CHAPTER 8

CONCLUSIONS AND SUGGESTIONS FOR FUTURE WORK

8.1 Conclusions

In this thesis reduced switch count converters for single phase to three-phase conversion were analyzed and simulated using a 1 hp induction machine. The work undertakes an analysis of the operation of the converters. Moreover control strategies for the converters have been designed and simulated using Matlab/Simulink. The operations of these converters were simulated for speeds above and below the supply frequency of the single-phase supply. The control schemes were simulated for both no-load and on load conditions for the motor.

The simulation results were shown, at the place where the discussion about the converter was carried out. Some general conclusions about the simulation results can be made as; the waveforms for the motor phase currents (i_a, i_b, i_c) are distorted due to the presence of the zero-phase sequence component constituted by the power supply current (i_s). However, the positive phase sequence current ($i_{aa} = i_a - i_s / 3$) obtained by subtracting one-third of the power supply current from the motor current is almost sinusoidal.

The residual distortion is caused by the dead time in the inverter modulation. In conventional circuit, the disturbance voltage due to the dead time is synchronous with the motor currents. In the sparse converters the motor current has an additional 60 Hz frequency component constituted by the supply current and the resulting disturbance due to dead time is no longer synchronous with motor voltage, leading to a larger distortion. The phase displacement of each of the motor currents with respect to the power supply current is constant. This explains why the resulting motor phase currents are very different from each other and look like unbalanced. However positive-sequence current of the motor, which is obtained, from the actual phase current is balanced. When one of the motor current phases almost corresponds to the power supply phase, the relative motor phase current increases, while other motor phase currents decrease. However this is not likely to represent a problem of non-uniform heating of the motor because the power supply frequency never exactly equals the inverter output frequency, and therefore each phase is overloaded for the same period of time [8].

The simulation results of the drive operation above the single-phase supply frequency was presented and can it can be observed that the dc voltage required in this case is higher when compared to the one when the drive was operating at a lower frequency or at lower speed. This suggests that the sparse converter drives to be used for high power application need a PWM scheme which can reduce this increased dc voltage.

In the end it can be concluded that the thesis presented converter topologies with reduced switch count, which use the neutral point of the three-phase load for control of dc voltage and regulating the supply current to be in phase with supply voltage. The features of these circuits are to drain the power supply current to the motor as a zero-sequence current. These circuits have relative advantages of using less reactive components and reducing the number of switching devices when compared to their conventional counterparts.

8.2 Suggestions For Future Work

The sparse converter topologies presented in this thesis aim at achieving the same performance as that of the conventional converters while employing less number of switching devices. The sparse converter fed induction motor drive was simulated for the motor operating in both the forward motoring and the reverse braking region with appropriate control structure. The converter has been simulated for two-quadrant operation but the control strategy for the four-quadrant operation of the drive can be studied in detail.

Steady state analysis of the drive will give estimates of the dc voltage and the capacitance value of the capacitor, which was not done in this thesis. The comparison between the conventional and the sparse converters was focused on the number of switching devices being used. Further comparison should be based on the efficiency at which the sparse converter fed drives can operate, which involves the calculation of the switching and the conduction losses. A drive though cheap in cost cannot last long if the efficiency is less, and so it being cheap does not make it a strong candidate for long run.

In the event of occurrence of fault on any one leg, the zero-sequence current increases, since it is the one which charges the capacitor the dc voltage across the capacitor increases rapidly, thereby further increasing the zero-sequence current.

Moreover as the inverter and the converter are dependent on each other, the failure of any component can disturb the performance of the entire system. Thus the different types of possible faults, which can occur, should be studied and the system behavior should be observed

The PWM strategies explained for the single-phase inverter can be extended for three-phase and at the same time be applied to the sparse converter fed induction motor drives. The stability analysis of the system under different operating conditions should be analyzed.

Finally, computer simulations of some sparse converter fed motor drives have been completed for operations above and below the supply frequency. An experimental verification for these drive systems should be undertaken to verify the simulation results.