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Estimation of Optimum Capacitance Placement in Distribution Networks Victimisation Hymenopterous Insect Colony Optimization

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Abstract **-Radial distribution systems area unit generally adjoin giant area units and are answerable for a major portion of total power losses. Reduction of total power loss in distribution system is extremely essential to enhance the general potency of power delivery. this will be achieved by putting optimum price of capacitors at correct locations in radial distribution systems. Capacitors area unit put in at strategic locations to scale back the losses and to keep up the voltages at intervals the suitable limits. This paper aims to review distribution system operations by the hymenopterous insect colony search algorithmic program (ACSA). the target of this study is to gift new algorithms for finding the increasing profit downside, the optimum electrical device placement downside, and therefore the downside of a mixture of the hymenopterous insect Colony improvement (ACO), a non-deterministic algorithmic program category, aims to mimic the behaviours of real hymenopterous insect colonies to resolve real-world improvement issues. ACO algorithms area unit distinctive during this category by their use of past solutions in manipulating a man-made 'pheromone'. The secretion being a live associated to each distinctive resolution part that reflects the calculable utility of this resolution part. These secretion values area unit accustomed bias resolution construction by influencing the likelihood of {a resolution|an answer} part being further to a growing solution supported the quantity of secretion it contains. during this thesis, MATLAB primarily based algorithmic program is employed to come up with the optimisation results and proper placement of Capacitors.**

Index Terms – electrical device Placement, hymenopterous insect Colony optimisation.

I. INTRODUCTION

The analysis of a distribution system is a very important space of activity, as distribution systems offer the very important link between the majority grid and also the customers. A distribution circuit commonly uses primary and main feeders and lateral distributors. A main feeder originates from the station and passes through the main load centers. Lateral distributors connect the individual transformers at their ends.

Several distribution systems utilized in observe have one circuit main feeder and square measure outlined as radial distribution systems. Radial distribution systems square measure common as a result of their straightforward style and usually low price.The need of up the potency of power delivery has the facility utilities to cut back the losses at distribution level. several arrangements is found out to cut back these losses like network reconfiguration, capacitance placements etc.[3] The shunt capacitors offer a part of the reactive power demand, thereby reducing the present and MVA in lines. Installation of shunt capacitors on distribution network can facilitate in reducing energy losses, peak demand losses and improvement within the system voltage profile, system stability and power issue of the system. Reactive power compensation plays a very important role within the coming up with of associate degree electrical system. but to realize these objectives, keeping in mind the economy, the dimensions and site of capacitors ought to be set. optimum placement of Capacitors would be straightforward if the load didn't amendment. the matter with placement studies is that masses amendment throughout the day, week, month and most theme shave to alter of these changes as best they will.[7]

II. PROBLEM STATEMENT

The analysis of a distribution system is a crucial space of activity, as distribution systems offer the very important link between the majority facility and therefore the shoppers. several distribution systems utilized in apply have one circuit main feeder and square measure outlined as radial distribution systems. Radial distribution systems square measure common owing to their easy style and usually low value

The modern power distribution network is consistently being long-faced with associate degree ever growing load demand; this increasing load is ensuing into accrued burden and reduced voltage. The distribution network additionally incorporates a typical feature that the voltages at buses (nodes) reduces if moved aloof from station.

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This decrease in voltage is principally owing to scant quantity of reactive power. Even in sure industrial areas beneath vital loading, it's going to result in voltage collapse. therefore to enhance the voltage profile and to avoid voltage collapse reactive compensation is needed.

Capacitors square measure wide utilized in distribution systems for reactive power compensation to attain power and energy loss reduction, system capability unleash and acceptable voltage profile. Economic advantages of the electrical condenser depends chiefly on wherever and the way several capacities of the electrical condenser square measure put in and correct management schemes of the capacitors at completely different load levels within the distribution system. [4]

It is renowned that losses during a distribution system square measure considerably high compared to it during a transmission. the requirement of up the general potency of power delivery has the facility utilities to scale back the losses at distribution level. several arrangements is figured out to scale back these losses like network reconfiguration, electrical condenser placements etc. [1]

The shunt capacitors offer a part of the reactive power demand, thereby reducing this in lines. Installation of shunt capacitors on distribution network can facilitate in reducing energy losses, peak demand losses and improvement within the system voltage profile, system stability and power issue of the system

III. PROPOSED ALGORITHEM

First step in implementation is initializing the system. within the projected work here the operate to be optimized is that the Associate in Nursingnual price savings in an distributed electrical system. The objectives for electrical device placement and reconfiguration ar the maximising the value savings by reducing the energy losses, KVA enhancements and considering the annual charges because of placement of the capacitors.

Each hymenopteran chooses future states to travel to in accordance with the probabilistic rule given in equation. once hymenopteran k moves from one node to a different the state of node are recorded at some place. once a tour is complete that hold on information is employed to reason current answer. once all ants within the colony complete their path, and therefore the answer of every hymenopteran is achieved, the fitness of every hymenopteran is computed.

Fig.4.1 shows the final rule of the ACO for finding the optimum electrical device placement downside.

Input information is fed to the most program and hymenopteran Colony improvement rule uses this data to calculate the optimum placement of the capacitors to be placed within the fifteen bus radial distribution system. Initial price is calculated mistreatment the input file and with the assistance of the higher than fitness operate.

Algorithm works on the idea of the iterations therefore|then|so|and then} for this explicit downside statement a hundred iterations ar set so on converge the ACO rule. One parameter that is denoted as beta is employed to see the relative importance of the secretion level supported the space. letter of the alphabet is that the heuristically outlined parameter.

Pheromone worth is at first set to zero. currently the new secretion worth is up to the new path to be searched or fashioned with the assistance of the hymenopteran that is electrical device here. The likelihood of the new path is comparable to the new secretion level. If the new secretion worth is lesser than the random worth created mistreatment the generation of the random numbers than that individual bus is enclosed within the path. With the assistance of the native change rules the secretion levels ar updated domestically 1st and so with the assistance of the worldwide change rules the secretion level ar updated globally.

After the completion of the secretion updation final path is created that is shortest path within the case of the ants. Here within the case of the distributed electrical system once the completion of the change rules the buses at that the electrical device has to be placed ar known and therefore the worth of the capacitors also are determined.

After the position of the capacitors is set {the cost|the worth|the price} saving value is additionally determined by the ACO rule. With the assistance of the flow sheet the most code is explained within the following sections. The input file used here ar taken from a paper that had used symbolic logic for crucial the value savings in distributed electrical systems.

With the results obtained from the projected approach it is seen that the ACO works a lot of expeditiously than the fuzzy technique for this explicit downside. The worths of the value savings in terms of the greenbacks with the ACO projected approach here is larger than that with the value saving value obtained with the fuzzy technique delineate within the paper.

Program Flow

Step 1 MATLAB data formatting

Step 2 Main.m is run interface

Step 3 ACO is termed from Main operate

Step 4 Random variety generation

Step 5 Various data formatting

Step 6 Random Path visit by Ants i.e capacitors

Step 7 Pheromone updation domestically and globally

Step 8 Final Calculations of price saving & Log file creation.

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In the rule solely hundred iterations ar unbroken in order that the convergence of the ACO rule Associate in Nursingd calculations is conveyance to an finish. As hymenopteran Colony improvement being associated with have problems with the convergence iterations worth should be outlined thus on avoid unwanted iteration within the rule. 1st the random numbers ar generated for randpern thus on have random ways for the capacitors. Than every electrical device starts its visit to every random path.

After the completion of the tour we've bound worth of the secretion at every path or we will say {that every|that every} bus has been visited by each electrical device. Than with the assistance of the native change rules offered within the

Ant Colony improvement the secretion levels ar updated domestically. once the completion of the native change rules the secretion levels ar updated globally thus on have the ultimate path or we will say the ultimate buses wherever the capacitors has to be placed.

Finally the value operate or the fitness operate is calculated with the assistance of the outlined equation. within the calculation of {the price|the value|the price} operate the value of electrical device in addition because the cost of the of the system over all ar thought-about thus on have a economical system style that is that the main goal of the projected approach.

The main program ought to be written rigorously in such how that it ought to run quicker and calculation time for the value determination ought to be low. The convergence of the rule thus as avoid situation condition ought to be taken care. Such all things ought to be thought-about whereas writing the program mistreatment MATLAB, for that we've to possess understood the execution rigorously.

IV. Result & Disscussion

Comparison ACO vs Fuzzy Logic Method

The results obtained with the proposed method have been compared with the annual cost saving obtained using Fuzzy logic method. A 15 bus distribution system is considered here in which 5 capacitors are to be placed so as to have maximum annual cost saving and minimum reactive power loss as per the problem statement. As ACO works on the basis of iterations, to converge the ACO algorithm used here I have kept 100 iterations in the process to find the optimal results. It has been found that ACO provides results in lesser time as compared to the time taken by fuzzy logic method. Also the annual cost saving increases as compared to the savings obtained while using Fuzzy Logic approach.

Following table describes reduction in energy loss, KVA enhancement which are used as the input parameters taken from the paper published which describes capacitor placement for a real time application.

Table 4.1
Input Parameters used in the implementation

Reduction in Energy Loss in $/-	KVA Enhancement in $/-
2100	20
3300	30
1400	50
6500	80
2600	30
4700	60
6800	40
8900	60
2500	20
6800	30
5300	50
8800	80
4300	30
4600	60
5500	40

Following table provides the size of capacitors used in the placement process. As shown in the table below for a 15 bus radial distribution system 5 capacitors are to be placed for optimal annual cost savings. For 15 bus system Ant Colony Optimization algorithm requires 15 capacitors for the calculation process so rest all the values are considered to be 0.

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Table 4.2
Size of Capacitors

Size of Capacitor
274
193
143
265
145
0
0
0
0
0
0
0
0
0
0

Following Table describes the Annual cost savings obtained with Fuzzy Logic method and Proposed Ant Colony Optimization approach.

Table 4.3
Capacitor Placements – 15 Bus System

Capacitor Placed	**Bus Number**
1	5
2	9
3	6
4	8
5	10

Table 4.4
Annual Cost Savings – 15 bus system

Method of Implementation	**Annual Cost Value ($)**
Fuzzy Logic Method	9001420
Proposed Approach – Using Ant Colony Optimization Algorithm	10009940

CASE : A 10 bus distribution system is considered in which three capacitors are to be placed for maximizing the annual cost savings. 10 Bus Distribution System where capacitors to be placed are of size 274, 265 and 145.

Table 4.5
Input Parameters for 10 Bus Distribution System

Reduction in Energy Loss in $/-	KVA Enhancement in $/-
2100	20
3300	30
1400	50
6500	80
2600	30
4700	60
6800	40
8900	60
2500	20
6800	30

For this particular case annual cost saving value is 4967341 $.

Table 4.6
Capacitor Placements – 10 Bus System

Capacitor Placed	**Bus Number**
1	5
2	3
3	9

As described in the above table for a 10 bus distributed system as per the proposed approach using Ant Colony Optimization algorithm three capacitors are to be placed at bus number 5, 3 and 9 respectively.

V. CONCLUSION

A new powerful formula has been conferred during this project work for condenser placement in radial distribution systems. This technique was galvanized by observation of the behavior of hymenopterous insect colonies. The ACO applies the state transition rule to favors transition towards nodes connected by shorter edges. Then it applies native change rule. Finally it applies a worldwide change rule to create search a lot of directed and enhance the aptitude of finding the best answer in condenser placement drawback. This ACO methodology for condenser placement drawback is economical to seek out the best answer for the system employed in the work.

It was discovered that best condenser placement method not solely cut back the ability loss, however additionally improve the voltage profile and maximising cyberspace savings. the matter has been developed as maximization of web savings obtained from energy loss reduction, kVA improvement and improvement of voltage profile.

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