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**Topic: Fault Identification in Power Systems Using Soft Computing Techniques**

## ABSTRACT

Power system is a geographically wide, complex, distributed system includes power generation, transmission and distribution. The development of electric power systems, for the past three decades has grown globally. This has resulted in a rapid increase of the electrical distribution network. Hence, the nature of distribution system has become more complex and fragile in reference of operation and faults. The total length of distribution system has also increased not globally only but in India also. Inspite of use of best technology and design of protection schemes, faults can never be ruled out in the power system. Faults may be technical or due to human error, and may take place in any part of the system. Faults in distribution lines are caused by short circuits due to falling trees, birds, storms, lightning, snow, freezing rain, insulation breakdown, short circuits and other external and internal reasons in power system. The occurrence of electrical faults leads to mechanical damage of the conductors or insulators, which must be rectified immediately before restoring the electrical power in line to service. Instantaneous and exact fault type identification plays a very important role in quick restoring of power system, reduces the system shutdown time, and significantly improves the system reliability. This thesis provides a comprehensive review of the conceptual aspects as well as recent soft computing techniques developed for fault identification and classification in power distribution system.

The first objective of the research focuses on identification and classification of faults on electric power distribution lines. Faults identification and fault classification have been achieved by using fuzzy logic and wavelet transform. The currents of three phases at distribution substation are measured and sampled for analyzing by discrete wavelet transform. The Fuzzy logic controller with rule viewer has been employed along with triangular membership function for each of the three phases in the fault identification process using normalized wavelet energy level. Analysis on fuzzy logic controller with only input line currents of the three phases are needed for fault type identification. The proposed work is implemented in the modeling of IEEE-13 bus system and on actual 11 kV distribution system of Janpur, (Madhya Pradesh, India).

In the second objective of the proposed work, to identify the type of fault an artificial neural network (ANN) soft computing technique is implemented for radial power distribution system of 11 kV, 50 Hz, Khidgaon, Madhya Pradesh, India. In this work, the three phase voltages and currents of faulted bus are taken as inputs to the neural network model. Various possible types of faults namely single line-ground, line-line, double line-ground and three phase faults have been taken into consideration and the feed forward neural network along with back propagation algorithm has been employed for training the ANN. To simulate the developed electrical distribution system model and to obtain the training data set, MATLAB has been used. In order to train and analyze the performance of the neural networks, the Artificial Neural Network Toolbox has been used extensively.

The third objective focuses on the application of Adaptive Neuro Fuzzy Inference System, commonly known as the ANFIS in identifying the type of fault. It is a form of hybrid computing methodology. That requires a thorough knowledge of nature of input variables. In ANFIS, network itself choose the suitable membership function for given input and adapt itself accordingly. The proposed method is a simple method of fault identification in distribution system, which utilizes the wavelet transform with ANFIS. In this method, only three phase current samples of source end of the distribution system for fault identification and classification are used. The proposed method employs four inputs and only one output for classification of fault. The input and output matrix is formed in the prescribed format which is suitable for ANFIS model.

The fourth objective of the proposed work focuses on identification of high impedance faults (HIFs) on electrical distribution feeder. The signal data of HIFs and normal switching events are obtained by the simulation of a radial distribution network using sim power system block set of MATLAB. These signal data are used to extract features of different transient conditions by using wavelet transform (WT). Feature vectors obtained from WT are then utilized in generalized neural network (GNN) to distinguish HIF from normal load transients. Distribution feeder of radial network consists of current detectors and voltage detectors to measure the current & voltage under different conditions. In this method only current pattern is observed in a distribution feeder to study HIFs, and normal switching characteristics. The method is implemented in two steps. The first step is feature extraction of current signal, which has been achieved by using wavelet transform and in the second step, classification of faults has been achieved by using GNN. This proposed work is implemented for modeling of IEEE-13 bus radial distribution system.