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Intelligent Transmission Line Fault Diagnoser

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ABSTRACT: Early diagnosis of fault that might occur in the supervised process renders it possible to perform important preventing action. Neural network can filter out noise and disturbance. It can provide stable, highly sensitive & economic diagnostics of faults without any past traditional methods. In this paper for fault diagnosis model based concept is used. Main advantage of model based fault diagnosis technique is to generate signals that reflect inconsistence between nominal and faulty system operation condition.

KEYWORDS: diagnosis, neural network, inconsistence, faults.

I.INTRODUCTION

In power system the main important component is transmission line which links the generating and distribution station. Transmission line transmit power over a given the required distance and satisfy the electrical and mechanical requirement. It would be necessary to transmit certain amount of power as a given power factor over a given range and be within the limit of given regulation. Among the other electrical component transmission line are suffer from unexpected failure due to various causes [1]. The probability of fault occurring in transmission line is quite large at it is open in environment. For protection against fault in transmission line relays and circuit breakers are used. Transmission line protection mainly depends on active tripping of circuit breaker at the time of fault. This operation of circuit breaker is controlled by a series of protective relay. The quick and precise operation is required to prevent the malfunctioning of the system. With the rapid development of power electronics technology, fault detection and localization are the focus of research efforts in the area of transmission and distribution system. Because faults in electrical power systems cannot be avoided, enough information provided from the fault analysis is needed to recognize the cause, and interpret the broken down system. It is also needed to restore as soon as possible the transfer of power, in addition to learning more about the system and aim to reduce the occurrence of future faults if possible. Circuit breakers and other control components are designed to help protect the relay and to take appropriate action and thus minimizing power loss and length of power disruption.

In electrical power system control centers, a great amount of information and data are collected from the transmission lines. Fault signals must be detected and classified in real time and accurately in order to protect the whole system. The related signals have to be received and processed by the operators in the control center. An effective and accurate mathematics based program and process is usually in place to help the operators to detect, classify, locate, and isolate faults in the transmission system once one occurs. The general procedure followed is based on preset threshold values according to the fault signal values of current and voltage. When a fault occurs, the transient DC offset and high-frequency transient components will be extracted along with the power frequency components from the fault current and voltage signals. The fault current and voltage vary with fault type, location, size of the fault, and the fault inception angle and other system conditions. These variations cause space to be non-linearly separable and no threshold values can be found that satisfy the various system and fault condition. Furthermore, when faults take place, the faulted phases have an effect on the healthy phases due to mutual coupling between these phases.

II. ARTIFICIAL NEURAL NETWORK

An ANN is information processing system that has certain performance characteristics in common with biological neural network. Artificial neural network have been developed as generalization of mathematical models of human cognition or neural biology, based on the assumption that [3].

- Information processing occurs at many simple elements called neuron.
- Signals are passed between neurons are connection links.

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The great majority of digital computer is used today are based around the principle of using one very powerful processor through which all computation are channelled. As digital or modern computers become even more powerful, scientist continue to be challenged to use machine effectively for tasks that are relatively simple for humans. The powerful processor is called von Neumann architecture, John von Neumann, one of the pioneers of modern computing [4]. The power of such a processor can be measured in terms of its speed (no. of instruction that it can execute in a unit of time) and complexity (the no. of different instruction that can execute).

The traditional way to use such types of digital computers has been to write precise sequence of steps (a computer program or an algorithm) to be executed by the computer. This is the algorithm approach. This type of program can be written in different computer language, where high level language will have commands that when transmitted to the machine level language will correspond to several instructions at the processor level [5]. In contrast of the conventional digital computer, ANN performs their computation using a large no. of very simple and highly interconnected processors operating in parallel. The representation of knowledge is distributed over these connections and “learning” is performed by changing certain value associated with such connection, not by performing. The learning methods still have to program, however and for each problem, we must choose a suitable learning algorithm but the some general approach is kept.

III. .FAULT DIAGNOSIS

Progress in the areas of communication and digital technology has increased the amount of information available at supervisory control and data acquisition (SCADA) systems. Although information is very useful, during events that cause outages, the operator may be overwhelmed by the excessive number of simultaneously operating alarms, which increases the time required for identifying the main outage cause and to start the restoration process. Besides, factors such as stress and inexperience can affect the operator’s performance; thus, the availability of a tool to support the real-time decision-making process is welcome [7].

The protection devices are responsible for detecting the occurrence of a fault, and when necessary, they send trip signals to circuit breakers (CBs) in order to isolate the defective part of the system. However, when relays or CBs do not work properly, larger parts of the system may be disconnected. After such events, in order to avoid damages to energy distribution utilities and consumers, it is essential to restore the system as soon as possible. Nevertheless, before starting the restoration, it is necessary to identify the event that caused the sequence of alarms such as protection system failure, defects in Communication channels, corrupted data acquisition [8].

The main advantage of neural network is its flexibility with noisy data and its main drawback is long time required for training feed forward network with back propagation training algorithm, especially when dimension of the power network is high. To short the training time using these substitute methods proposed: the general regression neural network (GRNN) in feed forward topology, the probabilistic neural network (PNN), adaptive neuro fuzzy methods and the selective back propagation algorithm.

IV. METHODOLOGY

Artificial neural networks have been used for the protection of power transmission lines. The excellent pattern recognition and classification abilities of neural networks have been cleverly utilized in this paper to address the issue of transmission line fault location. In this paper complete neural-network based approach has been outlined in detail for the location of faults on transmission lines in a power system. To achieve the same, the original problem has been dealt with in three different stages namely fault detection, fault classification and fault location.

A 11 kV transmission line system has been used to develop and implement the proposed strategy using ANNs. Fig 1.1 shows a one-line diagram of the system that has been used throughout the research. The system consists ofone synchronous machine and one generators of 500 kV located on ends of the transmission line along with a three phase fault simulator used to simulate faults at various positions on the transmission line. This power system was simulated using the SimPowerSystems toolbox in Simulink by The MathWorks. A snapshot of the model used for obtaining the training and test data sets is shown in Fig. The three phase V-I measurement block is used to measure the voltage and current samples at the terminal A. The transmission line (line 1 and line 2 together) is 300 km long and the three-phase

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fault simulator is used to simulate various types of faults at varying locations along the transmission line with different fault resistances.

The values of the three-phase voltages and currents are measured and modified accordingly and are ultimately fed into the neural network as inputs. The SimPowerSystems toolbox has been used to generate the entire set of training data for the neural network in both fault and non-fault cases.

Faults can be classified broadly into four different categories namely: line to ground faults, line to line faults. double-line to ground faults, three-phase faults There have been 1100 different fault cases simulated for the purpose of fault detection, 1100 different fault cases simulated for fault classification and varying number of fault cases (based on the type of fault) for the purpose of fault location.

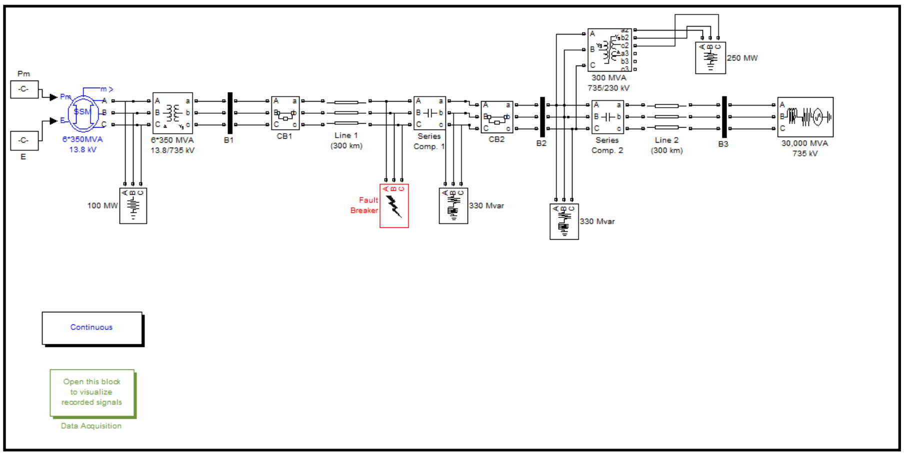

Fig.1 Simulated model of transmission line network

Fig.1 shows the simulated model of transmission line with use of MATLAB. In MATLAB sim power system toolbox is used for modelling a transmission line network.

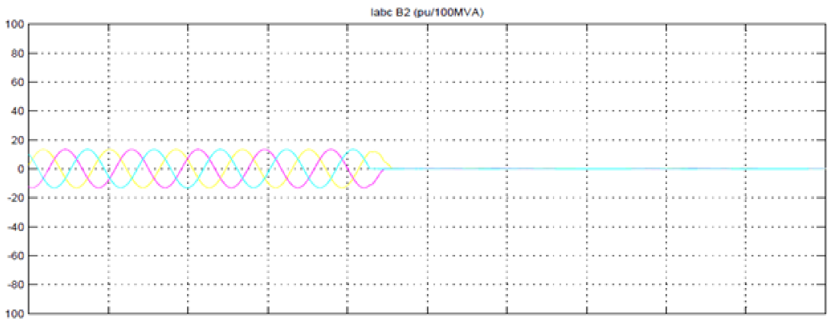

Fig. 2 Current waveform of transmission line at no fault

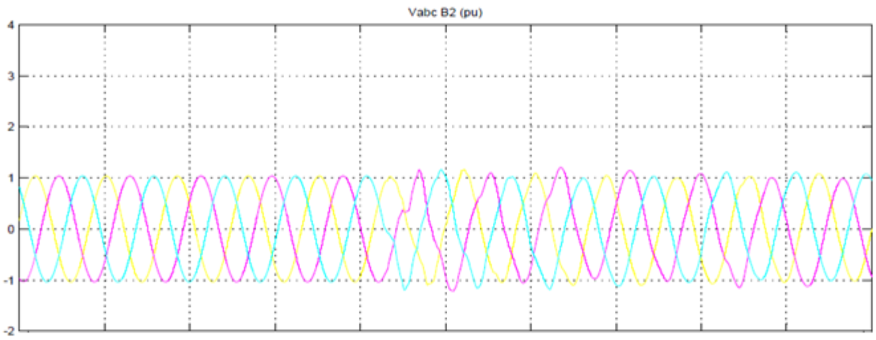

Fig. 2 Voltage waveform of transmission line at no fault

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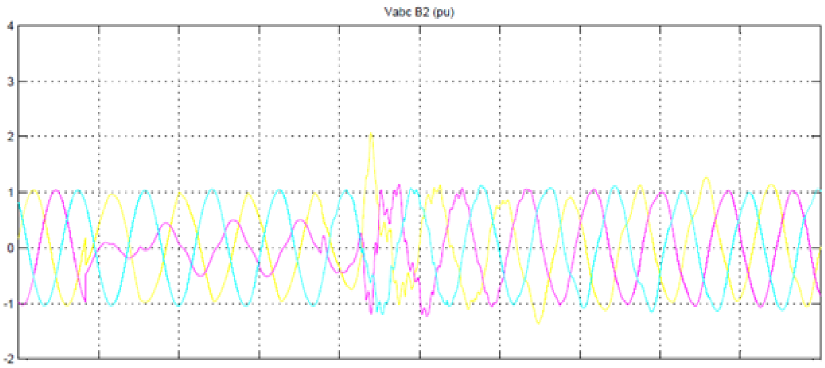

Fig. 3 Voltage waveform of transmission line at fault

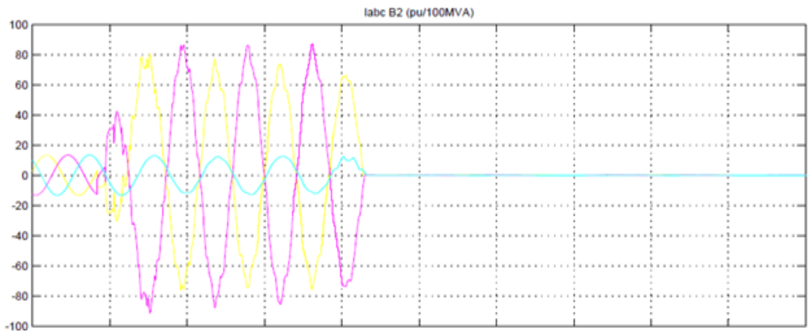

Fig. 3 Current waveform of transmission line at fault

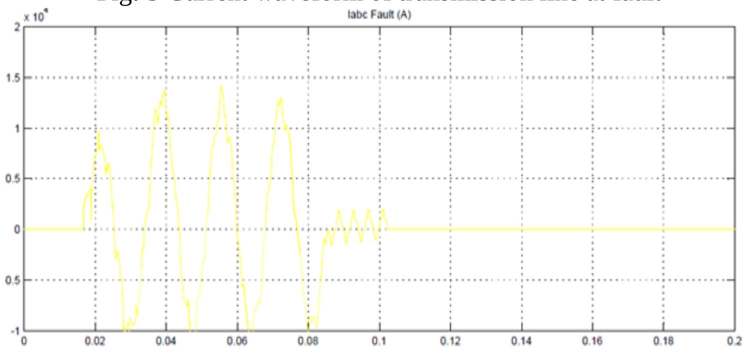

Fig. 4 Distorted Current waveform of transmission line at fault

The above Figure shows the faulted waveform when in three phase fault simulator we select the line to line fault with .25 ms time delay. In this fig waveform of voltage and current shows the faulted signal at Bus 2.

All the voltages and currents fed into the neural network are scaled with respect to the corresponding voltage and current values before the occurrence of the fault. The outputs, depending upon the purpose of the neural network might be the fault condition, the type of fault or the location of the fault on the transmission line.

For the task of training the neural networks for different stages, sequential feeding of input and output pair has been adopted. In order to obtain a large training set for efficient performance, each of the ten kinds of faults has been simulated at different locations along the considered transmission line. In view of all these issues, about 100 different fault cases for each of the 10 kinds of faults have been simulated.

Apart from the type of fault, the phases that are faulted and the distance of the fault along the transmission line, the fault resistance also has been varied to include several possible real-time fault scenario. The next important step to be performed before the application of neural networks is to test the trained neural network.

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Testing the artificial neural network is very important in order to make sure the trained network can generalize well and produce desired outputs when new data is presented to it. There are several techniques used to test the performance of a trained network, a few of which are discussed in this section. One such technique is to plot the best linear regression fit between the actual neural network's outputs and the desired targets [9]. Analyzing the slope of this line gives us an idea on the training process. Ideally the slope should be 1. Also, the correlation coefficient (r), of the outputs and the targets measures how well the ANN's outputs track the desired targets. The closer the value of 'r' is, to 1, the better the performance of the neural network.

Another technique employed to test is to test neural network is to plot the confusion matrix and look at the actual number of cases that have been classified positively by the neural network. Ideally this percentage is a 100 which means there has been no confusion in the classification process. Hence if the confusion matrix indicates very low positive classification rates, it indicates that the neural network might not perform well. The last and a very obvious means of testing the neural network is to present it with a whole new set of data with known inputs and targets and calculate the percentage error in the neural networks output. If the average percentage error in the ANN's output is acceptable, the neural network has passed the test and can be readily applied for future use.

The Neural Network toolbox in Simulink by The MathWorks divides the entire set of data provided to it into three different sets namely the training set, validation set and the testing set. The training data set as indicated above is used to train the network by computing the gradient and updating the network weights. The validation set is provided during to the network during the training process and the error in validation data set is monitored throughout the training process. When the network starts to fit the the data, the validation errors increase and when the number of validation fails increase beyond a particular value, the training process stops to avoid further fit the data and the network is returned at the minimum number of validation errors .

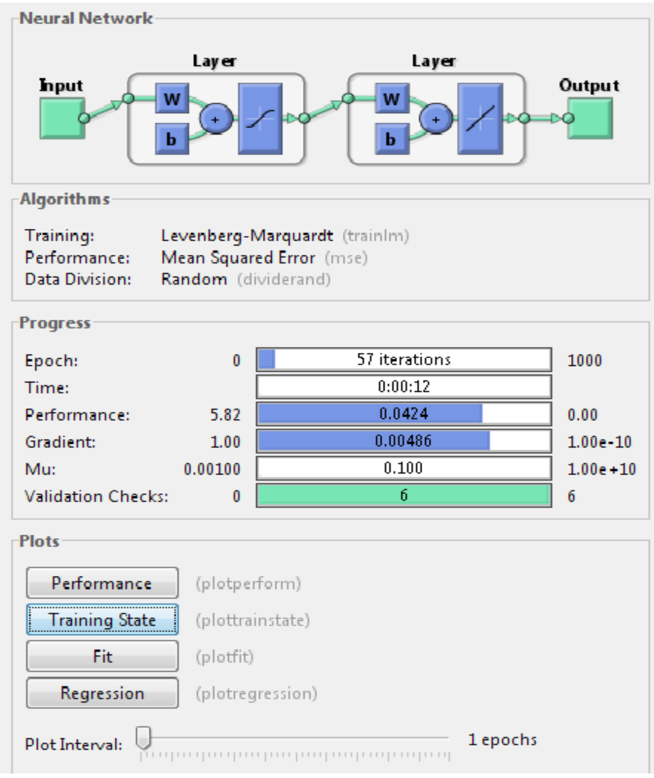

Fig. 6 neural network training

The test set is not used during the training process but is used to test the performance of the trained network. If the test set reaches the minimum value of MSE at a significantly different iteration than the validation set, then the neural network will not be able to provide satisfactory performance.

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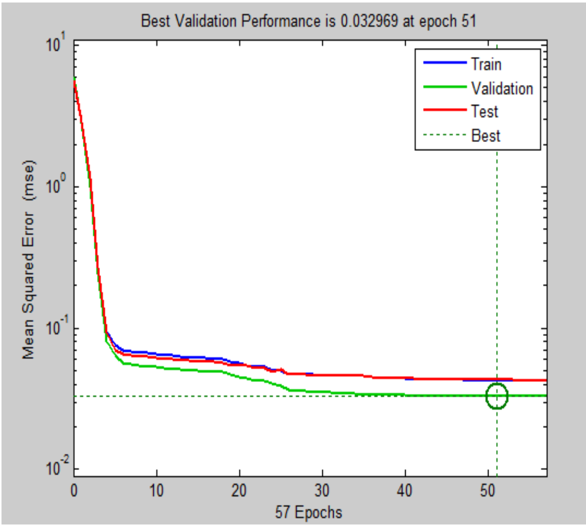

Fig. 7 Regression plot of input and target data

Fig.7 shows the regression plot of neural network as using the input data as faulted signal and target data as no fault condition of voltage and current of each phases.

V. RESULT AND DISCUSSION

Using MATLAB, simulation of transmission line is shows in paper. At both the condition no fault and with fault scope output is shown.

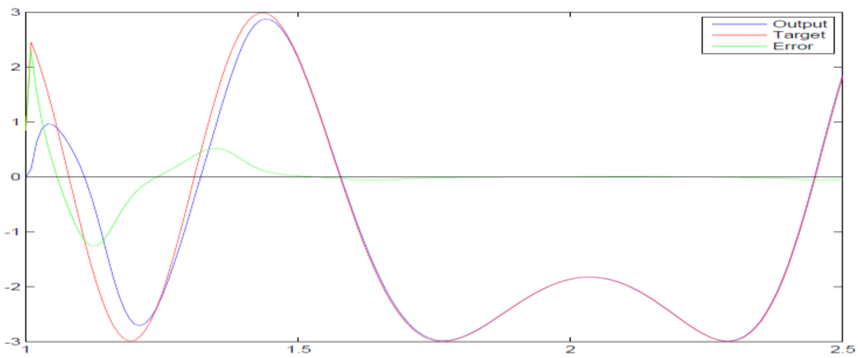

Fig. 8 plot of fault diagnosis of given network

With these data import to neural network to check the any type of fault is present or not at the line. Fig 6 shows the plot of diagnosis of line to line fault with parameters which is coded in MATLAB. Same methodology can be used in other type of transmission line fault.

VI.CONCLUSION

In this paper, artificial neural network architecture for transmission line fault diagnoser is introduced. The pattern recognition algorithm used along with the levenberg marquardt training which show that this is a promising approach to building adaptive intelligent information processing systems, which is suitable for fault diagnosis, is developed. The developed system is evaluated over a fault current signal extracted with the resolution feature description and passed to neural network model for the classification and detection of fault condition in observing power system

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