CHAPTER 6

CONCLUSION

In this thesis a new approach in Mathematical Modeling of a 3-phase induction motor drive fed by a Current Source Inverter (CSI) is developed and simulated using Matlab/Simulink software. Mathematical concepts are used in evolving the simulation and implementation to put forward the dynamic performance of different vector controlled CSI fed Induction Motor drives. In this work Synchronous Reference Frame is used to model the IM in V/F, IOL control technique, Rotor Flux Orientation (RFO) control is used in IFOC technique, Stator Flux Orientation (SFO) is used in DTC technique.

In this work a new vector based V/F control technique for a CSI-Fed Induction Motor drive is presented using Matlab/Simulink. The various drive sections are designed with the help of modest control programs in order to have high flexibility in control and to minimize the toughness in simulation procedures. This type of simulation procedure has the combined features of running the m-file openly by using different Simulink solvers. Also this type of programming is very much flexible in adopting for other drive structures. The simulation results of the dynamic characteristics shows the close tracking up of the reference command signals for respective dynamic changes made to the motor drive system.

In the implementation of IOL technique our approach to improve the dynamic characteristics of the drive system enhances the system performance even under transient changes. A reduced order rotor current observer is developed and implemented to improve the feedback controller. The simulation results and dynamic performance of the drive system are presented in waveform and tabular form. Also the experimental verification clearly shows that IOL is adaptive for speed response when subjected to changes in speed command. In this control method, the load torque as disturbance is detected directly and the effectiveness of the feed forward compensation in improving the dynamic response is demonstrated by the simulation results. The control method provides fast regulation and ensures the stability of the drive in the face of disturbance.

In IFOC technique a rotor flux based reference frame control method for PWM CSI fed IM with simplified simulation circuits have been developed in which the motor speed and torque follow the references closely. The Simulink models of various control sections are developed using Matlab/Simulink. The transient analysis is also made clear for the obtained simulation results for better understanding. Further the experimental study is made with the help of a laboratory prototype to meet out the real time application needs. From the simulation and experimental results we can clearly understood the close tracking up of dynamic parameters with its reference values. However its overshoot value for current has lower under 100% loading condition.

In DTC technique the stability of the drive is examined during change in speed and change in torque for a CSI-Fed Induction Motor. The modeling of the Induction Motor is done on the basis of the modular approach and simulated in Matlab/Simulink. The modeling also includes the design of estimators for calculating the torque, speed and flux values. The important contributions of this section are modular approach modeling of Induction Motor is modeled and simulated. The experimental results also presented for understanding the dynamic response of the drive by using laboratory prototype hardware. Also the dynamic response of the proposed Induction Motor Drive is observed under various loading conditions.

The results show that the IFOC drive obviously shows the best speed response, trailed by the IOL and DTC drives. The DTC drive also exhibits the best rapid torque response, trailed narrowly by the IFOC drive. The IOL and vector-based V/f drives are slightly substandard to the others. The IOL drive clearly exhibits the best speed response, trailed by the DTC and IFOC drives. The DTC drive also presents the best prompt torque response, followed by the IFOC and IOL. The vector-based V/f is slightly substandard to the others. Hence *DTC drive* is the best technique for varied ranges of *torque control applications*, where load is subjected to change with respect to changes in both speed and torque orientations. The *IOL drive* is the best performer for *speed control applications* with respect to *changes in speed orientation*, whereas the *IFOC drive* is the best performer for speed control applications with respect to *changes in torque orientation*. Thus, the DTC method is the most efficient technique for Industrial drives with Torque control applications to achieve the desired operation of the drive in handling a particular load. IOL is the most efficient method with respect to changes in speed reference for speed control applications, whereas IFOC is the most efficient method with respect to changes in torque reference.

FUTURE WORK

In this work the Dynamic Performances of a CSI-Fed IM drive is detailed with its performance characteristics and their change in responses under transient conditions. This work is highly concentrated on modeling and performance of different Vector control techniques for Induction Motor only. This can be further extended to other AC drives used in Industrial Applications. Further a new Integrated Control Algorithm is also proposed as a future expandability concept for the concluded results with the help of automation techniques and data acquisition controls. This concept enables the use of single Induction Motor for several Industrial applications without making any changes in the control circuit required for different applications i.e., a single Induction motor can be adopted for both speed control and torque control applications. Moreover the harmonic analysis on the output Current of the Inverter can be further analyzed on the basis of different PWM techniques to find an optimum PWM control strategy for appropriate control techniques for better results and increased efficiency.