different estimators for motor torque stator flux linkage have been fully developed. It is also very clear from the reported thesis that the DTC strategy is very simpler than the field oriented control method because of the absence of voltage modulators, current regulators and coordinate transformations. Although it introduces some of the disadvantages, which have been projected in this thesis. The major disadvantage stated in this thesis is the torque and flux ripple production at the variable switching frequency and low speed operation of the motor.
6.2 MODELING OF INDUCTION MOTOR

In chapter-2, the motor model has been deduced and explained. The model has been formulated by means of two-axis theory and space phasor representation. The space phasor representation is compact and easier to work with the model. The model has been developed for stator, rotor and synchronous reference frames. Torque expression for the motor has been deduced.

6.3 DIFFERENT STRATEGIES OF DTC

Different strategies of DTC are discussed in chapter-3. The following strategies of DTC for induction motor drive have been reported in this thesis.

(i) Classical DTC
(ii) Intelligent DTC
   a. Neural Network based Direct Torque Control
   b. Genetic Algorithm based Direct Torque Control
   c. Fuzzy Logic based Direct Torque Control
   d. Neuro Fuzzy based Direct Torque Control
(iii) Proposed strategy to minimize the torque and flux ripple to improve the performance of DTC

The above said DTC strategies are simulated and compared.
6.4 EXPERIMENTAL MOTOR DRIVE SYSTEM

Chapter-5 discusses the design and implementation of experimental induction motor drive system. The following key points are given in this section in order to validate the experimental motor drive system.

- A prototype squirrel cage induction motor drive has been designed and developed.
- IGBT based PWM inverter has been designed and developed
- Voltage and current sensors are used to collect the information of voltage and current from the Motor.
- Speed information is captured by speed encoder.
- TMS320LF2407 eZdsp kit is used to implement the control algorithms
- Lookup table, torque and flux hysteresis bands have been developed precisely for all of the DTC strategies.

6.5 REAL TIME IMPLEMENTATION

Chapter-5 also discusses the experimental results for classical, intelligent and deadbeat constant frequency DTC strategies. Experimental results, which match perfectly with the simulations, have been obtained showing the validity of the entire research. Therefore, the idea of reducing torque ripple, which is supposed to be one of the disadvantages of the classical DTC, by means of constant switching frequency and deadbeat strategy, has been experimentally proved. The experimental results show that the proposed torque and flux ripple minimization strategy is better than the classical DTC strategy and which has also been compared with the intelligent
DTC strategies. The reduction of torque ripple is shown by the experimental graphs. The percentage of reduced torque ripple by applying proposed constant frequency and deadbeat DTC strategy is less than 2.5%.

6.6 FUTURE WORK

All possible future works are summarized as follows:

- Development of adaptive intelligent controllers not only to induction motor but also to other electric motors such as permanent magnet and switched reluctance motors.
- Hardware implementation of constant switching frequency and dead beat direct torque control strategy using FPGA (Field Programmable Gate Array) processor for induction motor drive system.
- Development of optimal controllers, not only for ripple reductions, but also for reducing EMI and for increasing energy savings from the mains.
- Application of intelligent direct torque control strategies to other electric motors including special machines like permanent magnet synchronous motors and switched reluctance motors.
- Development of Multilevel inverters (More than three levels) fed induction motor drive system with proposed direct torque control strategy.

Hence the proposed approach and the results presented in this work will encourage further research in this field.