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Multiple Power Quality Issues Reorganization Analysis and Feature Extraction with the Discrete Wavelet Transform

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ABSTRACT- Now a day's utilization of the power is very important concept in term of the quality. Utilization of the power is very effective as compared to the generation, at the end point of the different issues are occurs when the power is uses these issues are affect the quality of power so in this paper present about the application of the wavelet for determination of the different power quality issues in the system. In this series first issues determination play very important role. For the determination of the quality issue different soft computational techniques can be apply. In this paper Daubechies mother wavelet utilize in Mat Lab environment of the soft computation. Wavelet technique is applied as a prototype function for determination of the discrete signal and then with the help of this function reconstruction of the discrete signal achieved.

Keywords: Reorganization, Power Quality Issues, Discrete Wavelet Transform, Voltage sag.

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1. INTRODUCTION

Nowadays, Energy is a very important concern for any country. In this way generation, transmission and utilization of the power are very important terms. Utilization of the power is dependent on the different types of the equipment. This equipment is totally responsible for the quality of power. These electronics equipment have the concern for the sensitivity for the power disturbances. Disturbances in the power system come in terms of voltage swell, voltage sag, harmonics disturbances, notching, transient. Above disturbances may come in terms of the voltage, current and frequencies that affect the quality of the power at the end of the customer side called power quality problems. So, both the energy generation side and customer utilization side should be aware of the disturbances in terms of the power quality of the system. A capacitor bank creates the cause of the voltage swell when a motor consumes the more current in the starting and less at it is running at their rated speed. The mitigation of the power quality issues is required before considering the disturbances in practical ways to the power quality. The world is choosing an alternative to fulfil the growing energy demands due to the recent depletion of non-renewable energy supplies. As daily usage of traditional energy sources declines, there is an increasing need for renewable energy sources. Due to their availability, affordability, and environmental friendliness, solar energy sources are practical renewable energy sources [1, 2].

Due to the large range of frequencies involved in STFT, it provides the facilities for detection of power quality with time and the frequency domain, which is insufficient for actual power quality occurrences [3]. In such situation, because DWT has a fixed window width, it is more effective for detecting time-frequency fluctuations. PQ itself has a number of meanings from the utility, manufacturer, and customer points of view. PQ is widely understood to be the idea of powering and grounding sensitive equipment in a way that is appropriate for the equipment's functioning [4, 5].

This chapter will define PQ, discuss PQ-related issues, and provide current approaches for analyzing and identifying these issues.

2. THE IMPORTANCE OF POWER QUALITY (PQ)

Electric utilities and customers, the quality of electric power has taken on significant importance. Consumers in particular are the party whose load suffers significantly as a result of the PQ issue, which is formally referred to as power disruptions. The performance and efficiency of consumer loads, particularly power electronics loads, have been negatively impacted by these disturbances. PQ covers the majority of power engineering disciplines, from generation to end users [2]. Electric power utilities and customers turn to examine, monitor, record, and analyze the electric power to identify the issue in an effort to find relief [6, 8].

3. PROBLEMS WITH POWER QUALITY (PQ) INCLUDE

Implementing an appropriate wiring and grounding system for electrical users is the primary strategy to mitigate the PQ issue [7]. Enhancing electrical system technical knowledge is necessary to prevent serious PQ-related issues. Applications of electrical equipment, especially non-linear loads, might also result in PQ issues. Because the non-linear loads produce harmonic currents, every time the harmonic current passes through the system's impedance, harmonic voltages are produced [8]. Harmonics may cause a variety of issues with users' electrical equipment and systems [9]. Knowledge of the PQ field is another component that might enhance power quality. Understanding the proper electrical wiring scheme is crucial for improving PQ. It is impossible to keep this kind of issues out of the system. To prevent the issue from spreading to a larger area, a strong defensive system has to be constructed [10].

4. PHENOMENA OF POWER QUALITY

There are several definitions of power quality (PQ) phenomena that have been employed in the relevant sector. PQ is loosely described as fewer trips, good electrical system performance, and fewer system malfunctions [11]. This definition is derived from the system application while taking the customer into account. PQ, from the utility's standpoint, refers to the generator's dependability to deliver electricity to the users. [12].

- Notch depth, Modulation of the frequency, Changes of the frequency with time domain Bandwidth in form of the spectrum, Modulation of the different parameters, Impedances of the sources, Notching area of the signals etc. Different type of the characterizes can be apply to satisfied the phenomena of the non-study state disturbances of the system as given below.
- Rate of rise of disturbances, Amplitude of the fault in system, Duration of the cycle, Bandwidth in form of the spectrum, Modulation of the frequency, Rate of the occurrence in the system, Available Potential Energy of the source, Impedance of the system at source end.

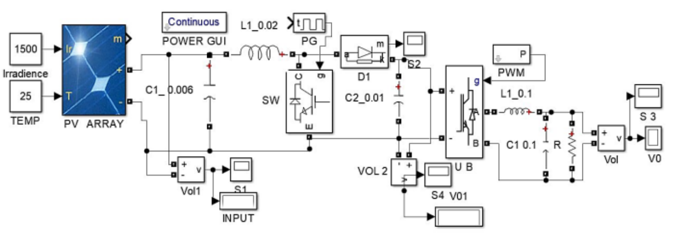


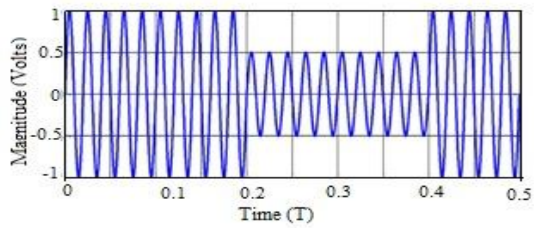
Figure 1: MATLAB simulation for determination of the different parameters in system

Mostly Five types of the power quality disturbances occur in the system that exhibit on one or more than one PQ phenomena are chosen for further examination in this study. The existing literature on disturbance waveform served as inspiration for the selection of disturbances [13].

5. RESULT

5.1 Voltage Sag

Voltage sag if defined when the voltage change occurs in the system between 0.1 p.u. to 0.9 p.u. at the nominal rms voltage will decrease, which is referred to as voltage sag. The voltage sag might last anywhere between 0.5 cycles and 1 minute. Sag is brought on by Single Line to Ground (SLG) faults, starting motors, and the presence of excess current. The short-duration fall in voltage is another name for the broad word for voltage sag. An under-voltage phrase is used if the voltage falls lasts for more than a minute. Voltage sag is often classified into three groups based on how long it lasts. The categories include immediate sag, transient sag, and temporary sag [14].



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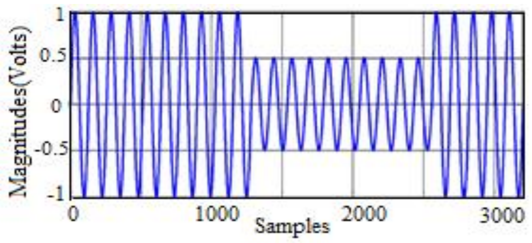
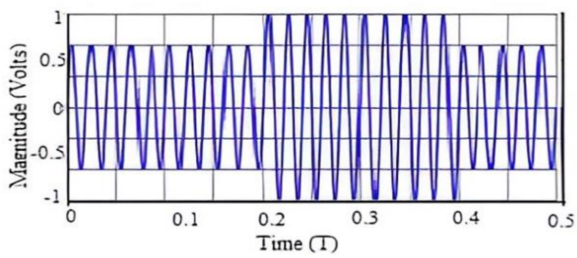


(b)

Figure 2 (a) & (b): Voltage sag disturbances on the applied frequency of 6.4 KHz

5.2 Voltage Swell

In the voltage swell the voltage is increase in term of the RMS voltage between 1.1 and 1.8 p.u. is referred to as voltage swell. When compared to voltage sag, the frequency of voltage swell events is modest. Coincidentally, voltage swell lasts for the same amount of time as voltage sag, which is 0.5 cycles to 1 minute. The beginning of a big motor, an SLG failure, light system loads, and an erroneous tap setting on the transformer are the causes of the voltage swell [15] Voltage swell can be reduced by installing quick acting tap changers in the system. As a result of this incident, most machine applications experience greater iron loss and overheated DC regulators.



(a)

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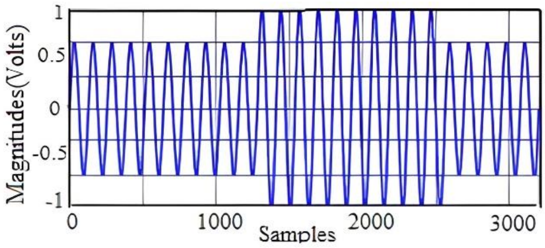
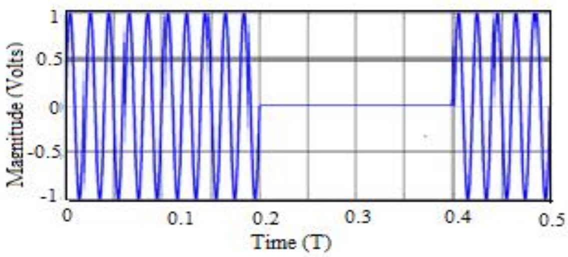


(b)

Figure 3(a) & (b): Voltage swell disturbances on the apply frequency of 6.4 KHz

5.3 Interruption

The term "interruption" refers to a decrease in RMS voltage of less than 0.1 p.u. After the power sag, the interruption happens most frequently. The interruption is the consequence of a loose connection, a serious failure, and the circuit breaker being reset the interruption causes the system as a whole to malfunction and cause bothersome tripping. The voltages are practically low and there is no more power accessible to the system, according to interruptions [16].



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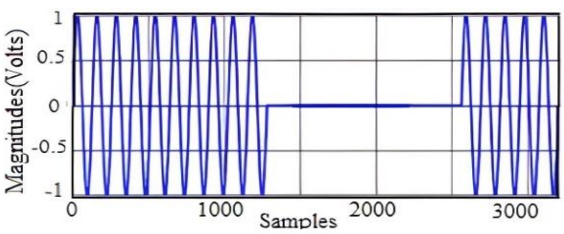


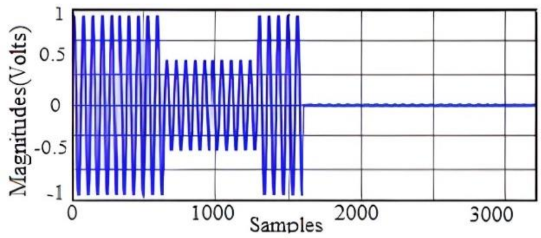
(b)

Figure 4(a) & (b): Produce interruption on the apply frequency of 6.4 KHz

6. PQ EVENT USING WAVELET TRANSFORM

Using the Wavelet Transform PQ Event With the development of digital technology, PQ disturbances are now tracked both locally and online. A recent development in the identification of Q disturbances is the WT. The WT, which scales itself in accordance with the frequency being analyzed, serves as the foundation function for the wavelet transform. Due to the use of basis function utilized with the preference of the exponential function inline FT and STFT in the WT. the system produces better results. The signal is divided into several frequency levels and displayed as wavelet coefficients using the WT [17]. In contrast, all of the signals in this work are discrete, so DWT-based decomposition is used in this section. Using MATLAB and after decomposition using the WT decomposition algorithm, the point of actual disturbance is located, as well as the type of disturbance, and this information is used to identify the disturbance.

6.1 Voltage Sag



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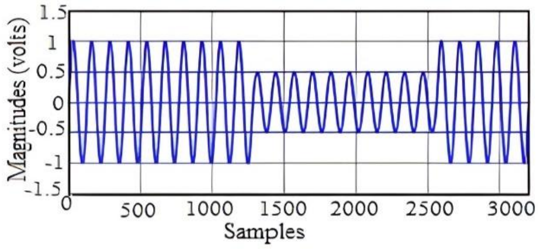
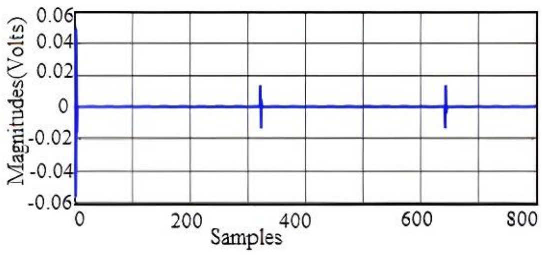


(b)

Figure 5 (a) & 5 (b): Achieved voltage sag decomposition level 1with using WT



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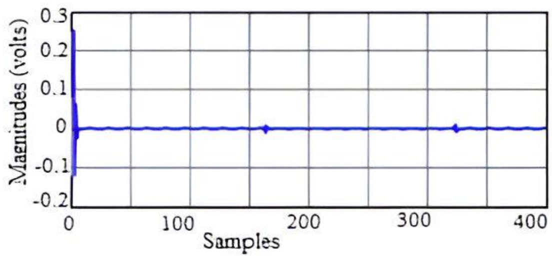
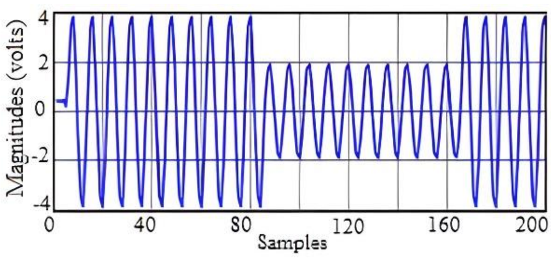


(d)

Figure 5 (c) & 5 (d): Achieved voltage sag decomposition detail signal level 1with using WT



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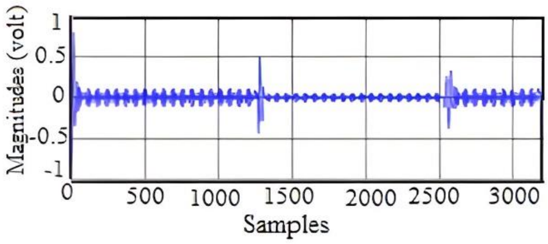

(f)

Figure 5 (e) & 5 (f): Achieved voltage sag decomposition level 2 and level 3 with using WT

Wavelet transform can be applied for the detection of decomposition level of the disturbances in the *figure 2 (a) & (b)* and disturbances are produced in the time interval 0.2 to 0.4 second with the 1250 to 2500 samples and the signal result has been confirm. Approximation value and reduction value of the signals can be achieved from the *figure (c, d, e & f)*. [18].

7. Discrete Wavelet Transform (DWT)

An inverse fourier transform must be used after the power signal has been broken down to obtain the original signal in the time domain. Consequently, the wavelet domain signal X (t) is as follows:

$$WT_x(a,b) = \int_{-\infty}^{\infty} S(t)\ \varphi_{a,b}\, dt \qquad (1)$$

$$\varphi_{a,b} = \varphi \frac{\frac{t-b}{a}}{\sqrt{a}} \qquad (2)$$

In the mother wavelet (t) scaled and displaced. The scale and frequency domain properties of t are represented by the parameter A. The time domain attribute of (t) relates to the parameter B. The digital filter that is equal to the DWT's sub band decomposition is used to introduce the DWT [19].

8. SELECTION OF MOTHER WAVELET

Choice or selection of the mother wavelet is very important term for determination of the PQ disturbances and identification of the disturbances accurately. To translate and scale the original signal at various levels, the original signal is decomposed in different parts with the help of selecting and chosen mother wavelet. There are several mother wavelets in the wavelet library, including Daubechies, Morlet, Haar, Symlet, etc., however research shows that Daubechies wavelets produce the needed results for power quality analysis. The Daubechies wavelet again includes a variety of orders, including Db2, Db3, Db4, Db5, Db6, Db7, Db8, and Db10, among others [20-21].

9. DETECTION OF PQ DISTURBANCES USING S-TRANSFORM

The Stock well transform, which is an expanded variant of the continuous wavelet transform (CWT) and a generalized version of the STFT, can address the drawbacks of the Wavelet Transform. Sinusoids are fixed with regard to the time axis in S-transform modulation [22]. The window of the Gaussian scalable localized by these modulation sinusoids, such as the need for more complicated calculation [23-24].

$$THD = \frac{\sqrt{1/N_j \sum n \ \ [cD_j(n)]^2}}{\sqrt{\frac{1}{N_6}} \sum n\ [cA_6\,(n)]^2} \qquad (3)$$

10. CONCLUSION

The classification of PQ and pure sine disturbances, including sag of voltage, swell of voltage, and fluctuation in voltage with harmonics, transient's conditions, and also including flicker at power system frequency, is attempted first. Prior to categorization, data is normalized, pure sine wave has been decomposition in the five PQ disturbances. The energy utilization and distributions of the including the detail coefficients of PQ disturbances and pure sine are computed, together with a discrete wavelet filter. With the use of a four-layer feed-forward neural network and wavelet multi-resolution analysis standard deviation curves, it was possible to attain nearly zero error rates for the datasets under consideration.

Future work scope

In this study, a detection system utilizing THD and Energy, are taken into account for modelling the PQD. Additional PQ signal properties, like as entropy and standard deviation, can be included for modelling and classification purposes.

Author Contributions

In this paper first author completed research work with simulation and literature review and simulation and result is achieved under the guidance of second author.

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