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RESEARCH ARTICLE

Fault Analysis of Transmission Line using Wavelet and ANN

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ABSTRACT

This paper an analyze review on responsibility finding and arrangement inside a extended communication line which is cycle remunerated using artificial neural networks (ANN) and wavelet transform. The future method make utilize of one rotation post fault and one rotation pre fault and samples of the 3- phase current signals to get the view current signal. Daubechies is worn as the mother wavelet at the same time with the separate wavelet transform method. The degree of difference force, based happening separate wavelet transform is useful to supply a scheme, planned calculated for the group of all fault types. Firstly the most select features which be the energies obtain from separate wavelet transform of the current signals preferred are feed to neural networks for the idea of responsibility arrangement. The dependability of the optional method is qualified in a 735-kV, 50 Hz power systems in changed operating settings using MATLAB. The fault was detected and confidential using separate wavelet transform in addition to ANN. The outcome indicates to the planned design know how to suitably categorize every potential fault with large variation into organization condition.

Keywords: Discrete wavelet transforms, Artificial neural networks faults, Fault, Power transmission lines

INTRODUCTION

The wavelet transform is definitely a useful instrument used for analyze the signal's superior frequencies. The Short Time Fourier transformation (STFT) is also another approach where the rangeof the window enclose is complex, but this method absorb knowledge of the range of the window and is not totally consistent to have enough decision.

Wavelet transform solve these troubles of the Fourier transform. In Fourier transform, waveform can be experiential in the frequency area or the waveform does not contain time domain information. However, within wavelet transform inputs it is create in both the frequency and the point domain. WT's attempt using it as method which associatedresearchers to estimate the transients in the power scheme. Available in different shapes and sizes, such as morel, coif lets, hair and Daubechies, wavelet selection is a major strength. Wavelet investigates consistent power interruption, the study process, called wavelets, modify with their time size by frequency, while the lesser frequency wavelet is wider and the superior frequency wavelets are especially narrow. Study for wavelets depend sin the equations below

Scaling equation

$$\emptyset(x)=\sum n\ h\emptyset(n)\sqrt{2}\ \emptyset(2x - n) \qquad (1)$$

Wavelet equation

$$\varphi(x) = \sum n g\varphi(n)\sqrt{2}\varphi(2x - n) \qquad (2)$$

Where $\emptyset(x)$ scaling equation $\varphi(x)$ are wavelet equation $h\emptyset(n)$ and $g_{\varphi}(n)$ are separate filter. Theequations are choosing a mother wavelet for which the below condition have to be met

$$\sum_{m=1}^{m} h\emptyset(n) = \sqrt{2} \qquad (3)$$

$$\sum_{l=1}^{l} h\emptyset(n) \,.\, h_{n+2m} = 1 \quad If\ z = 0 \qquad (4)$$

$$=0 \text{ if} \in Z_l\ z \neq 0$$

It is set up that divide Wavelet Transform is useful in analyze a transient incident like this essential to compact with faults in the power line. The MRA is one of separate Wavelet Transform device. The non-stationary signals have been converted in to the small frequency and high frequency variables in this wavelet based system and these are called approximation and particulars coefficientswith such broad range decision level, which is between [12]. In the high-pass filter, wavelet transformation is being used to estimate high frequency in cycle of signal and low frequency. Low pass filter at ease analyzed. It performs two stages of disintegration. The indication through the first stage was decomposed into CA1 and CD1 with type of frequency band among0-fs/4and fs/4-fs/2 all during which fs is called selection frequency. CA1 is broken behind toward present rise to CA2 and CD2 unconnectedly, in the second stage decomposition. The CD2 branch band frequency is fs/8-fs/4, and 0-fs/8 for CA2 [12]. Upon breakdown the energy can be designed from the complete coefficients expressed in mathematical equations as below:

$$E(t_a, t_b) = \int_{t_a}^{t_b} (|y(t)|)^2 dt$$

Where Y(t) represents the signals

Learning by ANN

Error Back-Propagation typically includes a least amount of two neuron layers: the hidden layer and the output layer. The input layer is not occupied and as such was not incorporated structure. Training using procedure for error back-propagation needs a controlled difficulty, i.e. they be supposed to have a collection of pairs {XS, TS} of r input and target. In many other terms, they should provide a collection of m-variable input items XS (m-intensity range, m-component study m-consecutive observations of a time dependent variable, etc.) for the testing and the suitable n dimensional target (response) Ts (n structural fragments) should be associated with any X. Because of the mores technique, the breakdown back-propagation scheme has be established the name: the weights of neurons are fixed first in the output layer, then in the second hidden layer and at the ends during the first hidden layer , i.e. in the first layer that gets the input signals from the data. A variables h and m are called learning rate and momentum, which scope mostly 0.1 to 0.9. In view of the 1st layer output being identical to the 2layer input(Figure 2), we can see that the word y1 is comparable to the term input i. Both quantities are equal to the elements x1, x2, ... when the first sheet of weights is adjusted (= 1). Input vector.

Fault Classification by ANN

While its overall conception of relays continues the same, the technology age has a major outcome on how controllers operate, which has introduced numerous enhancements to conservative electrical apparatus. The entire data collected in ANN-based approach is divided into three configurations, including training and validation. Fault finding is the first part of the method. If they appreciate there has a fault on the power line, one more be in motion to organize the fault in a variety of groups based on the phases of fault. This paper has the purpose of implement system used for artificial neural networks to perform each of those tasks. Neural networks focused on Back propagation are used for error identification and the arrangement of faults. Different neural networks are used for each of various types of classification fault. The flowchart shown in Figure 3 depict every of these steps.

Flow Chart (Fig.3)

The flowchart describes the basic method used to implement the detection and diagnosis of faults is based on ANN. Three major input signals should be measured at a sampling rate of 1.0 MH all throughdata pre-processing or advance analyze by means of a low-pass filter [2] and for calculate the energy sense of balance of three currents, a maximum set DFT is used. To cause to be ANN input point between +1 or 0, the input signals were identical. Network design, a learning rule set, training method and ANN-based fault locator processing are the most critical aspects of flaw position systems. The four output of neural network correspond to a fault for every one of the 3 phases and 1 output is ground line. Thus, all outputs is either 0 or 1 suggesting a yes or no fault on the line (A, B, C or G, where A, B and C represents 3 phases of transmission line network and G indicates ground) [1].Therefore, each of different faults be represented accordingly by the various possible permutations. The proposed neural network is able to precisely differentiate ten feasible kind of faults. The table 1 shows the truth value describing faults and efficient operationfor each of faults.

SIMULATION AND RESULTS OF FAULTS

The Fourier transform is a valuable tool for measuring the signal's high frequencies. The Short Time Fourier transformation (STFT) is also approach at which scale of the window pane is complex, but this method involves awareness of the scale of the window and is not necessarily reliable to have sufficient resolution. The modern, DWT-based methodology for fault identification and transmission line diagnosis. For this system current values are transmitted from each step. Moreover, the standardized values approach reference values with in presence of irregular workingconditions. MATLAB circuit for 3-phase transmission line method of 13.8 kV seen in figure 4. ,must have a generator at bus A and a load at bus B, its principal component study discrete wavelet Transform with MRA is being used for modeling. Power network is composed of a 13.8kV, 350 MVA generator, current transformers required by each step, 30 km variable distributed transmission linesfor part, 90 km line length and a three-phase load. Power Grid block Used to simulate the method that enable for the collection of continuous, discrete and phasor come within reach of to solving electrical circuit. Faults of various types on transmission lines at different locations are simulated using the MATLAB / Simulink. In MATLAB work space, current signals of increasing step are captured as DWT is implemented for detection and diagnosis of faults on such current signals. This technique proposed has been recognized at Simulink. And at current signal increasing step, separate wavelet transform with multi resolution study was added to measure normalized values from detail coefficients typical up to 2nd stage. No fault voltage and current signals sine wave and Figure 5. shows phase to phase fault current and voltage signal waveforms. Figure 6. displays the uniform no fault values for all phases. Whenever the maximum peak of any normalized phase value will be less than the threshold value 0.380, a method is regarded strong system. Figures 7., 8., and 9, illustrate the process of ground faults including A-G, B-G, and C-G. In these figures it is evident that phase to ground faults arise while normalized phase values outpace the threshold value. Phase comparison of phase faults including A-B, BC, and C-A is shown in Figures 10, 11 and 12. A Strong system endures the phase-to - phase fault as per the suggested technique is when normalized values of each of the two phases reach the threshold value. Figure 12 shows the symmetric (three-phase) fault. For this situation normalized values approach the threshold value of all phases. The Frequency of Parameters faults table 2 shown in the figure.

Simulation of ANN

A present, 13.8 KV 3-phase transmission line devices exhibited in figure.13, with a generator at bus A and load at bus B was utilized mat lab using present system described based on discrete wavelet transform are ANN. Network can be made up of 13.8 KV, 350 MVA generator, current transformer utilized every one step, 30 km parameter dispersed transmission lines for each segment, 90 km line length and a three-phase load [4].In MATLAB work space, current signals to each phase are recorded ANN is applied detection and diagnosis of faults on these current signals. The sampling frequency takes 20 kHz and base frequency of 50 Hz. The MATLAB circuit ANN- Based Simulation Platform for Detection and Classification of faults shown in the 5. This technique proposed has been recognized at Simulink. And at current sign increasing step, separate wavelet transform with multi resolution study was added to measure normalized values from detail coefficients typical up to 2nd stage. No fault voltage and current signals sine wave and Figure 14 shows phase to phase fault current and voltage signal waveforms. Figure 15 displays the uniform no fault values for all phases. Whenever the maximum peak of any normalized phase value will be less than the threshold value 0.380, a method is regarded strong system. Figures 15, 16, and 16 illustrate the process of ground faults including A-G, B-G, and C-G. In these figures it is evident that phase to ground faults arise while normalized phase values outpace the threshold value. Phase comparison of phase faults including A-B, BC, and C-A is shown in Figures 17, 18 and 19. A Strong system endures the phase-to - phase fault as per the suggested technique is when normalized values of each of the two phases reach the threshold value. Figure 21 shows the symmetric (three-phase) fault. For this situation normalized values approach the threshold value of all phases. The Frequency of Parameters faults table 3 shown in the figure.

CONCLUSION

Transmission lines are part of the power systems, but power systems are experience a large number of faults. A range of efforts to reduce transmission line faults have be formed in reaction to this . The function of this learning was to explore the viability of Artificial Neural Networks as a method for transmission lines to common sense faults. There are unusual techniques of protection for the transmission lines: detection of faults, organization of faults and determination of the location of faults. The focus of the study was on the application of Artificial Neural Networks to fault detection. This paper aimed to identify and recognize electrical faults in real time inside a simulated environment. For this paper we researched that operation of ANN on the three-phase transmission line network to detect & diagnose faults [9]. The industrial method uses of three phase currents and voltages as input to neural networks. Its variables have been regular in relation to their various pre- fault standards. A finding contained in this statement is for a field to ground only with the fault line. Both these types of faults, -for example Line to line, symmetrical three phase faults, has been recognized and artificial neural networks are being created for all of those faults. The neural network design of the back propagation was followed by any of the artificial neural networks which were analyzed

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Table 1 Values of Various Faults

Fault Types	Phase A	Phase B	Phase C	Ground
AG	1	0	0	1
BG	0	1	0	1
CG	0	0	1	1
AB	1	1	0	0
BC	0	1	1	0
CA	1	0	1	0
ABC	1	1	1	0
NO FAULT	0	0	0	0

Table 2 The Frequency of Parameters faults

S. No.	Types of faults	Settling time			Peak time (sec)			Maximum peak over shoot(%)		
		P-A	P-B	P-C	P-A	P-B	P-C	P-A	P-B	P-C
1	AG Fault	2.843	2.643	1.949	0.057	0.087	0.070	8.223%	29.574%	44.975%
2	BG Fault	2.843	2.643	1.949	0.033	0.056	0.070	33.386%	-1.994%	44.975%
3	CG Fault	2.843	2.643	1.949	0.033	0.087	0.045	33.386%	29.574%	39.291%
4	AB Fault	2.843	2.643	1.949	0.057	0.056	0.070	44.975%	30.027%	-8.223%
5	BC Fault	2.843	2.643	1.949	0.33	0.056	0.045	33.386%	-1.994%	18.743%
6	AC Fault	2.843	2.643	1.949	0.057	0.087	0.045	10.823%	29.574%	34.257%
7	ABC Fault	2.843	2.643	1.949	0.057	0.056	0.045	2.956%	5.947%	63.639%
8	No Fault	2.843	2.643	1.949	0.033	0.087	0.070	37.832%	29.574%	44.948%

Table 3 Parameters of The Frequency Response

S. No.	Types of faults	Settling time			Peak time (sec)			Maximum peak over shoot(%)		
		P-A	P-B	P-C	P-A	P-B	P-C	P-A	P-B	P-C
1	AG Fault	1.672	1.315	1.332	0.056	0.007	0.087	35.720	38.735	244.741

2	**BG Fault**	1.672	1.315	1.332	0.032	0.045	0.062	162.800	19.345	244.741
3	**CG Fault**	1.672	1.315	1.332	0.032	0.007	0.046	162.800	38.735	47.000
4	**AB Fault**	1.672	1.315	1.332	0.056	0.045	0.062	35.720	230.082	244.741
5	**BC Fault**	1.672	1.315	1.332	0.032	0.045	0.046	162.800	145.651	51.042
6	**AC Fault**	1.672	1.315	1.332	0.056	0.007	0.046	31.760	38.735	47.000
7	**ABC Fault**	1.672	1.315	1.332	0.056	0.045	0.046	27.977	14.912	33.607
8	**No Fault**	1.672	1.315	1.332	0.032	0.007	0.087	162.800	38.735	244.741

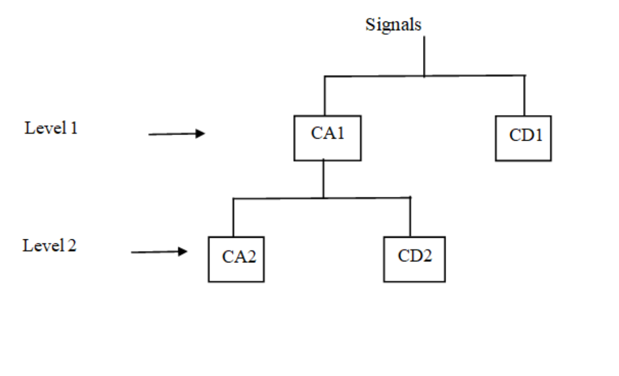

Fig.1. Discrete Wavelet Transform

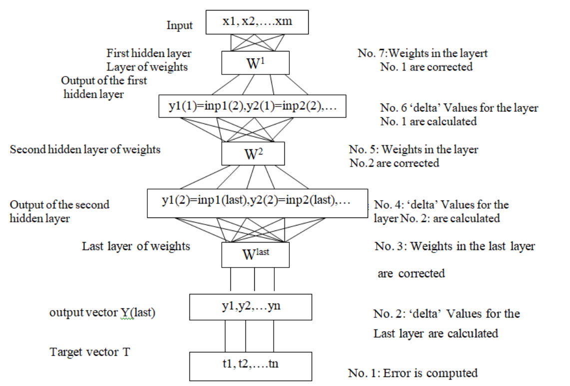

Fig. 2. Order for correction of weights in the error back-propagation learning is 'bottom-top' oriented.

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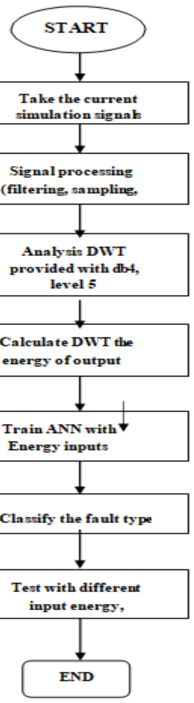

Fig. 3. Flow chart of Fault Classification on ANN Based

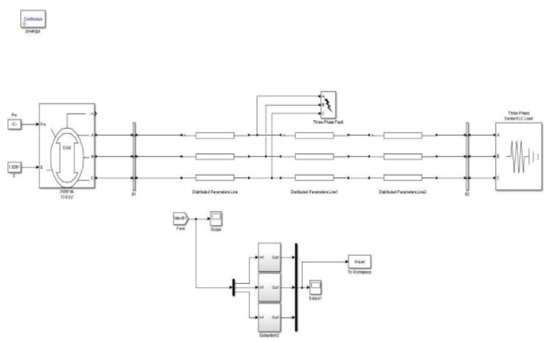

Fig. 4 MATLAB circuit for 3-phase transmission line method of 13.8 kV

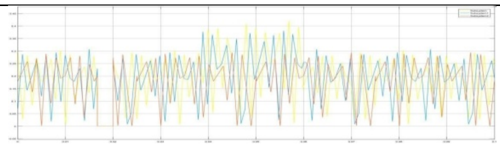

Fig. 5. phase to phase (AB) fault current and voltage signal waveform

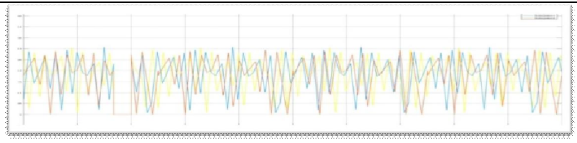

Fig. 6. No fault voltage and current signals waveform.

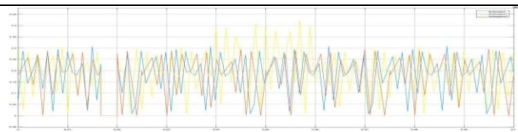

Fig. 7. phase to phase (AG) fault current and voltage signal waveform

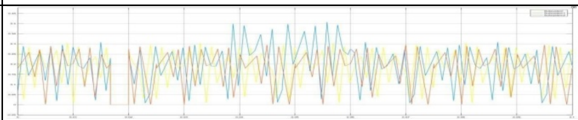

Fig. 8. phase to phase (BG) fault current and voltage signal waveform

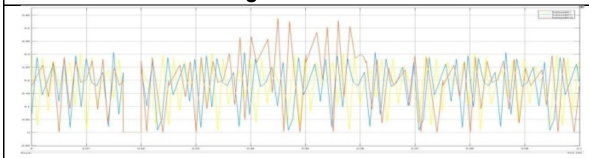

Fig. 9. phase to phase (CG) fault current and voltage signal waveform

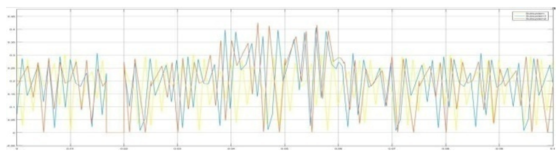

Fig. 10. phase to phase (BC) fault current and voltage signal waveform

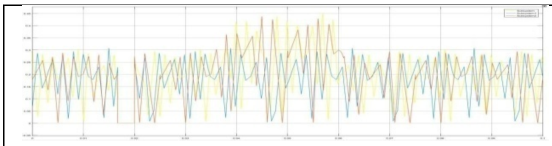

Fig. 11. phase to phase (AC) fault current and voltage signal waveform

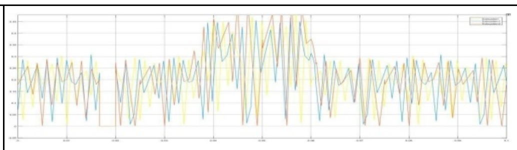

Fig. 12. Three phase (ABC) fault current and voltage signal waveform

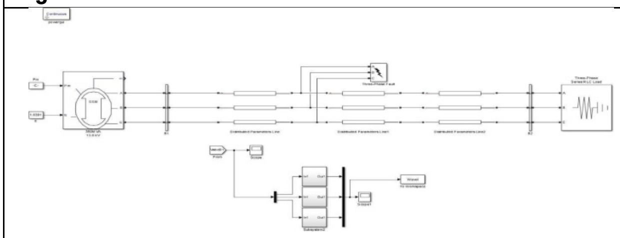

Fig. 13. MATLAB circuit ANN-Based Simulation Platform for Detection and Classification of faults

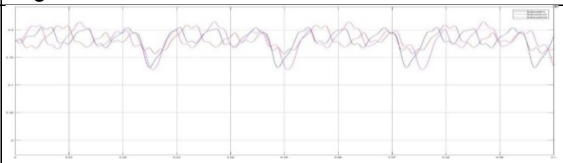

Fig. 14. No fault voltage and current signals waveform.

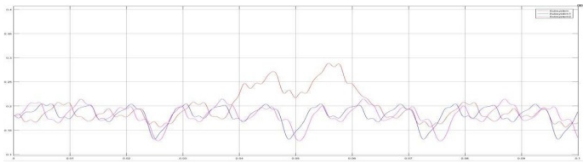

Fig. 15. phase to phase (AG) fault current and voltage signal waveform

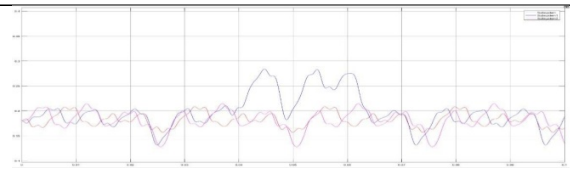

Fig .16. phase to phase (BG) fault current and voltage signal waveform

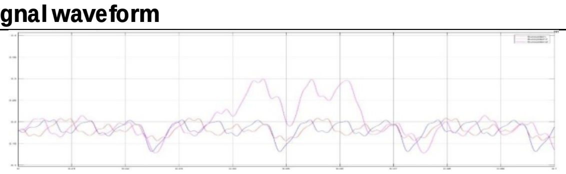

Fig. 17. phase to phase (CG) fault current and voltage signal waveform.

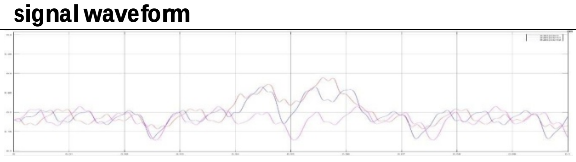

Fig. 18. phase to phase (AB) fault current and voltage signal waveform.

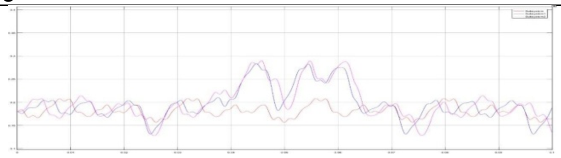

Fig. 19. phase to phase (BC) fault current and voltage signal waveform.

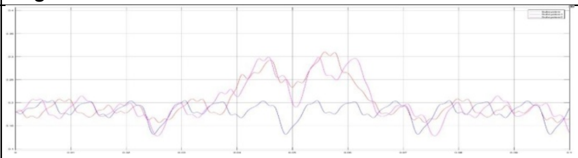

Fig. 20. phase to phase (AC) fault current and voltage signal waveform.

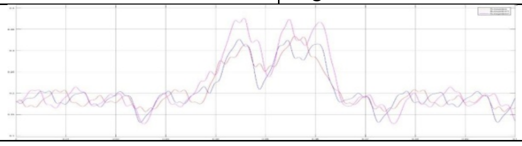

Fig. 21. Three phase (ABC) fault current and voltage signal waveform