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FAULT ANALYSIS ON TRANSMISSION LINES USING ARTIFICIAL NEURAL NETWORK

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ABSTRACT

The transmission line among the other electrical power technique component suffers from unexpected failure due to various random causes. The transmission line is quite large as it is open in the environment. The fault occurs on transmission line when two or more conductors come in contact with each other or ground. This paper presents a proposed model based on MATLAB/SIMULINK software to detect the fault on transmission line. The output of the system is used to train an artificial neural network to detect the transmission line faults. The fault detection has been achieved by using artificial neural network.

KEYWORDS: Transmission line, Faults, Protection, neural network.

INTRODUCTION

Transmission line is the most likely element in the power scheme to be exposed especially when its physical dimension is taken into consideration. This paper has concentrated on understanding the behaviour of the transmission line phase voltages and currents scheme as a consequence of faults. The objective of this work is to study and employ neural network (NN) method as a reliable tool to identify or detect faults in a transmission line scheme Artificial neural network (ANN) is a powerful method to be used in transmission line fault identification, isolation and classification. The parallelism inherent in neural networks (NN) enables them with faster computational time than the traditional techniques. Using this technology in transmission line fault diagnosis validates its utility and encourages engineers to use this technique in other power systems. The main objective of this paper is to develop neural network based autonomous learning scheme that acquire knowledge incrementally in real time, with as little supervision as possible and to deploy effective strategies for practical application of such scheme for fault identification and diagnosis. In protection of transmission line the fault identification, classification and location plays an important role.

Due to the limited available amount of practical fault data, it is necessary to generate examples of fault data transmission using simulation. To generate data for the typical transmission system, this paper observed the values of the fault voltage and current for all types of transmission line fault. The output of this paper is used to generate simulation fault data for the model of transmission line in normal and faulty condition to detect the fault.

The neural network represents a network with a finite number of layers consisting of solitary elements that are similar to neurons with different types of connection among layers. The number of neurons in the layers is selected to be sufficient for the provision of required problem solving quality. The number of layers is desired to be minimal in order to decrease the problem solving time. Basically, we can design and train the neural networks for solving particular problems which are difficult to solve through the human beings or the conventional computational algorithms. The computational of the training comes down to the adjustments of certain weights which are the key elements of the Artificial Neural Network. This is one of the key differences of the neural network approach to problem solving than conventional computational method. This adjustment of the weights takes place when the neural network is presented with the input data records and the corresponding target values. In the possibility of training neural networks with off-line data, they are found useful for power system. The neural network (NN) applications in transmission line protection are mainly concerned with in improvements in achieving more effective and efficient fault diagnosis and distance relaying. NN application can be used for overhead transmission lines, as well as in power distribution systems. Back propagation neural network approach is studied and implemented. The voltage and current signals of the line are observed to perform these three tasks. The detailed coefficients of all phase current that are collected only at the sending end of a transmission line are selected as parameters for fault detection classification. The transmission line models are constructed and simulated to generate information which in that case channeled using the software MATLAB and accompanying Power System Block Set.

ARTIFICIAL NEURAL NETWORK (ANN)

Artificial Neural Networks, or simply called neural networks, use the neurophysiology of the brain as the basis for its processing model. The brain consists of millions of neurons interconnected to each other through the synapse. In the learning process, weight of the synapse is increased, decreased or unchanged.

This operating procedure should be contrasted with the traditional engineering design model, made of exhaustive subsystem specifications and intercommunication protocols. In Artificial neural networks (ANN), the designer chooses the network topology, the performance function, the learning rule, the criterion to stop the training phase, but the system automatically adjusts the parameters. So, it is difficult to bring a priori information into the design process, and when the system does not work properly, it is also hard to incrementally refine the solution. ANN-based solutions are extremely efficient in terms of development time and resources. In many difficult problems artificial neural networks (ANN) provide performance that is difficult to match with other technology. Denker 10 years ago said that "artificial neural networks are the second best way to implement a solution" motivated through the simplicity of their design and because of their universality, only shadowed by the traditional design obtained through studying the physics of the problem. At present, artificial neural networks are emerging as the technology of choice for different applications, such as pattern recognition, prediction, and control and system identification.

A. Neuron Model

Neuron is modeled as follows.

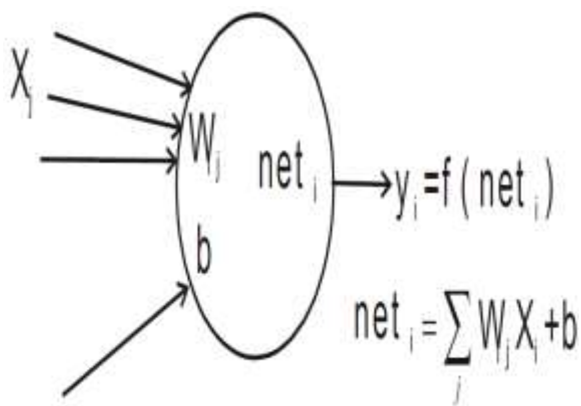

Fig: 1 Neuron Model

Each node has inputs connected to it and weights corresponding to each input data. Each node only has one output. The above neuron, based on the above notation, is called neuron i. j inputs Xj and one bias b. Each input correspond to a weight Wij, thus there are j weights in the neuron. Output of the neuron y_i is produced by a function of net_i where

$$net_i = \sum_j W_{ij} X_i + b$$

This function is called activation function. There are many types of activation functions; two examples are hard limit and log-sigmoid functions.

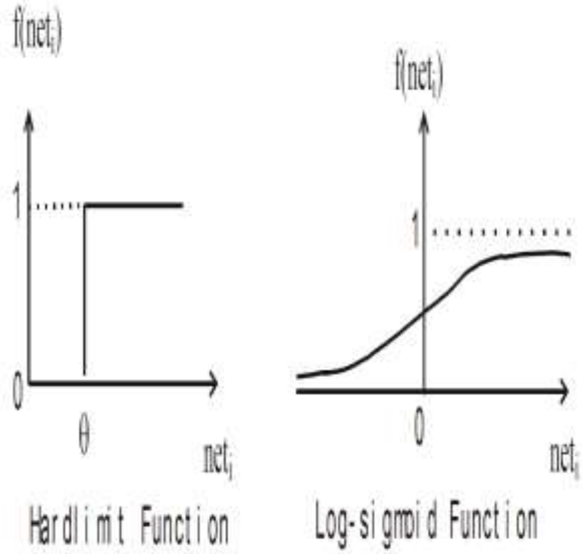

Fig: 2 Activation Functions

Hard limit function is defined as

$$f(\mathrm{net_i}) = \begin{cases} 0 & \mathrm{net_i} < \theta \\ 1 & \mathrm{net_i} \geq \theta \end{cases}$$

$$F[\mathrm{net_i}] = \frac{1}{1 + e^{-\mathrm{net_i}}}$$

PROPOSED FAULT DETECTOR AND LOCATOR BASED ON NEURAL NETWORKS (NN)

Major functional blocks of the proposed fault detector and locator are shown in Fig. 3. Voltage and current signals at the transmission line end S will be acquired by the relay through CTs and VTs. After preprocessing, they will be fed to the FD (fault detector) to detect a fault, and if the fault is detected, the fault locator estimates the distance to the fault in the transmission line.

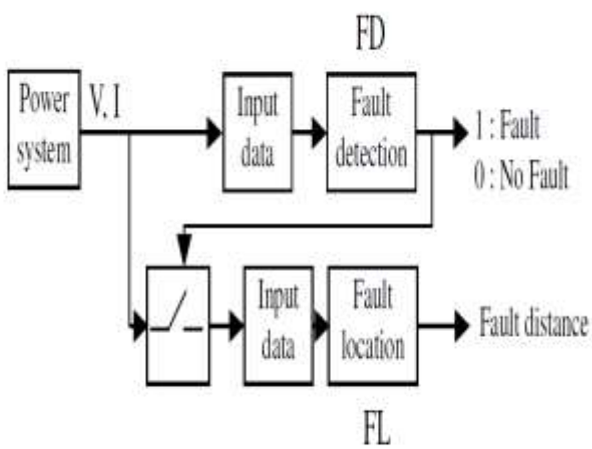

Fig: 3 Major blocks constituting the fault detector and locator.

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The proposed fault detector (FD) is designed to indicate the presence or absence of a fault. In the occurrence of the fault, it is determined by identifying the power system state directly from instantaneous current and voltage data. The fault locator (FL) is designed to estimate the distance of the fault detector in the transmission line using the fundamental phasor magnitude of the voltage and current signals. The fault detector and the fault locator uses only one terminal line datum extracted at the relay location (S).

DESIGN OF FAULT DETECTION AND CLASSIFICATION SYSTEM

The design process of proposed fault detection and classification approach is as follows,

- Creating data acquisition of current and voltage signals in the power system.
- Changing the system parameters, data acquisition of current and voltage signals and storing and analyzing results.
- Application of D.W.T on the current signals and calculating in detail the coefficients of energy.
- Selection of suitable ANN topology for given application.
- Training of artificial neural network and validation of the trained ANN using test patterns to check its correctness and generalization.

The combination of different fault conditions are to be considered and training patterns are required to be generated by simulating different kinds of faults on the power system model. The fault resistance, fault location, and fault type are changed to generate different training patterns.

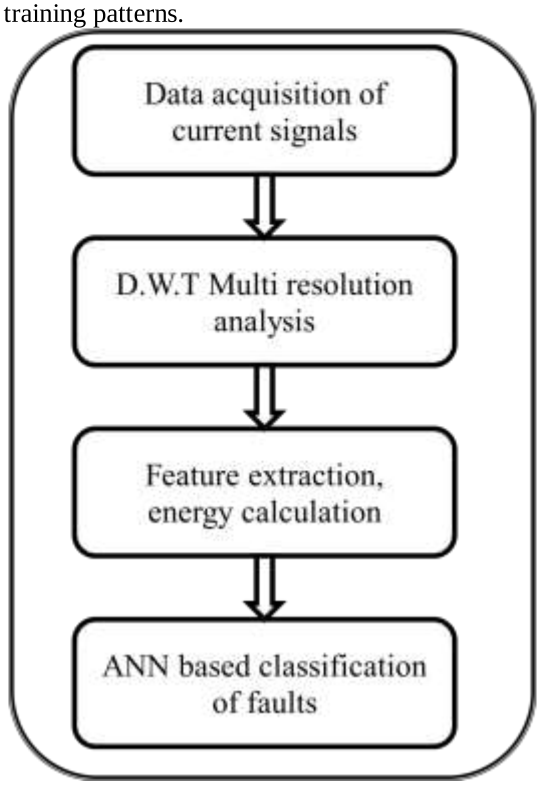

Fig: 4 Process of fault detection and classification.

RESULTS AND DISCUSSION

The principle of variation of voltage and current signals before and after the fault incidence is used and a fast and reliable ANN-based fault detector/classifier module is designed to detect the fault and classify the fault type.

A validation data set consisting of different fault types was generated using the power system model.

Table. 1Diffrent Fault Type Data

Fault type	P		Q	
	Maximum	**Minimum**	**Maximum**	**Minimum**
ag	1.5431	0.5361	9.9341	0.7440
bg	1.5360	0.5341	9.8961	0.7405
cg	1.5397	0.5336	9.9154	0.7406
ab	3.8933	1.2584	16.7097	2.5648
bc	3.8970	1.2597	16.7754	2.6058
ac	3.8856	1.2553	16.6143	2.5835
abg	4.4724	1.7914	21.5815	2.6700
acg	4.4732	1.7940	21.5810	2.6738
bcg	4.5223	1.7997	21.8823	2.7214
abc	11.8804	2.5437	30.5240	7.3863

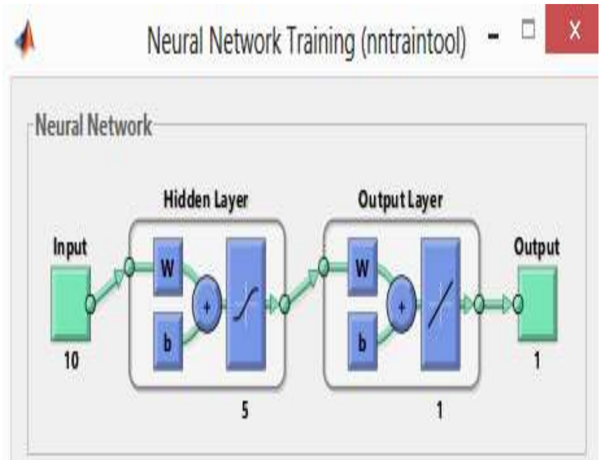

Fig: 5 Neural Network Training Block

Waveforms of Trained ANN.

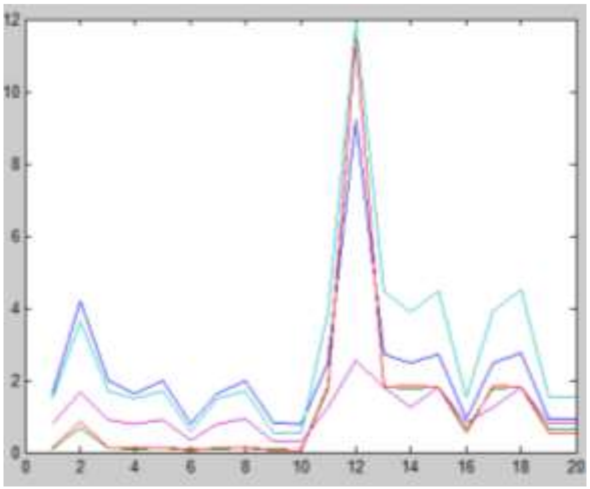

Fig: 6 Waveform Of P

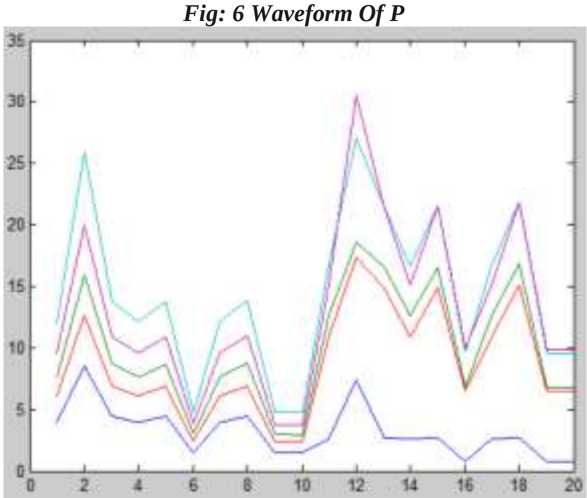

Fig: 7 Waveform of Q

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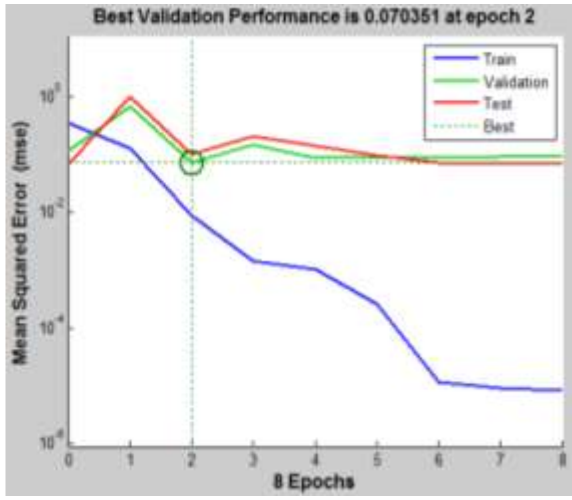

Fig: 8 Performance of ANN

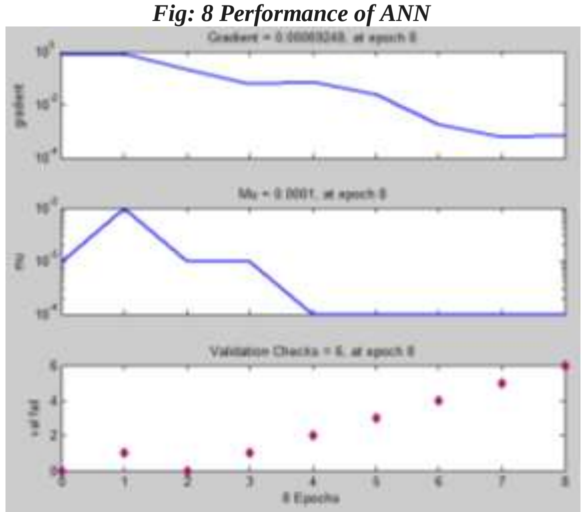

Fig: 9 C5 ANN Training State

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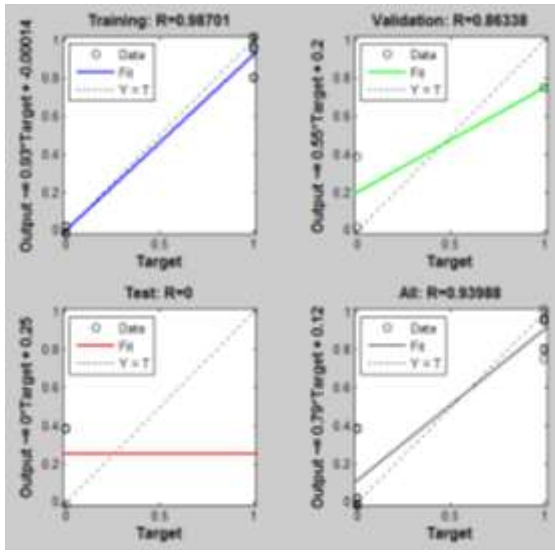

Fig: 10 ANN Training Regression Plot

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