RESEARCH ARTICLE OPEN ACCESS

Comparison in Wavelets for Dynamic Monitoring Of Voltage Fluctuation & Flicker

Amandeep Kushan, Prof.Khushdeep Singh
Guru Nanak Dev Engineering College. Panjab Technical University, Ludihana, INDIA
Guru Nanak Dev Engineering College,Panjab Technical University, Ludihana, INDIA

Abstract
Voltage fluctuation is depicted as a sequence of root mean square voltage changes or a cyclic difference of the voltage waveform envelopeThe non-resistive loads used in the power system are the major source of fluctuation. Such fluctuating loads include arc furnaces, rolling mill drives, and main winder. All of these have loads with a high rate of change of power with respect to the short-circuit capacity at the point of common coupling (PCC). Small power loads also can be sources of flicker, such as starting of induction motors, welders, boilers, power regulators, electric saws and hammers, pumps and compressors, cranes, and elevators. In power systems, a number of harmful technical problems occur due to voltage fluctuation, resulting in disturbance to production processes and considerable costs. But flicker has its negative physiological results, which can affect worker safety as well as productivity. This paper represent various wavelets used for monitoring of Fluctuation and Flicker.
Keywords**—** *flicker, frequency, power*

I. INTRODUCTION

A rapid, repeated change in light intensity i.e. the light that appears to flutter and be unsteady is referred to light flicker. It is caused when the voltage supplied to a light source changes or when the power line voltage itself fluctuates.

The severity of the flicker depends on several factors.

- The time rate at which voltage fluctuates,
- The change in the amplitude of voltage value, due to fluctuation.
- The kind of bulbs or tubes used such as, incandescent, fluorescent, or HID - high intensity discharge lighting systems).
- The gain factor of the light which measures the change in light intensity when the value of voltage, fluctuates.

Light flickering at a frequency of 50 Hertz (Hz, cycles per second), is produced by lamps operating on AC electric systems (alternating current). The power is turning on and off 50 times a second. The phenomenon of flickering in light sources is not the latest one, takes place since the beginning of power distribution systems. Due to the increase in number of residential customers and factories, the problem of flicker is increasing day by day in the power system. [1][2]

II. NEED OF STUDY

By reducing the use of non-resistive loads in the supply system leads to reduce the amplitude of voltage fluctuation. This is another way to reduce the amplitude of voltage fluctuations. It can be done by installing dynamic voltage stabilizers. Their effectiveness depends mainly on their rated power and speed of reaction.

This section introduces the different types of Wavelets:

Wavelet transforms are broadly divided into following two classes:
a) Continuous wavelet transforms (CWT)
b) Discrete wavelet transforms (DWT)
Both DWT and CWT are continuous-time (analog) transforms. They can be used to characterize continuous-time (analog) signals. CWTs operate over every possible scale and translation whereas; DWTs use a particular subset of scale and translation values or representation grid

Sets of complementary wavelets are useful in wavelet based compression/decompression algorithms, where it is desirable to improve the original information with minimal loss. The fundamental idea behind wavelets is to analyse according to scale.

1.Biorthogonal wavelet

1.1 A biorthogonal wavelet is a wavelet where the associated wavelet transform is invertible but not necessarily orthogonal. Designing biorthogonal wavelets allows more degrees of freedom than orthogonal wavelet. The possibility to construct symmetric wavelet functions is one additional degree of freedom.[2]

1.2 In the biorthogonal case, there are two scaling functions $\phi, \tilde{\phi}$, which may generate different multi-resolution analyses, and accordingly two different wavelet functions $\psi, \tilde{\psi}$. So the numbers *M* and *N* of coefficients in the scaling sequences $a, \tilde{a}$ may differ.

2.Coiflet wavelet

Coiflet wavelet is a discrete wavelet designed by Ingrid Daubechies, to have scaling functions with vanishing moments. The wavelet is near symmetric, their wavelet functions have $N / 3$ vanishing moments and scaling functions $N / 3 - 1$.

2.1 The Coiflet wavelet is orthogonal and near symmetric. This property of near symmetry leads to the near linear phase characteristics of the Coiflet wavelet.Coiflet scaling functions also display vanishing moments. For both the wavelet and scaling functions, N is the number of vanishing moments in coifN.

3.Haar Wavelet

The Haar wavelet is a sequence of rescaled "square-shaped" functions which together form a wavelet family or basis. The Haar sequence is recognized as the first known wavelet basis and extensively used as a teaching example in the theory of wavelets

4.dB-N Wavelet

Daubechies wavelets are the family of orthogonal wavelets, which defines a discrete wavelet transform and characterized by a maximal number of vanishing moments for some given support. There is a scaling function (also called father wavelet) with each wavelet type of this class, which generates an orthogonal multi-resolution analysis.

4.1 The dbN wavelets are the Daubechies' external phase wavelets in which "N" refers to the number of vanishing moments. In the literature, these filters are also referred by the number of filter taps, which is 2N. The db1 wavelet is also known as the Haar wavelet.

5.Symlet wavelet

The symN wavelets are also known as Daubechies' least-asymmetric wavelets. The symlets are more symmetric than the external phase wavelets. In symN, "N"is the order, the number of vanishing moments. Some authors use "2N" instead of "N".Symlet is only near symmetric but is not completely symmetric; as a result some authors do not call them symlets. In the literature, these filters are also referred by the number of filter taps, which is 2N[3][6]

III. DESIGN & IMPLEMENTATION

Lab-VIEW is a graphical programming language that uses icons instead of lines ofText to create applications. The name Lab VIEWstands for Laboratory Virtual Instrumentation Engineering Workbench. Lab VIEW is a system design platform and development environment for a visual programming language from National Instruments. In contrast to text-based programming languages, where instructions determine program execution, Lab VIEW uses dataflow programming, where the flow of data determines execution order. Lab VIEW also includes several wizards to help us quickly for configuring our DAQ Devices and computer-based instruments and build applications.Block diagram to monitor the flicker and fluctuation in the power system, the block diagram in Lab-VIEW is drawn below:-

A. **Block Diagram-**

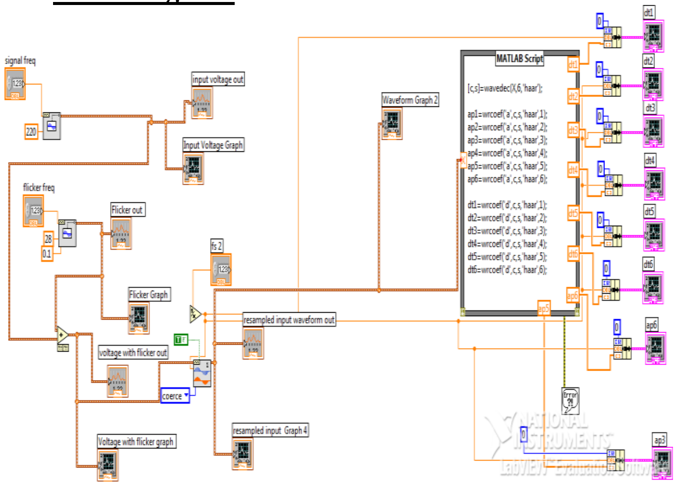

Fig.1 Block Diagram to Monitor Flicker by Using HAAR Wavelet

Figure 2 clear the instructions written in formula node where X is the signal which is to be decomposed into number of components in the form of approximation (ap6) and detail (dt1 to dt6) signals.

SYM8 is the type of wavelet to be used. S is the bookkeeper where these signals are stored in the form of array. 1, 2, 3, 4, 5, 6 …n are the decomposition levels, which can be increased or decreased according to the requirements. The instruction, wavedec is used to decompose the signal whereas wrcoef is used for the reconstruction of the signal.

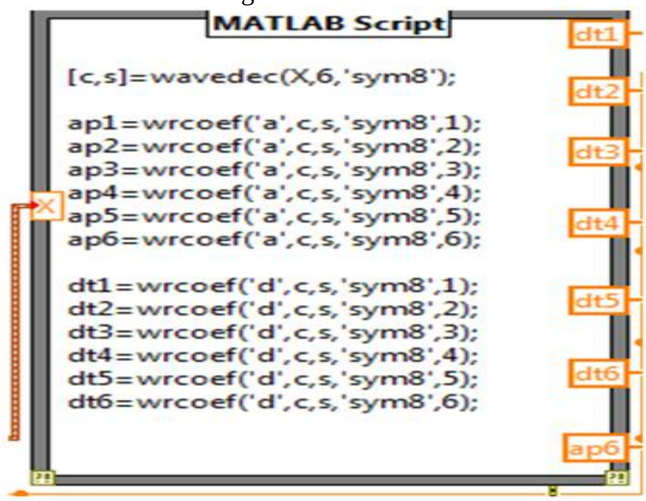

Fig2. Formula Node Used in the block diagram [2]

Where,
wrcoef = reconstructs the coefficients of the given signal.
X = the signal to be decompose
ap = approximation of the signal

- dt = detail of the signal
- wavedec = decomposition of the signal
- 1,2,…….,6…….,n = number of levels
- S = bookkeeper,
- C = wavelet decomposition vector or coefficient and SYM8 is the type of wavelet.

B. Observations-Here are the simulation diagrams which are observed with the predefined parameters as shown in fig2

B.1 Input Voltage-

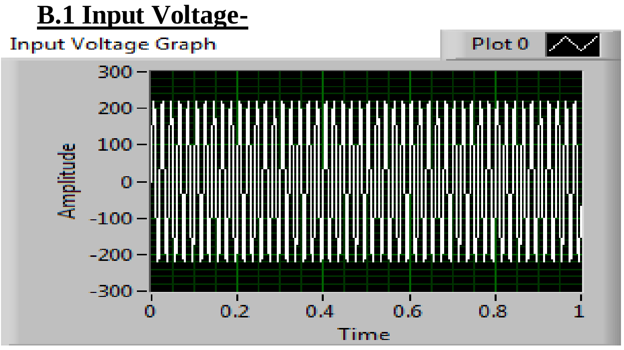

Fig 3. Input Voltage

B.2 Flicker Voltage

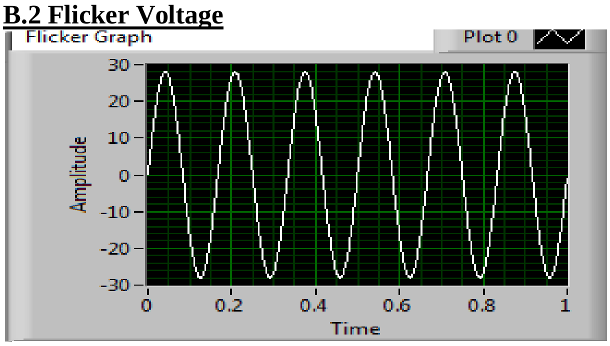

Fig4. Flicker Voltage

B.3 Voltage Flicker Monitoring-

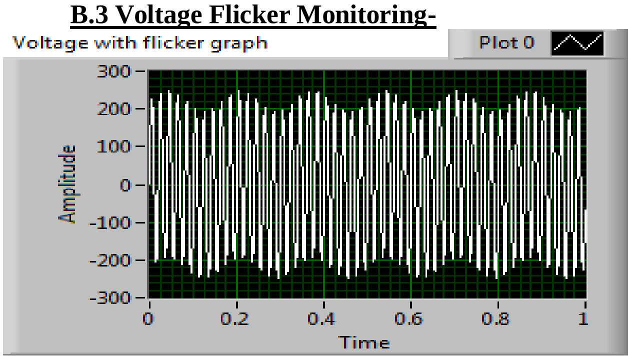

Fig 5. Voltage with Flicker

C.Comparison of Different Number of Wavelets at Different Number of Flicker Frequencies With Respect to Voltage

Frequency (HZ)	Flicker Voltage	Haar Voltage	Symlet Voltage	Coiflet Voltage	Biorthognal voltage	DB-4 voltage	Reverse Biorthognal	Frequency bspline	Shanon	Complex gaussian
6	28 V	28 V	30 V	30 V	28 V	28 V	28	27	28	28
8	28 V	27 V	30 V	30 V	28 V	28 V	27	26	28	28
10	28 V	26.3V	30.2V	30 V	28 V	28 V	28	26	27	28
12	28 V	26 V	30.2V	30 V	28 V	28 V	26	26	28	28
14	28 V	24.5V	30.3V	30 V	28 V	28 V	29	27	27	28
16	28 V	23.5V	31 V	32 V	28 V	28 V	30	28	28	28
18	28 V	22 V	32 V	33 V	30 V	28 V	27	28	28	29
20	28 V	20 V	33.2V	35 V	30 V	28 V	26	28	29	29
22	28 V	19.2V	32.4V	35 V	29 V	28 V	28	28	29	29
24	28 V	19 V	31.2	32 V	28 V	28 V	30	29	30	30

Table1. Performance parameters of all wavelets

E. Some Observational Graphs based on frequency ,wavelet and Flicker Voltage

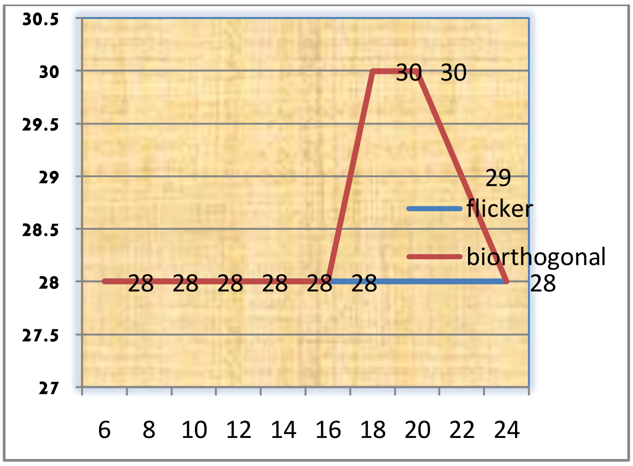

Fig 6. Monitoring with Biorthognal wavelet

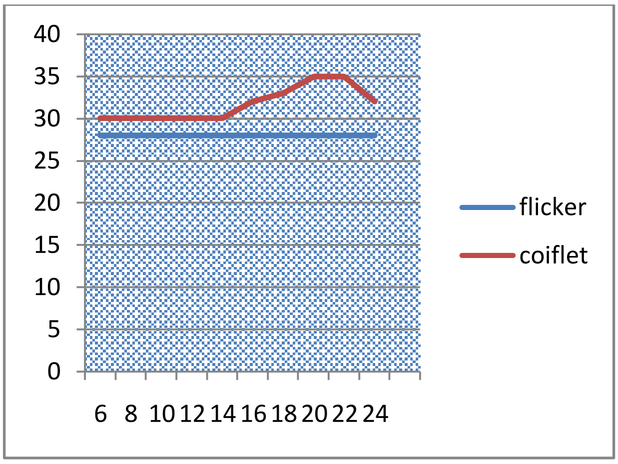

Fig 7 Monitoring with coiflet wavelet

IV. CONCLUSION

This paper has presented Wavelet based flicker analysis system by using Lab-View to monitor its level. Mat-lab is used for formula node in the basic block diagram. This paper also describe variation of voltage with frequency for few wavelets.

V. ACKNOWLEDGMENT

I Would like to thanks GNDEC, for providing tools and support.

REFERENCES

[1] Tom Short, "Electric Power Distribution Handbook", CRC Press, Vol. 143, no.1, Jan 2004.
[2] G. Morison, B. Gao, P. Kundur, "Voltage stability analysis using static and dynamic approaches", IEEE Transactions on Power System, vol.8, no.3, pp.1159-1171, August 1993
[3] "Voltage Stability Assessment: Concepts, Practices and Tools," IEEE Catalog Number SP101PSS, August, 2002.
[4] D. Zhang, W. Xu, A. Nassif, "Flicker source identification by inter harmonic power direction", In the proceedings of Canadian Conference on Electrical and Computer Engineering, 1-4, May 2005
[5] Y. Y. Hong, L. H. Lee, "Stochastic voltage-flicker power flow", Power Delivery, vol. 15, no. 1, pp. 407-411, Jan 2000
[6] M.A. Cody, "The Wavelet Packet Transform," *Dr. Dobb's Journal*,Vol 19, pp. 44-46, 50-54. Apr. 1994
[7] J. E.Farrell," An analytical method for predicting perceived flicker", Journal ofBehavior and Information Technology, 1986.