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Research Paper

OPTIMISTIC RESEARCH FOR VOLTAGE FLUCTUATION AND FLICKER BY HAAR WAVELET TRANSFORM

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Voltage fluctuation and flicker has been one of the main power reliability threats. In order to reduce the harm of voltage fluctuation and flicker, effective measurement is necessary for providing accurate parameters needed in evaluation and compensation. Flicker is the light intensity caused by voltage fluctuations which might bring out lighting equipment's glitter and TV images distortion, make people's visual fatigue and adversely affect people's daily lives. This paper is based on Wavelet based flicker analysis system by using Lab-View and Matlab to study the characteristics of flicker.

Keywords: Voltage, Flicker, Frequency

INTRODUCTION

Flicker is defined as the feeling of unsteadiness of visual sensation induced by a light source whose luminance or spectral distribution varies with time. Usually, it applies to cyclic variation of light intensity resulting from fluctuation of the supply voltage, which in turn, can be caused by disturbances introduced during power generation, transmission, or distribution. However, the basis of flicker is usually the use of large loads having quickly fluctuating power demand. Humans can be sensitive to light flicker caused by voltage fluctuations. Our vision can be weakened much more with flicker and cause general discomfort and fatigue. In general terms, our vision process and brain reaction is affected by flicker, almost always producing discomfort and decline in work quality. In some situations, it can even result to accidents in workplace due to operator fatigue and reduced concentration levels. By this, it affects the ergonomics of the production environment. 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

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voltage supplied to a light source changes or when the power line voltage itself fluctuates (Farrell, 1986; and Tom Short, 2004).

RELATED WORK

This section introduces the different types of Wavelets:

A wavelet is a wave-like oscillation with amplitude that starts out at zero, increases and then decreases back to zero. The wavelet transform is a tool that cuts up data or functions or operators into different frequency component, and then studied each component with a resolution matched to its scale. Sometime the wavelet transform is often compared with the Fourier transform, in which signals are represented as a sum of sinusoids.,Wavelets can be used as a mathematical tool to extract information from many different kinds of data, including audio signals and images but unquestionably not limited to these. Sets of wavelets are required to examine data completely (Cody, 1994).

Biorthogonal Wavelet

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.

In the biorthogonal case, there are two scaling functions ¤, ¤̃, which may generate different multi-resolution analyses, and accordingly two different wavelet functions ·, ·̃. So the numbers *M* and *N* of coefficients in the scaling sequences *a*, *ã* may differ.

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.

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 coif *N*.

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.

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.

The *db-N* 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 2*N*. The *db*1 wavelet is also known as the Haar wavelet.

DESIGN AND IMPLEMENTATION

To monitor the flicker and fluctuation in the power system, the block diagram in Lab-View is drawn below:

The actual waveform of HAAR wavelet is a square tooth waveform.For the analysis of HAAR wavelet, we will write 'haar' in the FORMULA NODE of block diagram (Voltage Stability Assessment: Concepts, Practices and Tools, 2002).

Figure 1: Block Diagram to Monitor Flicker by Using HAAR Wavelet

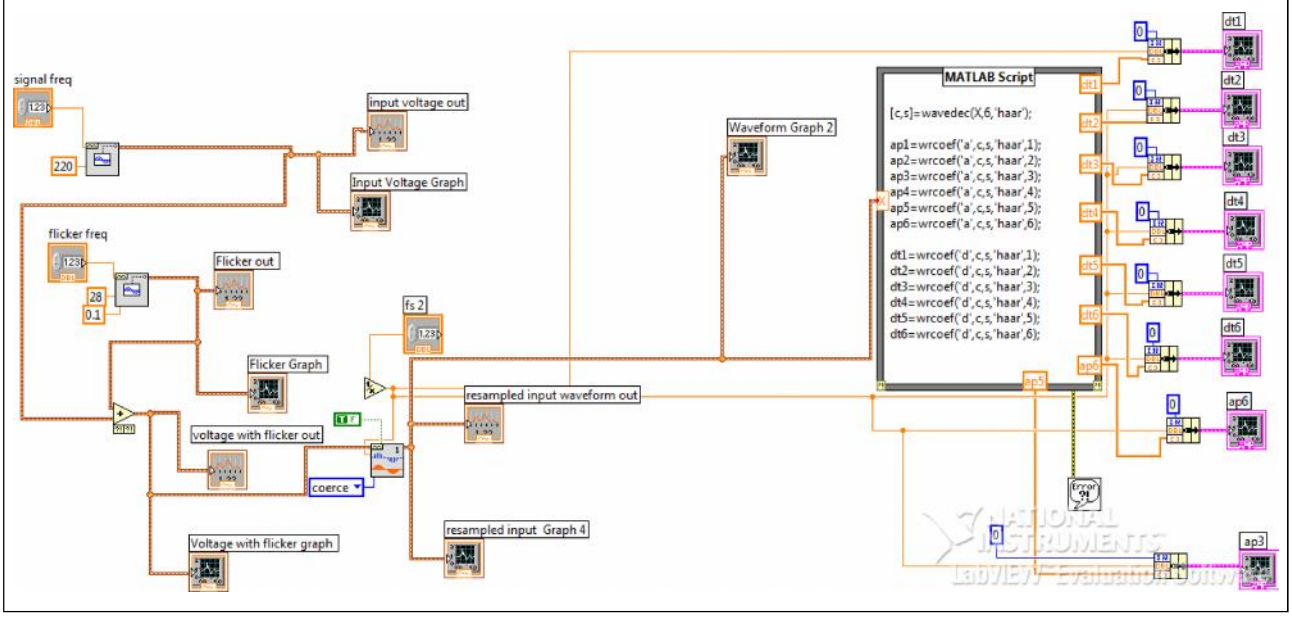
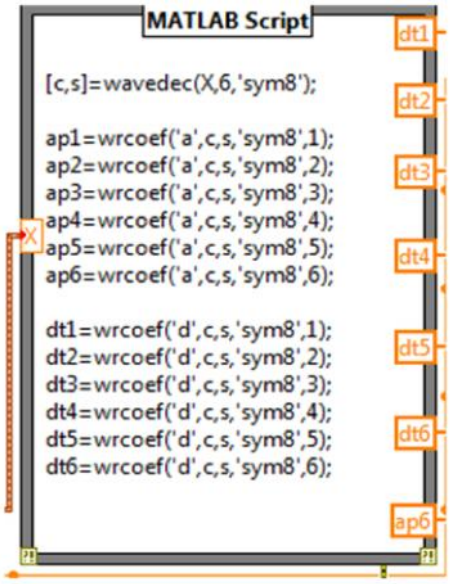


Figure 2: Formula Node Used in the Block Diagram



Source: Morison et al. (1993)

The Haar transform decomposes a discrete signal into two sub-signals of half of its length, like all wavelet transforms. One subsignal is a running average or trend, and the other subsignal is a running difference or fluctuation. The Haar wavelet transform has the advantages of being theoretically simple, fast and memory efficient, since it can be calculated in place without a temporary array (Cody, 1994; and Hong and Lee, 2000).

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 (*ap*6) and detail (*dt*1 to *dt*6) 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.

where,

- *wrcoef* = Reconstructs the coefficients of the given signal.
- *X* = The signal to be decompose
- *ap* = Approximationof the signal
- *dt* = Detail of the signal

Figure 3: Input Voltage

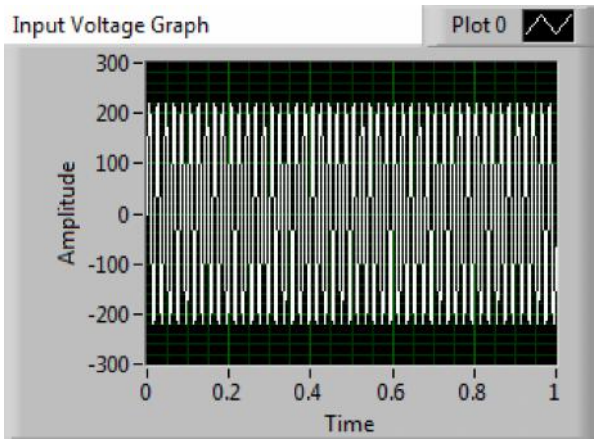


Figure 4: Flicker Voltage

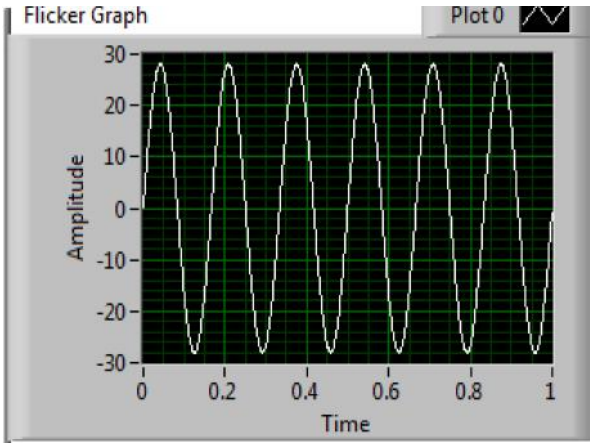
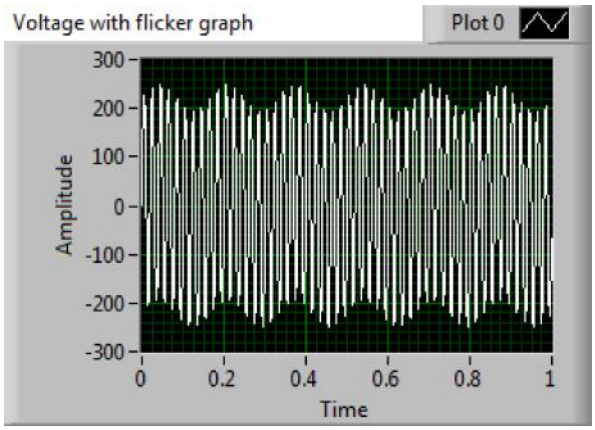


Figure 5: Voltage with Flicker



- *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.

Observations: Here are the simulation diagrams which are observed with the predefined parameters as shown in above Figure 2.

CONCLUSION

This paper has presented Wavelet based flicker analysis system by using Lab-View and Matlab to study the characteristics of flicker. This paper also describe that how to design a haar wavelet and used for monitoring of flicker.

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