Presenting a Novel Algorithm to Optimal Designing Power Distribution Network in the Presence of DG

Amir Rahimi, Hossein Nasiraghdam
Department of Electrical Engineering .Ahar Branch, Islamic Azad University, Ahar, Iran
Email: amir_rahimi61@ymail.com , H_Nasir59@yahoo.com

Abstract

Regarding the nature of non-linear discrete placement, and in order to determine the optimal capacity of the substation, the goal in the present study will be a number of local optimum points. In this research, the problem of optimal placement posts to reduce power losses by considering Distributed Generation (DG). In formulating the objective function, geographical distribution density in the study period and places constraints on electric posts and geographic terms were investigated. The proposed technique would be based on testing a sample network.

Keywords : Substation placement, Genetic algorithm, Distributed generation, Distribution system planning, radial distribution network.

1-Introduction

The main objective of the distribution system planning (DSP) problem is to provide a reliable and cost effective service to consumers while ensuring voltages and power quality are within standard ranges. Several objective functions, including new equipment installation cost, equipment utilization rate, reliability of the target distribution system, and loss minimization were evaluated considering an increase of system loads and newly installed loads for the planning horizon. New optimization models, new techniques aimed to find optimal or even good solutions for the DSP problem are still needed, considering the location and size of substations and circuits, the construction of new circuits as well as new substations or, alternatively, the reinforcement of the existing ones in order to allow a viable system operation in a pre-defined horizon [1-2].

In this section, previous works on OSP have been organized in four categorizes based on solution techniques; evolutionary algorithms, Particle Intelligence Algorithms (PIAs), fuzzy sets and heuristic techniques. Different approaches of evolutionary algorithms have been employed to solve OSP in [3-8]. Genetic Algorithm (GA) is one of the most current algorithms among evolutionary algorithms, which in [3-4] have solved OSP problem. In [5-8], other evolutionary techniques have been suggested to solve OSP problem.

In PIAs, Particle Swarm Optimization (PSO) [9-10] and Ant Colony Search (ACS) [11-13] have been proposed to optimal planning of distribution systems.

Heuristic methods are other categories been used to find optimal location and size of substation in power systems [14-16]. Fuzzy sets in [17-19] have been proposed to optimal sizing and sitting substations. This paper has been organized in five sections. In second section, the Optimal Sizing and Sitting Substation is formulated in three stages. The concept of genetic algorithm is presented in section 3. Simulations have been done in section 4. This work has been concluded in section 5.

2-Objective Function

Final goal is to minimize the cost of the network. The new Objective Function (OF) was defined to be similar to the following relationships.

$$OF = CLoss_{LV} + C_{LV} + CSubIns_{NS} + CSubIns_{NL} + DG_{\cos t} \tag{1}$$

Where, $CLoss_{LV}$: the cost of lossesinlow voltage level, C_{LV}: the cost of low voltage lines, $CsubIns_{NS}$: The cost of establishing new posts, $CsubIns_{NL}$: the cost of construction of medium voltage lines and DG_{cost}: DG is the cost of resources. In order to calculate the amount $CLoss_{LV}$, can be used in the following equation:

$$CLoss_{LV} = Load_{pu}^{2}.LV_{L}.8760.S_{base}.CE.(1+Inc_{CE})^{b-1}.(1+Groth)^{b-1} \tag{2}$$

Where, LV_L: once the candidate, S_{base}: powerbase, CE: energy costs, Inc_{CE}: the growth rate of energy expenditure, Groth: annual grow than d$Load_{pu}$: per united load is calculated by the following equation:

$$Load_{pu} = \frac{Load}{S_{base}.LF} \tag{3}$$

Where, Load: load in kVA load points and LF: is the study period. We have to calculate C_{LV}

$$C_{LV}^{D} = LV_{L}.C_{LV}.(1+bahre)^{y-1} + C_{LV}^{D,old} \tag{4}$$

Where, C^{D}_{LV}: low-cost lines for each candidate point, C_{LV}: cost per kilometer low-voltage lines, bah are: bank interest rates and y: years. Subsequently, the $CSubIns_N$ formulations can be made as follows:

$$CSubIns_{N} = \sum Cap_{sub}.S_{base}.CSubIns_{base}.(1+bahare)^{y-1} \tag{5}$$

Where, Cap_{sub}: initial capacity of substations and $CSubIns_{base}$: cost is mounting posts per kVA. Other parameters, $CSubIns_L$ of this formulation are made:

$$CSubIns_{L} = \sum\left(Cap_{sub} / (5000/S_{base}).MV_{L}\right).S_{base}.CSubIns_{base}.(1+bahare)^{y-1} \tag{6}$$

Where, CMV Ins_{base}: the cost of construction per kilometer equals medium voltage lines.

3- Genetic Algorithm

Genetic algorithms perform a heuristic global optimization search using a form of guided random search. The search is performed using a population of individuals. Each individual represents a point in the search space. For the traffic signal timing problem, each individual represents a particular network signal timing plan. The set of decision variables is encoded into a form of genetic material. Associated with each individual is the computed objective function value. For delay minimization in traffic networks, the associated objective function value will be the delay produced by the particular signal timings. Optimization is performed by manipulating the population of individuals [20]. Figure 1 shows optimization by genetic algorithm.

Optimization is performed by manipulating the population of individuals using the following steps:

Initialization: The individuals in the initial population are assigned to points in the search domain. Typically, each individual is assigned to a random point in the search domain (i.e. each point in the search domain has the same probability of being chosen).

Selection: Individuals in the population are selected for reproduction. The selection probability for each individual is usually a function of the objective function value. For maximization problems, individuals with a larger objective function values have a larger selection probability. For minimization problems, individuals with a smaller objective function values are favored for selection.

Recombination/Crossover: Once individuals have been selected for reproduction, these “parents” are paired and one or more “children" are created using a crossover operator. Crossover creates children by combining or blending the genetic material of the two parents (i.e. the decision variable sets of the two parents are combined to form a new set for each child).

Mutation: The mutation operator performs random alterations to the genetic material of an individual. Mutation will alter one or more of the individual’s decision variables with small probability. Mutation is typically applied to the children created by recombination.

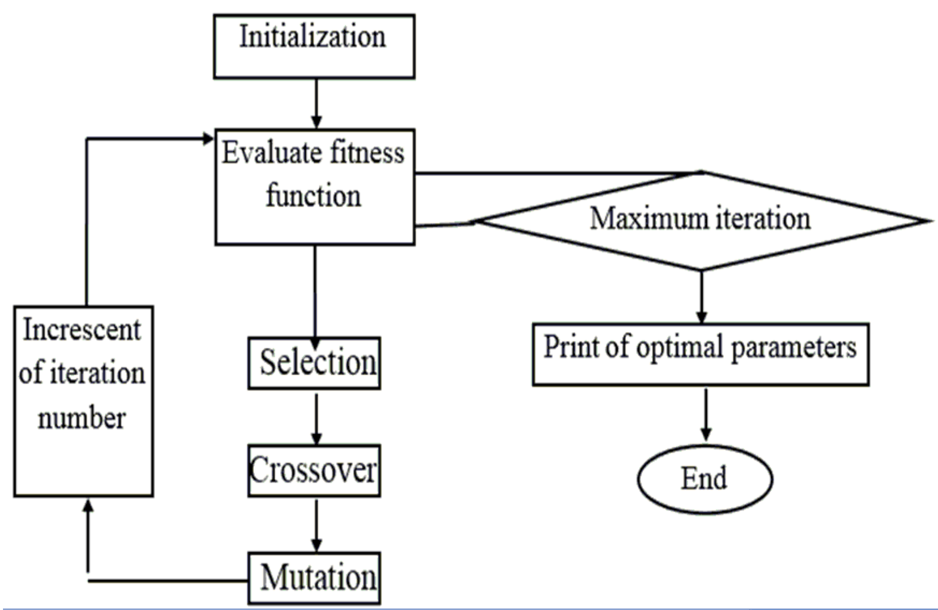

Fig.1. Flowchart of optimization by genetic algorithm

4- Simulation Results

In this section, the results of the simulation are presented. To this end, the network has 12 substations and 10 points once considered to be. For this model, three scenarios were proposed, the objective of the project scenario Mkan¬Hay Effects of changing the number of candidates, and the candidate is the network load and time intervals. Thus, three scenarios are:

Scenario 1: Change the number of candidate locations: In the first scenario, changing the number of candidate locations, its impact on the parameters of the study. Three modes are defined for this scenario.

- Case 1. Low candidate points: 10 points once there.
- Case 2. Basic candidate points: 12 points once there.
- Case 3 large candidate points: 14 points once there.

Scenario 2: Change the load level: In the second scenario, the load levels change. To this end, low load levels, base and peak were defined. The three modes are:

- Case 1: Low candidate points: 10 load points.
- Case 2: Base candidate points: 12 load points.
- Case 3: Hight candidate points: 14 load points.

Scenario 3: change the distance between load and candidate points: In last scenario, the distance between the times and places candidates will be changed. Accordingly, three suggestions are:

- Case 1: Minimum distance: 70% distance between points of load and candidiate.
- Case 2: Base distance: 100% distance between points of load and candidiate.
- Case 3: Maximum distance: 150% distance between points of load and candidiate.

4-1- Basic case

Given that, the situation is similar in all scenarios and base load is the same, the results will be examined this time. In this case, 12 times the load point of 100 percent and 100 percent of the time interval is considered. Table 1. Results of the exercise of the options provided by the network.

According to the results in Table 1, the best response is obtained in the presence of DG. Although this model has not been followed in all cases and the presence of five to six DG DG lower response has to offer. The presence of DG, the least amount of losses, the cost of low voltage lines and the cost of the post has to be offered.

At the expense of medium voltage lines, the ten, six, five and zero-DG have to offer are the same values. How to feed bars of candidate sites in table 2 and the location and capacity of DG resources allocation in the table 2 is visible. In view of the results of table 3, the maximum capacity of 2500 kilowatts used, which used eleven times. The most likely place to install DG place 10 to 12 times and reduce the likeliest places 3, 7 and 8 are the only two times.

Table.1.Results of base load

DG No.	OF	$CLoss_{LV}$	C_{LV}	$CsubIns_{NS}$	$CsubIns_{NL}$
0	444856	427889	58.1899	1435	15473
1	390506	370408	63.4799	1423	18052
2	335423	312866	63.4799	1556	20631
3	350547	328981	42.3199	1182	18052
4	348133	324180	68.7699	1355	20631
5	303377	283854	55.5449	1306	15473
6	304015	283830	52.8999	1273	15473
7	302700	278600	97.8649	1188	18052
8	291578	270959	66.1249	1270	15473
9	244270	215217	63.4799	1263	23209
10	232072	210465	39.6749	1149	15473

Table.2.Feeding load from candidate locations in base case

DG No.	Feed from									
0	10	13	11	13	2	11	18	18	9	16
1	13	20	17	15	15	11	19	19	9	2
2	10	9	18	15	11	11	19	16	13	9
3	10	12	15	9	1	11	19	18	18	3
4	10	12	13	6	16	11	19	15	10	9
5	10	14	10	15	15	6	10	9	9	16
6	10	14	11	14	10	20	20	17	9	7
7	15	15	13	15	14	16	13	19	11	2
8	15	12	5	13	11	11	19	11	13	10
9	20	10	18	14	16	11	13	17	9	5
10	10	12	11	9	1	7	13	17	9	9

Table.3. Location (size) of DGs in base case

DG No.	Location (size in kW)
1	10(1250)
2	5(150) ،5(50)
3	3(2500) ،2(2000)،10(2500)
4	4(2500)،10(1600) ،4(100) ،5(400)
5	9(1000) ،5(1000) ،6(2000) ،4(300)،10(2000)
6	7(800) ،2(1250)،10(2500) ،7(1600) ،8(250) ،2(2000)
7	6(2500) ،1(2500) ،9(1250) ،5(2000)،10(2000)،10(2000) ،9(1000)
8	5(200) ،9(800) ،3(600) ،1(2500) ،9(150) ،6(800) ،9(1500)،10(2000)
9	2(1000)،10(2500) ،6(300) ،2(2500) ،1(1600) ،4(300)،10(2000) ،5(300) ،8(300)
10	6(2500)،9(1600)،2(800)،10(250)،6(1000)،1(800)،10(1600)،4(100)،5(2500)،1(350)

4.2- Scenario1: change of the number of candidate locations

The main focus of the first scenario, candidates study the impact of the shift on the net results. For this purpose, three-defined 10, 12 and 14 points will be considered in the process. The results of 12 times base load point were providedas defined previously.

4.2.1- Case 1. Low candidate points

For this purpose, in the first case, the numbers of points were only 10 times the intended results in the table 4-6 listed. Precision in the results table 4 it can be seen that the best value for the objective function and power losses obtained in the presence of DG is not the source.

The lower the tension lines in the presence of a DG unit is visible. The cost of establishing new posts lowest in the six-DG provides and the cost of construction of medium voltage lines in the presence of DG 5 for substantially less than the other. Table 5 shows the location and capacity of DG units installed in this case.You can view the power to loads of places nominated to the table 6. As it can be seen in table 6, capacity of 2500 kW has been used nine times. Most units in the ninth place with eight units installed and lowest installed in locations 1 and 8 as two notables.

Table.4.Results of first case of first scenario

DG No.	OF	$CLoss_{LV}$	C_{LV}	$CsubIns_{NS}$	$CsubIns_{NL}$
0	523749	473406	81.9949	1414	48139
1	466626	434089	42.3199	1297	30946
2	450199	414794	87.2849	1414	32665
3	401848	369228	68.7699	1268	29227
4	400152	354985	92.5749	1408	41262
5	366614	350839	52.8999	1332	12034
6	358242	322293	50.2549	1237	31806
7	349298	310903	58.1899	1435	34385
8	303501	272703	79.3499	1276	24929
9	287972	256949	58.1899	1320	25788
10	327039	288858	55.5449	1261	31806

Table.5.Location (size) of DGs in first case of first scenario

DG No.	Location (size in kW)
1	5(250)
2	10(800)،5(2500)
3	3(1250)،5(2000)،7(2500)
4	10(1500)،9(1000)،9(2500)،7(1000)
5	9(1000)،5(350)،3(1250)،10(600)،2(1500)
6	8(500)،9(1600)،5(2500)،10(50)،1(1500)،9(500)
7	5(150)،5(1000)،5(250)،8(2500)،1(200)،9(50)،2(800)
8	9(500)،4(2500)،3(200)،6(2000)،9(1250)،10(1500)،2(1250)،7(2000)
9	3(500)،6(2500)،8 (400)،10(600)،6(150)،2(350)،7(1600)،4(300)،6(1500)
10	5(2500)،4(150)،3(1600)،3(800)،7(1250)،7(200)،6(250)،5(1250) ،5(2500)،10(1500)

4.2.2- Case 3 large candidate points

In the third case of the first scenario, the network can be defined once for 14 points. The results of this case are listed in table 7. According to table 7 it can be argued that the best possible answer for the eight-DG provides objective function and power losses. The presence of three of the four DG will produce a better response. The cost of establishing lines of low pressure in the presence of 7 DG least amount of support. Placement of Unit DG best value for the cost lines of medium voltage and cost of establishing the new post has to offer. Location and optimized capacity of DG units in the table 8 is visible. Table 9 shows the power to loads of places candidates in the third case of the first scenario.

According to Table 8, first place with fourteen of installation, is the most likely place to locate DG. Least likely to be installed in place of 4, 8 and 9 with two cases are allocated to installation.

Table. 6.Feeding load from candidate locations in first case of first scenario

DG No.	Feed from									
0	10	2	19	14	15	16	13	14	9	14
1	10	11	19	14	3	11	10	9	10	4
2	15	12	13	12	3	11	19	17	10	15
3	15	1	14	15	15	11	16	9	13	11
4	20	15	11	13	15	11	20	18	14	13
5	13	1	11	15	15	11	19	11	13	16
6	15	14	19	4	11	20	19	9	10	11
7	15	15	15	15	11	11	18	17	13	16
8	15	15	15	9	15	11	20	18	15	18
9	15	15	13	15	11	8	19	17	10	11
10	10	13	3	20	4	20	19	18	9	11

Table.7.Results of third case of first scenario

DG No.	OF	$C_{Loss\,LV}$	C_{LV}	$C_{subIns\,NS}$	$C_{subIns\,NL}$
0	391756	369490	74.0599	1561	20631
1	371782	354249	60.8349	1440	15473
2	374699	354137	87.2849	1514	18052
3	318564	297609	55.5449	1332	18052
4	324749	300661	55.5449	1439	20631
5	294462	272690	71.4149	1447	18052
6	282406	260207	76.7049	1421	18052
7	281463	258753	47.6099	1275	18052
8	220796	197116	58.1899	1297	18052
9	255672	229696	74.0599	1351	20631
10	239167	216940	63.4799	1164	15473

Table.8.Location (size) of DGs in third case of first scenario

DG No.	Location (size in kW)
1	8(1250)
2	3(350) ،10(1500)
3	1(50)،1(1500)،9(2500)
4	6(2500)،3(1000)،4(1250)،3(50)
5	10(800)،6(150)،1(1600)،5(1600)،1(350)
6	1(800)،2(400)،2(1600)،6(600)،2(2000)،2(100)
7	5(150)،7(150)،7(1600)،5(1000)،3(2500)،10(2000)،3(400)
8	7(2500)،7(350)،1(350)،1(350)،10(2500)،5(2500)،1(1600)،7(1500)
9	10(2000)،1(50)،2(1600)،10(400)،4(1500)،1(400)،1(400)،7(300)،5(1600)
10	1(400)،10(2000)،7(2000)،9(200)،1(2000)،1(1250)،3(2500)،10(1600)،7(250)، 8(1600)

4.3 Scenario 2: Change the load level

In the second scenario, the defined network load level to level change and the response time of the simulation is evaluated. Accordingly, the three levels of low load (80% load), base load (100% load) and peak load (120% load) were defined and applied through research network. Base load was visible results in Section 4.2 in this section, the results offered the first and third scenarios.

4.3.1 Case 1: Low candidate points

The network and results defined in a table 10 were included. According to the results presented in table 10, the best answer for the objective function can be achieved in the presence of DG eight, then nine and ten respectively in the presence of DG. The cost of power losses as well as mood and behavior is similar to that objective.

Table. 9.Feeding load from candidate locations in third case of first scenario

DG No.	Feed from									
0	10	15	21	20	22	11	19	18	18	11
1	15	20	7	9	22	22	19	15	9	16
2	10	22	13	15	15	18	13	18	13	21
3	10	12	19	14	6	22	19	16	11	11
4	20	14	22	15	15	11	19	18	9	18
5	18	12	18	14	12	22	13	9	13	11
6	15	16	20	15	22	22	13	17	21	22
7	21	12	10	15	22	22	10	19	9	4
8	22	12	22	15	17	11	20	9	9	22
9	10	12	21	9	18	22	19	18	13	18
10	1	10	7	9	1	1	3	10	7	8

Table.10. Results of first case of second scenario

DG No.	OF	$CLoss_{LV}$	C_{LV}	$CsubIns_{NS}$	$CsubIns_{NL}$
0	376068	356384	69.8280	1561	18052
1	318082	295593	52.9000	1554	20631
2	302697	284539	74.0600	1497	15473
3	290904	267431	61.3640	1499	20631
4	259742	235927	48.6680	1485	20631
5	252157	229900	46.5520	1419	18052
6	258898	237060	40.2040	1347	18052
7	233378	210450	61.3640	1349	18052
8	211529	188257	42.3200	1301	18052
9	219652	195504	55.0160	1245	18052
10	222678	222678	50.7839	1290	18052

The lowest cost of low voltage lines in the six-DG is provided. Not locate the two DG best responses to arrange for the cost of establishing new posts and the cost of construction of medium voltage lines provided. The remarkable thing about the cost of construction of medium voltage lines after the placement of four units distributed generationis that the fixed cost is the same. Table 11 shows how to feed ten times defined in this case.Based on the results listed in table 12, the maximum capacity of 2500 kW capacity and four times have been used.

Table.11.Feeding load from candidate locations in first case of second scenario

DG No.	Feed from									
0	15	17	10	20	16	20	10	17	9	11
1	11	11	19	14	15	20	13	11	9	9
2	13	13	12	15	15	11	13	11	13	13
3	10	12	18	17	18	20	13	9	13	11
4	15	20	11	14	18	11	13	11	9	11
5	15	14	12	13	18	20	13	18	9	11
6	10	20	3	15	15	20	10	17	9	11
7	15	20	15	15	16	11	20	17	15	18
8	10	14	19	15	15	14	20	9	13	5
9	13	14	8	14	15	20	19	9	10	15
10	10	14	5	14	20	20	19	9	13	12

Table.12 Location (size) of DGs in first case of second scenario

DG No.	Location (size in kW)
1	4(250)
2	8(1000)،10(1500)
3	5(1600) ،4(350) ،6(500)
4	9(400) ،3(1500) ،5(800) ،2(300)
5	1(500) ،3(2000) ،5(1000) ،3(2500) ،7(600)
6	10(2000)،7(150)،10(800)،6(1600)،10(150)،4(200)
7	9(200)،10(2000)،9(1600)،5(50)،9(1000)،4(1000)،10(2500)
8	10(2500)،8(100)،8(300)،7(1000)،5(600)،6(2000) ،10(1500)،7(800)
9	1(1600)،4(1000)،6(1600)،10(2000)،4(100)،3(2500)،1(400)،7(1250)،6(1000)
10	7(2000)،3(1250)،4(300)،3(400)،9(100)،7(2000)،4(600)،1(50)،4(500)،5(1600)

4.3.2 Case 3: Height candidate points

The definition for the network and results were included in table 13 By studying table 13, it can be seen to function, the cost of losses in low voltage, low voltage line construction costs and the cost of new posts by ten, ten, four and seven DG, the best responses present limitations. The presence of one or two DG jointly lowest cost of medium voltage lines to impose network addressing.

Table.13.Results of third case of second scenario

DG No.	OF	$CLoss_{LV}$	C_{LV}	$CsubIns_{NS}$	$CsubIns_{NL}$
0	524942	505211	117.4380	1561	18052
1	446027	428702	73.0019	1462	15473
2	402029	384186	69.8279	1425	15473
3	347282	323957	53.9579	1419	20631
4	355575	334741	38.0879	1256	18052
5	357352	332460	95.2199	1386	20631
6	335438	315079	44.4359	1176	15473
7	335291	312281	60.3059	1217	18052
8	330432	304081	69.8279	1126	20631
9	298798	275148	63.4799	1303	18052
10	292400	267003	104.7420	1076	18052

Table.14.Feeding load from candidate locations in third case of second scenario

DG No.	Feed from									
0	15	14	9	17	17	11	19	16	9	16
1	15	11	6	15	11	11	19	18	13	13
2	15	14	18	14	3	20	19	15	9	9
3	10	20	8	15	11	11	19	18	13	11
4	15	14	18	14	1	11	19	17	13	2
5	15	14	10	15	11	13	19	17	18	11
6	15	13	11	14	11	11	10	18	6	8
7	11	12	7	15	11	5	10	9	13	14
8	10	15	18	14	2	2	13	17	12	11
9	13	13	19	15	16	11	13	17	13	11
10	1	20	14	9	15	14	13	17	13	11

Table 14 shows the nutrition bars and tables 15, the location and capacity of the installed units at this location. Precision in the results of table 15can be attributed to the capacity of 2500 kilowatts using the highest possible capacity used seven times. The number of DGs in places 8 and 9 with three installation, is visible. Also place, number one is the most likely location for the installation of DG units, and eleven times at this location DG are allocated.

Table.15. Location (size) of DGs in thirdcase of second scenario

DG No.	Location (size in kW)
1	5(400)
2	5(1250) ،10(400)
3	8(800)،2(1000)،1(300)
4	1(1000)،10(800)،1(400)،2(200)
5	1(2500)،2(500)،6(2000)،4(400)،4(1500)
6	10(2000)،9(1500)،10(1600)،5(1250)،4(800)،2(2000)
7	3(1000)،6(800)،1(1600)،6(2500)،3(350)،10(2500)،4(200)
8	5(2000)،3(800)،6(800)،8(1000)،6(1600)،10(1500)،1(600)،9(2500)
9	7(1250)،1(50)،3(2500)،7(400)،5(1500)،7(150)،3(200)،9(2500)،1(1600)
10	4(800)،7(1000)،3(1500)،6(800)،1(1500)،1(2500)،6(2000)،6(2000)،8(2000)،1(2000)

4.4 Scenario 3: change the distance between load and candidate points.

In the proposed scenario, the changes of the times and places of candidates for the post were installed. Accordingly, three distances can be defined for the network. In cases of first, second and third, respectively 70, 100 and 150% are considered. 100% Barpayh that the results presented earlier in this chapter, and in this section the results of Modes 1 and 3 will be discussed.

Table.16. Results of first case of third scenario

DG No.	OF	CLoss LV	C_{LV}	CsubIns NS	CsubIns NL
0	228312	211959	34.3849	845	15473
1	193461	176320	63.4799	992	15473
2	174714	159962	71.4149	1062	12894
3	166085	143214	74.0599	1030	20631
4	156958	133920	60.8349	1038	20631
5	150628	131803	47.6099	863	15473
6	147351	125243	58.1899	933	18052
7	110521	84431	68.7699	712	20631
8	129695	104874	50.2549	876	20631
9	106086	84623	44.9649	771	15473
10	110628	86937	81.9949	811	18052

4.4.1 Case 1: Minimum distance: 70% distance between points of load and candidate

Table 16 shows the results of taking the first case, where the distance between the load and the location of its candidate for the post, as little as 70% of the initial value, for the network is in its place.

Table. 17..Feeding load from candidate locations in first case of third scenario

DG No.	Feed from									
0	15	20	2	14	3	11	19	19	9	5
1	10	14	8	9	11	14	19	18	9	11
2	10	14	10	14	16	11	19	11	10	16
3	10	12	13	15	11	11	20	16	10	18
4	10	12	11	13	11	20	13	18	9	14
5	10	12	15	15	11	11	19	19	18	7
6	15	12	11	15	15	10	19	16	14	9
7	15	20	19	14	10	18	19	5	13	11
8	10	15	13	15	11	20	19	17	9	5
9	15	12	9	15	15	18	13	17	13	14
10	13	14	13	15	11	8	10	9	13	9

Table.18. Location (size) of DGs in first case of third scenario

DG No.	Location (size in kW)
1	10(1500)
2	3(200)،5(1000)
3	10(400)،10(2000)،10(50)
4	4(1250)،10(600)،10(250)،3(50)
5	1(1500)،10(350)،5(150)،7(2000)،9(1600)
6	2(300)،6(1500)،9(1600)،9(1250)،6(500)،9(1600)
7	10(250)،5(1600)،8(2500)،6(2500)،2(1600)،7(2500)،10(2500)
8	3(400)،1(50)،6(350)،5(2000)،2(250)،10(2000)،1(1250)،7(400)
9	1(1500)،6(200)،9(1600)،6(1500)،8(350)،8(1250)،10(2500)،5(1600)،1(600)
10	7(500)،1(2500)،1(1500)،4(250)،6(1000)،10(1250)،3(2500)،6(600)،4(200)،6(2000)

According to the results in table 16, the best response network and even locating seven of nine DG is also better response than ten placements have to be offered. Price losses in low voltage level completely objective function value modeled compared with similar discordance.

Table.19. Results of third case of third scenario

DG No.	OF	$CLoss_{LV}$	C_{LV}	$CsubIns_{NS}$	$CsubIns_{NL}$
0	986194	963368	71.4149	2122	20631
1	910536	884330	79.3499	2303	23209
2	857679	833974	58.1899	2150	20631
3	830126	803354	76.7049	2286	23209
4	829471	805561	50.2549	2117	206310
5	781147	781147	66.1249	2134	20631
6	740124	711971	87.2849	2195	23209
7	672747	644089	81.9949	2178	23209
8	648243	621119	74.0599	2091	20630
9	593890	564094	63.4799	2075	23209
10	614315	586711	47.6099	1973	20631

In the absence of the DG, LV is the lowest cost line to be allocated. The presence of seven and two respectively showed DG best answer for the cost of establishing new posts and the cost of construction of medium voltage lines of their own. Tables17 and 18 respectively, show how to feed and space (capacity) distributed generation units to display this location. Carefully at table 19, it can be claimed that the capacity of 2500 kilowatts, the highest possible capacity network, is used seven times.

Table.20.Feeding load from candidate locations in third case of third scenario

DG No.	Feed from									
0	15	15	10	14	12	7	13	17	9	12
1	15	16	19	15	15	20	19	18	18	14
2	15	15	15	13	4	20	20	9	13	11
3	15	12	10	9	11	20	19	15	10	16
4	10	20	11	15	11	18	13	17	10	1
5	10	14	15	15	10	11	19	17	19	20
6	15	12	9	9	15	11	13	19	10	16
7	10	14	12	14	17	11	20	16	9	11
8	10	14	11	14	16	20	13	9	14	11
9	10	20	13	15	11	11	20	9	9	9
10	11	13	19	14	11	11	20	17	18	3

Place 10 to 12 times and locations 2, 4 and 8 with 3 times the amount DG in order to have the highest and lowest installations.

Table.21. Location (size) of DGs in third case of third scenario

DG No.	Location (size in kW)
1	9(1500)
2	5(2000) ،2(100)
3	3(150) ،3(800) ،8(1250)
4	6(600)،10(400)،10(250) ،1(100)
5	4(300) ،3(2500) ،6(350) ،2(250) ،8(2000)
6	3(50) ،3(1500) ،6(800) ،9(1600) ،1(200)،10(1600)
7	5(1500) ،3(500) ،3(1600)،10(1600) ،5(300) ،7(600) ،6(350)
8	10(2000) ،5(600) ،5(500) ،9(1250) ،8(2000) ،2(1000)،10(1500) ،9(1000)
9	9(50) ،8(1500) ،3(2000) ،3(1250)،10(1250) ،8(1600) ،7(2000) ،1(800)، 5(50)
10	7(150)،10(1000)،7(250)،2(400)،8(250)،2(2000)،10(2500)،1(2500)،5(800)،10(2000)

4.4.2-Case 3: Maximum distance: 150% distance between points of load and candidate

In the last case, the maximum amount of space possible for the network considered and the distance between the load and candidates increased to 150% of the initial value of the screw. This result is shown in table 19.

Based on the above table, not the best possible answer for DG provided by the objective function and power losses. Placement of DG lowest possible cost for the construction of low voltage lines to the network impose such an event occur for the cost of establishing the new post. The cost of construction of medium voltage lines in the presence of DG to the other eight cases shows what the best value is. Table 21 shows ways to feed over and the table 22 shows the location and capacity of the DG placement.

5- Conclusion

In this paper, the design of the power distribution network in the presence of DG resources based on cost allocation of posts is done using genetic algorithms. For this purpose, a network of twelve points based on ten points once considered a candidate for the post installed. For this model there were proposed three scenarios, the objective of the project scenario Effects of changing the number of candidate locations, the network load and distance candidates on times and places. Each scenario also includes three modes, which is a base case scenario is the same in all three, and it is compared to other cases.

The simulation results can claim that:

- Increasing the number of DG did not necessarily mean improvement in the objective function parameters. In some cases the increase had photo call. This can be due to network saturation (injection be needed over the network) as well as the lack of economic justification to increase the number of units.
- About 90 percent of the cost of losses in the objective function value is low voltage level. This should be the main target to reduce this cost.
- The maximum and minimum objective function value, respectively, in the event that 150% of the distance between the candidate and low load times and there have been times by 70%. This shows the extent to which the distance between the bar and the candidate for the post can be effective on total cost.
- Position 8 DG is lowest number in its place, while 10th place and after that, the most likely locations for distributed generation units are installed.
- The cost of low voltage lines from a certain pattern did not use the most changes among parameters allocated to the objective function.

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