DETECTION AND CLASSIFICATION OF OPEN CONDUCTOR FAULTS IN TWO CIRCUIT PARALLEL TRANSMISSION LINE USING ARTIFICIAL NEURAL NETWORK

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Abstract: The most cost-effective way of mitigating this instability problem is to use protection scheme called ANN, to provide a protection scheme for detection and classification of open conductor fault. The main objective of this paperwork is to detect and classify they open conductor fault by designing and implementing ANN based protection scheme in the parallel transmission line. A 765 kV double circuit transmission line of 300 km length has been simulated using MATLAB@13.0.1 software. A single neural network for fault distance location for all the seven types of open conductor fault (A1, B1, C1, A1B1, B1C1, A1C1, A1B1C1) in both the circuit of a doubly fed transmission line fed from sources at both the end. This technique detects and classify and locating the various fault and is achieved after one cycle from the inception of fault.

Index Terms - Parallel Transmission Lines, Open Conductors Faults, Neural Network, Fault Detection and Classification.

I. INTRODUCTION

The most integral part in a power system is transmission conductors. The production of electricity and its usage, the transmission conductors play a most important role. A transmission lines either double circuit or single circuit configuration, mostly three-phase AC system always preferred three-phase AC supplies. Due to single phase AC circuit not able to carry more power as compared to a double phase AC circuit, so double phase circuit is huge preferred and its power carrying ability is also more and circuit redundancy level also more provided. In the single circuit, whenever fail one circuit than overall supply shutdowns, in failure one of the two circuit in the double fed line provided continuously supply. so in the modern power system, parallel transmission lines have been extensively used [1].

The possibility of a fault in the transmission line is more, due to transmission conductors Spread over a wide range and environmental different condition also exposed this Transmission conductor. In case of fault quick system restoration and minimize the damage, then Transmission lines protection is very essential [2].

Shunt and Series fault are the two classifications of fault occurred, and open conductor fault also known as a series fault, between this two fault open conductors faults is more occurs [1]. The cause of Series fault is a jumper or joint of conductor break. Sometimes circuit breakers or isolators open but fail to close in one or more phase. Conventional protection devices are not able to detect a series fault. The series open conductor fault occurs whenever an energized primary conductors break, and contacting to earth. So risks of electrics shocks are posed to the public and a fire hazard also exist [2].

In the case of Open conductor fault, it cannot be detected by the distance protection and other schemes. Consequently, whenever other protection Schemes does not detect this High impedance fault, then this fault will continue to exist. In Power System. According to they Pre fault current value, the protection System which may detect this fault is the earth relay. However, this earth fault protection Schemes equipped with transmission lines and the pre-fault current value was large enough to initiate the operation of the earth fault relay, but in the operation of earth fault relay there will be a large time delay, So this protection Schemes is actually a back up protection for high voltage transmission lines[1-3]
For they protection of parallel transmission lines various protection Schemes have been reported, to protect from Series fault. Open Conductor fault is characterized ideally by zero current but practically its some value. The various technique is reported to protect they transmission conductor for Shunt fault. But this protection technique not appropriated for Series fault. According to they literature Survey, ANN-based protection of parallel Transmission against open conductor fault, but according to the ANN. Protection techniques also not developed any protection Scheme for open Conductor fault [1].

Consequently, in the case of an open conductor, there is a lack so researches. Since no any protection relay, which respond to they this fault. And accordingly to they protection engineering and field expert believe that in case of open conductor fault no any protection devices designed or no response from protection relays when open conductor fault occurs [1-2].

In this regard, this paper presents protection techniques based on ANN – techniques for parallel transmission lines against all types of open conductors fault [A,B,C,AB,BC,AC,ABC]. In both, the circuit of a doubly fed transmission line fed from a source at both the end, and the waveform of current value (Fundamental and Instantaneously) current value. Whenever open conductor fault occurs in the transmission conductor [1].

II. ARTIFICIAL NEURAL NETWORK

A powerful tools ANN is used for the purpose of recognition of pattern and prediction certain output data for a corresponding input data. The three basic layers of the neural network is a hidden layer (can be more than one), an input layer and an output layer.

Procedure for designing, a neural network has three basic steps involved. Training, Validation, and Prediction. The Structure of the network fixing, then Selects the number of hidden layers, number of nodes in each layer and each layer activation function. If neural network through the use of Programming language then giving its initial weight and biases, otherwise giving trained, then its Validation also be done with the remaining set of data. this step is an important step since the network efficiency can be determined based on this step, if the desirable output is not achieved than network re-designed and trained again and re-validated.

In neural network, data is processed in a Sequential order and then a proper network designed, so we get desired output. Each circle in the above fig is called a node or neuron and each layer has any numbers of nodes. All Computations are done inside the nodes and then data is processed Carried forward for the next step of the computation. The activation function is a function which does the computation in each node. There are Several Activation functions, for example, Sigmoid Function,

In this fig, each node in a layer is connected to other several nodes. the nodes in the previous layer are connected to present ones using weights and biases.
Training Algorithm is another important parameter, which is used for training the network.

III. POWER SYSTEM NETWORK SIMULATION

A 765 kV system is compared by using double circuit transmission line which is 300 km in length. In this transmission, conductor Sources are connected at each end and it's a double fed transmission line. The single line diagram is shown in fig. The Thevenin’s equivalent sources are connected on the two sides of the line is considered to be 1.25 GVA.

By using MATLAB®13 software used to simulate the transmission line with distributed parameter as shown in fig.

3.3 Fault Pattern Generation and Pre-Processing

Pre-processing is a useful method that significantly reduces the size of the neural network and improves the performance and speed of training process. The current input signal was sampled at a sampling frequency of 1.2 kHz and further processed by simple 2nd-order low-pass Butterworth filter with a cut-off frequency of 400Hz. Subsequently, one full cycle Discrete Fourier transform is used to calculate the fundamental component of voltage and current. The input signal was normalized in order to reach the ANN input level (+). After pre-processing Post-fault samples are extracted from fundamental component of the phase current of each circuit to create input matrix for the training of ANN-based fault detector classifier.
VI. ANALYSIS OF FUNDAMENTAL CURRENT AND VOLTAGE

The detection of Single and three phase open conductor fault by measuring the magnitude of current in the faulty phase which is reduced to approximately zero value and voltage slightly change.

The change in the waveform of voltage during pre-fault and post-fault condition are shown in fig.

![three phase voltage wave form in healthy condition.](image)
figure 4.2. three phase current wave form in healthy condition.

figure 4.3. three phase current wave form in faulty condition.

figure 4.4. single phase current wave form in faulty condition.

INSTANTANEOUS VOLTAGE AND CURRENT

The change in the wave form of voltage during pre-fault and post fault condition are shown in fig
V. CONCLUSIONS

This paper proposes an accurate approach for fault detection and classification of open conductor fault in parallel transmission line based on supervised feed neural network. A transmission line fed from sources at both ends is used. Various types of open conductor fault, under varying fault condition such as the location of fault from relaying point (2km to 300), The approach employs the fundamental components of the phase current of the parallel transmission line at one end only. The performance of the proposed scheme has been investigated by a number of tests. The simulation result confirms the suitability of proposed protection scheme.

REFERENCES


