IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE)
e-ISSN: 2278-1676,p-ISSN: 2320-3331, Volume 5, Issue 3 (Mar. - Apr. 2013), PP 21-28
www.iosrjournals.org

Comparison of Over-current Relay Coordination by using fuzzy and genetic algorithm Methods

Prof. Manjusha K.Parve
Priyadarshini Institute of Engineering and Technology ,Nagpur

Abstract: *The inverse definite minimum time relay has been used in the power distribution system in order to protect the system from power system faults.[1] These relays will function after a certain time delay when the current going through the relay exceeds a predefined set point. This time delay depends on the ratio of the fault current flowing through the relay with the set point current defined by the protection engineer [2]. The basic problem with these relays is that the relays will have a longer time delay for a less severe fault [3]. Another problem that these relays would face is when the impedance between the backup relay and the main relay is much smaller than the impedance between the fault and the main relay. In this paper, the possibility of using a fuzzy logic controller (FLC) is studied in order to determine the time delay of the over current relay. a new genetic algorithm (GA) method is presented to solve the optimization problem in coordination of over current and distance relays. The objective function (OF) is developed in a way that in addition to coordination of over current relays, the coordination of over current and distance relays is achieved. Various relay characteristics are considered for each over current relay and the best of them is selected by GA to fulfill optimal coordination. The proposed method is applied to a sample power network. Simulation results demonstrate that the method can obtain feasible and effective solutions and, it is a promising approach for optimal coordination in practical power networks.*
Keywords*: Gain scheduling, PID controller, over current Relay*

I. Introduction:

Over current and distance relays are mostly used for transmission and sub transmission protection systems [1].To consider comprehensive coordination, a distance relay with a distance one, an over current relay with an over current one and finally a distance relay with an over current one, must be coordinated when one of them is considered to be the main relay and the other is the backup

The control logic of the pickup current (Fig. 2) has the task of maintaining constancy of I_{pickup}, during a fault to avoid pickup setting changes. If the line is de-energized $(I_k^r < \varepsilon)$, , the control logic assigns a maximum value "$I_{\text{pumáx}}$," which can be the setting of a conventional relay (dead line logic). The output signal.

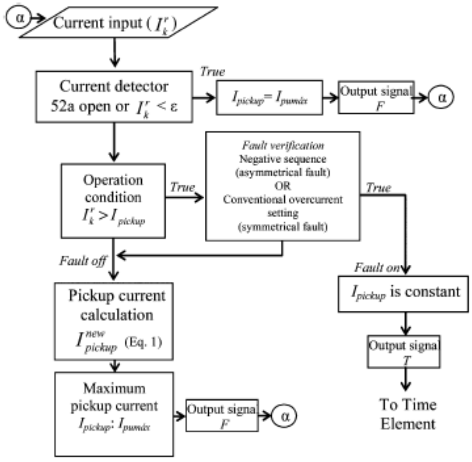

Fig. 2: Control logic of an adaptive pickup current.

II. SYSTEM UNDER STUDY

The inverse time delay characteristic works on the basis of the bigger the ratio of the fault current compared to the set point current, the smaller the time delay would be.

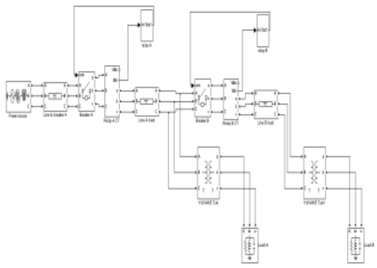

Figure 1: System diagram under study.

The formula used for the time delay of an inverse time characteristic is as

$$f(t) = \frac{c}{\left(\frac{I_{fault}}{I_{setpoint}}\right)^{\alpha} - 1} \qquad \text{equation 1}$$

follows:

Where f(t) represents the time delay that is generated by the inverse time characteristic while c and α is determined by the time multiplier setting and characteristic chosen by the user either standard inverse, very inverse or extremely inverse. If we were to study this equation using a ohms law, then network is used in order to determine the TMS from the desired time delay. This TMS is then used in a fuzzy logic engine to determine the time delay in order to ensure that the relay characteristics are easily modeled. In this paper we shall develop the fuzzy membership functions for the input and output and also the fuzzy rules to determine the time delay of the over-current relay. We shall see how the fuzzy logic relay would eliminate the problems of varying fault severity and source impedance problems.

III. The Inverse Time Over current Relay

Table 1: Current set point and time multiplier setting of all relays in the system.

Relay	Current set point	Time multiplier setting
A	150	0.06
B	75	0.01

The equation governing the time delay for
the inverse time overcurrent relay abides by the IEEE std. C37.112 [8].

In simulating a three phase fault to ground 10Km from relay B, we obtained the response for the backup relay as shown in figure 2.

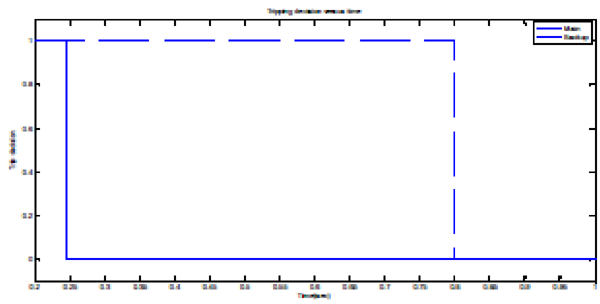

Figure 2: Trip decision of backup relay(relay A) for a three phase and single phase fault 10Km in front of relay B after 0.2 seconds.

The results of these simulations are shown in table 2 below:

Table 2: Tripping time of main and backup relay for IDMT relay.

Fault Type	Distance to main relay	Main relay timing	Backup relay timing	Coordination difference
Single phase fault	10Km	0.282	1.617	1.335
	25Km	0.298	2.534	2.236
Double phase to ground fault	10Km	0.247	0.774	0.527
	25Km	0.256	0.937	0.681
Phase to phase fault	10Km	0.249	0.778	0.529
	25Km	0.257	0.936	0.679
Three phase fault	10Km	0.246	0.801	0.555
	25Km	0.256	1.015	0.759

Table 8: Tripping time of main and backup relay for fuzzy over-current relay.

Fault Type	Distance to main relay	Main relay timing	Backup relay timing	Coordination difference
Single phase fault	10Km	0.262	0.808	0.546
	25Km	0.270	0.840	0.57
Double phase to ground fault	10Km	0.256	0.768	0.512
	25Km	0.262	0.800	0.538
Phase to phase fault	10Km	0.290	0.798	0.508
	25Km	0.318	0.800	0.482
Three phase fault	10Km	0.254	0.764	0.51
	25Km	0.262	0.802	0.54

IV. Application Of FLC As Over current Relay

The fuzzy logic over current relay uses the voltage ratio and the current ratio as the input to the fuzzy logic controller. Equation 2 and Equation 3 describe the inputs of the fuzzy logic controller

$$e = \frac{I_{fault}}{I_s}$$

$$V_{ratio} = \frac{V_{relay}}{V_{nominal}}$$

The output of the fuzzy logic controller will be the amount of time delay that the relay will have. The block diagram for a three phase overcurrent relay utilizing the FLC is shown in figure 13 below. The main The main thing that controls the time delay in this method would be how the membership functions of the input and output is formed and also the fuzzy rules that exist. The time delay generated by the fuzzy logic controller is compared with a timer value which is activated only when the value of fault current exceeds the setpoint value given by the user. If at any time, any phase orders a trip, the whole relaywill order a trip through the AND gate.

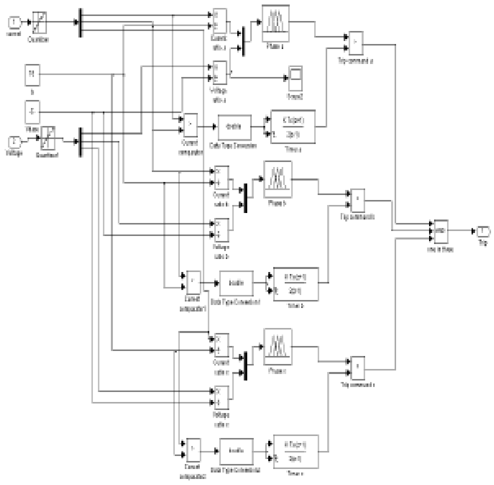

Figure 4: Usage of FLC as a three phase overcurrent relay.

V. Input, membership functions and rules.

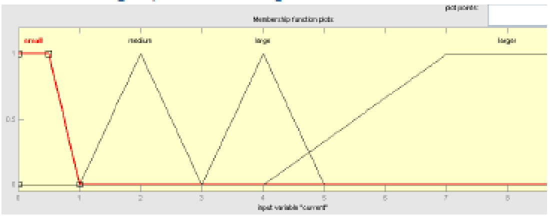

Figure 6: Membership function for current ratio

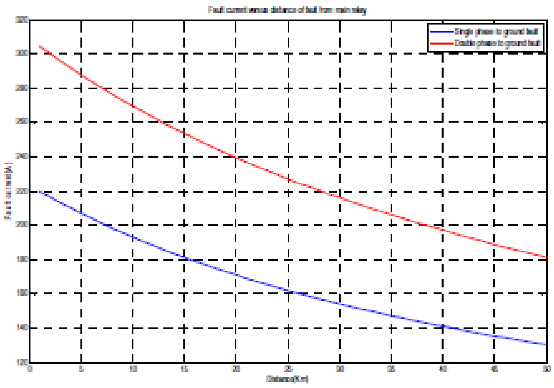

Figure 7: Fault current at main and backup relay for single and double phase fault

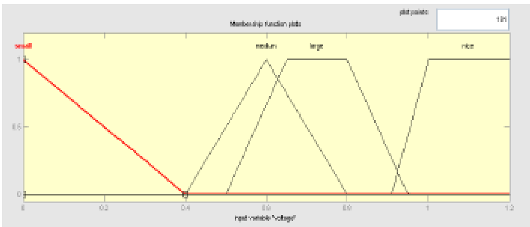

Figure 8: Membership function for voltage ratio.

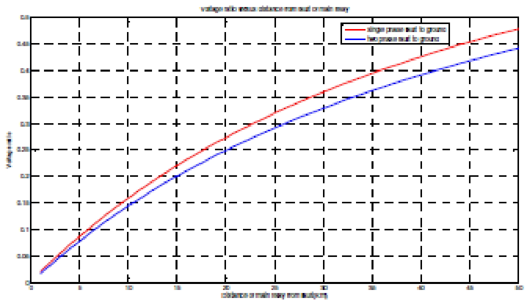

Figure 9: Voltage ratio for a simple radial system at the main relay for a single and double phase to ground fault.

Table 8: Tripping time of main and backup relay for fuzzy overcurrent relay.

Fault Type	Distance to main relay	Main relay timing	Backup relay timing	Coordination difference
Single phase fault	10Km	0.262	0.808	0.546
	25Km	0.270	0.840	0.57
Double phase to ground fault	10Km	0.256	0.768	0.512
	25Km	0.262	0.800	0.538
Phase to phase fault	10Km	0.290	0.798	0.508
	25Km	0.318	0.800	0.482
Three phase fault	10Km	0.254	0.764	0.51
	25Km	0.262	0.802	0.54

Table 8: Tripping time of main and backup relay for fuzzy overcurrent relay.

Fault Type	Distance to main relay	Main relay timing	Backup relay timing	Coordination difference
Single phase fault	10Km	0.262	0.808	0.546
	25Km	0.270	0.840	0.57
Double phase to ground fault	10Km	0.256	0.768	0.512
	25Km	0.262	0.800	0.538
Phase to phase fault	10Km	0.290	0.798	0.508
	25Km	0.318	0.800	0.482
Three phase fault	10Km	0.254	0.764	0.51
	25Km	0.262	0.802	0.54

Genetic algorithm method:

By applying the GA with selected control parameters, the output results for TSMs and over current relays characteristics are obtained. These TSMs and characteristics are given in Table VI. The operating time of the second and third zones of distance relays are selected respectively 0.3(sec) and 0.6(sec)

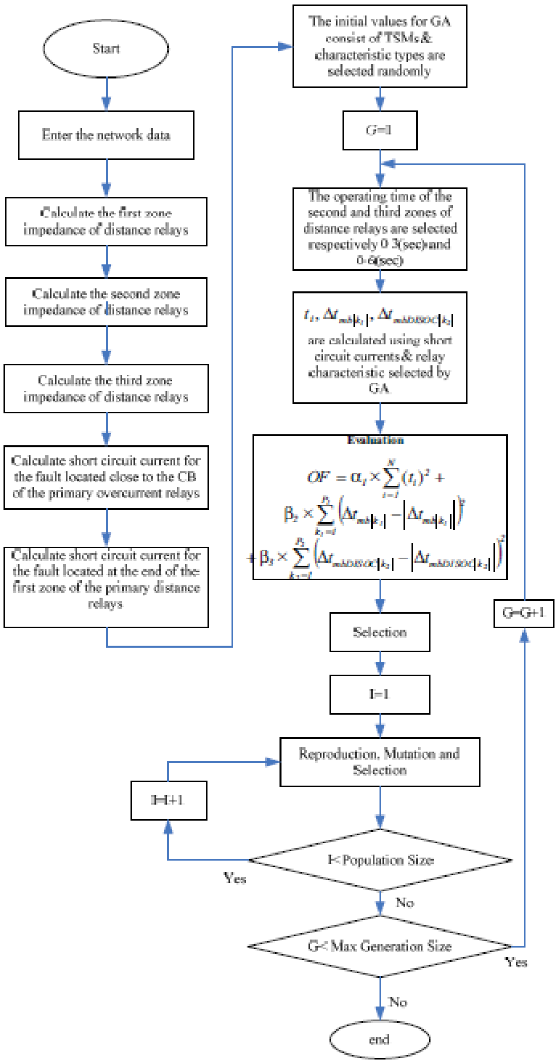

Fig. Flow chart of Genetic algorithm method

TABLE VI
TSMs AND SELECTED CHARACTERISTICS OF OVERCURRENT RELAYS

Relay Number	TSM (Considering Characteristics Selected by GA)	TSM (Considering Fixed Characteristics)	Number of Selected Characteristic	Number of Fixed Characteristic
1	0.05	0.1	4	2
2	0.35	0.2	4	2
3	0.05	0.15	5	2
4	0.05	0.05	1	2
5	0.05	0.05	4	2
6	0.05	0.2	5	2
7	0.05	0.1	4	2
8	0.05	0.15	5	2
9	0.05	0.05	1	2
10	0.05	0.1	4	2
11	0.15	0.15	2	2
12	0.05	0.25	5	2
13	0.3	0.05	1	2
14	0.4	0.1	1	2

TABLE VII
OPERATING TIME OF OVERCURRENT RELAYS

Relay Number	Operating Time of OC Relays (Considering Characteristics Selected by GA) (sec)	Operating Time of OC Relays (Considering Fixed Characteristics) (sec)
1	0.0359	0.3262
2	0.2570	0.7219
3	0.0341	0.5049
4	0.0775	0.4389
5	0.0885	0.5047
6	0.0326	0.5416
7	0.0445	0.4196
8	0.0334	0.4433
9	0.0791	0.4488
10	0.0391	0.3457
11	0.0880	0.5160
12	0.0293	0.7575
13	0.2294	0.2331
14	0.4064	0.3964

VI. CONCLUSION.

The results obtained from the fuzzy logic overcurrent relay and the inverse time relay shows that the response of the fuzzy logic relay is superior compared to the inverse time overcurrent relay when it comes to distance of fault from main relay and fault severity. This can be seen from the fact that the biggest coordination difference of the fuzzy overcurrent relay was only 70ms. However the membership functions of this relay needs to be refined in order to solve the problems of violating the coordination constraint.

A new computer program for distance and overcurrent relay coordination based on GA has been developed. In the proposed method, the OF has been modified by adding a new term which presents the constraint for distance and overcurrent relay coordination. Various relay characteristics have been considered for each overcurrent relay and the best of them has been selected by GA to fulfill optimal coordination. The computer program has been tested on a sample power network.

From the obtained results, it has been shown that the new method is successful and accurate.

References:

[1] Reza.Mohammadi.Chabanloo, Hossein.Askarian.Abyaneh, Somayeh.Sadat.Hashemi.KamangarFarzad.Razavi Amirkabir University of Technology/ Department of Electrical Engineering, Tehran, Iran"A New Genetic Algorithm Method for Optimal Coordination of Overcurrent and Distance Relays Considering Various Characteristics for Overcurrent Relays" 2nd IEEE International Conference on Power and Energy (PECon 08), December 1-3, 2008, Johor Baharu, Malaysia.

[2] Aidil Azwin Bin Zainul Abidin, Agileswari K. Ramasamy, Dr. Universiti Tenaga Nasional Jalan Kajang Farrukh Hafiz Nagi Dr. Universiti Tenaga Nasional Km7 Jalan Kajang puchong Izham Bin Zainal Abidin, Dr., Universiti Tenaga Nasional "Determination of overcurrent time delay using fuzzy logic relays." 2009 Conference on Innovative Technologies in Intelligent Systems and Industrial Applications (CITISIA 2009)Monash University, Sunway campus, Malaysia, 25th & 26th July 2009."

[3] Stanley H. Horowitz and Arun G. Phadke. " Power System Relaying" Research Studies Press Ltd. And John Wiley and Sons INC. 1993 (pp 74-78)
[4] Badri Ram and D.N. Vishwakarma " Power system Protection and Switchgear" Tata McGraw- Hill 1995(pp72-75)
[5] Arturo Conde And Ernesto Vazquez "Operation Logic Proposed For Time Overcurrent Relay" Ieee Transaction On Power Delivery, Vol. 22 No. 4 October 2007.
[6] A.F. Elneweihi. E.O. Schweitzer III, and M.W.Feltis, "Negative Sequence Overcurrent Element Application and Coordination in Distribution Protection" Presented at the IEEE Power Eng. Soc.Summer Meeting, Seattle, WA, Jul. 12-16. 1992.
[7] Hossien Askarian Abyaneh, Majid Al-Dabbagh,Hossien Kazemi Karegar Seyed Hesameddin Hossien Sadeghi " A New Optimal Approach for Coordination of Overcurrent Relays in Interconnected Power System" IEEE Transactions On Power Delivery, Vol 18, No 2, April 2003.
[8] Bijoy Chattopadhyay, M.S. Sachdev, T.S. Sidhu "An On-Line Relay Coordination Algorithm For Adaptive Protection Using Linear Programming Technique" IEEE Transactions On Power Delivery, Vol. 11, No 1, January 1996.
[9] Hossien Askarian Abyane, Karim Faez, Hossien Kazemi Karager " A New Method For Overcurrent Relay Using Neural Network and Fuzzy Logic" 1997 IEEE TENCON pp 407-409.
[10] IEEE Standard Inverse-time Characteristic Equations for overcurrent relays, IEEE Std C37.112- 1996. 2009 Conference on Innovative Technologies in Intelligent Systems and Industrial Applications (CITISIA 2009) Monash University, Sunway campus, Malaysia, 25th & 26th July 2009. 485