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ABSTRACT

Faults can occur in any components of power system including generator, transformer, buses and transmission lines. The transmission line is one of the main component of power system and being exposed to the environmental conditions, the possibility of experiencing faults on the transmission system is generally higher than that on other components, therefore the detection of faults on transmission lines is the primary concern, necessitating high speed fault clearance and improved transient stability. The time needed to determine the fault point along the line affect the quality of the power delivery. Therefore, to maintain the efficient and reliable operation of power systems, it is extremely important that the transmission line faults need to be identified and located in a reliable and accurate manner as fast as possible. A number of relevant literatures are available in which attempts have been made to identify the faulty phase and to locate fault points and faulted section of the transmission line but they have their own limitations and complexities and the results are not satisfactory due to the wide variation in operating conditions such as; fault inception instance, fault resistance, system loading level and the dc offset and harmonics contents in the transient signal of the faulted transmission line. Besides that transmission line being geographically wide distributed systems and exposed to the atmosphere there is uncertainty about the fault events and the line parameters. Therefore, in such situation, where there is ambiguity and uncertainty about the fault events and the line parameters, it is difficult to deal with the transmission lines protection problems through strict mathematical approaches (deterministic approaches) effectively.

Keeping in view of aforesaid, in the present research work, application of intelligent techniques such as fuzzy logic, artificial neural network (ANN) and generalized neural network (GNN) along with signal processing tools like discrete fourier and wavelet transforms are proposed for fault detection, faulty phase identification and for faults

classification and fault location estimation of the transmission line for the satisfactory operation of protection relays.

In the proposed research work, wavelet transform is used as a features extractor of transient signals (three phase fault current signals measured at the one terminal of transmission line) of the faulted transmission system in terms of wavelet energy, summation of detail coefficient and standard deviation because of its ability to extract time frequency information from the transient signal to detect and to identify the faulty phase and to locate the fault of a given transmission system. The task of faults classification of the transmission line is carried out extracting the features of the fault current signals using Discrete Fourier transform (DFT) at the fundamental frequency phasors of the fault current signals. The obtained features are applied as input parameters to the fuzzy logic system and output as types of fault. The proposed technique is able to identify all the ten types of shunt faults accurately and is quite effective over a wide range of fault operating conditions.

An artificial neural network (ANN) model which provides computationally efficient way of determining an empirical, possibly non linear relationship between a number of inputs and output is developed in the present work and used for fault location estimation of the transmission system. To overcome some of the problems of ANN and to improve its training and testing performance, the simple neuron is modified and a generalized neural network (GNN) model is developed, to estimate the fault location of the given transmission system.

In this study five methods such as conventional method based fault location estimation (measuring symmetrical components of voltage and current from one end of the transmission line at fundamental frequency phasors), Wavelet transform based fault detection and faulty phase identification, Fuzzy logic and discrete Fourier transform based faults type classification, wavelet-ANN and wavelet-GNN model based fault location estimation of the three phase transmission system have been investigated using MATLAB software. It is found that the distinctive characteristics features of wavelet signals detect the fault and identify the faulty phase successfully, and the fuzzy logic approach is capable to identify all the phase to phase and ground faults and the generalized neural network (GNN) is found more efficient and the better technique to estimate fault location of the transmission line as compared to the conventional mathematical model and the artificial neural network (ANN) for a wide variation of fault operating conditions and the obtained results found quite satisfactory. Moreover, GNN requires less data to analyze, therefore the time taken for identifying the location of the fault is quite less using GNN model.