Showing improve voltage profile and reduce losses using DG compared to flow without the use of DG in distribution network and locate the appropriate DG network in order to improve the voltage profile and reduce losses utilizes the algorithm GA

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Abstract
DG plant has a production capacity of a few kW to 10 MW for electricity generation in areas closer to costumers, they can be used for a variety of solar cells, fuel cells, micro turbines and wind farms and etc. If these power plants are connected to the network, the network has different effects including loss reduction, improved voltage profile and increase the reliability [1],[2].A total of distributed generation power plants, installed capacity and they are so determined that the maximum loss reduction and taking into account the constraints of problem arise In this paper the genetic algorithm, was used in the optimization problem After extracting the flowchart of this method in the optimal placement of distributed generation power plants, computer programs were developed and implemented this program on the network and has been implemented IEEE bus 33 ,How many times results obtained from implementing the program, its advantages and disadvantages compared with each other and stated that the results improved voltage profile and reduce losses and reduce congestion in the network lines shows.

Key words:
Dispatch - DG-losses - Improved voltage profiles – Power flow – Genetic algorithm

1. Introduction

The use of DG in the distribution of environmental benefits, a lot of economic and technical consequences. To achieve these benefits, the right size and DG should be installed in appropriate locations. Generally the distributed generation power plant in the power systems has the following benefits: 1. Reduce the cost of power equipment 2. Reduce power transmission losses 3. Ease the possibility of recycling the heat in power plants 4. Short installation time and operation of such plant 6. Reduce of environmental pollution and noise of large power plants 7. The power loss reduction with optimal placement of distributed generation in distribution networks 8. Release the capacity of transmission and distribution systems, including lines and substations Different applications have different technologies in distribution networks [2],[3].These applications are based on the needs of the consumer electrical load is variable. These applications are used in distributed generation efficiency.

2. Optimal placement DG utilizes genetic algorithms

Distributed generation plant has a production capacity of a few kW to 25 MW are For production of electrical energy used in areas closer to consumers That the plant, decentralized or local power plants may also be called And preceded by the DG (dispersed generation) are displayed If the plants are connected to the network, the network has different effects including loss reduction and voltage profile improvement and increase the network reliability. Lack of appropriate placement of the plant led to an increase in network transmission network losses and increased production costs and energy. Therefore, it is necessary to locate the plant network optimization method for doing so is the most profitable for the network to have. A total of distributed generation power plant , installed capacity, as determined and the reduction in transmission losses, taking into account technical constraints and economic problem. According to the above, in recent years, extensive research in the field of locating power distribution network to reduce losses have been scattered, In addition, several different ways to locate these resources have been usedو Such as sensitivity analysis, dynamic programming algorithm, PSO, and genetic algorithm. In this paper, A genetic algorithm to optimal placement of distributed generation plants have been used in the network. The need to locate plants scattered throughout the network as stated in the introduction to the network using distributed power plants will reduce losses and improve voltage. If you do not choose the right placement of plants scattered above mentioned positive effects appear negative. Increases the transmission losses in the first instance by providing a location the plants need to be raised and then the reasons will be using genetic

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algorithm. And then the reasons will be using genetic algorithm [8],[9],[11],[12],[14],[15].

Table1: Classification of types of distributed generation

Distributed generation capacity	amount
Micro	1W – 5KW
Small	5 KW – 5 MW
Medium	5 MW – 50 MW
Large	5 MW – 300 MW

3. The power losses in radial distribution networks

A radial network shown in Figure 1 on the side of a load distributed generation is connected. Power losses without distributed generation in the networks simply by adding the power losses can be won per line. The power losses in each line are calculated as follows:

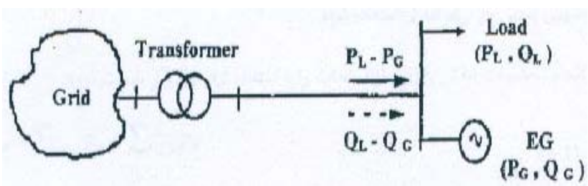

Fig. 1 Typical radial network

$$p_{lossi}=I^2_i R_i \quad (1)$$

R_i :i resistance line

I_i: Current line i

According to Figure 1 when added to the system to be distributed DG cover the reduce the electrical power. In this case, the total power losses in transmission lines known as network losses.

$$P_{lass} = \sum_{i:1,n} I^2{}_i.Ri \quad (2)$$

n: number of lines

Ii: new currents line

Ri: resistance line i

4. Network losses

Electric power transmission through the transmission lines or distribution is always accompanied by losses. Makes power networks losses in the electrical is resistance. Any network losses can be achieved with the help of load flow analysis. In fact, one of the output parameters of load flow study is network losses. To expressing a large network losses, according to the power injection buses can be used for load flow equations Details. Total network losses is total of active power injection.

$$P_{Loss} = \sum_{i=1}^{n} P_i \quad (3)$$

In this equation P_i is The power injected in bus. This equation can be expressed as follows in terms of the power apparent:

$$P_{Loss} = \Re\left\{\sum_{i=1}^{n} S_i\right\} = \Re\left\{\sum_{i=1}^{n} V_i I_i^*\right\} \quad (4)$$

Where in , Si , Vi , Ii are power apparent injection and voltage and current.

Voltage of each load with impedance Matrix :

$$V_i = \sum_{j=1}^{n} z_{ij} I_j \quad (5)$$

With parametric Placement in voltage equation will be:

$$P_{Loss} = \Re\left\{\sum_{i=1}^{n} I_i^* \sum_{j=1}^{n} z_{ij} I_j\right\} \quad (6)$$

So

$$P_{Loss} = \Re\left\{\sum_{i=1}^{n} I_i^* \left(\sum_{j=1}^{n} R_{ij} I_j\right)\right\} + \Re\left\{\sum_{i=1}^{n} I_i^* \left(\sum_{j=1}^{n} jX_{ij} I_j\right)\right\} \quad (7)$$

The first parameter of this equation is zero,so The first parameter will be the entire network losses.

Currents in terms of powers injection write:

$$P_{Loss} = \Re\left\{\sum_{i=1}^{n}\left(\frac{P_i + jQ_i}{|V_i|\angle\delta_i}\right)\left(\sum_{j=1}^{n} R_{ij}\left(\frac{P_j - jQ_j}{|V_j|\angle-\delta_j}\right)\right)\right\} \quad (8)$$

$$P_{Loss} = \Re\left\{\sum_{i=1}^{n}\sum_{j=1}^{n} R_{ij} \frac{(P_i P_j + Q_i Q_j) - j(P_i Q_j - Q_i P_j)}{|V_i||V_j|\angle(\delta_i - \delta_j)}\right\}$$

(9)

This equation is also cross-network losses in terms of casualties bus expressed the injection powers.

$$P_{Lossii} = \frac{R_{ii}}{|V_i|^2}\left[P_i^2 + Q_i^2\right] \quad (10)$$

In this equation, the non-diagonal elements also be expressed as follows

$$P_{Lossij} = \frac{R_{ij}}{|V_i||V_j|}[P_i P_j \cos\delta_{ij} + Q_i Q_j \cos\delta_{ij} - P_i Q_j \sin\delta_{ij} + Q_i P_j \sin\delta_{ij}]$$

(11)

This equation states that part of the network losses resulting from the interaction of different capacities on each other is injected buses [2],[10],[16].

5. DG impact on voltage profile

1. Due to the proximity to the load impedance of the power supply line low loads. As a result, according to equation (1) is a low voltage drop 2. The power supply causes the power to be transmitted loads the post of sub-transmission and distribution substation is reduced toward the end feeders As a result, according to the equation (1) active and reactive power injected by reducing the amount of voltage drop is reduced 3. Functional in PV can do much to help the grid voltage regulation [3],[4].

6. Optimization methods in solving problems locating DG

Sensitivity analysis

Use through a parameter defining sensitivity than other parameters, following changes in the value of the parameter for minor changes in other parameters. Due to the use of this method can be stated as follows. In a preferred network, there are many different buses, each of them acuity could be a candidate for local assembly plant. But a large number of network buses are not very effective in reducing losses. Therefore, it is better to reduce the size of the problem space and reduce the volume of calculations, the buses must be installed using sensitivity analysis of places local generation removed and a few busses that have a higher sensitivity to reduce losses. Using sensitivity analysis can be so reduced space of the problem First, to reduce the space of the problem and also reduce the amount of space to achieve the optimum point have no effect. In fact, sensitivity analysis, a method in which first place to install local power plant chosen so that The first place to have the maximum loss reduction. Use sensitivity analysis alone is but an approximation method to reduce the scale of the problem, this method with other methods such as dynamic programming optimization is used [5],[7],[10],[13].

7. Reasons for Using Genetic Algorithm

There are many methods other than the above two methods have been used to optimize power system issues Such as linear programming, quadratic gradient method, Newton's method and .... Although these methods have been successful , but the problem still remains using them.

One of the main problems of using them to achieve the optimum point locally instead of comprehensive optimization In other words, if the starting point is near a local optimum response to it has been integrated and comprehensive optimum point can be found.

Another problem with these methods, these methods require an auxiliary data such as gradients quadratic, Sensitivity matrix is the Jacobian Matrix and the possible absence or difficulty of computing the data. To alleviate problems of the above methods, techniques of dynamic programming and genetic algorithm is used Although it is possible to achieve optimum dynamic programming method is false, However, in this method by selecting the number of search paths can be closer to the optimum point was comprehensive.

To solve the problem of dynamic programming (achieving local optimum point or false) of the genetic algorithm is used. In this way, the optimization based on the mechanism of natural selection is done and the laws of genetics and start optimizing a set of data in parallel and simultaneously, and the number of points and follows a parallel path and thus reduce the likelihood of achieving local optimum point [8],[15].

8. Genetic algorithm optimal placement of distributed power plants

GA search method based on the mechanism of natural selection and genetics. This is the first time in 1975 by John Holland was introduced in the book, implementation and artificial systems and was developed by him and his colleagues .So far, many books and articles on the application of genetic algorithm optimization problems The reasons for the rapid expansion of this method in optimization problems can be easy computer simulation Computer, power efficient method of searching for answers and lack of restrictions by limiting assumptions stated in the search space In a few cases the usual methods such as genetic algorithm optimization, gradient methods, linear programming and ...There are differences among them can be named the following cases:

» Genetic Algorithm works with a set of encoding parameters.

» Search genetic algorithm instead of starting from a single point of a series of parallel low false starts and is likely to reach the optimum point.

» Objective function using genetic algorithm of information and does not aim to auxiliary information such as derivative.

Genetic Algorithm procedure includes encryption parameters , form fields and copy the fields and part of their movement. The process of genetic algorithm amplified in three functions, the failure of two strings and string of new and used mutation operator. Proliferation operator which aim to copy the virtual strings are in accordance function [6],[8],[12],[15].

9. Applying genetic algorithm to optimize the placement of plants distributed

To apply the new method in locating local power plants is necessary to mention a few points, Objective function, loss and the voltage loss is calculated by the following equation

$$P_{LOSS} = \sum_{i=1}^{n} P_{Gi} - \sum_{i=1}^{n} P_{Di} \qquad (12)$$

where in :

n = number of busses Network

PGi = potential of bus J

PDi = power consumption bus J

P LOSS = losses Active Network

Constraints are as follows:

1) Limit the power plants

$P_{Gi}^{min} < p_{Gi} < p_{Gi}^{max}$

2) Limit the reactive power plants

$Q_{Gi}^{max} < Q_{Gi}^{min} < Q_{Gi} <$

3) Limitation of the flow passage of lines

$P_{ij}^{min} < p_{ij} < p_{ij}^{max}$

4) Limitation of the bus voltage

$V_i^{in} < V_i < V_i^{ax}$

Objective function (losses) must consider the technical, minimum and maximum voltage profile is also you should also know that the important part of the genetic algorithm convergence condition and is achieving the desired goal. Most commonly placed on production or production time is cut in several successive population suitability of the average value is fixed There is no adverbial also been violated .It should also be noted that local plants are installed in buses of load [2],[8],[9].

10. Preparing flowcharts genetic algorithm for optimal placement

According to the above description, installation of power plants scattered flowchart of the optimization problem by genetic algorithm in Figure 2 is given [8],[9].

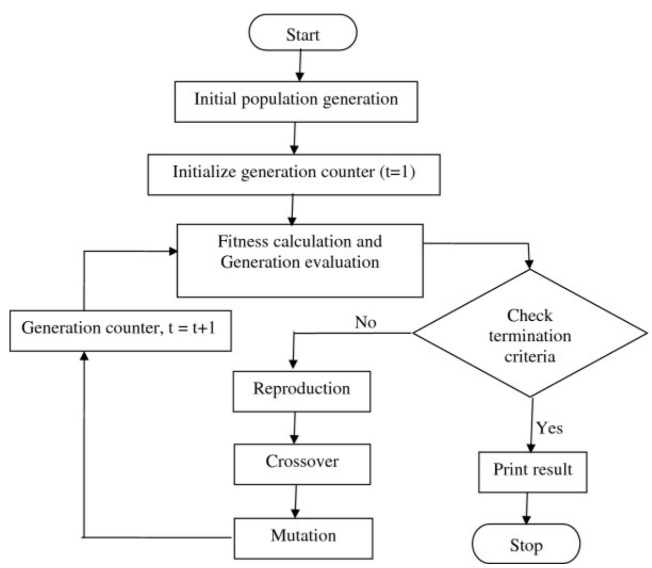

Fig. 2 Genetic Algorithm flowchart

11. Flowchart implementation of Genetic Algorithm

Simulation results using genetic algorithms for network IEEE 33-bus The method used here only for self-healing distribution network with a number of good performance And by increasing the number of units and the possibilities and resilient key situation can not occur without intelligent systems optimization And here, there is one single DG, the DG higher power and stability and is considered the island. To this end, DG location on the network for one unit will investigate.

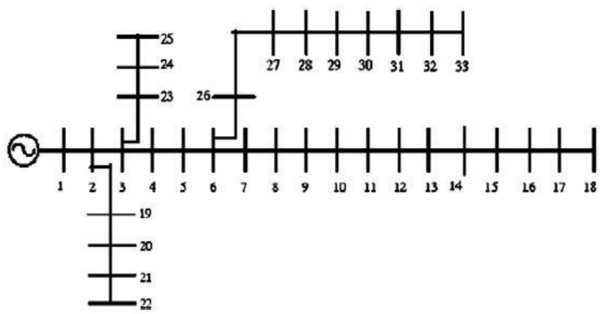

Fig. 3 Standard IEEE 33-bus network

of course, to properly dispatch network bus number (33) is arranged and the last bus At this stage the standard 33 IEEE feeder information written on the broadcast load flow has arrived And then broadcast load flow to run. The program flow diagram with voltage profile obtained is given below [15].

12. DG genetic algorithm to locate and determine the size of the network of 33 bus IEEE

As mentioned in previous seasons and proved the presence of DG in network losses and improve voltage profile and reduce filling will be lines, However, it should be noted that Just put the resources in the network's reach is not important. It should be understood that the location and size of each resource placement is very important, As far as if in the right location with the right amount of power to be Placement There is even the possibility that backfired as the voltage and losses, etc. to be achieved. According to this in this part of the article will be the best place with the best gain for DG, In order to do this we use a genetic algorithm [15].

13. We may come to the question:

Why do we locate DG install location?

One method is to use DG in the distribution network put it in any desired bus. But in this case we install location DG overall system is very effective in reducing losses. For clarity standard IEEE 33-bus network issues to consider:

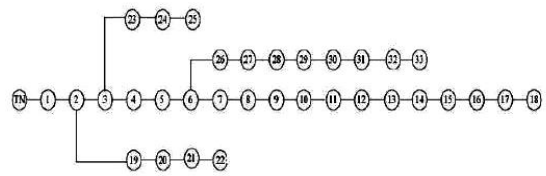

Fig. 4 Standard IEEE 33-bus network

A - DG to put in bus 3

B - DG to put in bus 9

Mode A: In the case of a stream to supply the bus terminal such as 17, 18, or 32 and 33 is produced by DG **Such as 3-4 and 4-5 and 6-7 should be primary shoots and ... pass** And in terms of distribution system losses this case is such that the flow of the transmission network suppliers Because in this case there during peak load due to the opening of branches funded And will result in the losses significant change. Of course, that's because the current supply mode of transmission network provided by DG. Transmission losses will be low.

Mode B: In the case of the bus terminal part of the load current is supplied by DG The primary plugs passes and therefore losses will be lower than A mode. Of course, here I only losses have regarded each branch to check the approximate location DG While the size of the bars also have an impact on DG place.

We had to find the exact location DG Or should we check every single bus (that is to increase the number of DG requires a lot of time) or to take advantage of intelligent algorithm for the job.

Now according to the previous description, load flow to do without the DG and Results will display the voltage and losses and after that , load flow to do with four DGs And to show results and compare them with each other . We show changes in the voltage profile and network losses. And finally the optimal placement and sizing by Genetic Algorithm To the best place and the best size for DG to improve voltage profile and reduce network losses.

First load flow without any DG:

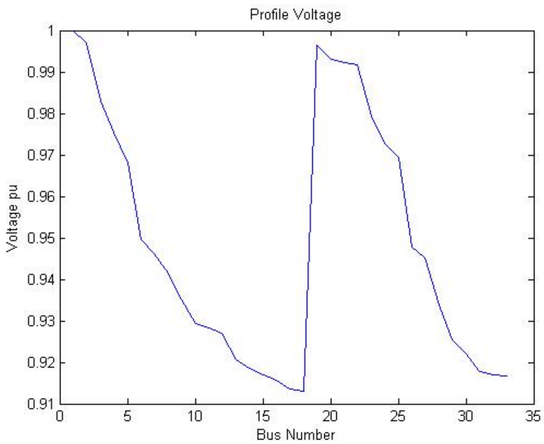

Fig. 5 voltage profile for load flow without DG

And total network losses is 202.487 KW for load flow without DG.

Second load flow with four DG's :

We want to show that improve voltage profile and reduce network losses by use DG , so we placement three DGs in 33-busses network and next we do load flow to show it. This DGs are selected on 11, 29 (PV) and 30 (PQ) busses, the bus numbers are based on random selection.

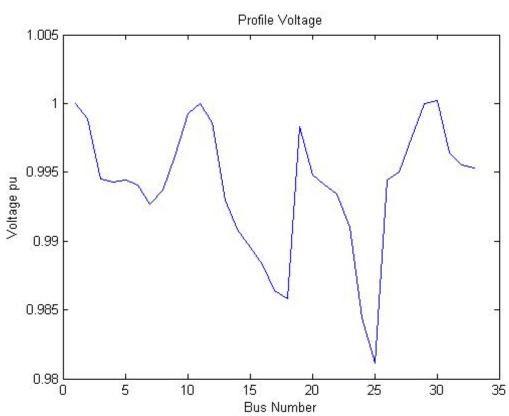

Fig. 6 Voltage profile for load flow with three DGs

And total network losses is 49.0055 KW for load flow with three DGs.

We show voltage profile and network losses in format of figures , now show that in format of charts of each busses voltage. It can be seen improve voltage, thus improving network losses.

Table 2: compare the voltage in network with DG and without DG

Bus number	Bus voltage without DG	Bus voltage with three DG
1	0.9970	1
2	0.9829	1.0035
3	0.9755	1.0104
4	0.9681	1.0134
5	0.9497	1.0169
6	0.9462	1.0251
7	0.9413	1.0272
8	0.9351	1.0317
9	0.9292	1.0409
10	0.9284	1.0357
11	0.9269	1.0349
12	0.9208	1.0336
13	0.9185	1.0281
14	0.9185	1.0261
15	0.9171	1.0248
16	0.9157	1.0236
17	0.9137	1.0218
18	0.9131	1.0213
19	0.9965	1.0057
20	0.9929	1.0021
21	0.9922	1.0014
22	0.9727	1.0008
23	0.9694	1.0136
24	0.9477	1.0071
25	0.9452	1.0039
26	0.9337	1.0234
27	0.9255	1.0210
28	0.9255	1.0104
29	0.9220	1.0029
30	0.9178	0.9996
31	0.9169	0.9958
32	0.9166	0.9949
33	0.9166	0.9947

Third load flow for choose the best location and best sizing to improve voltage profile and reduce network losses by Genetic Algorithm.

14. Genetic Algorithm how does it work?

To find the optimal placement of DG genetic algorithm uses an objective function. Here are our losses as we target Resulting in a total losses as a function of losses in the distribution network is considered. The process of genetic algorithm is as follows:

1-bus for each DG considers (with two DG, 32 and 33 cases arise)

2- Losses in this case, using the objective function (which we wrote) counts

3-Separate modes optimized and non-optimized mode (here has losses more) discards

4-We re-optimized modes more efficient modes searches

5- As long as the best or the best place to reach DG

It might come to mind is why do not we write a program that every DG to put on each bus and loss account, then select the best mode?

In this case there will be four DG's with 33,32,31,30 mode, the losses function should be run 33,32,31,30 = 982 080. Since the implementation of the losses in this case took some time to locate here will be much more If intelligent algorithms such as genetics at every stage of their implemented a number of cases aside And the best mode and are looking for the best mode this reduces the number of modes to be [8],[9],[12],[15].

15. Losses function consists of the following fields:

1-Information distribution system such as active and reactive load impedance lines and each bus 2-Distribution system load flow calculation and finding bus voltage and current lines 3-Losses are calculated using current and impedance lines [7],[10].

16. Run the program and results of the genetic algorithm in Matlab

Here the objective function is to implement a genetic algorithm introduced in order to reduce losses, with loss of function names that we remember.

After running the program the calculations by genetic algorithm we have:

The chart below is the fitness function value to different generation. Because this toolkit is the task of finding the lowest fitness function the lowest fitness is the best fitness for a population

According to previous, the use of DG in the wrong location can be unhelpful.so this process is done for the best location and size by Genetic Algorithm to choose the optimal sizing and optimal location [12],[15].

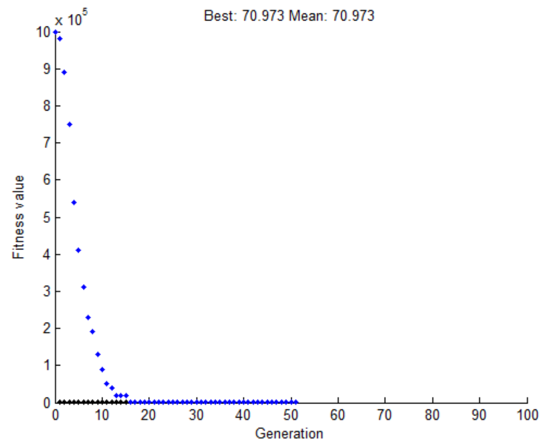

Fig. 7 Fitness is a function value to different people

The figure below charts the measure stopped drawing at any level are:

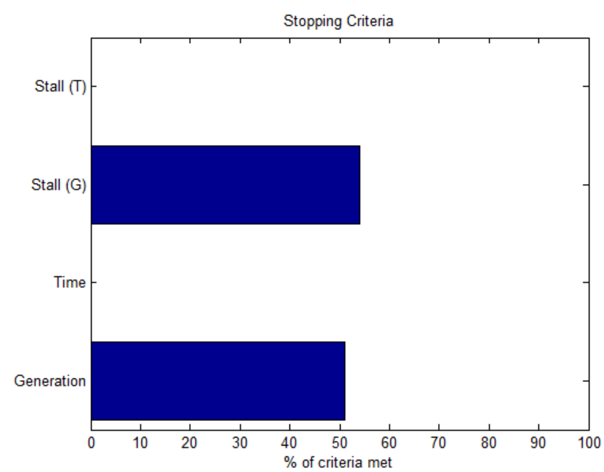

Fig. 8 stopping at every level

The figure below represents the drawing is a histogram of the points for each generation

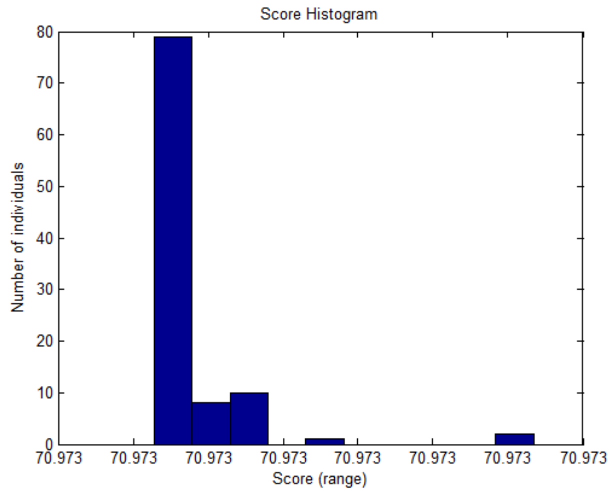

Fig. 9 Histogram of points for each generation

The figure below represents the histogram drawing parents:

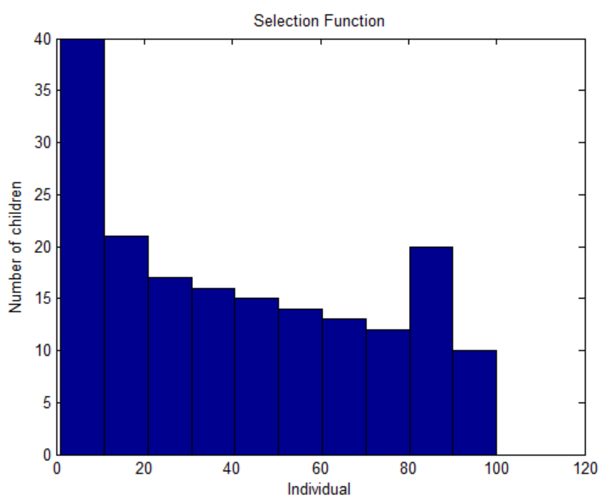

Fig. 10 Histogram drawing parents

The figure below represents the drawing minimum, maximum and average value of the function in every generation:

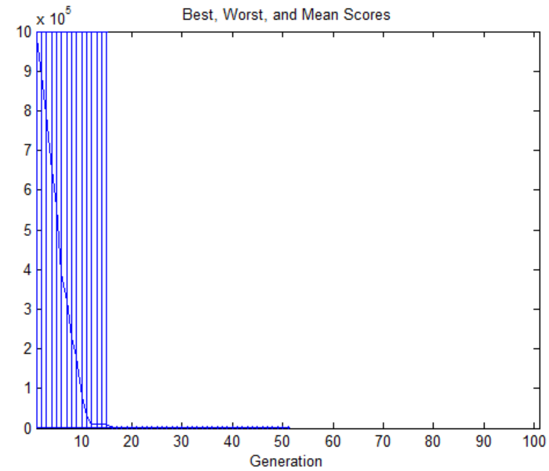

Fig. 11 drawing minimum, maximum average value of each generation

The figure below presents each individual with the best fitness is a vector drawing:

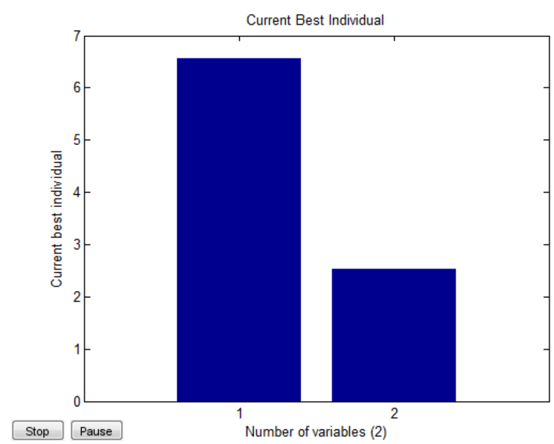

Fig. 12 Vector drawing each individual with the best fitness

The results of the genetic algorithm have made And the end result is the same algorithm That if a single DG to put on the network bus 33 The best place to put the DG at bus number 6, How much power is also equal to 2.53 KW suggests, The process to locate and sizing of the DG called on the network is said in this article were made by Genetic Algorithm.

17. Conclusions:

In this paper, the optimal placement and distributed generation plants (local) network was As was mentioned, the distributed generation power plants with low production Which are installed in areas closer to the consumer is told They can be a variety of wind energy, solar cells, fuel cells, small hydroelectric and ... The causes of these plants can be large plants such as environmental problems and low efficiency, high costs of production and transport, distribution, and ... Named If distributed generation plants connected to the network, various effects such as enhancing network reliability, reduce transmission losses and improve voltage profile, reducing the fill lines, reduce production costs and transmission and distribution and will ...

The important point in using the plants, locating them properly on the network So that the great losses in the network, taking into account technical and economic constraints is achieved. This article presents an example, the need for local plants were considered optimal placement And it was stated that it is necessary for the proper use of effects in a network of local plants, installation location and capacity is determined For this purpose, the genetic algorithm to optimal placement of local plants were used. Genetic algorithm for solving optimization problems in various sciences is a valuable program. And compared to other optimization methods, including sensitivity analysis and dynamic programming and… is better and faster answer, Because in this method start optimizing a set of data simultaneously and in parallel pursuing a number of points and get directions, It reduces the chances of reaching the optimal point in this method, only the numerical value of the objective function is needed And ancillary data such as derivate purpose is not required The flowchart implementing the genetic algorithm flowchart prepared in accordance with this computer program was developed.

It was observed on the network bus 33 IEEE and that the use of m implementing distributed generation plants fill lines decrease, reduce network losses and improve voltage profile.

Suggestions

According to the points made in the study did not show the presence of DG on power systems The power is in the right place in terms of improving the voltage profile and reduce network losses and improve the system for the benefit of filling lines. So, we can make it real for distribution networks and extend our network in the country. What is certain is that addressing the DG can be followed from different perspectives and with different goals. Therefore, the following can be one of the main indicators decisions about the use of distributed generation sources noted that in most countries:

1-Predict potential and capacity in the country

2-DG future of technology in the world (in terms of cost)

3-Forecast access to technology

4-Type of primary energy requirements and its future

5-Economic evaluation of DG (at the present time in the future)

Apart from deciding on the use of distributed generation sources need to be considered and introduced indicators, including indicators are as follows:

There is adequate capacity in the country**-**

-There Due process in the development of technology in the world (in terms of cost and performance)

- Ability to design and build the technology

- More appropriate use of primary energy with less pollution (eg : natural gas)

- Having economical than any other source

As a result, the above rating is recommended DGs as follows:

- The capacity of existing resources (primarily reciprocating and gas turbine)

- Urban applications (micro-turbines and gas turbines)

- Applications scattered locations (wind, small hydro and photovoltaic)

Finally, it should be noted that the placement of DG in the electricity network Can improve network status in terms of voltage losses and thus reduce the cost of repairs will be available as a result of these factors.

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