CHAPTER 7

CONCLUSION

7.1 CONCLUSION

Mathematical Modeling and analysis of Matrix converter, three popular modulation algorithms, namely Venturini control algorithm, Space Vector Modulation algorithm, Carrier based Modulation algorithms and d-q model of induction motor are carried out using Matlab/Simulink software. The mathematical model based simulation reduced the simulation time as compared to the Simulink block based simulation. Implementation of Space Vector Modulation technique involves sector identification and intricate calculations. The implementation of Venturini method and Carrier based modulation techniques does not require sector identification and intricate calculations. But Venturini method involves injection of harmonics to improve the voltage transfer ratio.

Analysis with different output frequencies of operation was carried out. In terms of output voltage transfer ratio, both Space Vector modulation and Venturini modulation algorithms give the maximum and it is less with carrier based modulation algorithm. The simulation results are analyzed for harmonics present in the output voltage. Lower order odd harmonic contents of the output voltage for different frequencies of operation are within the limit, in terms of their fundamental component of output voltage in Venturini and Space Vector Modulation techniques. Though the harmonics are within the limit in Venturini modulation algorithm and Space Vector Modulation
algorithm, waveform distortion is very less only with Space Vector Modulation algorithm.

The open loop dynamic performance of induction motor using three modulation algorithms is compared. From the results it is implied that the settling time and torque ripple are less with Space Vector Modulation algorithm.

Vector control technique with PI controller is implemented to matrix converter fed induction motor drive. The transient response of the open loop and vector controlled induction motor drive employing matrix converter is compared. From the simulation results it is clear that the torque ripple is reduced and dynamic response is faster in vector control technique. The transient time taken by the drive to change from one quadrant of operation to another quadrant of operation is reduced with vector control technique. The drive operation in all the four quadrants is verified. The Induction Generator operation in second quadrant is also realized by increasing the speed of Induction Motor above synchronous speed in this work and hence the drive is suitable for wind energy conversion system also.

The main advantage of IMC based controller is that the gain and integration time parameters are expressed directly in machine parameters and the desired closed-loop bandwidth. This simplified the controller design procedure and the need for time consuming trial-and-error steps using root locus analysis, Bode plots, and so on as in PI controller is avoided. IMC based controller is proposed in this research work for torque ripple minimization and load disturbance rejection in induction motor. Internal Model based current and speed controller parameter estimation was designed for vector controlled induction motor drive fed with Matrix converter.
The four quadrant operation of the drive with proposed controller is compared with PI controller. The torque ripple is minimized with IMC based controller. The settling time is reduced in all the step changes in speed achieved with the proposed controller as compared to PI controller. A step change in load is applied to the drive and the performance is noticed. A fast set point tracking and load disturbance rejection without any overshoot in speed is achieved with the proposed controller as compared to PI controller. Hence, the perfect set point tracking, load disturbance rejection and torque ripple minimization of the drive are achieved with proposed control method.

A Compensation Strategy of Matrix Converter fed Induction Motor Drive under Input Voltage disturbances in terms of unbalance in voltage, lower order harmonics, voltage sag and load disturbances using Internal Model Control is designed and implemented. Matrix converter output voltage and current under distorted input voltage condition using IMC based controller is compared with PI controller. The results show that the output voltage and current are distorted with PI controller but with the proposed control method the output voltage is not disturbed and the output current is sinusoidal. Presence of small ripples in terms of positive and negative excursion during negative and positive half cycles of output voltage respectively are observed with Venturini control algorithm. But, output voltage of the matrix converter using space vector modulation algorithm is better as compared to Venturini algorithm in terms of ripples in output voltage.

Also, output voltage and current of matrix converter is sinusoidal with IMC based controller as compared to distorted voltage and current in PI controller under voltage disturbances. Smooth transition of speed is achieved with IMC based controller under voltage disturbances as compared to PI controller. Hence, the input voltage disturbance is effectively rejected by the
proposed IMC based controller and hence improved steady state and dynamic behavior of the matrix converter fed induction motor drive is realized.

7.2 FUTURE SCOPE

Many commutation techniques applied to bidirectional switches of matrix converter were proposed by the researchers in literature. Hence, experimental realization and analysis of suitable commutation technique to reliable operation of matrix converter with IMC based controller in real time application has a good future scope for researchers.

Since artificial intelligence based controllers are popular in variable speed drive applications, the controller performance may be compared with Neuro-Fuzzy controller in real time applications by future researchers.

By using matrix converter, the voltage, frequency and power factor of induction generator can be varied to make wind turbine operate at maximum power point condition. Hence, real time implementation of matrix converter fed induction generator with proposed controller for wind energy conversion system is the future research direction.