A NEW TECHNIQUE & FAST ALGORITHM IN CLASSIFYING TRANSMISSION LINE FAULTS USING WAVELET TRANSFORMS

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ABSTRACT

Choice of rating, setting, and co-ordination of protective devices is very vital for improving the power quality in power systems. This necessitates detection and classification of the faults quickly and accurately. In this paper Wavelet Transforms have been used to obtain the detailed and approximate coefficients of the fault signal. An algorithm is developed based on the histogram representation of these detailed and approximate coefficients to classify the faults. The effectiveness of this new method is compared with that of the fuzzy logic.

Keywords: *Multi-Resolution Analysis, Wavelet Transforms, Rule Based Approach, Fuzzy Logic, And Fault Classification.*

1. INTRODUCTION

Protecting transmission lines is one important task to safe guard electrical power system. Faults on transmission lines should be detected and classified accurately for reliable operation of power system. Firstly such analysis facilitates assessment of fault event and enables protective action.. Secondly restoration measures can be under taken soon after the fault. If we could not able to detect and classify the faults accurately that may lead to low power quality and can cause serious problems such as short life time, malfunctions, instabilities, interruptions of power systems etc.

Existing methods for detection and classification of power disturbances are laborious since they are primarily based on visual inspection of waveforms. More over most of the existing methods are based on deterministic methods. The deterministic methods do not have the ability to adapt dynamically to the system operating conditions and makes correct decisions if the signals are uncertain.

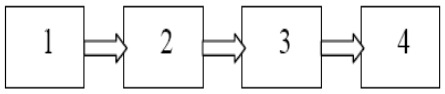
The solution to over come the above difficulty can be Wavelet Transforms which implements multi resolution analysis. In this paper an algorithm is developed based on Histogram representation of detailed and approximate coefficients. The algorithm is fast in classifying the faults as compared to that of Fuzzy logic.

Using MATLAB most commonly occurring faults (l-g, l-l-g, l-l-l-g, l-l) are initially simulated and they have been detected and classified with new technique and fast algorithm and compared the effectiveness of this new technique with Fuzzy logic.

.2. CLASSIFICATION USING FUZZY LOGIC

Most of the protection schemes that have been developed are based on deterministic methods such as representing the transmission lines either with first order (or) with second order differential equations and traveling wave techniques. Adaptability of these methods for system condition is major concern. Theories developed in the field of digital relaying assume that correct relay operations can be determined by means of deterministic computations on a well defined model of the system to be protected. But

some times it is difficult to put into practice because of the complexity of the system, scarce knowledge of the system parameters and great number of information to be processed. All situations that are not characterized by simple and well defined deterministic methods can be done by fuzzy logic.



1.Fault current
2.Ratio of sequence Component currents
3.F L C
4.Fault type **BLOCK DIAGRAM**

Fuzzy set theory implements IF THEN relations and set of rules along with simple memberships. Most of the protection schemes that have been developed are based on deterministic methods such as representing transmission lines either by first order (or) by second order differential equations and traveling wave techniques. Adaptability of these methods for system condition is major concern. Theories developed in the field of digital relaying assume that correct relay operations can be determined by means of deterministic computations on a well defined model of the system to be protected. But sometimes it is difficult to put into practice because of the complexity of the system parameters and great number of information to be processed. All situations that are not characterized by simple and well defined deterministic mathematical model can be handled in terms of Fuzzy Set theory.

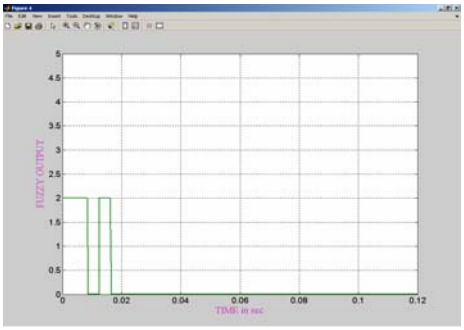
Fuzzy Set theory implements IF-THEN relations and set of rules along with membership functions. For classifying faults, ratio of sequence currents considered as membership functions as Low,, Medium Low, Medium High and High. Set of rules have been framed in fuzzy rule editor [17 rules with IF THEN clauses] to classify the faults.

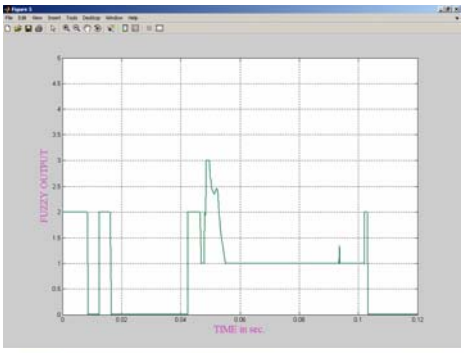
RESULTS:

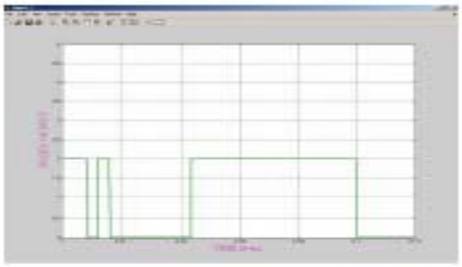
Basing on the fuzzy output (X) the faults are classified as

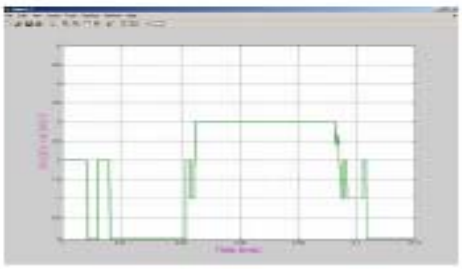
Fuzzy output		**Fault type**
-1≤ X ≤ 0.5	No Fault	
0.5 ≤ X ≤ 1.5		LG
1.5 ≤ X ≤ 2.5		LL
2.5 ≤ X ≤ 3.5		LLG
3.5≤ X ≤ 4.5		LLLG

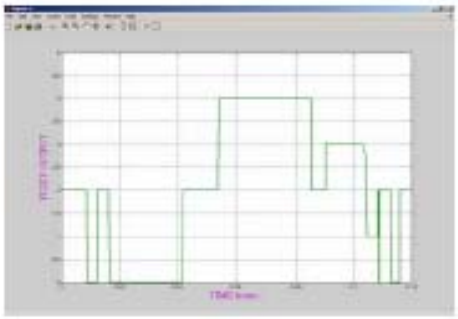
Figures have been displayed in the order of results.











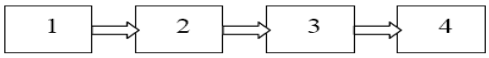
3 .FAULT CLASSIFICATION USING WAVELET TRANSFORMS

Wavelet techniques have been developed for multi scale representation and analysis of signals. Wavelets localize the information in time frequency plane. The important aspect of power disturbance signals is the fact that the information of interest is often a combination of features that are well localized temporally (or) spatially such as power disturbances.

This requires the use of analysis methods sufficiently which are versatile to handle faults [signals] in terms of their time-frequency localization. The main advantage of wavelet transforms over STFT is that the size of analysis window varies in proportion to the frequency. Fourier techniques can not simultaneously achieve good localization in both time and frequency for a signal.

Most of the power systems of interest include combination of impulses like events such as spikes and transients for which STFT and other combination time frequency methods are much less suited for analysis. Wavelet transforms can hence offer better compromise in terms of localization.

Wavelet transforms decomposes the fault signal into a series of wavelet components each of which corresponds to a time domain signal that covers a specific octave frequency band containing detailed information. Such components appear to be useful for detecting localizing and classifying the faults. Hence wavelet transform is feasible and practical for analyzing power system transients.

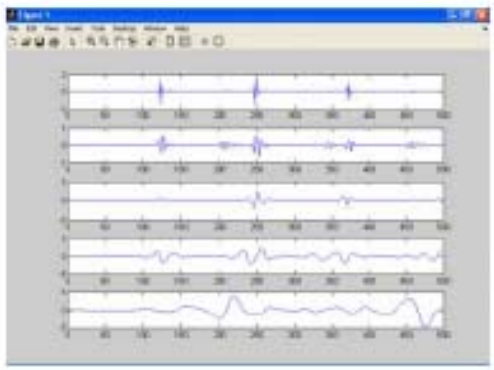


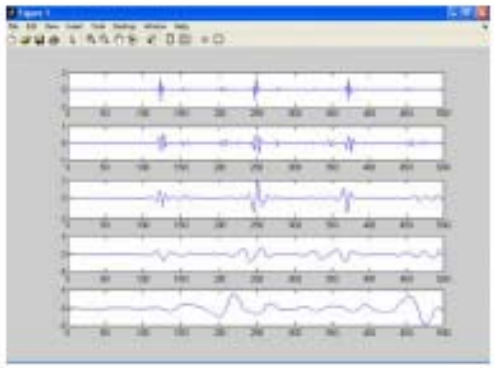
1. Fault Signal.
2. Program.
3. Histogram Representation of detailed co-efficients.
4. Fault type.

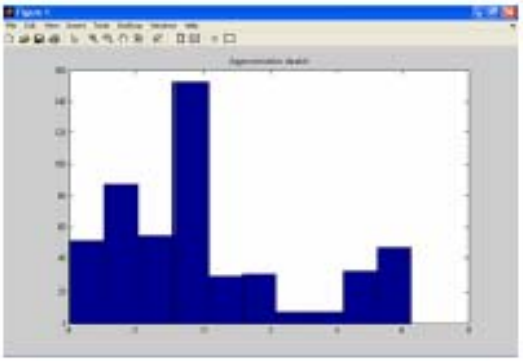
BLOCK DIAGRAM

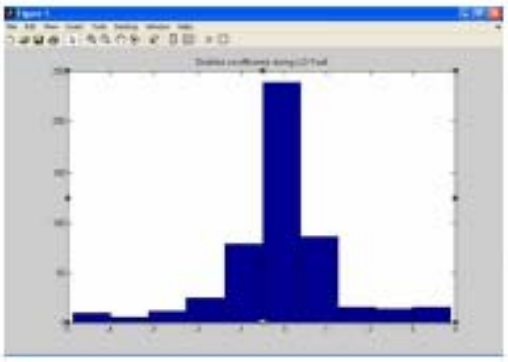
Fault signal is processed using Matlab code. After processing the fault current, detailed coefficients (in terms of histogram representation) are obtained for each of the fault. Basing on the magnitudes and frequency of occurrence of detailed coefficients an algorithm is written to classify the fault.

Fault type	Approximate coefficients		Detailed coefficients	
	Min	Max	Min	Max
LG	23	5146	3.2	6251
LLG	39	5176	5.4	7226
LLLG	27	5031	2.3	5696









CONCLUSION

The developed algorithm is fast & a new technique which is based on histogram representation of approximate & detailed coefficients of the fault signal. The algorithm is fast since wavelet can represent characteristic of a signal by reducing the redundancy of coefficients because of the localization property of the wavelet transform. Expert systems like fuzzy logic is adaptable the dynamic changes of system property while classifying the faults because it is difficult to estimate membership functions during dynamic changes of system properties. More over uniqueness of defining membership functions for a given problem is a major concern for the effectiveness of fuzzy logic.

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