Chapter 9
Concluding Remarks and Future Plans

A nonlinear control method UCI control is presented by researchers. UCI control has many merits such as: eliminating the steady-state error and dynamic error between the control reference and the average value of the switched variable in each cycle; no need to generate controlling reference; the circuit of control is simple and so on. On the base of mathematical model, simulation is done. The results reveal that the three-leg APF with UCI control in three-phase four-wire system can dynamically suppress harmonics, compensate reactive power and reduce zero line current. In addition, UCI control can suppress the voltage fluctuation on dc bus and make the APF operate normally.

The combined system of a shunt passive filter and a small rated series active filter was also considered The compensation principle applied to this system was quite different from conventional shunt and series active power filters, leads to better filtering characteristics and lower initial and running costs. The required rating of the series active filter is mainly determined by the quality factor of the shunt passive filter It is believed that the combined system is the most suitable to harmonic compensation for large rated thyristor converters and cycloconverters.

A four-stage inverter, using three-state "H" converters has been analyzed and simulated for use as a Voltage-Dip-proof active filter and VAR compensator by the researchers.. The advantages of this kind of converter have been displayed and compared with conventional PWM converter performance and has simple control scheme.

9.1 Goals Reached

1. The project work presents the design, simulation, analysis and implementation of Three Phase Four Wire Shunt Active Power Filter. The DSP based control unit reduces the system hardware and makes it more flexible in comparison with conventional digital control

2. The work presents the use of p-q theory for design, simulation, analysis and implementation of the control circuit of Active Power. This gives a cost effective solution, allowing the uses of a large number of low-power active power filters in the same fashion, close to each problematic load (or group of loads), avoiding the circulation of current harmonics, reactive currents and neutral currents through power lines.

3. Analog controller using various high speed analog IC's was developed for the purpose of benchmarking for digital controller. For digital approach, the possible realization is made by using either 16 bit or more processor or using DSP.

4. It is very difficult to generate corresponding compensation currents for the particular harmonic current. Realization is made by using DSP processor. This approach is very

useful for harmonic elimination in distribution system as now-a -days most of the home appliance are equipped with modern sophisticated power electronic control which affect the performance of the nearby equipment connected in the same bus.

5. It is also shown that the voltage and current harmonics as well as the non symmetric component of the load current can be cancelled the control was based on specialized DSP developed by TI 320C671X series providing an inexpensive solution.

6. Since new breads of DSP processors are available in the market with more features suitable for power electronics applications, this tends to reduce hardware and has more software support, the cost analysis is yet to be done

9.2 INNOVATIONS

1. The power module and digital controller interface for APF is developed as separate units with provisions for change of configuration or up gradation Power module as well as hardware interface to make it suitable for load up to 1 MW.

2. The Software is developed using combination of MATLAB/SIMULINK and Code composer studio which eliminates wring a code for the software. The technique can be used by the user who is not proficient in programming.

3. It is also possible to realize other power electronics systems for applications such as DC and AC drives.

9.3 Future Plans for Extension

We are able to obtain THD of 7% as shown in appendix B. Trying recent tools it may be possible to modify the system to reduce THD.

1. As already stated it is possible to modify the power and control circuit so that APF can be used up to load of 1MW.

2. The circuit is developed for three phase four wire shunt active filter. With some small modification it can be developed for the series active filter. In the project p-q theory is used for implementation purpose the but the d-q theory, FFT or Notch Filtering can also be used as control strategy.

3. Software can be generated in assembly language to optimize code size.

4. Circuit of APF with small modification can be used as a STATCOM, Static Reactive Power Compensator, for reactive power compensation. For high voltage application hybrid active power filter is used for harmonic elimination, which may be taken as future project.

5. The power module can be modified to realize other Active power filter configurations such as series APF or three phase, four line-three leg .Software technique developed in the project

can be directly used to generate controller software for any configuration.

6. We have procured DSP tools for designing using new DSP 28XX series, the effect of development in terms of cost and performance is to be carried out.

7. Simulation project on implementation of DC, AC drives using soft computing techniques such as: Fuzzy Logic, Neural Network, Genetic Algorithms etc, already done by my PG students.(list enclosed). The power module designed and developed (at the cost of about 2 Laks) during the project will be used to realize real time embedded systems.

8. We are planning to explore possibility to design and implement a generalized real time embedded controller for any Power electronics modules such as converter, Inverter, Choppers etc. using the software and hardware tools procured during the project.

9. The power module configurations are standard ones, the software development technique is developed by us. We are again in a process of developing Smart/ Intelligent controller using Fuzzy logic, ANN and GA. With the refined techniques the technology transfer as well as commercialization is possible.

10. The compensating technique uses a three-dimensional space vector modulation in the coordinate system. A four-legged inverter can be developed to handle the neutral current due to unbalanced load in a three-phase four wire system. Three-dimension space vector modulation schemes proposed for the four-legged power inverter are investigated. It may be shown that the neutral current can be controlled to achieve load voltage balancing.

9.4 Industry, Involvement and Interaction

1. The responses of the APF developed using analog controller cards components are used as a bench mark for our DSP based project.

2. The wiring for the power module, Signal Conditioning circuits and assembly work was done with he help of technicians and wireman at the Moonlight Electrical, Makarpura, Vadodara, leading manufacturers of control panels for all types of industrial applications

3. The software and Hardware development tools for DSP were supplied by Edutech Systems, Dandia Bazar, Vadodara. The hardware engineers of the company helped in PCB development for the expansion interfaces for EVM modules.

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