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PROTECTION OF POWER TRANSFORMER FROM VARIOUS FAULTS USING ANN

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ABSTRACT

Transformer protection is critical issue in power system as the issue lies in the accurate and rapid discrimination of magnetizing inrush current from internal fault current. Artificial neural network has been proposed and has demonstrated the capability of solving the transformer Monitoring and fault detection problem using an inexpensive, reliable, and noninvasive procedure. This paper gives algorithm where arithmetical parameters of detailed d1 level wavelet coefficients of signal are used as an input to the artificial neural network (ANN), which develops in to a original approach for online exposure method to distinguish the magnetizing inrush current and inter-turn fault, and even the location of fault i.e. whether the inter-turn fault lies in primary winding or secondary winding through the use artificial neural-nets (ANNs).

KEYWORDS: ANN, MATLAB, Power Transformer, Introduction

INTRODUCTION

Power transformers are important elements of power system. So it is very significant to avoid any mal-operation of required protective system. For many years, differential protection has been used as the primary protection of power systems. It contains the differential relay, which operate for all internal fault types of power transformer and block due to inrush current. The major drawback of the branch of differential protection relays, its potential malfunction resulting from transient inrush current that flows when the transformer is energized. The input current contains a large second harmonic component. Most methods for digital transformer differential protection are based on the harmonic content of the current differential.

These methods are based on this fact that the ratio of the second harmonics to the fundamental component of differential current in inrush current condition is greater than the ratio in the fault condition. However, the second harmonic may also be generated during faults on the transformers. It might be due to saturation of CTs, parallel capacitances or disconnected transformers. The second harmonic in these situations might be greater than the second harmonic in inrush currents. Therefore, the commonly used conventional differential protection based on second harmonic restraint will face difficulties in distinguishing the input current and internal faults. Therefore, an improved technique for protecting discriminate between the input current and internal faults requires [1].

To overcome this difficulty and prevent the mal-function of differential relay, many methods have been presented to analyze and recognize inrush current and internal fault currents. As both inrush current and internal faults are non-stationary signals, wavelet based signal processing technique is an effective tool for power system analyze and feature extraction [2-6]. However, the methods based on wavelets are better able to time-frequency analysis, but usually require long data windows and are also sensitive to noise. The method presented in [6] WT and ANFIS used to discriminate internal fault from inrush current. Since the values of the wavelet coefficients in detail 5 (D5) are used for pattern recognition process, the algorithm is very sensitive to noise.

In [5] a new algorithm was presented that discriminates between the inter-turn and magnetizing inrush current failure. The algorithm uses wavelet coefficients as a discriminate function. Two peaks corresponding to l d5 l level after flash failure are used to discriminate the cases studied. As a criterion for comparison of the two peak values, therefore, are not required threshold settings in this algorithm, but we observe that in the noisy environment that is difficult to identify the correct switching moment not strategy fails.

Moreover, feed forward neural network (FFNN) [7-10] 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 [11]. 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. In some methods differential current harmonics are used as inputs to fuzzy logic [6], [12].

ARTIFICIAL NEURAL NETWORK

The application of artificial neural networks to categorize the fault has given a lot of attention recently. The simplest explanation of a neural network, more properly referred to as an 'artificial' neural network (ANN), is provided by the inventor of one of the first neuro computers, Dr. Robert Hecht-Nielsen. He defines a neural network as: "a computing system made up of a number of simple, highly interconnected processing elements, which process information by their dynamic state response to external inputs.” An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process.

ARCHITECTURE OF NEURAL NETWORKS

Neural networks are typically organized in layers. Layers are made up of a number of interconnected 'nodes' which contain an 'activation function'. Patterns are presented to the network via the 'input layer', which communicates to one or more 'hidden layers' where the actual processing is done via a system of weighted 'connections'. The hidden layers then link to an „output layer' where the answer is output as shown in Figure.

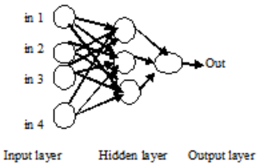


Figure 1: Architecture of ANN

PROPOSED ALGORITHM

MLP with 2 hidden neurons has demonstrated the ability to discriminate the input current internal fault current.

Weights of long-term memory are then used in the processor level to make decisions regarding the classification of inrush and faults. The process of online discrimination inrush and faults illustrated in Figure.

The method for moving out the on-line detection scheme is obtainable as under:

- Captured one cycle of primary and secondary current by data gaining system.
- Obtain differential current Id= Ip-Is
- If the RMS value of differential current value is less than threshold value, go to step 1.
- Calculate DWT of differential current whose value is above threshold value.
- Obtain statistical parameters of decomposed level d1.
- These obtained parameters are given to ANN as input data to discriminate the faults and inrush that is healthy condition.
- If ANN output is discriminate as fault, then issue trip signal otherwise proceed further i.e. monitor the differential current.

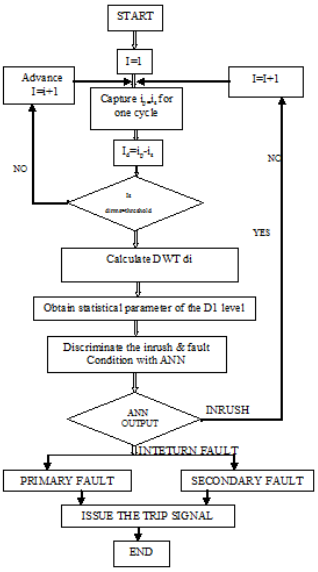


Figure 2: Flowchart for On-Line Detection Scheme

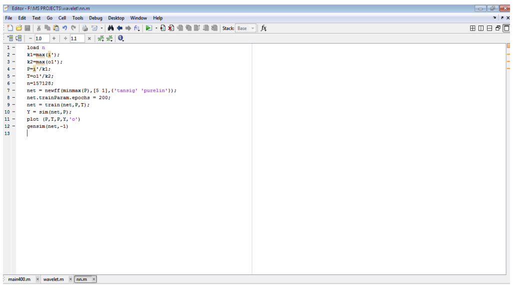
SIMULATION RESULTS

Neural networks can perform massively parallel operations. The exhibit fault tolerance since the information is distributed in the connections throughout the network. By using neural PI controller the peak overshoot is reduced and the system reaches the steady state quickly when compared to a conventional PI controller.

Program for creating the Neural Network:

```
load n

k1=max(i');
```

```
k2=max(o1');

P=i'/k1;

T=o1'/k2;

n=157128;

net = newff(minmax(P),[5 1],{'tansig' 'purelin'});

net.trainParam.epochs = 200;

net = train(net, P, T);

Y = sim(net, P);

plot (P,T, P, Y, 'o')

gensim (net,-1)
```



```
load n
k1=max(i');
k2=max(o1');
P=i'/k1;
T=o1'/k2;
n=157128;
net = newff(minmax(P),[5 1],{'tansig' 'purelin'});
net.trainParam.epochs = 200;
net = train(net,P,T);
Y = sim(net,P);
plot (P,T,P,Y,'o')
gensim(net,-1)
```

Figure 3: ANN M-File Program

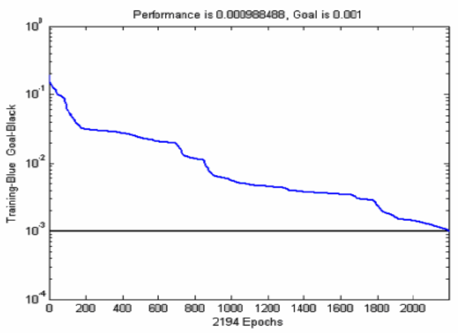


Figure 4

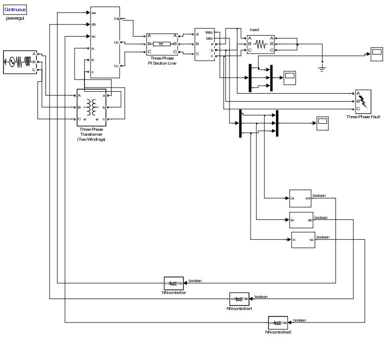


Figure 5: Simulation Model with ANN

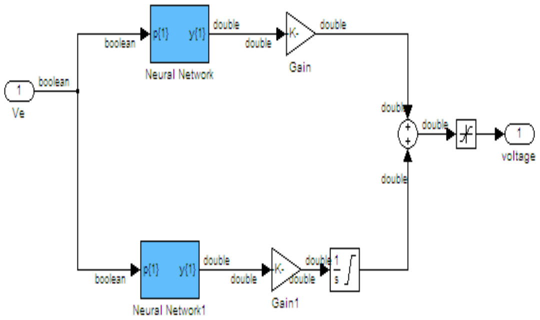
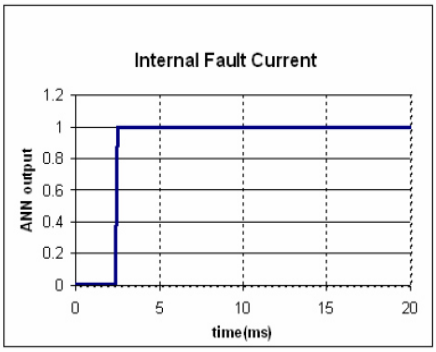
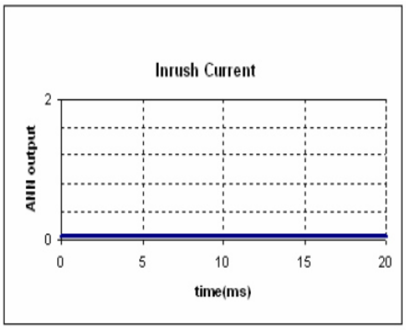


Figure 6: Subsystem Model of ANN



ANN output for internal fault current

Figure 7: Training Epochs of ANN



ANN output for inrush current

Figure 8

CONCLUSIONS

A new method for discriminating the magnetizing inrush current fault between turns of a transformer is presented. Wavelet Transform with its inherent time-frequency localization property is used to extract discriminant features of the differential current. The ANN is successful in classifying the type of event given the extracted features as input. The algorithm has been tested successfully online, through the organization of these events in the transformer to measure. These events are identified in less than one cycle after its inception. This classification can occur for situations in which the angle setting, fault resistance and other parameters are very different from those used during the ANN is learning. If this is the case, you need to add a record bad fouls ranked, a database of learning and re-train the neural network.

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