Differential Protection scheme for Power Transformer

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***Abstract*- The power transformer is one of the most vital links in a power system. Because of its relatively simple in construction, it is highly reliable piece of equipment. This reliability, however, requires proper design methodologies, annual overhauling and different protection schemes for different possible issues. Main aim is to discriminate between internal fault and external fault happening in power transformers. Internal faults are of major concern since there is always the risk of havoc. Primarily it's the magnetizing inrush current which brings instability in power system. In this paper, a review on differential protection of power transformer is given.**

***Index Terms*- Protection of Power Transformer, ANN.**

INTRODUCTION

Protection of large power transformers is a big problem in power system relaying. The protective system include devices that recognize the existence of a fault, indicates its location and class, detect some other abnormal fault like operating conditions and starts the inceptive steps of opening of circuit breakers to disconnect the faulty equipment of the power system. Since the transformer inrush current is rich in second harmonic component therefore to avoid the needless trip by inrush current harmonic restraint logic together with differential logic is used in most of the fault detection algorithm in the digital differential protection of power transformer.

Artificial Neural Networks (ANN) is extremely used particularly in the field of power system protection since 1994 as this problem is subclass of pattern recognition of current waveforms. It is to be noted that ANNs were primarily used in different areas such as pattern recognition, image processing, load forecasting, power quality analysis, and data compression. The main advantage of the ANN method over the conventional method is the non-algorithmic parallel distributed architecture for information processing and inherent ability to take intelligent decision. In recent years, few works which investigate the feasibility of using ANN for power transformer differential protection has also been reported However, the ANNs in these existing studies are specific to particular transformer systems, and would have to be retrained again for other systems. Moreover, the employed feature extraction techniques are based on either time or frequency domain signals, or not both time and frequency features of the signal; this is very important for accurately distinguishing between an internal fault and inrush current.

Differential Protection in Transformer

Principle of Differential Protection scheme is a simple conceptual technique. The differential relay compares current between primary and secondary of power transformer, if any unbalance found in between primary and secondary currents the relay will actuate and inter trip both the primary and secondary circuit breaker of the transformer.

The differential protection of transformer has many advantages over other schemes of protection. The faults occur in the transformer inside the insulating oil can be detected by Buchholz relay. But if any fault occurs in the transformer but not in oil then it cannot be detected by Buchholz relay. Any flash over at the bushings are not adequately covered by Buchholz relay. Differential relays can detect such type of faults. Moreover Buchholz relay is provided in transformer for detecting any internal fault in the transformer but Differential Protection scheme detects the same in faster way. The differential relays normally response to those faults which occur inside the differential protection zone of transformer. The differential relay is one that operates when there is a difference between two or more similar electrical quantities exceeds a predetermined value According to Kirchhoff Current Law, the resultant current flowing through the relay coil is nothing but summation of two currents, coming from two

different parts of the electrical power circuit. If the polarity and amplitude of both currents are so adjusted that the phasor sum of these two currents, is zero at normal operating condition. Thereby there will be no current flowing through the relay coil at normal operating conditions. But due to any abnormality in the power circuit, if this balance is broken, that means the phasor sum of these two currents no longer remains zero and there will be non-zero current flowing through the relay coil thereby relay being operated. In current differential scheme, there are two sets of current transformer each connected to either side of the equipment protected by differential relay.

Basics of ANN

The artificial neural network(ANN) Artificial neural network (ANN) is from the perspective of simulated neurons process information using nonlinear mapping method of brain information processing, storage and search mechanism and combining it with AI mechanism. Through connections in a number of simple elements and samples to learn, constantly adjusting weight finally getting the right results and resolve the complex equations and nonlinear problems brought by the difficulties. And ANN massively parallel processing capabilities, and ANN's large scale parallel processing ability, adaptive learning ability, using information distributed storage capacity and robustness of fault tolerance and generalization ability in fault diagnosis have important application.

Any basic neuron model as shown in Fig 3.2 can be described by a function that calculates the output as a function of N0 inputs to it.

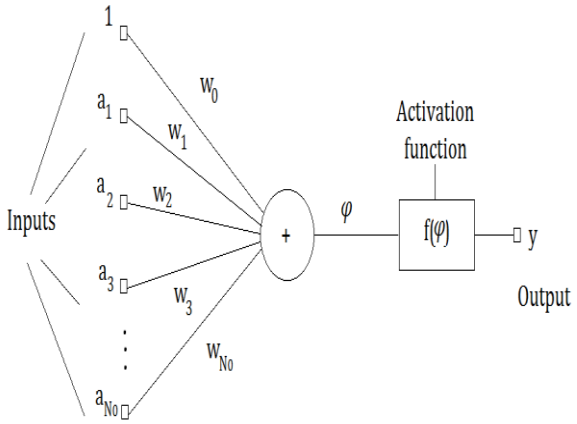

Figure 1.1 Neuron in ANN

The basic concept behind the successful application of neural networks in any field is to determine the weights to achieve the desired target and this process is called learning or training. The two different learning mechanisms usually employed are supervised and unsupervised learning. In the case of supervised learning the network weights are modified with the prime objective of minimization of the error between a given set of inputs and their corresponding target values. Hence we know the training data set which is a set of inputs and the corresponding targets the neural network should output ideally. This is called supervised learning because both the inputs and the expected target values are known prior to the training of ANN.

On the other hand, in the case of unsupervised learning, we are unaware of the relationship between the inputs and the target values. We train the neural network with a training data set in which only the input values are known.

Use of ANN in Power Transformer Protection

It has been shown that a feed forward neural network can be used to discriminate between faults and other abnormalities in power transformer protection applications. ANN classifies fault and no-fault condition accurately. The FFNN network and its training process can be implemented to enhance the performance of digital protection scheme.

Feed forward neural network (FFNN) has found wide application for detection of inrush current from internal faults but they have two major drawbacks: First, the learning process is usually time consuming. Second, there is no exact rule for setting the number of neurons to avoid over -fitting or under fitting. To avoid these problems, a Radial Basis Function Network (RBFN) has been developed. RBFs are well suited for these problems due to their simple topological structure and their ability to reveal how learning proceeds in an explicit manner.

An Artificial Neural Network (ANN) can be used as a pattern classifier for differential relay operation in the protection scheme for power transformer protection.

CONCLUSION

The protection of transformers is very important because the transformer is a very important in the power system. So, for this purpose, digital relays are

used which are fast and accurate. Unit differential relaying scheme is applied for the protection of power transformer. Moreover, ANN can be used as a classifier in differential protection of transformer due to its pattern recognition and mapping capabilities. Using ANN improves conventional differential protection of power transformer

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