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MODERN APPROACH FOR DIAGNOSING AND DETECTING FAULTS ON OVERHEAD TRANSMISSION LINES USING ARTIFICIAL NEURAL NETWORKS

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ABSTRACT

The high voltage transmission over long distance is mainly focused on safety and economic. If necessary, to transmit certain amount of power through long area should care about power regulation, efficiency and losses. Any time fault may occur if any deviation in voltage and current reaches above normal range. The faults in power system causes over current, under voltage, unbalance of the phases, reversed power and high voltage surges. Three-phase symmetrical faults are known to be the most severe in a power system due to large fault currents. However, single phase, phase to ground faults are more common faults that occur. If not checked in due time, these faults may grow to symmetrical fault which is uncommon but most severe. Trial and error method is usually practices for detecting the fault location on transmission line. In this method, the supply feeds at the single end at a time by dividing that transmission line into two parts and detect the fault up to that limit. This paper provides a modern approach for detecting a fault and diagnosing overhead transmission lines through the implementation of DWT and ANN controllers. Voltage signals are found from the sending end for each phase, the decomposition using DWT to obtain a detail coefficient of up to 2 stages.

KEYWORDS: BPN, Faults, Transmission line, DWT & Learning Algorithm

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Original Article

INTRODUCTION

In power transmission lines if any deviation of voltages and currents from nominal values or states are normally called electrical faults. At any circumstance, if the operating conditions are normal, the power system equipment or lines carry normal voltages and currents which results in safer operation of the system. Whenever the fault occurs in transmission lines, it may cause excessive flow of currents and make severe damages to the electrical equipments and devices. So, avoiding such kind of damages and protection of switchgear equipment, electromechanical relays circuit breakers, and other protection devices it is necessary to select or design suitable fault detection and diagnosis method.

Fault condition in the Phasor measurement unit is calculated measured input voltages comprises of 2 steps:

- First step authors in have matched degree measurement utilized to classify defective location, as defective buses have low matching degree value systems.
- A mathematical generator was used in second step to evaluate the accurate location of the fault. This method is taken to transmission lines on networks.

ANN provides to detect and diagnose errors. This is a natural or artificial method which these are upon this design and real functions of the neurons in the brain biological systems. This could receive all the functions: failure identification, error diagnosis and fault position. It's also proposed in a feed forward propagation network for detecting faults. Neural network training is provided with inputs and targets. Hence it is identified that the technique based on ANN can solve the problems that are common in the design of conventional distance relays. Through this method, a final stage of voltage and current being utilized to detect faults using ANN with feed forward neural scheme as the primary approach. Efficiently this approach identifies and classifies electrical power failures. This scheme can therefore easily solve the problems as opposed to non-linear loads. The sample rate for each period is 1KHZ for training ANN results. The method involves two steps in detecting and classifying faults. For the detection of faults, human beings are using six input data of ANN technique and analyze these value systems with pre-fault values obtain sample set. Output of the artificial neural network system is 1 and 0 that both detects presence and shortage of fault. For fault classification, a certain approach selected and 4 inputs of the ANN method, that are A, B, C and G have been utilized. Results of the model are dependent on reliability of the artificial neural network design to identify and recognize faults.

TYPES OF FAULTS

Symmetrical Faults

Attention need for these faults because it makes more damage and interruption on the power transmission.

But it occurs in frequently in the power lines. Another name of this fault is balanced faults (IX, X).

In Figure 1, these faults are classified in to two types

- Line to line to ground (L-L-L-G) and
- Line to line (L-L-L).

Total faults in power line the symmetrical faults estimate only 2-5 percent of system. But these faults occur, the system remains balanced but results in severe damage to the electrical power system equipment also.

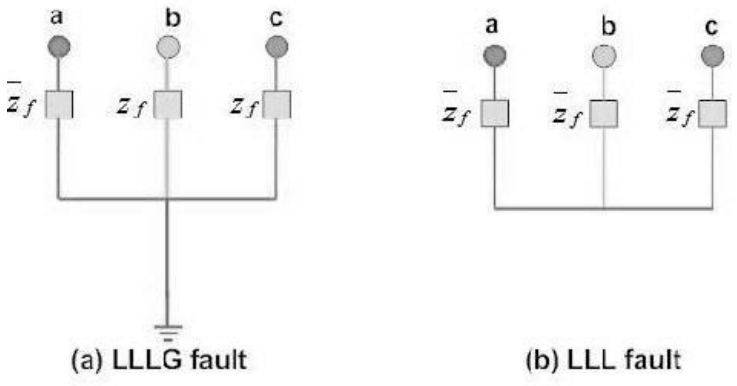

Figure 1: Symmetrical Faults

Asymmetrical Faults

In Figure 2, Asymmetrical faults are common faults occurs in transmission lines and less severe.

The followings are main type of asymmetrical faults

- Line to Ground (L-G),
- Line to Line (L-L), and
- Double Line to Ground (LL-G) faults.

All the above line to ground fault (L-G) is the most common fault and 65-70 percent of faults are of this type.

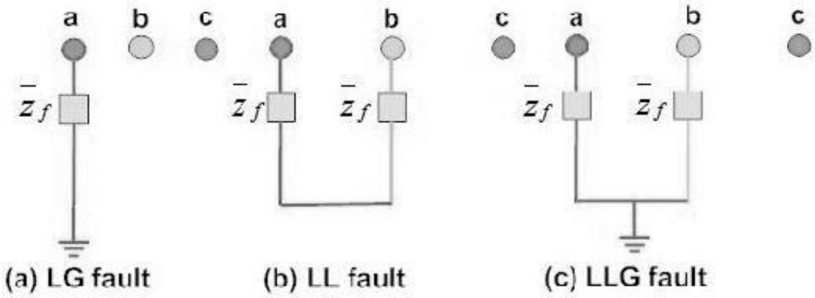

Figure 2: Asymmetrical Faults

MATERIALS AND METHODS

The electrical faults occur because of following weather conditions, equipment failures, human errors and smoke of fires. Once fault occurs it may create over current flow, danger to operating personnel, loss of equipment, electrical fires and Disturbs interconnected active circuits.

Discrete Wavelet Transform

In Figure 3, wavelet transformation, the high-pass filter is being used to evaluate high frequency information of signal and low frequency. Low-pass filter content analyzed. It performs two stages of decomposition. The signal during the first stage was decomposed into cA1 and cD1 with this kind of frequency band among 0-fs/4 and fs/4-fs/2 during which fs is called sampling frequency. cA1 is broken down to give rise to cA2 and cD2 discretely, in the second stage decomposition. The cD2 part band frequency is fs/8-fs/4, and 0-fs/8 for cA2. Upon decomposition the energy can be calculated from the detailed coefficients expressed in mathematical equations as below:

$$E(t_a, t_b) = \int_{t_a}^{t_b} (|y(t)|)^2 dt \quad \ldots\ldots \quad (1)$$

Where,

y(t) represents the signal,

E = Time interval of energy (ta, tb)

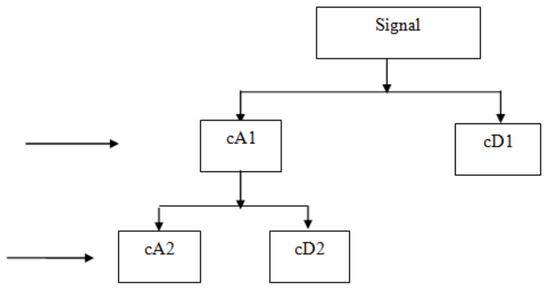

Figure 3: Discrete Wavelet Transform

ARTIFICIAL NEURAL NETWORKS

The Figure 4, network generally comprises of 3 layers, such as input, output, intermediate layer or the hidden layer shown in Fig.4. Each of these layers is made up of artificial neurons form wide network of neurons. Weights assigned the interconnection indicate strength of signal. Depending on the back - propagation algorithm, those weight values are modified.

Voltage and current values for the corresponding 3 stages are dissimilar and remain controlled through the fault category. Fault classification thus necessary a neural network that enables to identify type of fault from trends of voltages and currents produced from principles are calculated after a single terminal, electrical power system's three-phase transmission system. The neural network is calculated by sum 3 input quantities, i.e. the three-phase current etc. Using such six inputs, the neural network remains equipped. The number of total neural network output are in three stages A, B, C and four are grounded on three stage transmission networks. As we discussed protection and prevention of transmission line is most important work in order to safeguard electric the power systems. Hence, detection of faults in transmission lines, classified, and located accurately. Immediate action should be taken in very short duration whenever fault occurs. The proposed methods are based on the use of neural network and implementation of digital signal processing concepts.

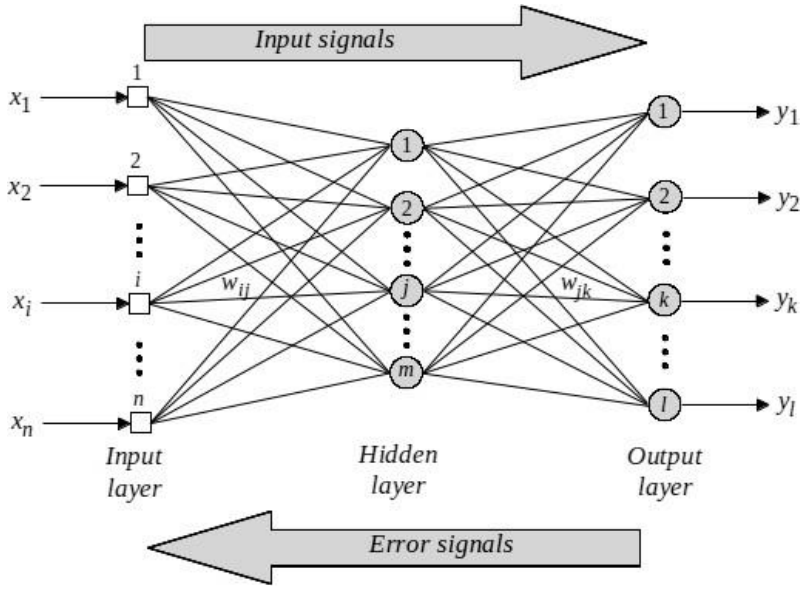

Figure 4: The Structure of BPN

SIMULATION RESULTS AND ANALYSIS

Over long distance power transmission normally high voltages are used. In our country standard voltages are used for power transmission over long distance. Moreover, cost is the main constraint for those transmission in terms of power lines, circuit breakers, insulators and transformers etc. In high voltage transmission those equipments cost are very high in the range above 230 KV. Using low power voltages, it is worth to check whether the required power can be transmitted. The different countries are following some standard voltage rating like 11 kV, 22 kV, and 33 kV for short lines, 66 kV and 110 kV for medium lines and 132 kV, 166 kV, 230 kV and above for long lines. Test data was obtained from MATLAB/ Simulink modeling, using 70-percent sample data and 30- percent testing dataset. Throughout comparison with WT, ANN has contributed to finding solutions with the power system, including such load estimation, error detection, fault diagnosis and structure. WT is also used for this method by converting the currents and voltage signals to find fault, artificial neural network identifies fault depending on the dissolved wavelet transform input signal. The normalized Voltage (v) and Current (i) are used as signals for the fault detection module and those signals samples are used for a fault location classification module. The results are shown in Figures 6 to 13.

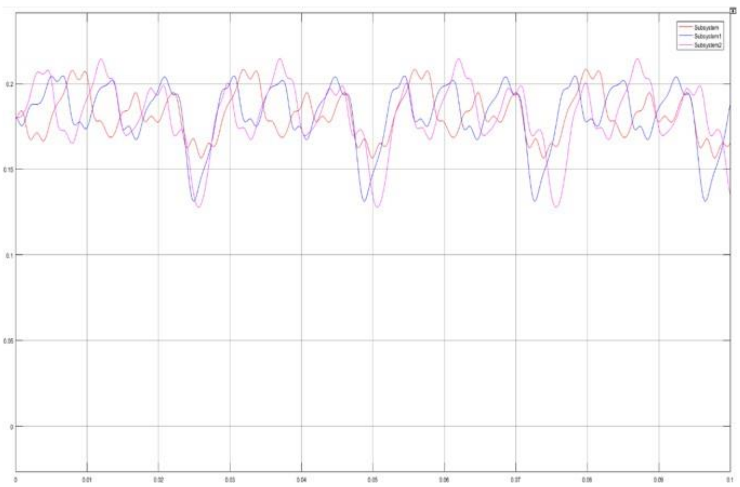

Figure 6: NO Fault

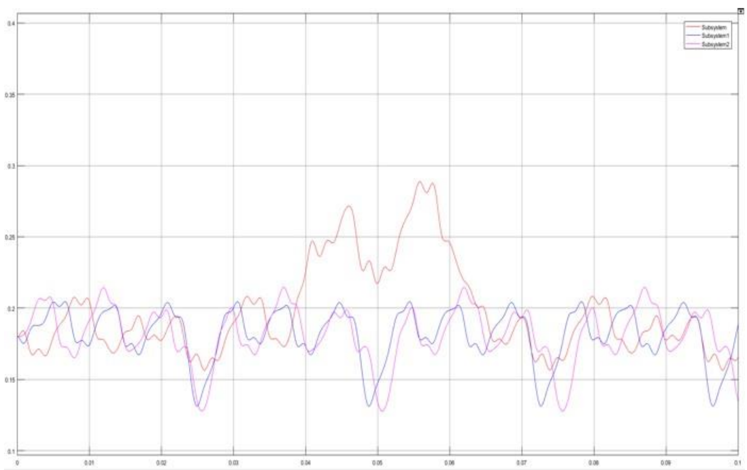

Figure 7: AG Fault

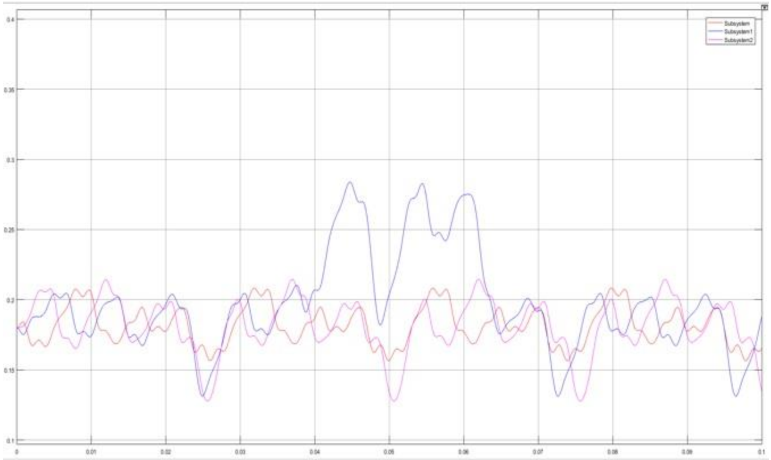

Figure 8: BG Fault

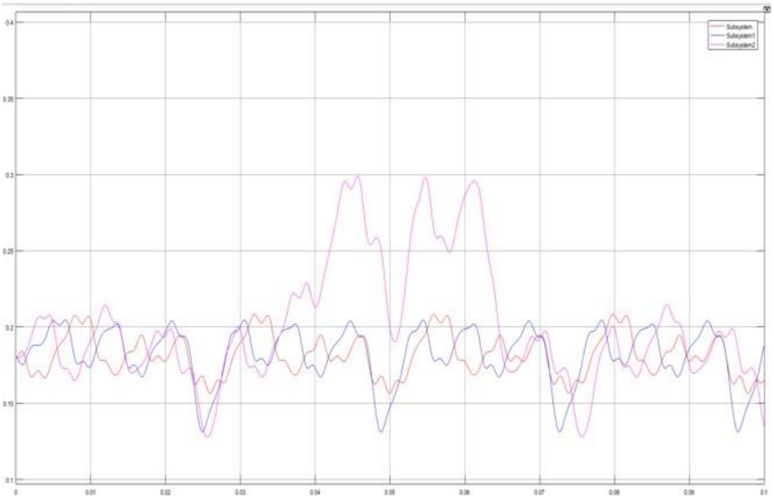

Figure 9: CG Fault

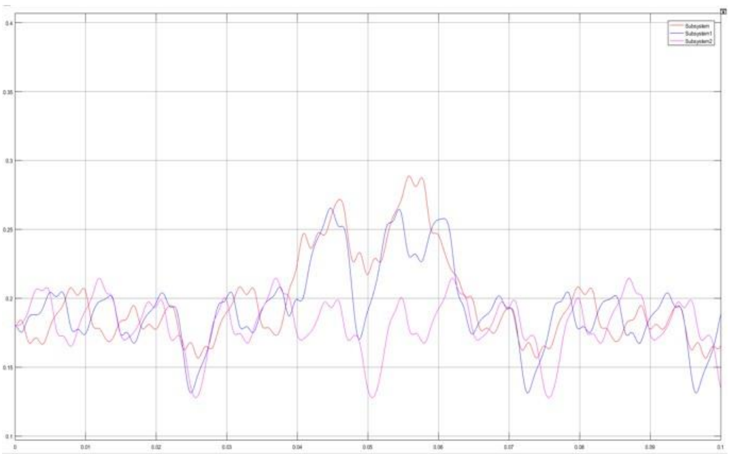

Figure 10: AB Fault

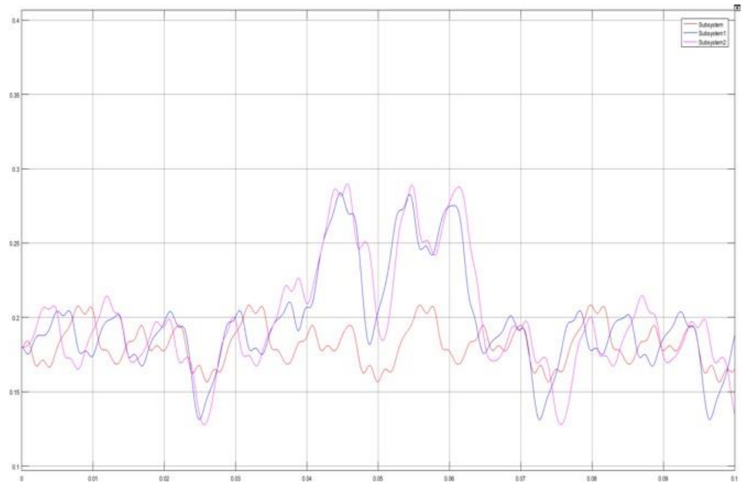

Figure 11: BC Fault

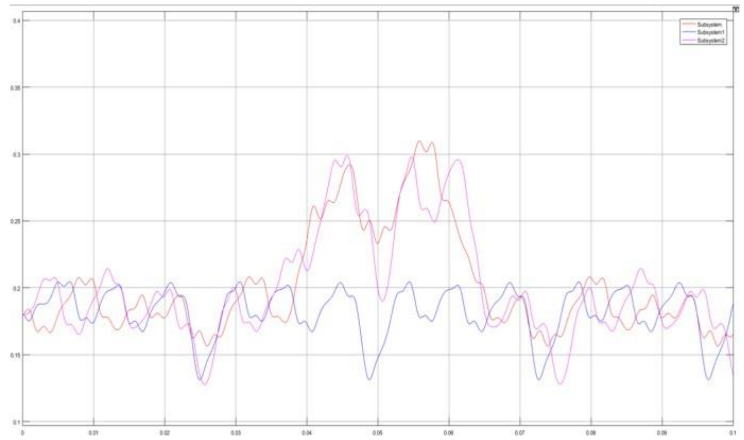

Figure 12: AC Fault

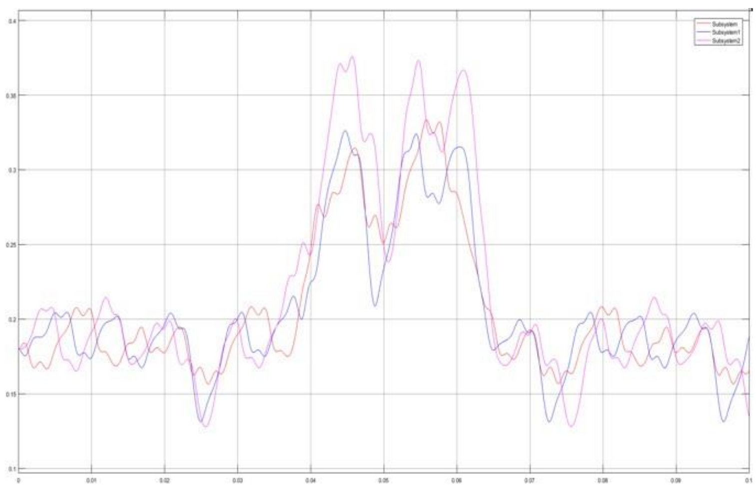

Figure.13: ABC Fault

It is observed from the above results during the fault voltages and currents more oscillations and it takes more time for settled. By using DWT with neural network based BPN technique is used to mitigate the voltage and current harmonics.

CONCLUSIONS

Different Faults are in the transmission lines and are affected by one of the elements that the reliability of the system. If the faults are increased it may reduce the reliable the system. Also it may disturb the service. The result of the experiment illustrates which all have proposed neural networks have achieved the satisfactory performance and are practically implementable. In this work, importance has been placed on the necessity of selecting the correct ANN model to get the maximum network output.

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