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Performance Neuro-Fuzzy for Power System Fault Location

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ABSTRACT

This paper is proposed for power systems fault location using Neuron Fuzzy (NF). The NF consists of approaching architecture Neural Network and Fuzzy Sets. The Neural Network is being responsible for detecting faults involving a limited number of components. The fuzzy sets represented diagram consisting of three node, that are; node1 for the system components, and node 2 for relays, node 3 for the circuit breakers. The NF uses primary and backup information to protective devices and to set generate training . The NF can be retained and estimated effectively. The software was conducted to show the effectiveness of the proposed NF is tested by using 13 bus test system.

Keywords: *circuit breaker, fault location,neuro fuzzy, power system, relay*

1. INTRODUCTION

In the electric power system most of the large number on alarms and messages were received at the control center after fault happened. This fault is adjusted in many cases, different types of fault, and also includes the system components. Protective devices are responsible for detecting and isolating part of the system fault. Restoration of systems are critical and need requires action as soon as possible. Then it is important that the fault location should be placed quickly and accurately. In the control center, operator usually has to make any conclusions from amounts of data that will take time. The application of intelligent techniques for the fault diagnosis has been proposed in several references [1, 2, 5].

The Neural Network has been successfully applied to many problems in the operation and planning in electrical power system [3, 4]. The Neural Network was faulted and on certained and very short execution time. In addition, the present Neural Network generalization capabilities that can be implemented for an invisible alarm pattern. The use of Neural Network for the overall monitoring on the electric power system in a very difficult application on area power system, if the number of input variables are big so it will be very large. This method assumes that the protection system will not fail and all the messages and alarms will be available at the control center. This situation would not have happened on area system. Testing a small system shows this method can produce good results under difficult situations such as equipment failure and data loss protection. This paper extends the concept leads to obtain more general methodology that can be applied on area power system. These methods of investigating the facts that identify the components require interruption need alarm information from a limited area in the system. Some neural classification used, each Neural Network was responsible because of monitor limits the number of system components. Decisions are introduced to achieve the ultimate goal NN for classification accuracy of diagnosis. Correctly diagnosis is obtain eviden in case of equipment failure protection, data loss, etc. The test system is proposed for testing the 13 bus systems.

2. THE NEURO-FUZZY

The Various approaches have been planned for a combined Fuzzy Sets (FS) and Neural Network (NN). This combined approach is known as Neuro-Fuzzy (NF) method. There are several categories of Neuro-fuzzy namely: based on the ability of the learner, neural network is represented by the structure diagram, fuzzyfication, Defuzzyfication [3]. Adjustment of fuzzy systems by Wang is classified in this category. The fuzzy sets with if-then rules in the trained fuzzy method of data input and output by a method similar to back propagation neural network. The rules of fuzzy if-then in the real value in the fuzzy system can be trained with a minimum service to calculate the suitability of fuzzy If-then rules [4].

There are used two methods in the writing of this article, which is a combination of neural network and fuzzy Sets.

2.1 Fuzzy Sets

A fuzzy method represented by diagram consisting of three nodes are: node1 for the system components, and node 2 for relays, node 3 for the circuit breakers. Diagram constructed to explain the operation of the relay and the circuit breaker in case of interruption. Fig.1 shows an example of diagram if one interference line 1-5 of 13 bus test system. The label one arrow connects the two vertices are determined with the help of informants in the field

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with experience in the field of power system protection. For example, primary protection will be responsible for choosing the region that there is an interruption and if applicable interference with the adjacent back up protection that will be used. The operational system zone protection will include and joining beside of the components when applicable interference. The relationship between the relays and the circuit breakers can be constructed in a way as seen in Fig. 1.

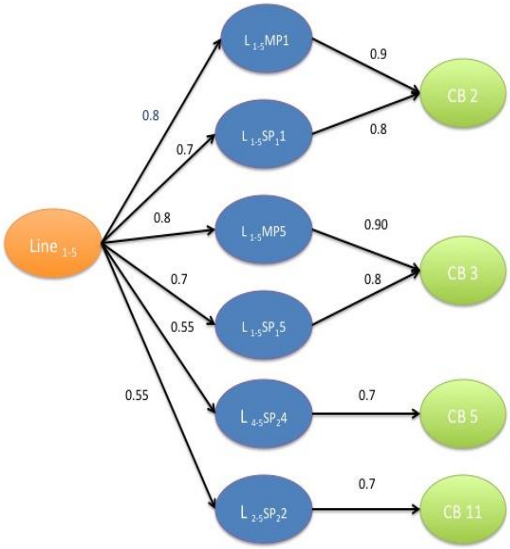

Fig. 1 Examples of diagrams for represented the line1-5

Fuzzy sets featuring alarm patterns and systems components depicted as Fig. 1 is built in two steps: the first is Intersection, is an operation to label the arrows in diagram. The system components are represented by interference relays and circuit breakers that work or trip. The second is Union, is the operating results obtained from step i for the portion that connects to one system component to another system component.

The second step were generated the Membership Values (MV) of the system components in the component class that it faults. Operator's minimum and maximum were obtained the union and intersection of fuzzy. It produces a different back up operations depend on capabilities such calculation according to membership values [1]. Operating capability maybe achieved through the use of operations according to membership values. Computer simulations have been made in the calculation to get the fuzzy membership value between alarm pattern and system components that was fault. Each operation will be perform the test operation Hamacher [2]. Hamacher operations get in part of union and intersection of the two Set A and Set B depicted in equation (1) and (2).

$$\mu_{A\cap B}(x) = \frac{ab}{\gamma + (1-\gamma)(a+b-ab)} \qquad (1)$$

$$\mu_{A\cup B}(x) = \frac{a+b+(\gamma^{'}-1)ab}{1+\gamma^{'}ab} \qquad (2)$$

2.2 Neural Network

Neural network detect the fact that there is an interruption system components based on information from the alarm signal that was fault. This is illustrated in the 13 bus system shown in Fig. 2, the system is divided into several different regions for the different of the system components. In several different regions, each region are responsible for oversight of each system components. Training NN awoken to provide alarm patterns associated with the different component of system. Each neuron put in a variable binary number 1 were represented by an alarm signal and 0 are not represented by an alarm signal [5]. Many variable output neuron pairs with system components. Each training pattern is formed by a pair alarm input and output neurons in which input neuron represent one alarm pattern given the existing state of fault. Every output is in the form of membership value part of system component in existing component interference. Neural network implemented in Fig. 2 below.

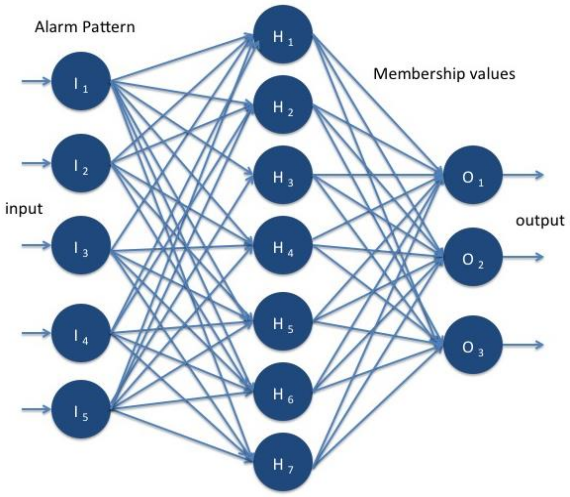

Fig 2. Structure of neural network

The detection fault used method NF that achieved in the two step power system. The first step; fuzzy method represents the relationship between the alarm pattern and system components was fault. Step two; data base consisting of fuzzy method is an exercise from the NN method for use calculation of the membership values in each system components that every in component classes were got the fault. The zone protection distributed to certain area as shown in Fig. 3, it is showed on area of protection for equipment protection. Protective devices shall provide backup protection if the primary protection fail to work.

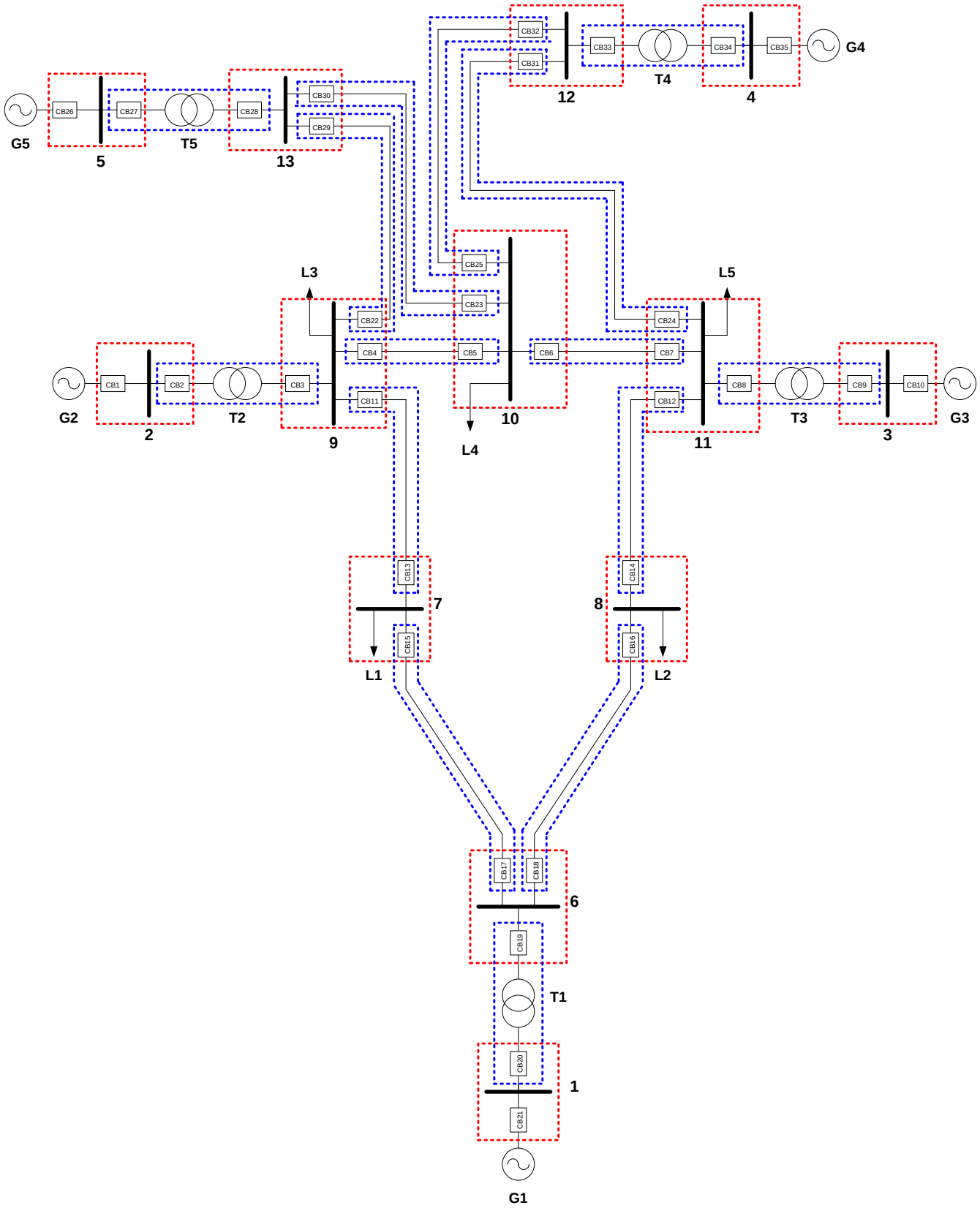

Fig. 3. The 13 bus system protection

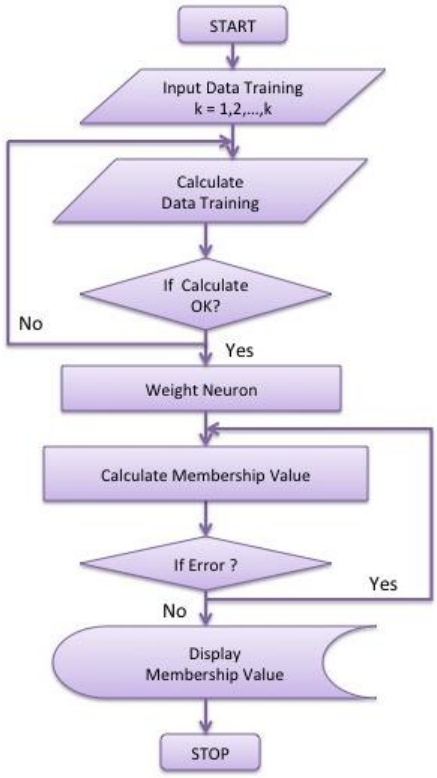

Fig. 4. Flowchart to generate membership value

3. RESULT AND DISCUSSION

Table 1 shows the training data the 13 bus system for multi interference. The data get in the table for system classes are components consisting of the number of layers for each neural network. Table1shows the system is for the classes is for the classes component that contains the number of the layers for each NN. For every NN is composed to many input layers, the hidden layer and output layer. Every layer is aiming to build a structure diagram NN.

Analysis of NF method performed by using FS and NN method sat the same time. NN Method run by using classes the testing alarm pattern base on the detection interference. The steps used in the method NF: alarm received will be used for variable input neurons, provide alarm pattern on each NN, the calculation value membership by using fuzzy operations.

Fig. 6 shows the results of value calculating from membership of each test as in Table 1. Calculate the output of each system component in the class component, there is find fault in the form of membership value. The value of membership 0.87 is shown that there has been a disruption on the system components. Further, the value of membership 0.8 indicates possible disruption of the system components. The membership value shows there is no indicate fault happened.

Table1.Some of tested for 13 bus system

System Component	Protective Devices		Alarm
	Relays are worked	Circuit Breakers are Trip	
FAULT 1 $L_{1\text{-}6}$, $L_{3\text{-}11}$ and bus $_5$ (Multi Fault)	$L_{1\text{-}6}MP_6$, $L_{1\text{-}6}MP_1$, $L_{3\text{-}11}MP_{11}$, $L_{3\text{-}11}MP_3$, MP_5	CB_{19}, CB_{20}, CB_8, CB_9, CB_{26}, CB_{27}	Normal Operation
FAULT 2 Bus 4 (Single Fault)	MP_4, $L_{4\text{-}12}SP2_{12}$	CB_{35} CB_{33}	Failed Trip CB_{34}
FAULT 3 $L_{2\text{-}9}$, $L_{5\text{-}13}$ (Dual fault with a relay fail to work)	$L_{2\text{-}9}MP_2$, $L_{5\text{-}13}MP_5$, $L_{5\text{-}13}MP_{13}$	CB_2 CB_{27} CB_{28}	$L_{2\text{-}9}MP_9$ is not operation
FAULT 4 Bus 2 (Error at communication data)	-	-	Error at CB_{35}

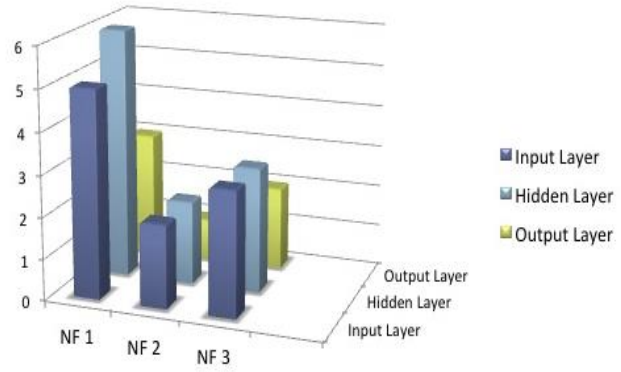

Fig.5. Chart of test13 bus system

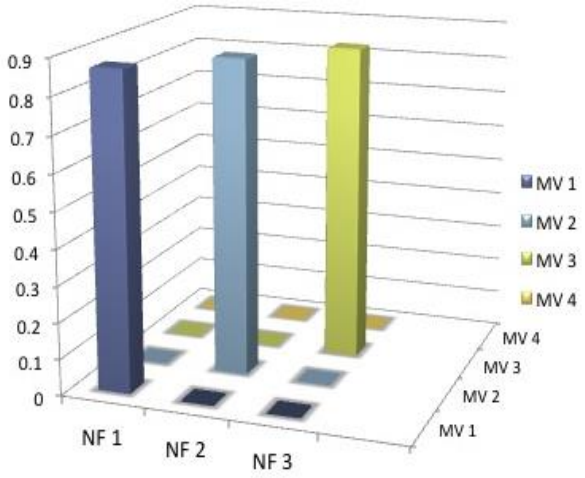

Fig.6. The result of test 13 bus system

4. CONCLUSION

This article has introduced the NF method for the detection line fault in electrical power system. Fuzzy represents the relationship between the pattern of alarms and system components were fault. Alarm signal that there is fault from input to NN structure. NN is used as a method of exercise in classes neurons for interference system components Fuzzy used to calculate the value of membership in each system component interference.The test results of test each every system components in the form are highest membership value.The value of Membership displayed consist of the highest grade of membership, there is value membership zero and the value highest membership and zero. The Highest value membership indicates there is an interruption of information systems components and value membership zero indicates no interference, then the valueof membership between the highest and zero indicates the possibility of interface.

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