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Discrete Wavelet Analysis based Five Level Decomposition of Power Quality Disturbances

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ABSTRACT

Supply voltage across various loads must be constant.And any deviations are termed as power quality disturbances. Wavelet transform is used for analyzing power quality disturbances. The disturbances considered for analysis are voltage sag, swell, interruption, transient, harmonics, and voltage fluctuations. The aim of this paper is to present discrete wavelet analysis based five level decomposition of power quality disturbances using wavelet transform. This is termed as multiresolution analysis and the signals are decomposed into approximation and detail components It is observed that approximations give low frequency information and details give high frequency information about the signals. Five level decomposition of power quality disturbances is processed by using Daubechies 4 (db4) as mother wavelet. in MATLAB environment.

Key Words: Approximations; decomposition; details; discrete wavelet transform; power quality disturbances.

Introduction

Power quality is defined as a set of boundaries that allows electrical systems to function in their intended manner without significant loss of performance [1]. Power quality disturbance, also termed as power quality problem is defined as, "Any power problem manifested in voltage, current, or frequency deviations that results in failure or mis operation of customer equipment" [2].Any deviation of voltage or current from the ideal is a power quality disturbance [3].

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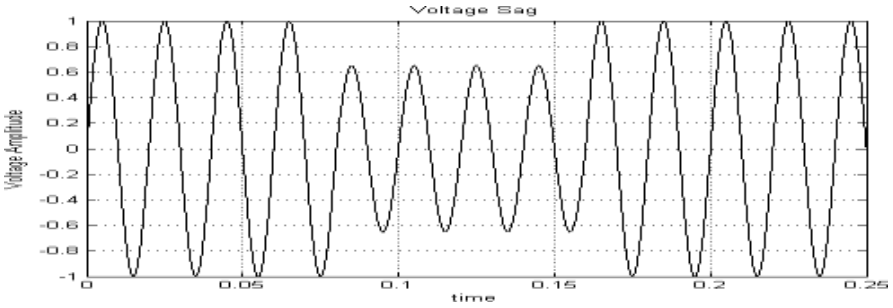
They result in increased power losses, abnormal and undesirable behavior of equipment, and interference with nearby communication lines. [4].

Wavelet transform isused for an analysis of power quality disturbances. In [5] it is presented that in wavelet analysis after a series of decomposition is represented at different frequency ranges. In [6] multiresolutionsignal decomposition is used technique for decomposing a signal into its detailed and smoothed versions In[7] it is presented thatdetail coefficients are used for detection and approximations for characterization.The focus of this paper is to present wavelet analysis based five level decomposition of power quality disturbances generated in MATLAB The signals used for analysis are voltage sag, swell, interruption, transient, harmonics, and voltagefluctuations.

Different Waveforms of Power Quality Disturbances

The disturbances considered are voltage sag, swell, interruption, transient, harmonics, and voltage fluctuations.Voltage sag, shown in fig.1, is simulated in MATLAB and indicates a sudden decrease in voltage.



Voltage swell, shown in fig.2, is simulated in MATLAB and indicates a sudden increase involtage.

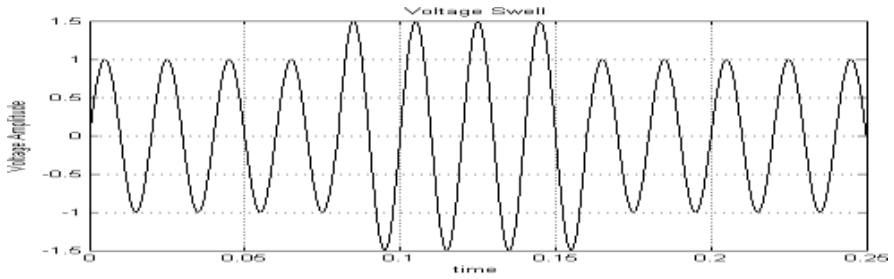


Fig.2Voltage signal with swell

Voltage interruption, shown in fig.3, is simulated in MATLAB and indicates a complete loss of voltage for a short duration.

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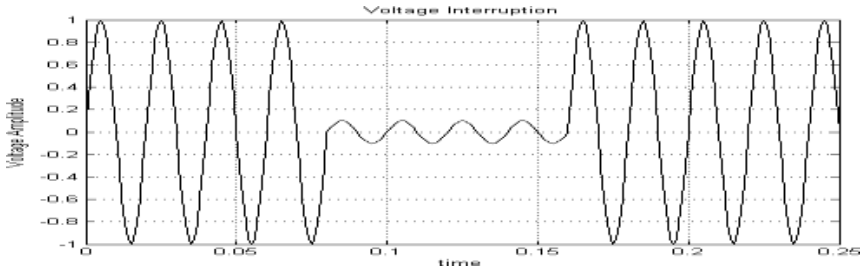

Fig.3Voltage signal with interruption

Transient, shown in fig.4, is simulated in MATLAB and indicates a very short duration voltage spike in voltagewaveform.

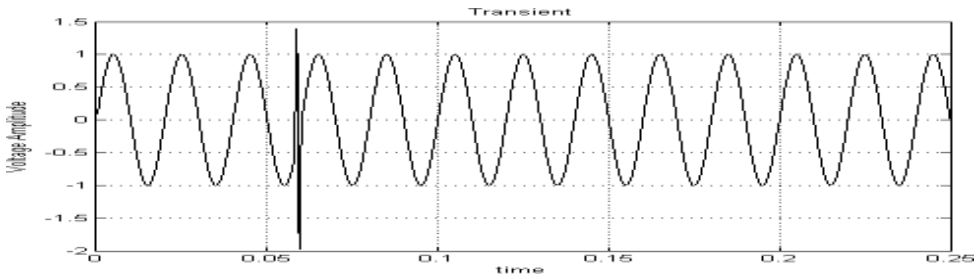

Fig.4: Voltage signal with atransient

The frequency at which the supply system is designed to operate is termed as fundamental frequency. Voltage signal with harmonics, shown in figure 5, is simulated in MATLAB.

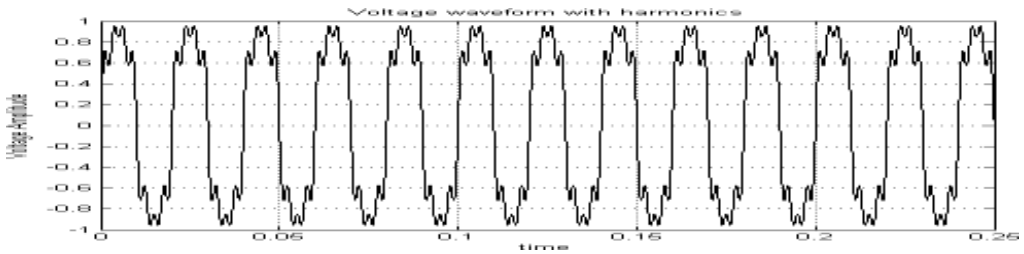

Fig.5Voltage waveform with harmonics

Voltage waveform with fluctuations, shown in figure 6 is simulated in MATLAB.

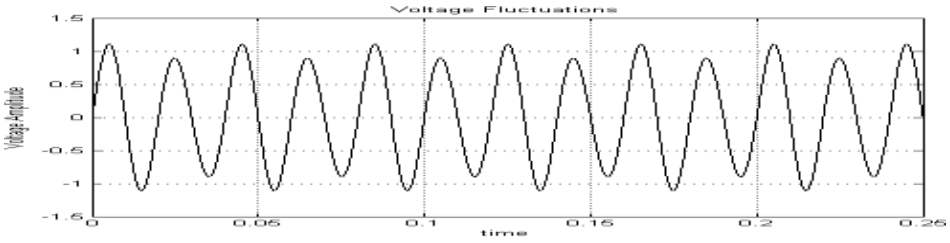

Fig.6 Voltage waveform with fluctuations

All these generated signals are used for wavelet analysis-based processing.

Discrete Wavelet Analysis based Five Level Decomposition

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Discrete wavelet transform is a method that is suitable for detecting of changes in signals Wavelet transform decomposes a signal into different scales with different levels of resolution by dilating a single prototype function termed as mother wavelet [6]. In this analysis, Daubechies 4 (db4) is used as mother wavelet. Extraction of low frequency approximations and high leveldetails from original signal is termed as multiresolution decomposition of a function. The signals are decomposed to five levels.Figures 7 to 12 show the power quality disturbances like sag, swell, interruption, transient, harmonics and voltage fluctuations are decomposed fifth level one approximation and five level details. From detail coefficients in figures 7 to 12, information about the localization of power quality disturbance can be obtained.For analysis purpose, five level decomposition is considered.

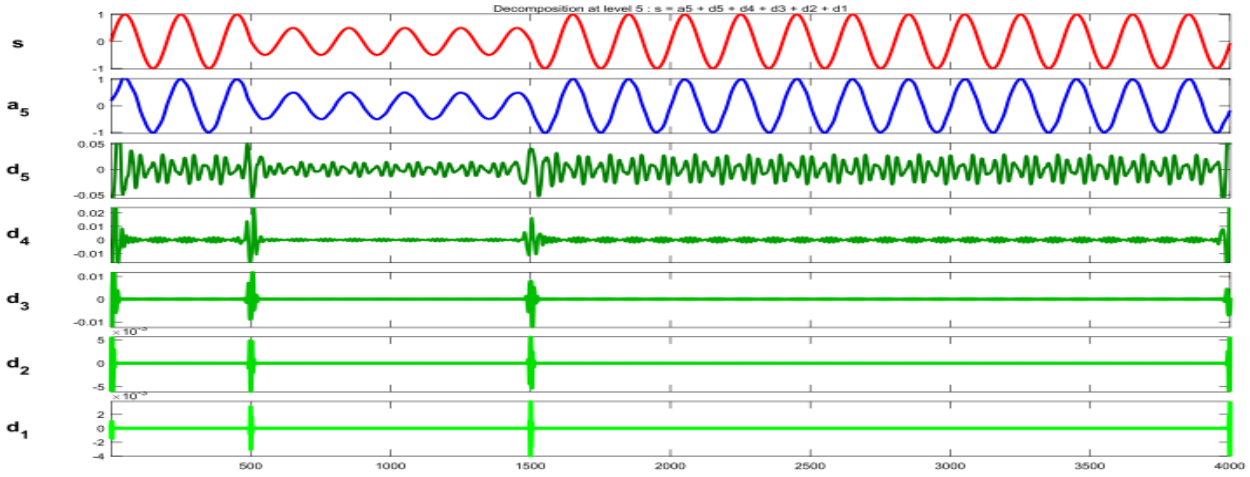

Fig.7: (a) Sag (b) Level 5 Approximation (c)-(g) Level 5, 4, 3, 2 and 1 details

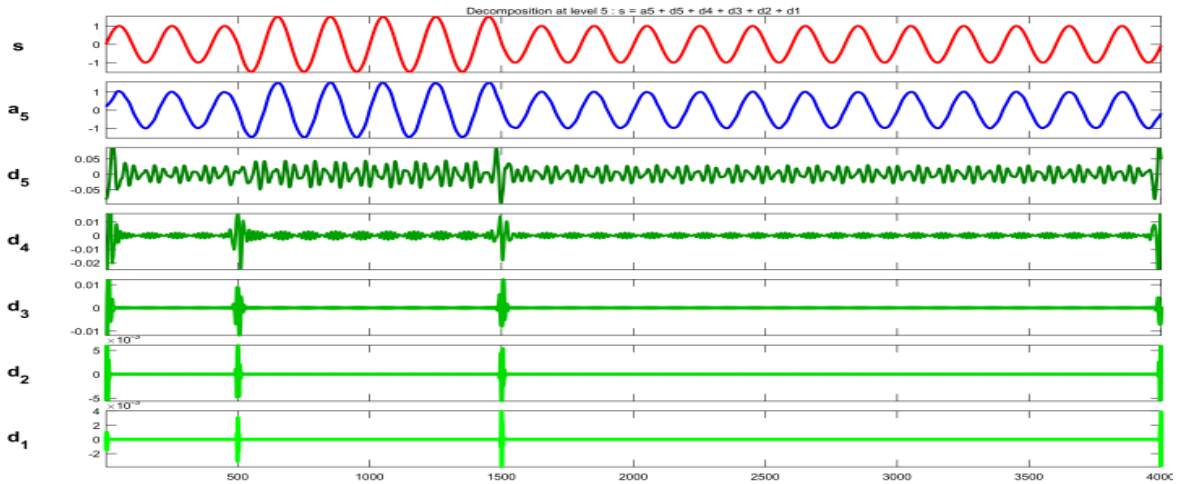

Fig.8: (a) Swell (b) Level 5 Approximation (c)-(g) Level 5, 4, 3, 2 and 1 details

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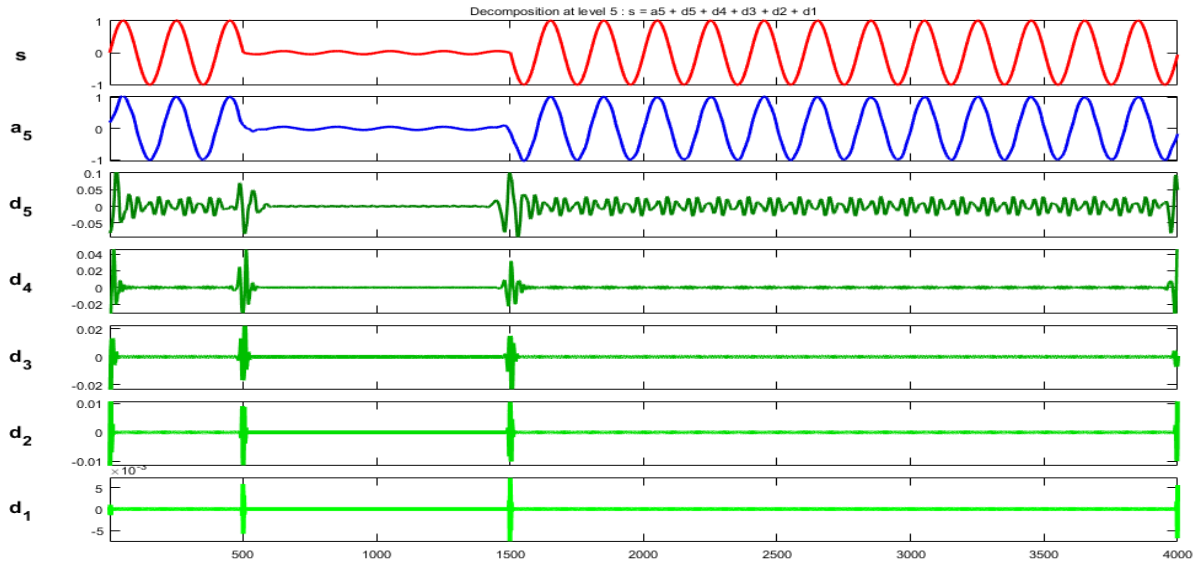

Fig.9: (a) Interruption (b) Level 5 Approximation (c)-(g) Level 5, 4, 3, 2 and 1 details

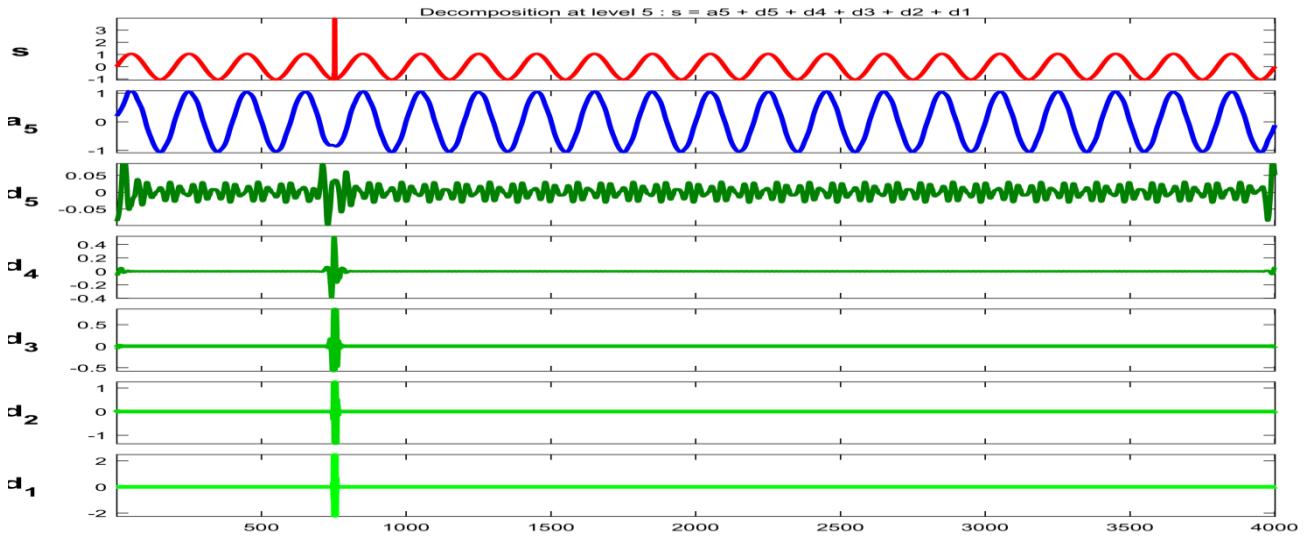

Fig.10: (a) Transient (b) Level 5 Approximation (c)-(g) Level 5, 4, 3, 2 and 1 details

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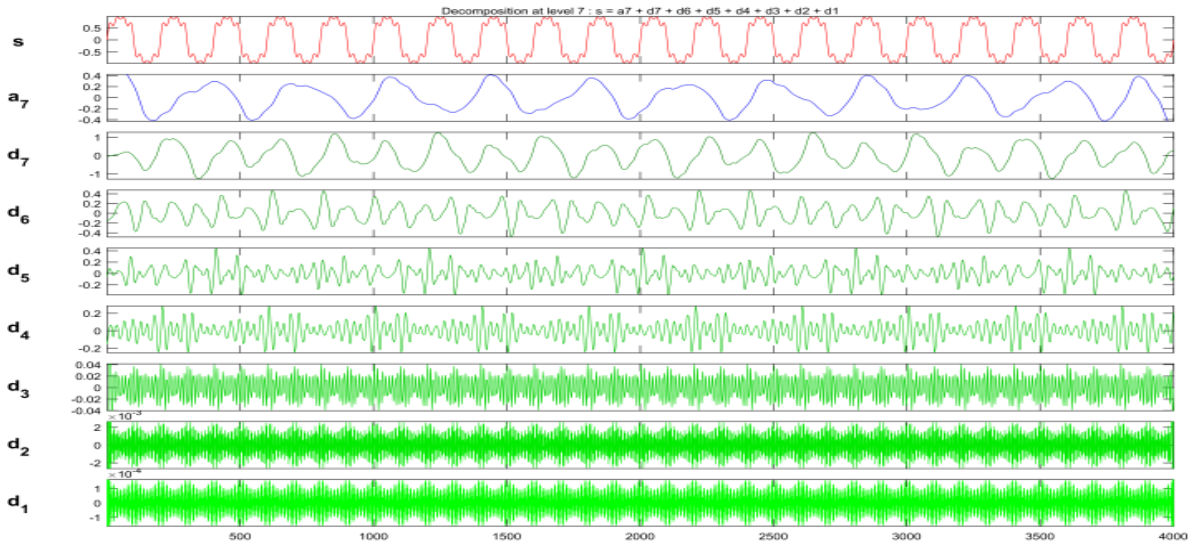

Fig.11: (a)Harmonics (b) Level 7 Approximation (c)-(g) Level7,6, 5, 4, 3, 2 and 1 details.

For better interpretation, harmonics signal is decomposed to seven levels

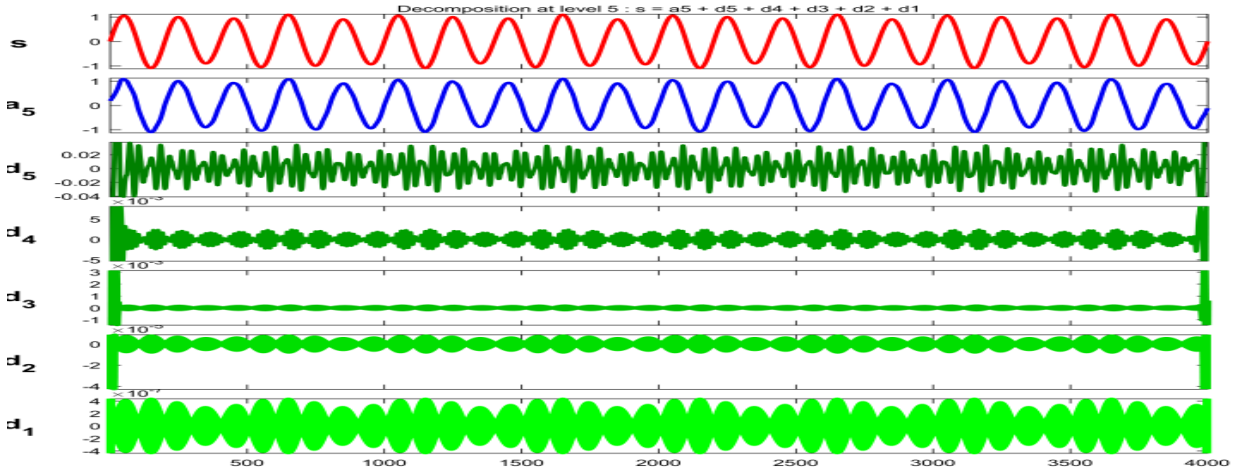

Fig.12: (a)Fluctuations (b) Level 5 Approximation (c)-(g) Level 5, 4, 3, 2 and 1 details

Conclusion

The basic step in power quality evaluation is to identify type of power quality problem. Approximations are low-frequency components and details are high-frequency components. Due to features of high- frequency, details give precise information about initiation and recovery of power quality disturbances. The examination of fifth level approximation and five detail levels. Multiresolution analysis based discrete wavelet transform is applied, using suitable command line functions in MATLAB environment, forfive level decomposition power

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quality disturbances.

References

[1] "Signal Processing of Power Quality Disturbances", M. H. J. Bollen and I. Y.-H. Gu, NewYork, U.S.A,: Wiley-IEEEPress,2006.

[2] "Electrical Power SystemsQuality", R.C.Dugan, M.F.McGranaghan, S.Santoso and .W.Beaty Mc Graw-Hill Professional Engineering,2004.

[3] "Power Quality",C.Sankaran, CRC Press,2002.

[4] "Enhancing Electric Power Quality Using UPQC",VinodKhadkikar, IEEE Transactions on Power Electronics, Vol. 27, No. 5,2012.

[5] "Detection and Classification of High Frequency Transients Using Wavelet Analysis",S. A. Probert and Y. H. Song, IEEE Power Engineering Society Summer Meeting, Vol.2, pp: 801-806,2002.

[6] "Power quality assessment via wavelet transform analysis", S. Santoso, E. J. Powers, W. M. Grady, and P. Hofmann, IEEE Transactions on. PowerDelivery., vol. 11, no. 2, pp. 924–930,1996.

[7] "Detection and Characterization of Voltage Disturbances using Wavelet Transforms". E.S.T. Eldin, Large Engineering systems conference on power engineering, 2004.