DISCRIMINATION OF POWER QUALITY DISTURBANCES USING WAVELET TRANSFORM

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Abstract: Power quality define as current & voltage quality where voltage quality is concerned with change in voltage from actual voltage from ideal value of voltage& current quality is defined as change in current from actual value of current from ideal value. In power system poor power quality causes many problem such as failure of equipment mal operation of devices etc. It causes mainly by deviation of voltage and current such as fault, harmonics, voltage sag, voltage swell, interruption, outage, transient, flicker etc. For continuity of power supply without any disturbances it is important to detect these power quality disturbances. In this paper wavelet transform is used for discrimination of power quality disturbances. In wavelet transform the multi resolution technique are used for discrimination purpose.

Keywords: Power quality, harmonics, discrimination, wavelet, multi resolution analysis.

1. INTRODUCTION

For better quality of electric consumer at level of usage, power quality is important for that. In modern power system the sensitive equipments and non linear loads such as computers , communication equipment, electronic devices are inter connected in network, these are used for growth of productivity in domestic & industrial sector. Any of these having any problem, all the systems are affected. The power quality mainly concerned with the voltage & current. Power quality depends upon to electromagnetic phenomenon that defines the magnitude of voltage & current at given time[1,2]. The detection of power quality is mainly due to the change in sinusoidal wave shape of voltage & current. According to IEEE the power quality disturbances are voltage sag, voltage swell, interruption, transient, faults, flicker, outage etc. are the terms. In my previous paper the detection of power quality disturbance have explain the all the term of power quality terms by using of MATLAB/Simulink [1,8].

Detection of power quality disturbance are done by using wavelet transform. Wavelet transform is a advanced signal processing technique used for signal pattern such as sag, swell, transient and interruption. Power quality disturbances commonly caused by frequency deviation, voltage variation, switching phenomenon, loss of synchronism of machine etc. The large amount of use of electronic devices are cause the poor power quality. Poor power quality can cause damage of line & electrical equipment, surges, faults, mal operation of devices etc.

The study of power quality is depends to detection of power quality disturbances & discriminate from each other. Many methods are used for these purposes like S transform, state vector machine, wavelet transform, fuzzy logic, neural network, neuro fuzzy [2,3]. In this paper multi resolution analysis of wavelet transform is used for discrimination of power quality disturbances.

A simple method for detection of power quality is observing by the rms value of voltage & current. The rms value of the voltage & current signal gives good approximation for detection purpose. Using wavelet transform for detection it's more important become of its simplicity, speed of calculation and less requirement of memory. The wavelet transform is probably the most recent solution for overcome the short coming of the Fourier transform. In wavelet analysis the use of window size is solve the discriminate of power quality disturbances.

2. WAVELET ANALYSIS

Wavelet transform is a methodology to deal with the signal which cannot be processed in fourier transform & S transform. The signals of wavelet transform having an zero average value, while the other transforms have a positive & negative values. In wavelet analysis the use of a totally scalable modulate window are use for the inspection of signal. For generate of single basic wavelet translation and scaling are used. In wavelet analysis we get the synthesized signal, approximation & detailed signal.

The approximation level defines the high scale low frequency component of the signal and the detail coefficient defines as the low scale, high frequency component of the signal.

The strength of wavelet analysis is its ability to representing the signals in compact form in many level of resolution.

Wavelets are irregular in nature, they are also non symmetrical and are mainly used for the analysis of frequency signals.

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Wavelet transform is a recent signal processing tool which is used for detection & discrimination of power quality disturbances [4].

Wavelet transform consists of pair of transformation from one domain to another domain. The original domain is the time domain in wavelet transform while the transformed domain is called the time scale domain because a given signal is decomposed in different level of resolution.

A wavelet transform expands a signal not in terms of a trigonometric polynomial like in Fourier transform but by wavelet generated by using the translation & dilation of a fixed wavelet function called the mother wavelet. The extensive use of the wavelet transform in various fields is due to its variety of operation.

Discrete wavelet transform gives faster analysis in comparison with continuous wavelet transform. Discrete wavelet transform is based on the sub band coding. Wavelet transform are used to obtain the distinctive feature of faulty signal. Discrete wavelet transform are used for feature extraction of signals. The wavelet transform f(t)is defined by:

$$f(t) = \sum\sum C_{ab}\, \psi_{ab}(t) \qquad (1)$$

Where,

$$C_{ab} = \int f(t)\, \psi_{ab}(t)\, dt \qquad (2)$$

$$\Psi_{ab} = 2^{a/2}\, \psi(2^{a}t - b) \qquad (3)$$

Where, Ψ is the mother wavelet [5-7].

3. SIMULATION STUDY

In this paper MATLAB is used for discrimination of power quality disturbances. MATLAB is a tool for numerical computation & visualization. The basic data element is a matrix. It allows the matrix manipulation, plotting of function & data, implementation of algorithm, creation of user interface etc. MATLAB is widely used for signal processing, control system, test & measurement, image processing, denoising etc [8].

Simulink is a data flow graphical programming language tool for modeling, simulating & analyzing multi domain dynamic system. It is basically graphical block diagram tool. Simulink is capable of systematic, verification and validation of model through modeling. In previous paper the model of power quality disturbances are already explain, those signals are used for discrimination purpose [10].

4. MULTI RESOLUTION ANALYSIS

In multi resolution analysis, the analyze the signal at different frequencies with different resolution; it is the good time resolution at high frequency and good frequency resolution and also poor time resolution at low frequencies. Wavelet analysis can be done by passing an input signal through a filter bank with variable frequency & different bandwidth. The approximation coefficient & detailed coefficient of such filters are calculated by the selected mother wavelet. Filter bank is composed of multi level stages, each stage is composed of low pass & high pass filter with output of approximation coefficient & detailed coefficient respectively.

This all structure of filter can create a multi resolution analysis. Fig 1 shows the four level of multi resolution analysis [4,5,6].

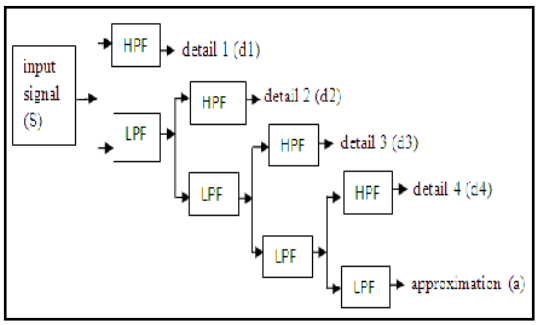

Fig.1 Four level multi resolution analysis signal decomposition using wavelet transform

Daubechies wavelet are used for multi resolution analysis to monitor multi resolution analysis to monitor power quality disturbances among all the families of wavelet like haar , mother etc. The multi resolution analysis of voltage sag, transient and capacitor switching are shown in fig 2 to fig 6. These disturbances always found to have a pattern in first level, but for more accuracy we increase the detail coefficient level from 1 to level 5[7,9].

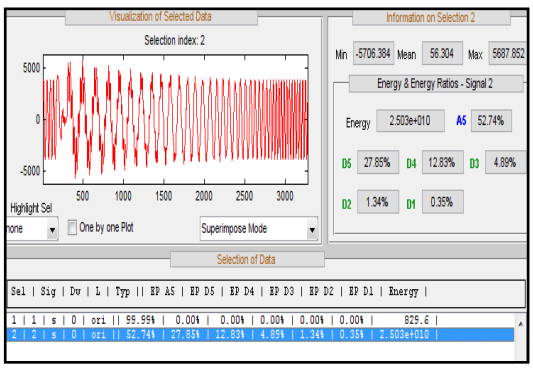

Fig.2 Spectral energy of voltage sag

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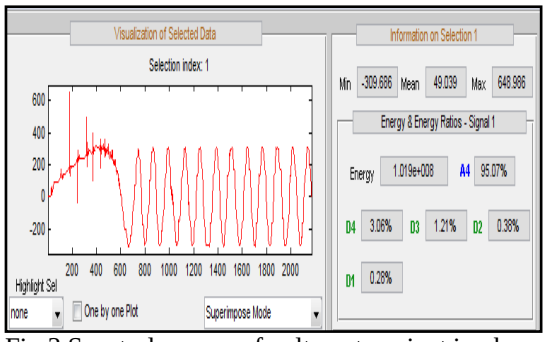

Fig.3 Spectral energy of voltage transient in phase A

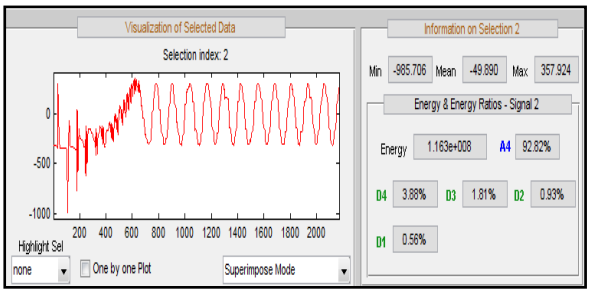

Fig.4 Spectral energy of voltage transient in phase B

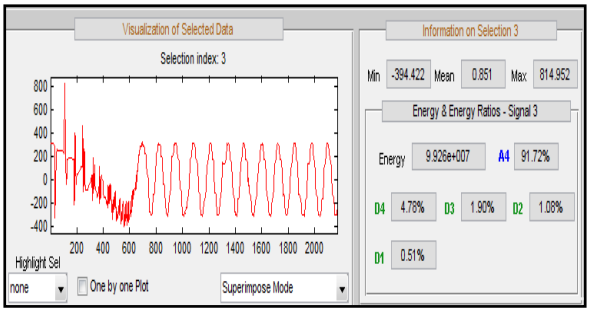

Fig.5 Spectral energy of voltage transient in phase C

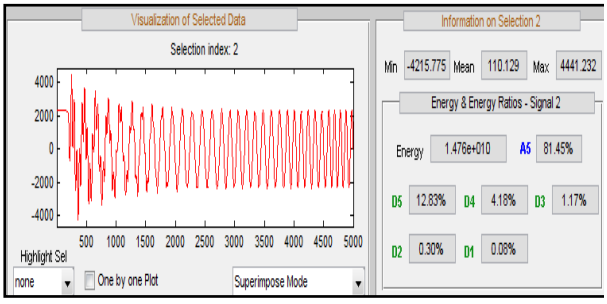

Fig.6 Spectral energy of switching voltage

Fig. 2 to fig.6 shows the spectral energy of different power quality signals. The different energies of power quality signals are used for discrimination of power quality disturbances as voltage sag, voltage transient and capacitor switching voltage.

5. RESULT & DISCUSSION

The table I shows the different spectral energy level of different power quality disturbances. The different power quality energy levels are used for the discrimination of power quality disturbances such as voltage sag, transient and capacitor switching voltage.

TABLE I Spectral energy of different power quality disturbances

S.NO.	Power quality disturbances	Energy level	Approximation (An)	Detail coefficient (dn)
1.	Voltage Sag	2.503e +010	52.74	27.85
2.	Voltage transient	1.019e +008	95.07	3.06
3.	Capacitor switching	1.476e +010	81.45	81.45

6. CONCLUSION

Electric power quality, affected by the variation of voltage and current it causes the disturbances. Due to increase use of various non linear load & electric equipment in power system, this will increase the power quality disturbances. By the use of MATLAB it is easily showing that in different power quality disturbances in different model. In this paper mainly sag, transient, & capacitor switching voltage phenomenon are shown. For discrimination of power quality disturbances wavelet analysis is used. There is no unique method which can assess the power quality disturbances & to identify and classify them properly. But the wavelet analysis is advanced process for signal analysis and for discrimination of power quality disturbances.

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