CHAPTER 7

CONCLUSIONS

The multilevel inverter topology can overcome some of the limitations of the standard two-level inverter. Output voltage and power increase with number of levels. Harmonics decrease as the number of levels increase discussed in Chapter 5 and 6. In addition, increasing output voltage does not require an increase in voltage rating of individual force commutated devices. In the thesis, several multilevel voltage source inverters and their modulation topologies are introduced. The cascaded-inverter with separated dc sources is discussed in detail with experimental results to verify the proposed concepts.

A new concept of the optimized harmonic stepped-waveform (OHSW), one of the multilevel modulation techniques, is presented. The basic idea is to combine the SHE PWM with quarter-wave symmetric stepped waveform. The switching angles can be easily solved by using a computer program, which is MATLAB in this thesis. The Newton-Raphson method is used as the algorithm for computer programming and shows very effective performance.

At the same output rating, the harmonic contents in the OHSW multilevel wave is compared with the SHE PWM inverter waveform. The results show that the line voltage THD of both waveforms are inversely proportional to the modulation, when the modulation index is less than 0.80. The results also show that the line voltage THD of the OHSW can be reduced by increasing the number of the switching angles. To increase the

number of the switching angles, the number of the H-bridge inverter per phase required to add up. From the simulation results, the line voltage THD of the 13-level waveform with M = 0.80 can meets the 5% IEEE standard without any filter circuits. On the other hand, the line voltage THD of SHE PWM waveform does not decrease, when the number of the switching angles increases. To meet the IEEE standard, some filter circuit require in the inverter circuit. However, size of the filter circuit might be decreased with increasing the number of the switching angles because the lowest surplus harmonic component is shifted to higher frequency. In OHSW, not only does the line voltage THD decrease, but also the lowest exist harmonics is shifted to higher frequency. This, size of a filter circuit applied in OHSW inverter can be decreased dramatically.

The experimental line voltage THD is higher than the simulated THD. From the frequency spectrum, obviously, the output waveforms consist of unexpected even harmonics. As introduced in 4.2.2, even harmonic components are generated by an asymmetric waveform. Mainly, the microcontroller, which generates the switching signal, causes such a problem. Because of low clock speed, the approximated switching angles have to be employed instead of the accurate ones. Therefore, the experimental output waveform is less precise than the simulation output waveform. In future work, a digital signal processing is preferred.