A NOVEL APPROACH TO POWER TRANSFORMER FAULT PROTECTION USING ARTIFICIAL NEURAL NETWORK

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Abstract

This paper describes a novel algorithm where arithmetical restrictions of comprehensive d1 level wavelet coefficients of signal are used as an input to the artificial neural network (ANN), which progresses into an 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 deceits in primary winding or secondary winding through the use artificial neural-network (ANNs).

Index Terms: artificial neural network, MATLAB simulation, power transformer faults, power transformer protection

I. INTRODUCTION

Protection of transformer is critical issue in power system as the issue deceits in the precise and rapid enhancement of magnetizing inrush current from internal fault current. Artificial neural network has been suggested and has revealed the capability of resolving the transformer Monitoring and fault detection problem using an economical, reliable, and noninvasive procedure.

Protective relaying principle exhibits certain limitations in applications with power transformers. This is because the detection of a differential current does not clearly distinguish between internal faults and other possible conditions. This brings the application of Artificial Intelligence methods as an alternative or improvement to the existing protective relaying functions [1].

Research work in the above areas naturally focuses on a multicriteria approach to power transformer relaying. One result of which has been the development of a general fuzzy logic based platform for a multi-criteria transformer relay that introduces several new artificial intelligence (AI) related concepts [2]. Fuzzy Logic systems (FL) are well suited for solving various decision-making problems, especially when the precise analytical model of the process/object to be tracked is not known or is very complicated (e.g. non-linear); Power Transformer protection belongs to the family of tasks that can be quite well carried out with use of FL based decision modules or classifiers [3].

II. DESIGN CONSIDERATIONS

The design of the fuzzy logic based protective relay is to overcome the three main difficulties which handicap the conventional differential protection. These difficulties induce the differential relay to release a false trip signal without the existence of any fault. The fuzzy logic based relay makes differential relaying very reliable by overcoming the following complications:

- Magnetizing inrush current during initial energization,
- CTs Mismatch and saturation,
- Transformation ratio changes due to Tap changer.

A. Artificial Neural Network

The application of artificial neural networks to classify the fault has given a lot of attention recently. The simplest illumination of a neural network, more appropriately revealed to as an 'artificial' neural network (ANN), is delivered by the inventor of one of the first neuro computers, Dr. Robert Hecht-Nielsen.

B. Architecture of Neural Networks

Neural networks are typically systematized in layers. Layers are made up of a number of interrelated 'nodes' which comprise an 'activation function'. Patterns are obtainable to the network via the 'input layer', which connects to one or more 'hidden layers' where the authentic dispensation is completed via a system of weighted 'connections'. The hidden layers then link to an „output layer' where the answer is output as shown in Figure 1.

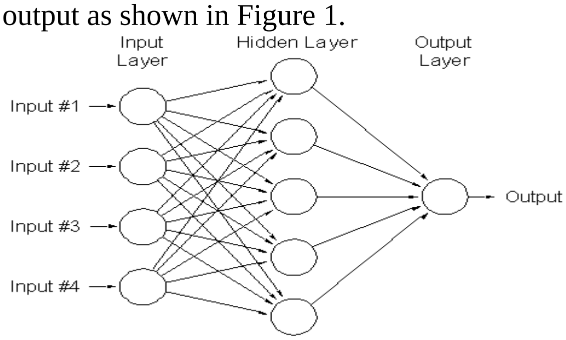


Fig. 1: Architecture of ANN

III. PROPOSED ALGORITHM

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

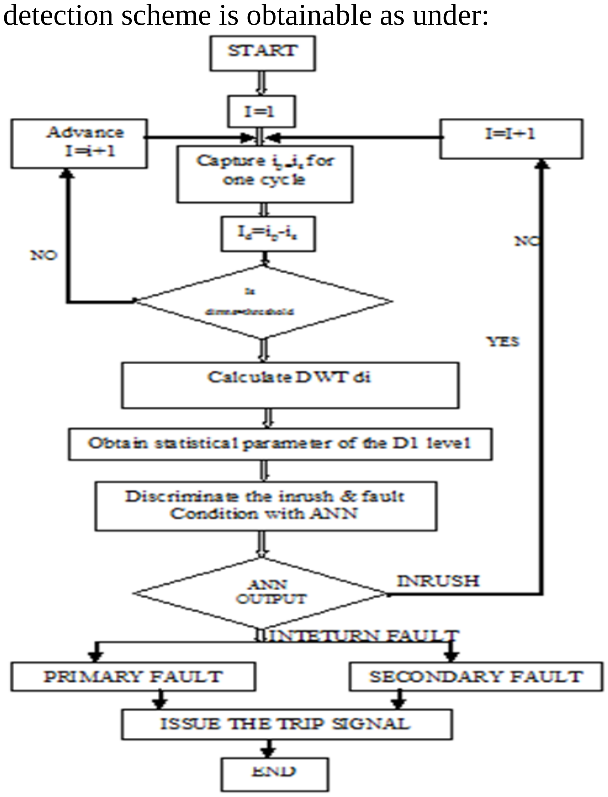


Fig. 2: Flowchart for On-Line Detection Scheme

IV. SIMULATION RESULTS

Neural networks can accomplish massively parallel operations. By using neural PI controller, the peak overrun is reduced and the scheme reaches the steady state rapidly when paralleled 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)
```

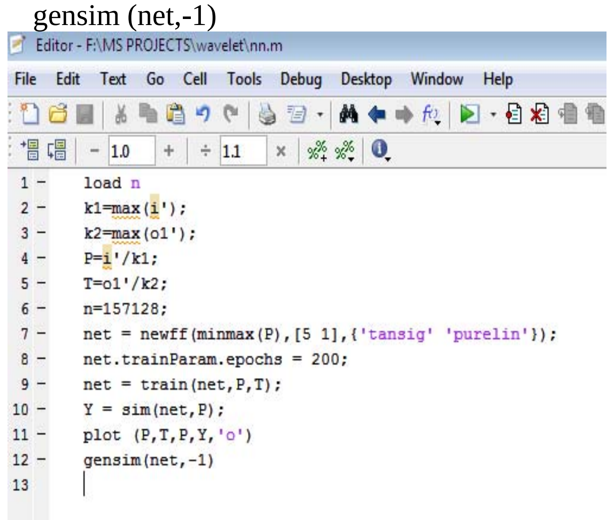


Fig. 3: ANN M-File Program

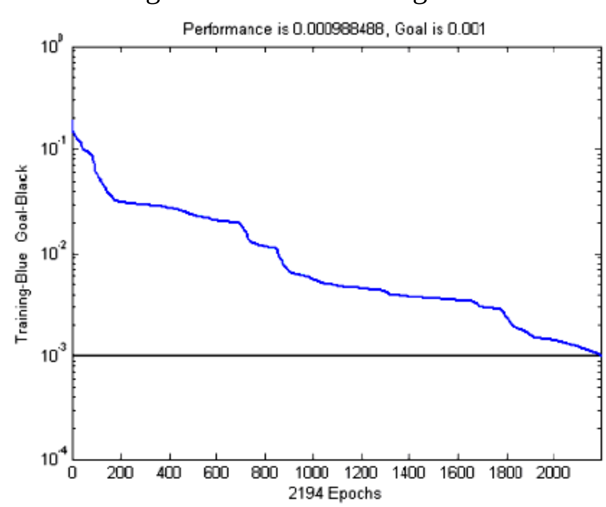


Fig. 4: Training and Performance Graph

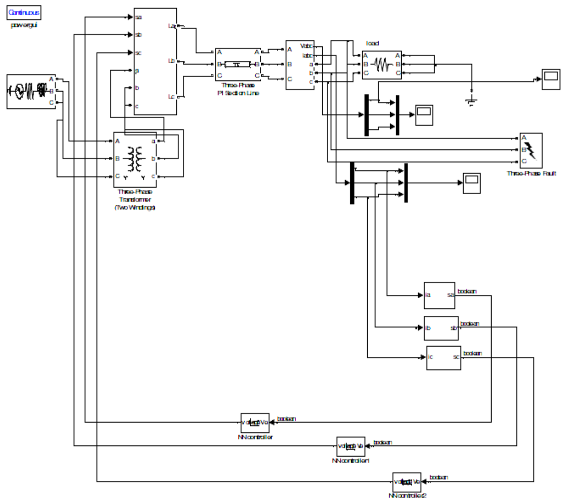


Fig. 5: Simulation Model with ANN

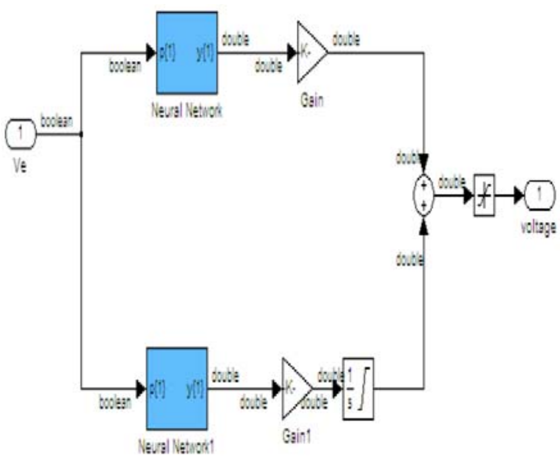
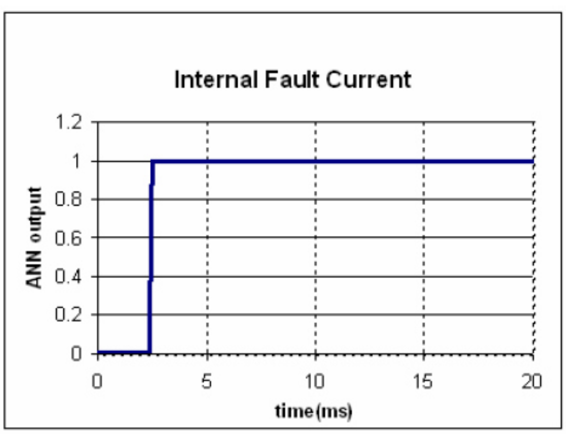
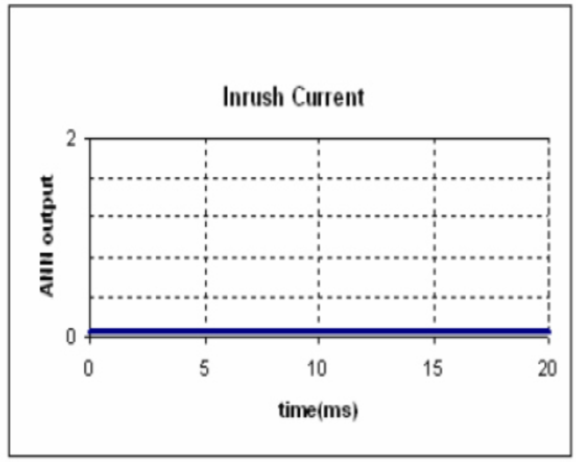


Fig. 6: Subsystem Model of ANN



ANN output for internal fault current

Fig. 7: Training Epochs of ANN



ANN output for inrush current

Fig. 8: ANN Output for Inrush Current

V. CONCLUSIONS

A new method for discerning the magnetizing inrush current fault between turns of a transformer is offered. Wavelet Transform with its inherent time-frequency localization property is used to excerpt discriminant features of the differential current. The ANN is successful in categorizing the type of event given the extracted features as input. The algorithm has been verified successfully online, through the association of these events in the transformer to measure.

These events are acknowledged in less than one cycle after its commencement. This classification can ensue for situations in which the angle setting, fault resistance and other parameters are dissimilar from those used during the ANN is learning. If this is the case, you need to add a record bad fouls rated, a database of learning and re-train the neural network

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