CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

In this research work artificial intelligence technique with less number of features are proposed for power quality disturbance detection and classification. The over view of PQ has been discussed with issues related to power quality detection and classification. Causes and impacts of various PQ disturbances have been described along with utility, manufacturer and consumer's perspective. Traditional and present method of monitoring is discussed to assess the patterns of electrical features for to identify and classify the disturbance, to take necessary preventive action in order to avoid the complexity in the power system. IEC61000 series of standards and IEEE standards are discussed to check the ranges of various power quality disturbances discussed.

To extract various information from the collected raw data, wavelet transforms has been proposed and the importance of wavelet in the detection and classification of power quality disturbance in a power system are discussed. With the help of MATLAB coding 20 different types of signals are generated for study purpose. Then various steps involved extracting features from the disturbed signals by representing the signals in wavelet transforms are carried out. Then MRA based, decomposition and reconstruction are carried which is very much important to have approximation and detail coefficient. Wavelet toolbox is used for feature extraction, by selecting more appropriate wavelet and decomposition scale. Among them, Db4 and wavelet at scale 5 has the highest energy which is

used as optimal decomposition scale for MRA. From this various features, almost 10 features are extracted .Intelligent methods have been developed and applied in which application of wavelet transform combined with RBFNN are used. A numerical simulation is conducted to exhibit the properties of WT-based MRA. The features extracted by wavelet are used as inputs to RBFNN for detection and classification. The performance of RBFNN is compared with FFML, LVQ, GRNN and PNN. The comparison is carried out based on the features and number of features used with respect to time which is very much needed for online application. To improve the results further and to give results less than a cycle, FL has been proposed. The feature extracted by wavelet is used, as to create membership function in fuzzy Logic. It is evident from the results, the classification accuracy of wavelet based fuzzy logic has been improved further as compared to wavelet based RBFNN. Again, for further improvement of detection and classification accuracy, Particle Swarm Optimization (PSO) is proposed along with wavelet based fuzzy logic.

The PSO is used to determine the ranges of the features in membership function to identify each disturbance specifically. Here to check the proposed FL potential, less number of events indicies, were taken from others work and used as inputs. The results were compared, from the results it is inferred that the fuzzy technique has the potential to deal with any type of data.In same way the comparisions were done based on the number of features, in this first the analysis were done with three features, next with five features and then with all the ten proposed features are taken.The results were compared and inferred that the network with less number of features gives the higer classification rate. The performance of the proposed technique were also compared with other works done with some other features.The overall performance comparision are shown in Table 5.1. The performance of FL-PSO stands an evident, that it can be implemented in any online application and may help to take appropriate measures while facing the power quality problems.

Table 5.1 Over all performance comparison

Power Quality Events	Comparisons of classification rate in %													
	References						**Simulated results**					**Proposed**		
	[49]	[66]	[55]	[39]	[3]	[4]	FFML	GRNN	LVQ	PNN	RBF	FL	FL - PSO	FL -PSO (Noise)
Normal	100	--	100	90	--	--	91	97	93	100	95	98	100	95
Sag	100	100	95	90	100	98	95	89	93	94	93	95	97	93
Swell	100	97	91	70	100	100	89	86	90	90	96	97	99	94
Interruption	--	--	99	--	100	100	87	97	89	97	93	96	98	92
Transient	98	--	100	--	--	96	89	89	84	90	94	97	98	94
Outage	--	--	--	--	--	--	--	--	--	--	96	95	99	93
Harmonics	--	--	98	80	97	100	93	89	87	92	94	97	98	95

5.2 FUTURE SCOPE

In this research work, identification and classification of power quality disturbances are done using RBFNN, FL and FL-PSO.

- In future, this same work can be done with some other expert system such as SVM , modular based ANNs etc. to achieve further better results.
- Enhanced detection of power quality events using intra and interscale dependencies of various coefficients for various techniques can be done.
- This research work can be extended by exploring other signal processing techniques with the aim of maintaining quality supply power, energy efficiency and cost management in electrical power distribution system and some of the key areas which can be further investigated.
- In the case of hybrid identification system, some other combination of AI expert system may be used such as Neurofuzzy, PSO-ANFIS etc. for further improvement.
- The number of feature can be reduced to avoid complexity and for speedy convergence and can try with other feature extraction techniques.
- This framework used the simulated data for PQ data analysis. This research can be extended by considering the on-line data analysis.
- PQ disturbances detection can be done specifically for industries to assess the rate of down time cost estimation.
- This data analysis can be very helpful for corrective actions as this data will capture the PQ disturbances as they will occur. The analysis results will be available on plant for quick decision making.
- Based on extracted features, for detection of islanding and power quality disturbances in hybrid distributed generation system is

presented. The hybrid system may consist of DG resources like photovoltaic, fuel cell and wind energy systems connected to grid.

- This research work can be furthur extended to design and fabricate hardwares by using these proposed expert system concepts and logics.
- The proposed method can be implemented and tested in application like smart grid etc.