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Detection of Earth Fault by controlling Petersen Coil using Adaptive Neural Fuzzy Inference System in Distribution Grid

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Abstract

In the all world, the most common faults in the distribution network is the single line to ground fault. As the that single phase's fault to ground in the distribution networks causes electrical arc as well as high voltage than the two phases together which increases the danger of separation and isolation in networks. Consequently, this case can be controlled through Peterson Coil which turns off or reduces the electrical arc that makes the network safer. Used controlling of the Peterson coil is hybrid method at the Fuzzy Logic and neural network system. The perfect results of the fault current equal to the rated current.

Keywords: neural network, single phase, fuzzy logic**.**

INTRODUCTION

Ungrounding distribution networks, correctly, will cause a big problem in high voltages due to residual current resulted from the intermittent electrical arc during the single line to grounded fault. It causes overvoltage equals two times the phase-to-phase voltage, and this causes a danger on operation and the network isolators. Therefore, the neutral point is earthed by using Peterson Coils to compensate the residual current and to suppress the electrical arc, where this coil prevents the leakage of unbalanced capacitors currents from the earth fault [3].

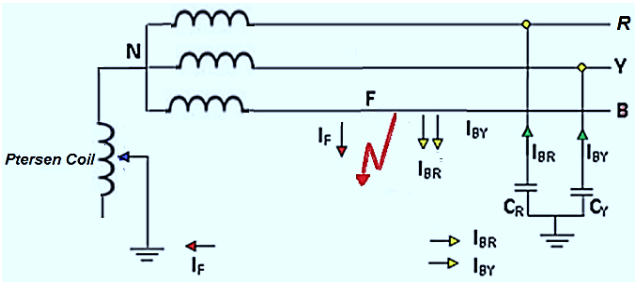

Figure 1-a: Peterson coil grounding

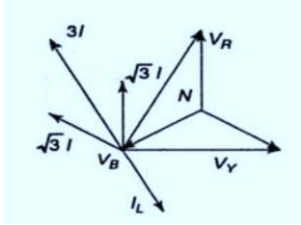

Figure 1-b: Vector Diagram Peterson coil grounding

In figure (1) the values of the currents I_R and I_Y of the capacitors R and Y in the two sound phases will be even and they will reduce each other until reaching to zero value. Then the current will not leak to the system during earth fault in line B because the capacitive currents of the unearthed lines goes back to the source through extinguishing electric arc coil, and the capacitor current value is three times the conventional charging current. In this Thesis we have dealt with finding the optimal method of Peterson coil values which specify the value of earth fault current as low as possible[3,4]. Moreover, we have used many methods to control Peterson coils such as using Hybrid control PID and Fuzzy System**.** To determine the earth fault current at values equals to the current in the two sound phases. The results were accurate and objective in short time comparing to using techniques, previously.

Hereupon, we have succeeded to suppress the electrical arc and converges the fault current from the rated current, saved thousands of tons of copper cables which are used to bear these high voltages and we have ensured the continuity of power without interruption during earth fault and maintained the tools and equipment.

Adaptive Neural Fuzzy Inference System [ANFIS] [6]

It is a linear system which uses a base Segouno to be known as the system that adapted Fuzzy System by using a neural network. Because no need try and error but used only data and bias neural network and usually using triamf. Why do we use Adaptive Neural Fuzzy Inference System [ANFIS] because we mentioned that trial and error is not required only data and bias neural network can be used.

The treatment process is done through. Data replication until time to an event is carried out to be used in where result is estimated. [5] ANFIS uses a hybrid learning algorithm Sugeno Model, assuming that the fuzzy inference system has two inputs x and y and one output z. a first-order Sugeno fuzzy model has rules as the following: [42]

Simulation at Adaptive Neural Fuzzy Inference System [ANFIS]

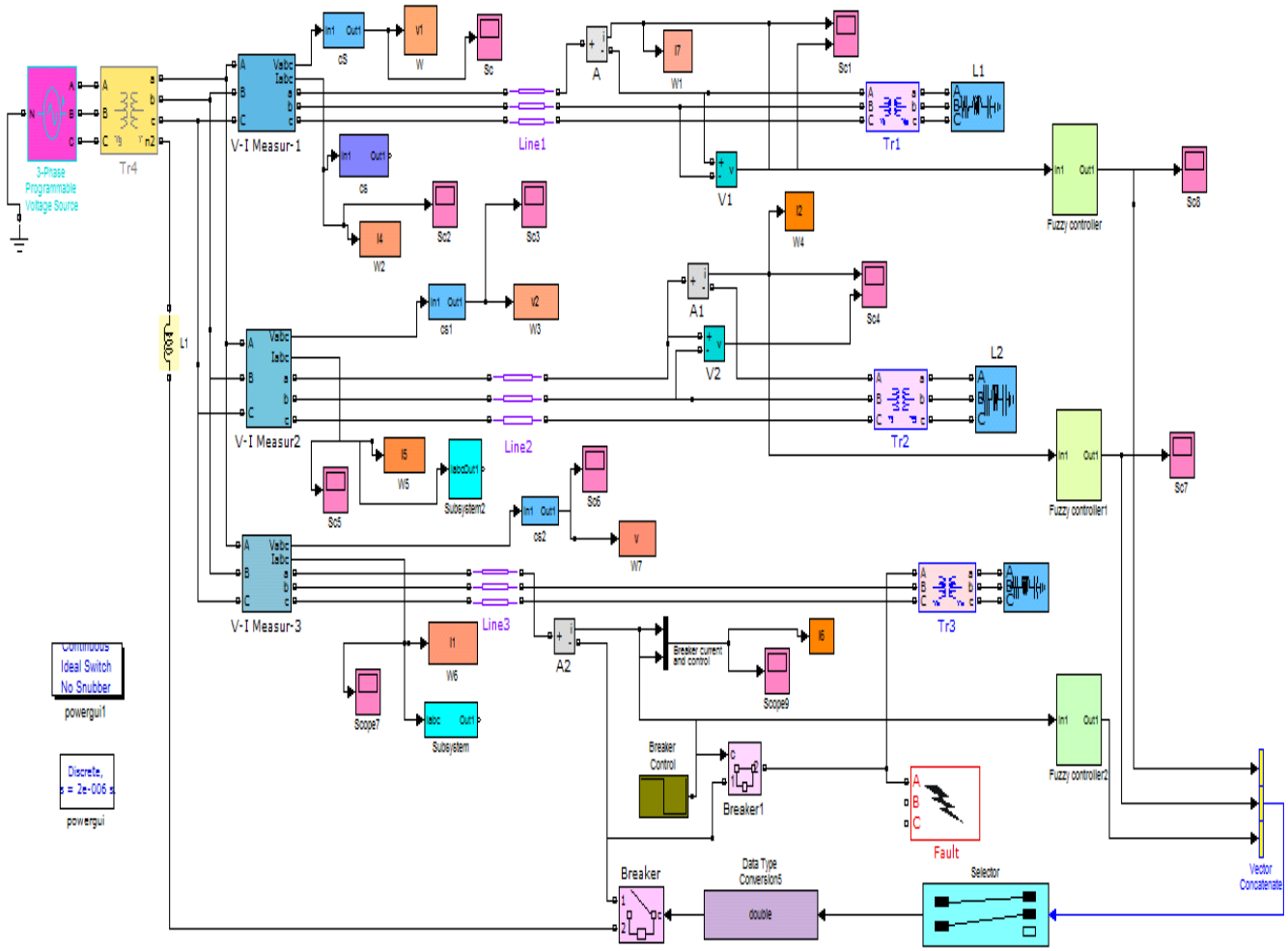

Figure 2: Simulink of (SLG) controllable by Adaptive Neural Fuzzy Inference System [ANFIS]

Simulation and Verification of Adaptive Neural Fuzzy Inference System [ANFIS]

This combined at method of Neural Network and the Fuzzy Logic Controller. The method takes advantage of auto training is without and data base. Advantage also without distortion and it's very smooth. That the reason for using [ANFSI] that the Fuzzy Logic control System is non-linearity, but when using Adaptive Neural Fuzzy Inference System is to convert to linear [5,6].

1. Multi input the first input actual fault current and second input derivative current.
2. Signal output.

Figure (3) represents earth fault grounding when adaptive Neural Fuzzy Inference System. We got the ideal values at current fault phase, to be (400) Amp without any interruption.

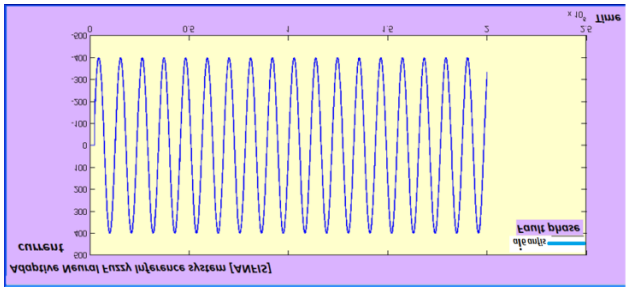

Figure 3: Curve at fault current(ai_6) in [ANFIS]

Figure (4) demonstrates the current at a sound phase which has been (400) equal to the value of the fault current when it is adaptive neural fuzzy inference system.

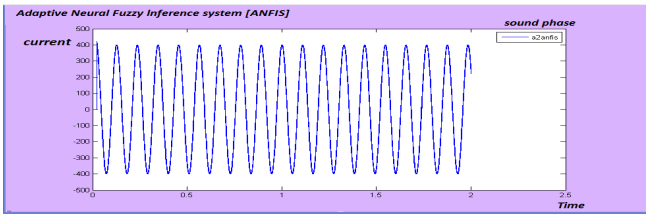

Figure 4: Curve at a sound phase (ai_2) in [ANFIS]

Figure (5) represents the final comparison between the grounded fault current (i_6) before tunings and the value at a sound current ($i_2.i_7$) to be equal 500 Amp The earth fault current (ai_6f) Upon the occurrence of the first fault equals 1800Amp and the second fault equals 3200 Amp but when adaptive by [ANFIS] we get an earth fault current 500 that is equal to the current (i_2,i_7) In these ways our

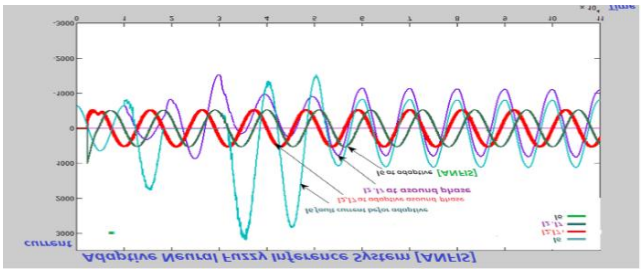

Figure 5: A comparison of the curve between (i_6, i_2, i_7) before and after adaptive [ANFIS]

Values not previously accessible to researchers by this, we are able to provide thousands of tons of copper, which is used in cables that have the ability to withstand high fault current.

CONCLUSION

The fuzzy inference system under consideration which has two inputs x=I_f and y =I_A in addition to one output z =I_A is to be assumed. Supposing that the rule base contains two fuzzy if-then rules of Sugeno's type So as given in equations

Rule 1: If x_1 is I_{f_1} and y is I_{A_1}, then $f_1 = p_1x + q_1y + r_1$

Rule 2: If x_2 is I_{f_2} and y is I_{A_2}, then $f_2 = p_2x + q_2y + r_2$

As shown figure (5)

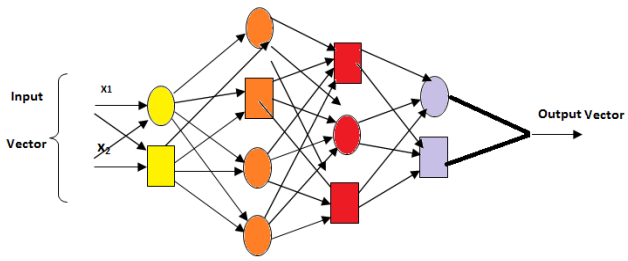

Figure 5: General Neural network [6].

We conclude for calculating the function:

$$f_1 = p_1x + q_1y + r_1 \quad \Rightarrow \quad f = \frac{W_1 f_1 + W_2 f_2}{W_1 + W_2} = \bar{W_1} f_1 + \bar{W_2} f_2 \qquad (1)$$

$$f_2 = p_2x + q_2y + r_2$$

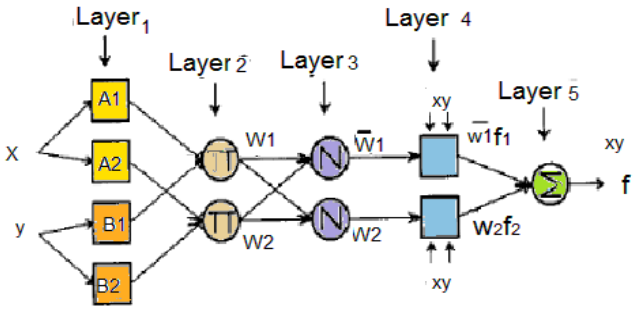

Figure 6: Neural network with five layers [6, 7].

Layer 1 = $O_i^1 = \mu_{Ai}(x)$ (2)

Layer 2 = $w_i = \mu_{Ai}(x) \times \mu_{Bi}(y), \quad i = 1,2.$ (3)

Layer 3 = $\overline{w_i} = \frac{w_i}{w_1 + w_2}, \quad i = 1,2.$ (4)

Layer 4 = $O_i^4 = \overline{w_i} \cdot f_i = \overline{w_i} \cdot (p_i \cdot x + q_i \cdot y + r_i)$ (5)

Layer 5 = $O_i^5 = overall\ output = \sum_i \overline{w_i} \cdot f_i = \frac{\sum_i w_i \cdot f_i}{\sum_i w_i}$ (6)

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