CHAPTER 6
CONCLUSION AND FUTURE WORK

6.1 Conclusion

Voltage sag may cause problems to both low-power rating and high-power rating equipments that are based on power electronics devices. Low-power equipments involve programmable logic controllers (PLCs), IT equipment and process control equipment. Examples of high-power equipment are adjustable speed drives; both AC and DC drives. Not only power electronic based equipments is sensitive to voltage sag; also electromechanical relay and motor contractors are reported to open their contacts when voltage drops below 0.5 to 0.7 pu.

They are several solutions providing ride-through to solve the voltage sag problem. They are presented in two main groups, the first ones using energy storage device and the seconds ones that do not require energy storage devices. The first groups consist of Battery Back-up Systems, Advanced Batteries, Large Capacitor, Supercapacitors, Uninterruptible Power Supply(UPS), Rotary based Uninterruptible Power Supplies, Superconducting magnetic energy storage systems(SMES), Fuel cells, Dynamic Voltage Restorer(DVR). The seconds groups consist of Power line conditioners, Static Transfer Switch(STS), Transformer with tap changer and AC-AC converters. Most solutions are high in cost and complexity.

This thesis presents a 3-phase 4-leg 4-wire voltage sag compensator based on three dimensional space vector modulation in *abc* coordinates which can handle the neutral current under voltage sag and nonlinear load conditions. The topology of this hardware consists of a voltage sag detector, a DC/DC converter, a solid state transfer switch, and a   4-leg inverter. The space vector modulation algorithm in *abc* coordinates is much simpler and more intuitive than in $\alpha\beta\gamma$ representation, reducing the complexity of modulation algorithm and the computational load associated to it. The main advantage of 4-leg inverter topology and the algorithm lie in and extended range for the zero sequence voltages and currents. A 3kVA prototype has been implemented on a dsPIC microcontroller to verify its capabilities.

The operation of voltage sag compensator are verified through voltage sag 1-phase and 3-phase under unbalance and nonlinear load. The experimental results have shown that the presented voltage sag compensator is able to supply constant voltages to the loads under unbalanced and nonlinear load conditions and voltage sags. In addition, it is able to regulate the DC-Link voltage during the occurrence of voltage sags. Therefore, this voltage sag compensator is able to mitigate power quality problem when supplying to critical loads.

6.2 Future work

In the above work, due to hardware implementation using electronic component and power electronic can be used to construction 3-phase 4-wire 4-leg voltage sag compensator. The hardware is complex and large space are required. The future work will study how to implement the software phase locked loop(SPLL) and the *abc* algorithm on a field programmable gate array(FPGA). The implementation of the algorithm on a FPGA could improve the calculation speed and also lighten the workload of the CPU.