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Optimal Capacitor Placement in Radial Distribution System Using Hybrid GA-ST Algorithm

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Abstract:
Capacitor is a device which is used for transferring the reactive power and the main focus or aim is to reduce the loss and to improve the voltage profile. But the placement or location of the capacitors is the main concern. The concept of capacitor placement and sizing is an interesting topic to the researchers. Since lot of research work is going on under this topic. Capacitor is a device which is widely used in distributed networks for reactive power consumption. Large number of techniques had been developed till now to perform optimal capacitor placement.This study has been conducted with an objective to perform optimized capacitor placement in a distributed power system by using most prominent methods i.e. Genetic Algorithm and State Transition. These two techniques are used to revise the value of the capacitor in order to evaluate exact size and location for the specific capacitor placement in the distributed system. In this proposal firstly the number of buses are elected for capacitor placement and then the fitness value is evaluated by implementing GA-ST and then on the basis of observed results the capacitor are placed optimally in the system. The performance parameters that are used to evaluate the proficiency of the proposed work are total installed capacitor, total annual cost and total active power loss etc.

Keywords: Distributed Power System, Optimum Capacitor Placement, State Transition, Genetic Algorithm.

I. INTRODUCTION

With the enhancement in the technology the work in various fields become quite easy but complicated too. The rise in the technology gives birth to various problems in various fields. The electrical field is also facing such kind of problems [1]. The main problem that comes into existence is network's load demand. Hence the electrical industry is trying to set up such a system or power plant which can satisfies the requirement of network's load demand. If sometimes the transmission process is aborted in between due to any problems then various equations are calculated for recovery of lost transmission [2]. Hence various calculations are used or analyzed for reducing the transmission loss [3].These calculations used for transmission loss seems to be simple but are not that easy. The complication rises because of variations in transmission power, power factors, changes in voltage level etc. In case of system where the voltage level is high then the lost of transmission is less but in case of low voltage the transmission lost is high. Hence the techniques used for reducing loss origin should be quite easy, less complex, and reliable, So that the lost origin or transmission can be found easily [4].

II. PROBLEM FORMULATION

Capacitors in the distributed networks are used for reactive power consumption. It has been used for power loss reduction and to improve the voltage profilers. But these features can only be obtained if the placement of the capacitor in the bus should be at right place. Several traditional techniques have been proposed till now in which placement of the capacitor has done through single optimization technique. In other words a single technique is used to evaluate which size of the capacitor should put in the bus. But use of a single technique is not able to reduce the overall cost of the network as well as power losses are high in value. Due to the bad placement of capacitor results found are not efficient.

III. PROPOSED WORK

As right placement of the capacitor is necessary for distribution system; a new technique has proposed which can be used to overcome the issues having in the existing techniques. In the proposed technique hybrid optimization algorithms has used which is a combination of Genetic Algorithm and State Transition. This combination of optimization algorithm has used to update the value of the capacitor to evaluate the right size and place for the particular capacitor in the bus. Capacitor has placed according to requirement of the situation due to which annual cost has reduced using proposed technique. This proposed technique provides several benefits as:

- Better result than traditional techniques
- Less number of power losses in the network
- Reduced annual cost of the network.

The proposed work is based on GA-ST technique for optimal capacitor placements in a distributed system. The methodology for implementation of the proposed work is defined in the following steps:

STEP 1: First step is to load the dataset for buses.
STEP 2: Select the number of buses for capacitor placement.
STEP 3: Generate Initial population for placing the capacitors.
STEP 4: update the value of initial population.
STEP 5: this is an iterative process in this step the GA-ST is applied for evaluating the fitness value. It includes the following steps:

(a) Firstly perform crossover and generate a fitness value.
(b) If the fitness value is greater than the initial fitness value then save the population and fitness value.
(c) Then perform Shift operation on generated crossovers and swap them.

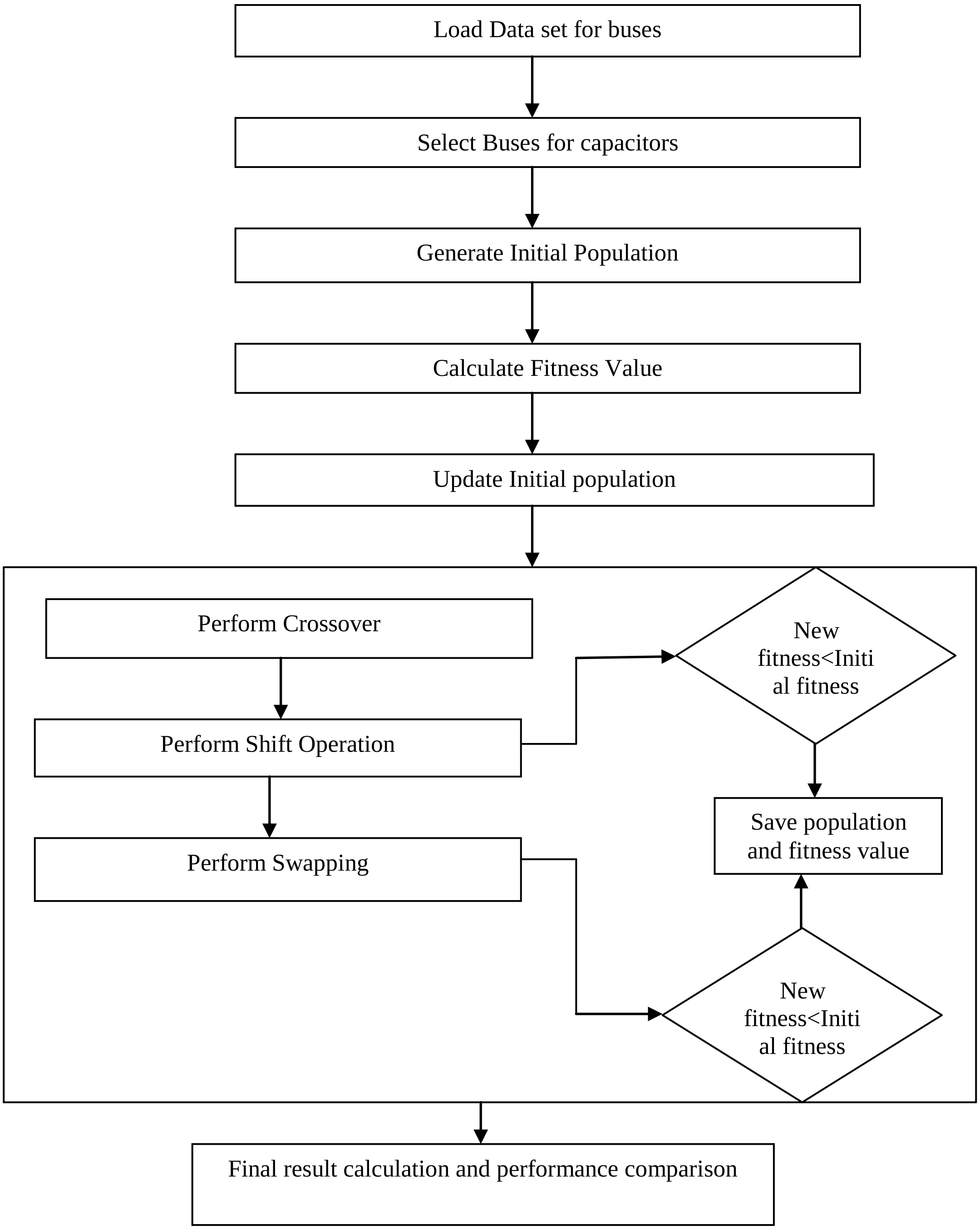

Figure 1 Flow chart of proposed work

(d) Next step is to check whether the new fitness value is greater than the initial value if so then save the population and fitness value.

STEP 6: In this step final result is calculated which is obtained after applying GA-ST technique for optimal capacitor placement.
STEP 7 in this step the comparison of the performance parameter of proposed and traditional is compared. The parameters are like total installed capacitors, total annual cost, total Active power loss etc.

IV. RESULTS

This section represents the results which are obtained after implementing the proposed work. The efficiency of the technique is proved on basis of comparison between proposed and traditional techniques.
The graph in figure 2 shows the performance of the proposed work on the basis of installed capacity of the individual bus system. The propose work merge the GA and ST to obtain more reliable results. Hence from the graph below it is clear that the total installed capacity of the bus system is more than 1800 Kvar.

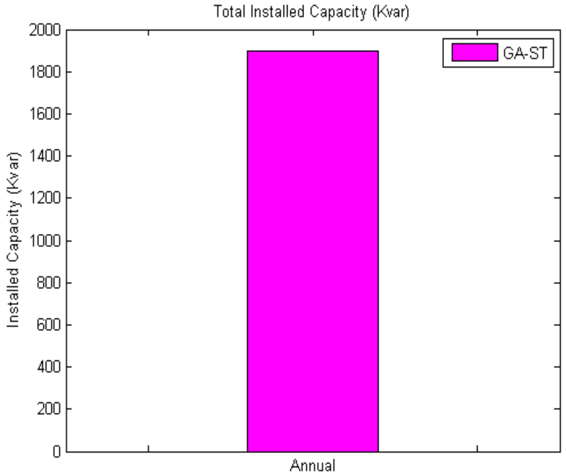

Figure 2 Installed capacity of bus system

The graph shown in figure 3 depicts the annual cost of the bus system with respect to the implementation of proposed work. Initially annual cost of the system is high but as the number of buses increases the fall in the annual cost has been recorded.

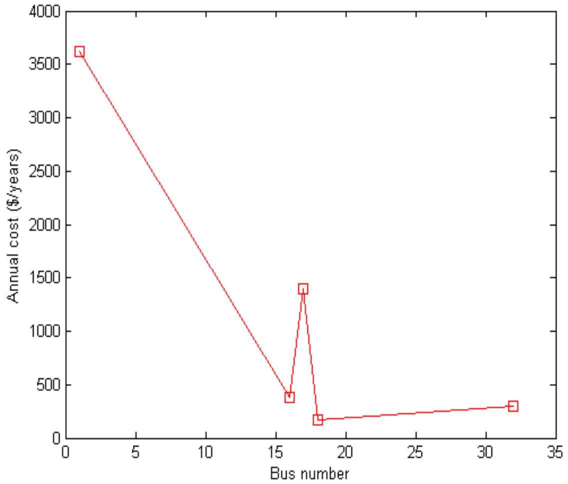

Figure 3 Annual Cost of bus system

The graph in figure 4 represents the active power loss in the bus system. Power loss refers to the loss of energy after performing the operations on the annual basis. The graph depicts that the active power loss is high initially but as the number of buses are induced it leads to the reduction in the amount of active power loss.

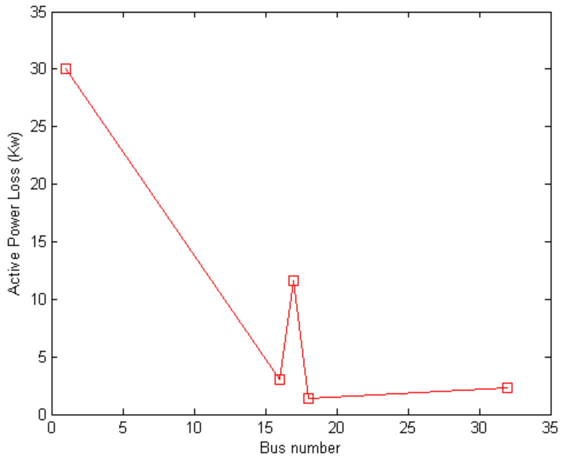

Figure 4 Active Power Loss in the system.

The figure 5 represents the graph which depicts the total installed capacity of the bus system annually after the implementation of proposed work. The total installed capacity is computed on the basis of whole system instead of individual bus.

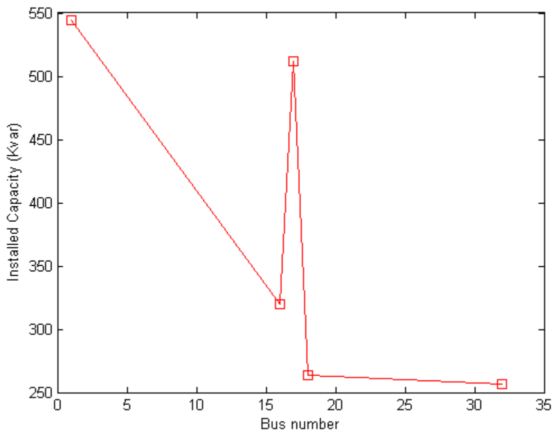

Figure 5 Total Installed capacity

The figure below (6) shows the graph of total active power loss on the annual basis in the whole bus system. The proposed work is a combination of GA and ST, the purpose of this combination is to achieve less amount of power loss in the system by placing the capacitors in the bus system. From the graph it is observed that the total active power loss is between 45 to 50 (Kw).

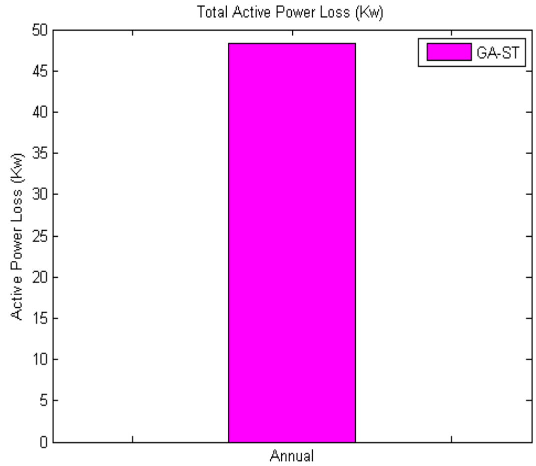

Figure 6 Total Active Power Losses (Annual)

The graph (fig 7) shows that the total annual cost of the bus system after implementing the proposed work lies between 5000 to 6000 dollars. The graph shows the amount which is incurred on full fledge bus system on annual basis.

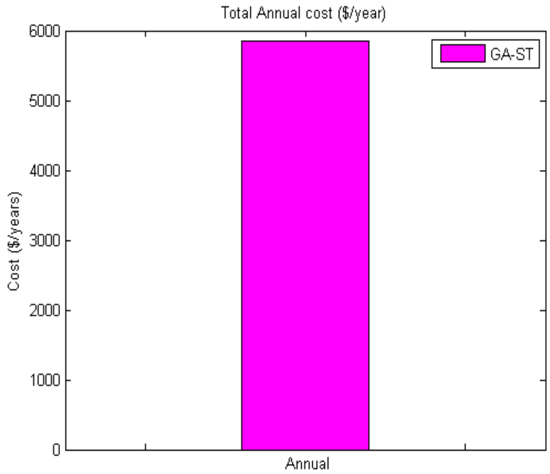

Figure 7 Total Annual Cost of the system

The figure 8 above shows the comparison between various techniques with respect to total number of installed capacitors in distributed system. As the graph shows the comparison between

Fuzzy approach: in this there are total number installed capacitor is between 2500 to 3000.

Plant Growth: in this total number of installed capacitor is 2000.

PSO: in this total number of capacitor is above 2500.

IPSO: in this total number of installed capacitors is more than 2000.

GA-ST: in this the total number of installed capacitor is less than 2000.

Hence it is observed that the total number of installed capacitor is lesser in case of GA-ST. which shows that the proposed work is more efficient as compare to other techniques. The advantages of employing less number of capacitors is that it will lead to reduction in cost incurred on the system

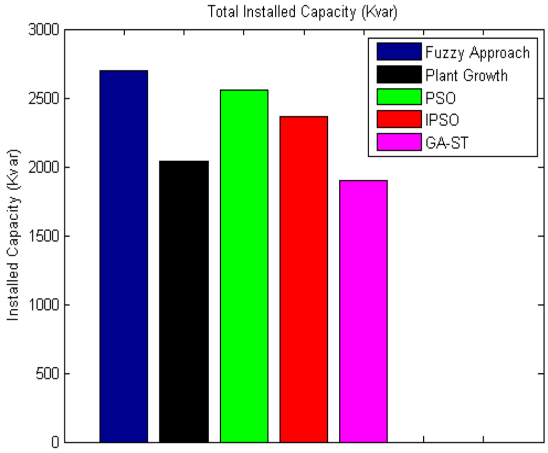

Figure 8 Comparisons between various techniques and proposed techniques with respect to total installed capacitors

The figure below (9) shows a graph which is a comparison between traditional and proposed work on the basis of total annual cost that is incurred on the network. As it can be observed from the graph that the total annual cost of GA-ST is lesser than the total annual cost of other techniques. But the total annual cost of GA-ST is quite minimum amount as compare to others. If the annual cost of the network is less than it will affect the overall economic growth.

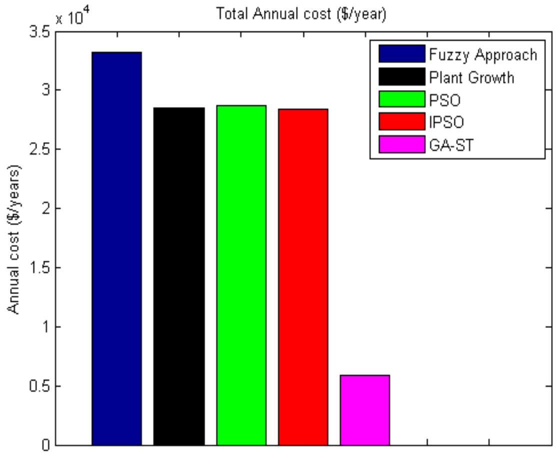

Figure 9 shows the comparison between various techniques and proposed work on the basis of total annual cost

Figure below (10) shows the comparison graph between various techniques on the basis of total active power loss. It is observed that the number of total active power loss is lower in the case of GA-ST, whereas it is quite high in the case of other techniques such as fuzzy approach, plant growth, PSO, IPSO etc. thus it shows that the proposed work is more efficient as compare to traditional technique with respect to every aspect such as total number of installed capacitors, total number of active loss, total annual cost of the distributed network. If the number of total active power loss is low then it will lead to more efficient system performance. The advantage is that if the number of power losses in the system is low than it will increase the system efficiency and also lead to the reduction in cost.

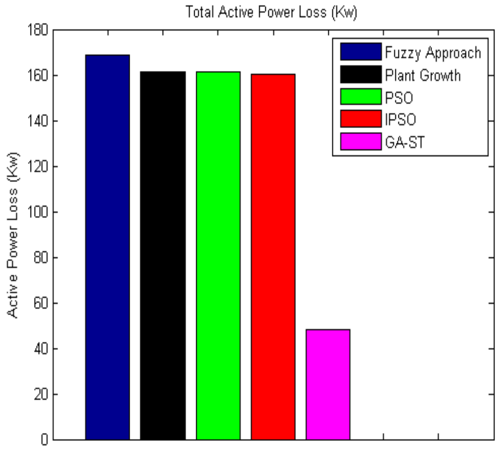

Figure 10 shows the comparison of various techniques with proposed one on the basis of total active power loss

V. CONCLUSION

Distributed power system is a system which generated the power and then transfers the power over distributed links. In this paper it is concluded that the distributed system can consume more energy hence in order to make the system energy efficient the overall performance of the system should be enhanced. The overall performance of the system leaves an impact on various problems that occur in the system. In this work a new technique with the combination of two techniques that is GA and ST is implemented to overcome the problems of the initial techniques. The objective of the proposed work is to reduce the overall cost of the system. The result section shows the comparison of proposed technique with traditional technique on the basis of various parameters. The results shows that the proposed work is much efficient as compare to various traditional.

In future more trending algorithms can be used for enhancing the performance of the system. The combination of more than one technique can be done for enhancing the reliability and efficiency of the system. Further to enhance the systems proficiency and to reduce the maintenance cost various parameters can also taken into consideration. In traditional work PSO has been used for optimizing the cluster placement in a bus system. The implementation of single technique for capacitor placement is not so much efficient as it can only place the clusters of suitable size but is not capable to reduce the number of power losses along with the small cost incurred on system. Further, two techniques are combined together to resolve the problem of highest power loss and continuous increase in cost of the overall system. Therefore further advancement can also do to reduce the power loss in the system at the minimum cost.

REFERENCES

[1] Mostafa Sedighizadeh, Reza Bakhtiary, "Optimal multi-objective reconfiguration and capacitor placement of distribution systems with the Hybrid Big Bang—Big Crunch algorithm in the fuzzy framework", *Ain Shams Engineering Journal*, vol. 7, pp. 113-129, 2016

[2] N. Gnanasekaran, S. Chandramohan, P. Sathish Kumar, A. Mohamed Imran, "Optimal placement of capacitors in radial distribution system using shark smell optimization algorithm", *Ain Shams Engineering Journal*, vol. 7, pp. 907-916, 2016.

[3] A.Y. Abdelaziz, E.S. Ali, S.M. Abd Elazim, "Optimal sizing and locations of capacitors in radial distribution systems via flower pollination optimization algorithm and power loss index", *Engineering Science and Technology an International Journal*, vol. 19, pp. 610-618, 2016.

[4] N. Ganesankaran, "Maximum Cost Saving Approach for optimal capacitor placement in radial distribution system using modified ABC algorithm", IJEEI, Vol 7(4), Pp 665-679, 2015

[5] P.M sonwane,"Optimal Capacitor Placement and Sizing: An overview", IJIRAE, Vol 2(5), Pp 103-114, 2015,

[6] Fitriana Suhartati,"Capacitor placement and sizing the distorted distribution system using Simplified Direct Search algorithm", Journal of clean energy technology, Vol 2(4), 2014

[7] Prof. Jaikaran singh,"Capacitor Placement in Radial Distribution System using Ant colony Search Algorithm", Vol 9(4), Pp 728-731, 2014

[8] Ahmed Elsheikh et al, "Optimal capacitor placement and sizing in radial electric power systems", ELSEVIER, Vol. 53, No. 4, Pp. 809-816, 2014

[9] Pravin Machindra,"Optimal Capacitor placement and sizing for enhancement of distribution system Reliability and power quality using PSO", IEEE, Pp 1-8, 2013

[10] Mr. Manish Gupta,"Optimal sizzing and placement of capacitor for loss minimization in 33 bus radial distribution system using GA in MATLAB", IJARCET, Vol 1(8), Pp 122-127, 2012,

[11] M. yarmohamaddi, "Capacitor placement of optimization in transmission system using hybrid PSO and HBMO algorithm", IJEP, Vol 1(1), Pp 26-30, 2012

[12] Reja Sirjani,"Heuristic Optimization Techniques to determine optimal capacitor placement and sizing in radial distribution networks: a comprehensive review", Research gate, Pp 1-7, 2012,

[13] Anwar S Siddiqui et al, "Optimal Capacitor Placement to reduce losses in Distribution System", Wseas Transactions On Power Systems, Vol. 7, No. 1, Pp. 12-17, 2012

[14] Ikbal Ali,"Optimal capacitor placement in smart distribution system to improve its maximum loadability and energy efficiency", IJEST, Vol 3(8), Pp 271-284, 2011

[15] B. Mirzaeian Dehkordi et al, "Optimal Capacitor Placement And Sizing In Tabriz Electric Power Distribution System Using Loss Sensitivity Factors And Particle Swarm Optimization (Pso)", IJTPE, Vol. 3, No. 7,Pp. 54-59, 2011

[16] Anwar Shahzad Siddiqui," Optimal Capacitor Placement in Distribution system using fuzzy techniques", AMAE, vol 1(30), Pp 28-32, 2010

[17] A.H Etemadi,"Distribution system reliability enhancement using optimal placement", IET, vol 2(5), Pp 621-631, 2008

[18] M.Damodar Reddy, "Optimal capacitor placement using fuzzy and real coded genetic algorithm for maximum savings", JTAIT, Pp 219227, 2008

[19] K. Parkash,"Particle Swarm Optimization Based Capacitor Placement on Radial Distribution System", IEEE, Vol 6(7), Pp 1-5, 2007

[20] Ali Hassan, "Capacitor placement in distributed system using Artificial intelligence techniques", IEEE, Pp 1-7, 2003,

[21] H. N Ng,"capacitor placement by apropriate reasoning: fuzzy capacitor placement", IEEE, Vol 15(1), 2000

[22] Shyh Jier Huang,"An immune based Optimization method to capacitor placement in Radial Distribution System", IEEE, vol 15(2), 2000