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Harmony Search Algorithmic Rule for Optimum Allocation and Size of Distributed Generation

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ABSTRACT

Various benefits earned by desegregation Distributed Generation (DG) in distribution systems. Such advantages are often achieved and increased if DGs area unit optimally sized and placed within the systems. The current work presents distribution generation (DG) allocation strategy with objective of up node voltage and minimizes power loss of radial distribution systems victimization improved multi objective harmony search algorithmic program (IMOHS).IMOHS algorithmic program uses sensitivity analysis for distinctive the optimum locations of distribution generation units, the successively reduces the real power loss and improves the voltage profile in distribution system. The target is to scale back active power losses to minimum, whereas to attain voltage profiles within the network in needed and determined limit. Within the gift work the optimum decigram placement and size drawback is developed as a multi-objective improvement drawback to attain the above mentioned situation.

An IEEE 33-node and IEEE 69-node radial distribution check systems are wont to show the effectiveness of the Improved multi objective Harmony Search rule (IMOHS). The results obtained from the IMOHS methodology shows that vital loss reduction is feasible mistreatment multiple optimum sized decigram units. It's shown that the IMOHS methodology provides higher ends up in comparisons thereto obtained mistreatment alternative optimization ways like GA and PSO.

Keywords— Distributed Generation(DG), Improved Multi Objective Harmony Search algorithmic program (IMOHS), Genetic Algorithm(GA), Particle Swarm Optimization(PSO)

I. INTRODUCTION

Distributed generation (DG) is outlined as wattage resources that square measure directly connected to the distribution network. Renewable and non-renewable energy resources are included in these Resources. Wind, solar and biomass for DG renewable energy sources are included. On the opposite facet, micro-turbines, gas turbines and fuel cells embrace non-renewable energies. At distribution point, about 13 percent of the produced total electricity is consumed as actual energy loss. In order to extract maximum possible advantages, the optimum distribution of these power sources is crucial.

DGs are of benefit only if their facilities are implemented according to the relevant plans. Two of the foremost vital factors of decigram plans are distinctive the capability and also the location of those resources [1]. Need of using DGs in Distributed Network are Reduction in line losses, Improvement in Voltage Profile and improvement in System responsibility.

DG Placement Problem is a complicated issue in relation to non-linear objective functions and nonlinear limitations. Harmony Search Algorithm (HSA) is a fresh, simple, parameter-free and easy-to-implement heuristic algorithm. HSA concept is from natural musical performance processes which explore for an ideal state of harmony. This formula uses a random search method [2]-[3].

In [4], a new method "Improved Multi-Objective Harmony Search algorithm" gives better optimal solution for DG placement problem. IMOHS is improved version of the basic HS Improvisation algorithm, update and save harmonies with extra memory for each iteration.

The effectiveness of the distribution system optimization issue depends on the algorithmic program of load flow. The distribution system load flow resolution ought to thus be strong and time-efficient. Therefore, a unique load flow algorithmic program for distribution systems is desired. This technique is especially supported development of 2 matrices, the bus-injection to branch-current matrix (B.I.B.C) and also the branch-current to bus-voltage matrix (B.C.B.V) [5].

In this paper, A multi-objective supported improved meta-heuristic algorithm is chosen as a device to solve most opted DG allocation problem in distribution systems. This technique enables the main purpose that helped in increasing enthusiasm in placing DGs, that is reduce power losses and specified voltage profiles. It's used a recent load flow technique for a radial distribution that used BIBC and BCBV matrix. This approach will be simulated in MATLAB environment by testing on standard IEEE test systems.

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II. PRIOR APPROACH

Harmony search (HS) is associated rule that simulates a phenomenon in computer science and operation research, and that is inspired by ZongWoo Geem's improvisation method of the 2001 improvisation method.[6]. Originally, the HS algorithm was based on the musician's improvisation method. Each musician corresponds to every variable of choice; the pitch range of the musical instrument corresponds to the value variable of choice; musical harmony refers to a vector solution for certain iteration at a certain moment and the aesthetics of the music instrument corresponds to the purpose function. Like musical harmony, solution vector is enhanced by iteration moment after moment.

HS algorithmic rule has the subsequent steps:

1) Problem formulation.
2) Algorithm parameter setting.
3) Random standardization for memory data format.
4) Harmony improvisation (random selection, memory consideration and Pitch adjustment).
5) Memory update.
6) Performing termination.

The conventional HS algorithm works well but has certain inconveniences that make it difficult to find the optimal solution for some issues. Considering these drawbacks, further developed version of the HS rule is employed to search out the optimum solution. This rule has improved the effectiveness of the essential HS, in addition of some advantages. In [13] the location and sizing of the DGs are found by Genetic Algorithm (GA), Particle Swarm optimization (PSO)

III. PROBLEM FORMULATION

A. Improved multi objective Harmony Search Algorithm (IMOHS)

The IMOHS Algorithm is used for the assessment of the effect on ideal distribution scheme developed by DG positioning. In improvisation, updating and saving non-dominated harmonies at each iteration with extra memory the algorithm IMOHS is distinct from the other variant of the HS [7]-[8] multi-objective.

Step 1: Helps in defining the main features and variables of choice. Enter system parameters and decision variables limits. The issue of multipurpose optimization can be described as

$$\text{minimise } \{f_1(X), f_2(X), f_3(X), \ldots\ldots\ldots, f_m(X)\}, m \geq 2 \quad (3.1)$$

$$\text{Subject to } x_i^L \leq x_i \leq x_i^U (\, i=1,2,\ldots n) \quad (3.2)$$

Where x_i^L , x_i^U are the lower, upper bounds for decision variables.

Step 2: This step specifies the HS algorithm parameters. They are the harmonic memory (HM), the harmonic memory size (HMS), the harmonic memory taking into consideration the rate (HMCR), and the number of improvisations (k) or stop criterion. HMS is the number of vectors that are managed in the algorithm concurrently. The HMCR frequency of HMCR (0 to HMCR) is that HS selects a value of Harmony randomly. Thus, (1-HMCR) is the speed in which HS chooses the amount of iterations to randomly select a value from complete value ranges. For every iteration, HS improvises a harmony (= vector).

Step 3: The harmony memory (HM) has been initialized. The primary harmony memory is created by random means that region $[x_i^L, x_i^U]$ (i=1,2,…n). This is often done supported the subsequent equation:

$$x_i^j = x_i^L + \left(rand * \left(x_i^U - x_i^L\right)\right); \quad (3.3)$$
$$j = 1,2, \ldots, HMS$$

Where rand could be a random variety from an identical distribution of [0, 1].

The harmony memory(HM) are often thought about as a matrix:

$$\begin{bmatrix} x_1^1 & x_2^1 & . & . & x_n^1 \\ x_1^2 & x_2^2 & . & . & x_n^2 \\ . & . & . & . & . \\ . & . & . & . & . \\ x_1^{HMS} & x_2^{HMS} & . & . & x_n^{HMS} \end{bmatrix}$$

Step 4: Improve a replacement harmony within the harmony memory by the subsequent steps: 1st, one random range is generated inside the [0, 1] range. If there are fewer than the HMCR then adaptive step ($step_i$) is calculated as,

$$step_i = |x_i^{best} - x_i^{worst}| \quad (3.4)$$

Here x_i^{best} and x_i^{worst} are the best and worst harmonies in the harmony memory.

The new decision variable is generated as,

$$x_i^{new} = x_i^{best} + r * step_i \quad (3.5)$$
$$x_i^{new} = \max(x_{iL}, \min(x_{iU}, x_i^{new})) \quad (3.6)$$

If r is not less than the HMCR then new decision variable is calculated as

$$x_i^{new} = x_{iL} + rand * (x_{iU} - x_{iL}) \quad (3.7)$$

The harmony memory are going to be updated once making a brand new Harmony vector. If you higher than the worst harmony the fitness of the jury-rigged harmony vector, the more serious harmony within the hectometer get replaced with x_i^{new} and become a brand new member of the hectometer.

Domination rank: The domination of decision vector X_1 over another decision vector X_2 (represented as $X_1 < X_2$), determined if and only if:

$$f_i(X_1) < f_i(X_2),\ i = 1,2, \ldots, m. \quad (3.8)$$

This shows that the vector of choice X_1 is not as bad as X_2 in all objectives and is obviously better than X_2. Here X_1 is called non dominated harmony and X_2 is called dominated harmony.

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To find the non-dominated members in population below in steps should be followed:
1. Consider a counter rank to 0.
2. Increment the value of n by 1: $n = n + 1$
3. From dominance definition, detect the non-dominated harmonics among the available harmonics. Harmonies from population.
4. Give rank n to detected harmonies.
5. In case, the population is vacant, stop. Otherwise, head to a pair of.

Then a brand new harmony X^{new} is turn out as follows. Select a dominated harmony (X^{d}) from HM on any choice.
non-dominated harmony (X^{Nd})

First of all, the range of [0, 1] provides a standardized random number.
If r is less than the HMCR then X^{new} is calculated as

$$X^{new} = X^{Nd} + r * \left|X^{Nd} - X^{d}\right| \text{ if } r < HMCR \qquad (2.9)$$

If r is not less than the HMCR then X^{new} is calculated as

$$X^{new} = X^{min} + r * \left|X^{max} - X^{min}\right| \text{ if } r \geq HMCR \qquad (3.10)$$

The dominated harmony X^{d} will be replaced by X^{new} if X^{new} dominates X^{d}. If X^{new}

Isn't better than repeated the above method. The highlights of the HM are arranged by the definition of domination at the end of each iteration, and the best new non-dominated harmonies square measure elect. Repeat the on top of steps till the criterion of stoppage is met (maximum number of improvisations, k). In this process, IMOHS returns the best non dominated harmony.
System Considered and Problem formulation

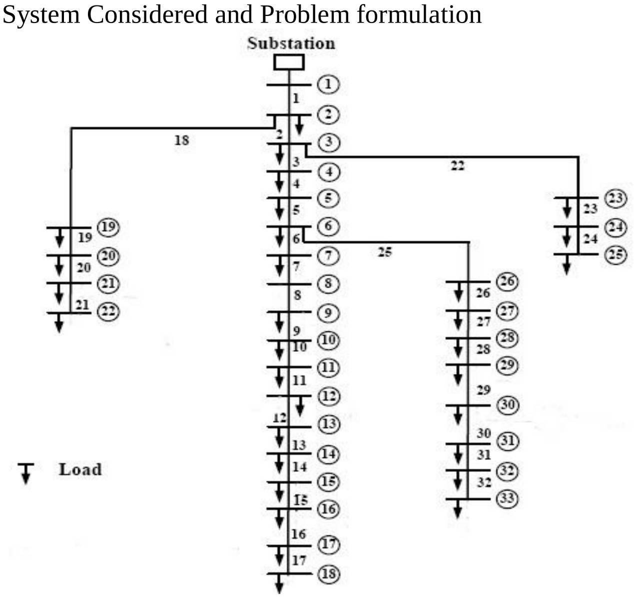

Figure 1: Single Line Diagram of IEEE 33-Bus Distribution System

Two IEEE in this work, testing systems are used and their characteristics are given below.

IEEE 33-Bus Distribution System

This check system is AN IEEE 33-bus distribution system illustrated in Fig. 1. That may be a radial distribution system and has the subsequent characteristics

- Total range of busses=33
- Total range of lines=32
- Slack Bus No=1
- Base Voltage=12.66 KV
- Base MVA=100 MVA
- Total load=3.72MW,2.3MVar.

IEEE 69-Bus Distribution System

This check system is associate degree IEEE 69-bus distribution system illustrated in Fig. 2. that is additionally a radial distribution system and has the subsequent characteristics

- Range of busses=69
- Range of lines=68
- Base Voltage=12.66 KV
- Base MVA=100 MVA

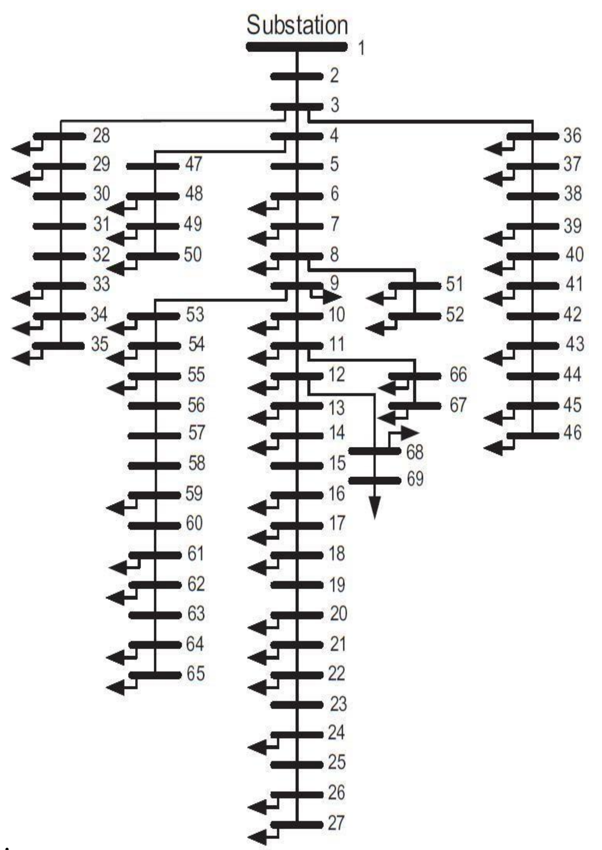

Figure 2: Single Line Diagram of IEEE 69-Bus Distribution System

B. Multi Objective Down Side Formulation

For decigram placement and distribution theme filler a multi-objective optimization technology, developed as a restricted nonlinear optimization issue. Total power

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loss and voltage are reduced to minimum deviations of the distribution system subject to the facility limit and voltage limit because the constraints.

To find the placement and rating (PDG) of DGs like to reduce the subsequent functions:

Min $F_1 = \sum(P_{loss})$ (3.11)

Min $F_2 = \sum_{i=1}^{n}(Vi - 1)^2$ (3.12)

Subject to 0 <PDG<PDG(max

V min < Vi < Vmax

Where n is that the variety of nodes.

Vi is that the voltage magnitude of node i.

PDG is that the power of decigram..

PDG(□□□) is that the most power of decigram.

Here the decision variables are the rating of DGs (PDG) and the bus numbers of a distribution system. Here the maximum power of DG PDG(□□□)is taken as 1.2 MW, the maximum bus number is 33 for study system-1 and 69 for study system-2.

In this chapter, a load flow approach to the distribution scheme was developed. These methods are based on the Bus injection into the current branch (BIBC) matrix and the current voltage to node (BCBV) matrix. These two matrices correlate the present injections to node voltage branch and branch present. The formation of the matrix flows the load calculation very easy. The two study systems and the mathematical problem formulation are discussed

IV. RESULTS

The results obtained from the load flow algorithm and IMOHS formula. The IMOHS formula is tested on the IEEE 33-bus and IEEE sixty nine bus radial distribution systems.

A. IEEE 33-Bus Distribution System

The load flow rule that is mentioned in above sections is tested on IEEE-33 bus distribution system that is shown in Figure 1. The road knowledge and therefore the load knowledge of AN IEEE-33 bus distribution system with none metric weight unit installation.

The total active and reactive power loss in IEEE-33 bus distribution system with none weight unit installation is 202.53 kilowatt and 135.2437 kVar severally and therefore the total voltage deviation with none weight unit installation is 0.1169 p.u.

TABLE-I
Voltage Magnitude and Phase for 33-Bus Distribution System (without DG)

Bus number	Voltage Magnitude in p.u.	Angle in Radians
1	1.0000	0
2	0.9970	0.0002
3	0.9829	0.0017
4	0.9754	0.0028
5	0.9680	0.0040
6	0.9496	0.0023
7	0.9462	-0.0017
8	0.9413	-0.0011
9	0.9351	-0.0023
10	0.9294	-0.0035
11	0.9285	-0.0034
12	0.9270	-0.0032
13	0.9209	-0.0048
14	0.9187	-0.0062
15	0.9173	-0.0068
16	0.9159	-0.0072
17	0.9139	-0.0086
18	0.9133	-0.0087
19	0.9965	0.0009
20	0.9929	-0.0011
21	0.9922	-0.0015
22	0.9916	-0.0018
23	0.9793	0.0011
24	0.9727	-0.0004
25	0.9693	-0.0012
26	0.9477	0.0030
27	0.9452	0.0040
28	0.9337	0.0054
29	0.9255	0.0068
30	0.9219	0.0086
31	0.9178	0.0072
32	0.9169	0.0068
33	0.9166	0.0066

As the power loss and the voltage deviations are high it is preferable to use DGs in the distribution network to reduce the power loss and to keep the voltage profile in the required limits. Allocating DGs randomly without using any optimization technique in the distribution system with random sizing may reduce the power loss but that is not the optimum result. So to obtain the better results it is necessary to use an optimization algorithm to solve the DG allocation problem and the optimization methods can give better results than the random allocation of DGs. Some random DG locations with random sizing are given in Table-V

Case 1: Optimal distribution network sizing and place is required so that actual power losses are determined. and voltage deviations are minimized. The Improved multi

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objective harmony search (IMOHS) algorithm which is discussed in above section is used to find the location and sizing of DGs in distribution system. Only one DG is taken in the system and the location, rating is shown in Table-II.

TABLE-II
Location and sizing of one DG in a 33-Bus Distribution System

DG Location (Bus number)	DG Rating (MW)	Total P loss (kW)	Total Q loss (kVar)	Total Voltage Deviaon (p. u)
30	1.14	99.2074	84.1519	0.0569

So by putting decigram at the higher than given location with the required rating the Active power loss is reduced from 202.53 power unit (without DG) to 99.2074 power unit and also the Reactive power loss is reduced from 135.2437 kVAr (without DG) to 84.1519 kVar. With the installation of decigram the voltage stability is additionally improved i.e, the voltage deviation is reduced from 0.1169 (without DG) p.u to 0.0569 p.u.

Case 2: The IMOHS algorithmic rule is employed to seek out the placement and filler of 4 DGs in distribution system to investigate its impact on reducing system losses. Total four DGs are taken within the system and their locations, ratings are shown in Table-III.

TABLE-III
Location and filler of 4 DGs in a very 33-Bus Distribution System

DG Locations (Bus number)				DG Ratings (MW)				Total P loss (kW)	Total Q los(kVar)	Total Voltage Deviation (p.u)
6	32	14	24	0.83	0.84	0.43	0.81	66.58	48.46	0.0162

In case 4 the reduction in losses and reduction in voltage deviation are more when compared with case 3, because in case 3 only three DGs are take.

The following Table-IV shows the voltage profile of a 33-bus distribution system within which four DGs square measure put in.

\TABLE-IV
Voltage Magnitude and point in time for 33-Bus Distribution System (with four DGs)

Bus number	Voltage Magnitude in p.u.	Angle in Radians
1	1.0000	0
2	0.9900	0.0011
3	0.9953	0.0072
4	0.9928	0.0110
5	0.9913	0.0150
6	0.9858	0.0239
7	0.9834	0.0233
8	0.9824	0.0251
9	0.9816	0.0276
10	0.9813	0.0303
11	0.9814	0.0308
12	0.9819	0.0316
13	0.9835	0.0360
14	0.9840	0.0384
15	0.9827	0.0379
16	0.9814	0.0375
17	0.9796	0.0363
18	0.9790	0.0362
19	0.9983	0.0009
20	0.9948	-0.0002
21	0.9941	-0.0006
22	0.9934	-0.0009
23	0.9932	0.0081
24	0.9907	0.0098
25	0.9874	0.0091
26	0.9852	0.0251
27	0.9844	0.0269
28	0.9797	0.0337
29	0.9766	0.0391
30	0.9762	0.0423
31	0.9723	0.0410
32	0.9714	0.0406
33	0.9711	0.0405

Fig. 3 shows the voltage profile comparison of AN IEEE 33-bus distribution system with four DGs put in and while not DGs. From Figure. 3 one can conclude that with the installation of DGs the voltage profile has been improved.

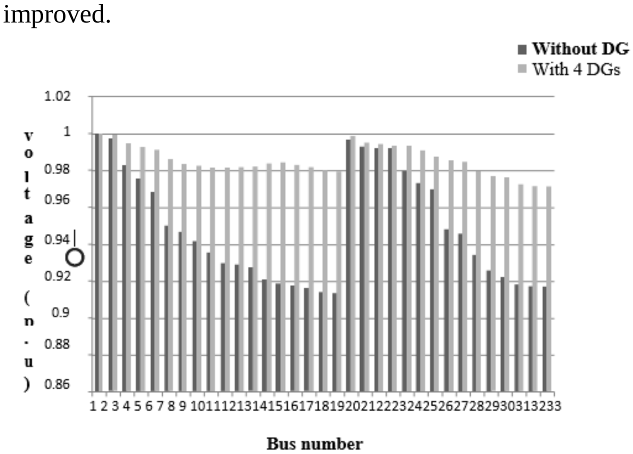

Figure 3: Voltage profile comparison of the IEEE-33 Four metric weight unit and metric weight unit bus distribution system

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The following Figure. 4 shows the Branch current magnitude comparison of associate IEEE 33-bus distribution system with four DGs put in and while not DGs.

The Figure. 4. conclude that with the installation of DGs the branch currents can be reduced so that the power loss will reduces.

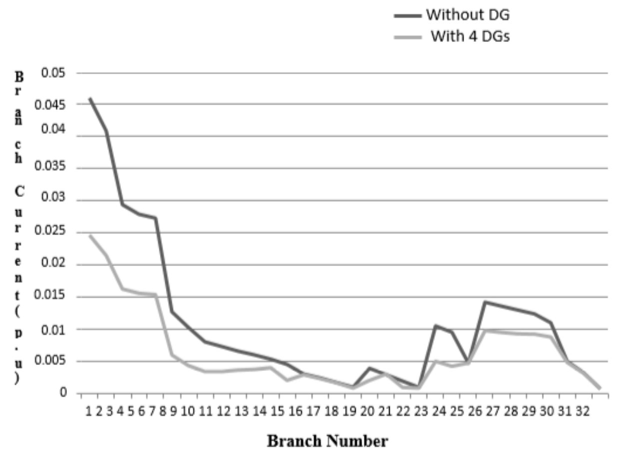

Figure 4: Branch current magnitude comparison of the IEEE-33 bus distribution system with four DGs and while not DGs

The following Figure.5. shows the voltage profile comparison of associate IEEE 33-bus distribution system with completely different variety of DGs put in and while not DGs. From Figure.5.The strain profile is ascertained improvement is additional once the quantity of metric weight unit installation within the system is additional, additionally there's no abundant modification within the voltage profile improvement once the quantity of DGs area unit quite 3. So the quantity of DGs in an exceedingly distribution system is mounted at four.

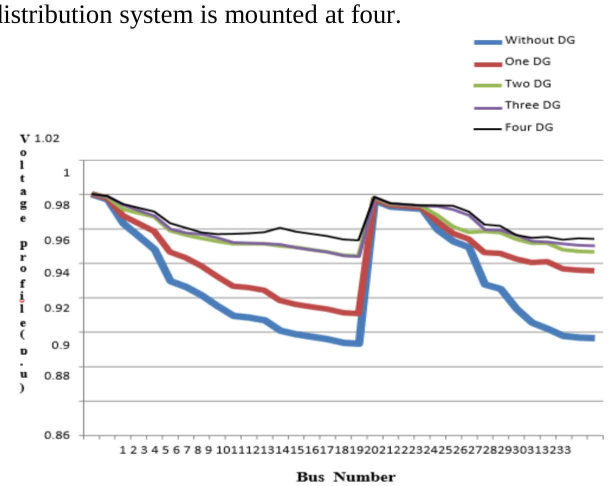

Figure 5: Voltage magnitude comparison of the IEEE-33 bus system with completely different variety of DGs and while not DGs

The following Table-V show different random locations and ratings of DGs in a distribution system without using any optimization technique. From the Table-V it is seen that the Random the distribution systems 'assignment of DGs resulted in increased power loss and a bad voltage profile. So it is necessary to use a DG allotment issue and optimization algorithm the IMOHS algorithm can find the better results compared to the random allocation of DGs.

Table-V
Random Location and sizing of four DGs

S. No	Distributed generations Locations (bus number) and DG Ratings (MW)				Total P loss (kW)
1	**13**	**17**	**31**	**3**	81.3
	0.24	0.41	1.11	0.89	
2	**25**	**30**	**17**	**5**	75.5
	1.02	1.18	0.33	0.61	
3	**13**	**5**	**6**	**29**	84.5
	0.37	1.1	0.4	0.6	
4	**31**	**16**	**22**	**26**	80.9
	0.8	0.78	0.28	0.6	
5	**23**	**27**	**10**	**29**	76.8
	1.02	0.49	0.61	0.94	

Particle Swarm Optimization (PSO), Genetic Algorithm (GA) is employed find the position and size of the DGs. The subsequent Table-VI shows the obtained location of the DGs and therefore the location of DGs obtained by IMOHS

TABLE-VI
Location and sizing of 4 DGs with completely different strategies

Method	Distributed generations Locations (bus number) and ratings (MW)				Worst increase in Voltage among all buses(p.u)	Total P loss (kW)
GA	24	6	13	30	0.9674	70.1
	0.85	0.64	0.85	0.73		
PSO	25	6	15	31	0.9696	71.3
	0.54	0.8301	0.833	0.6478		
IMOHS	6	32	14	24	0.9711	66.5
	0.83	0.84	0.43	0.81		

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B. IEEE 69-Bus Distribution System

The load flow rule that mentioned in section 3.6 is tested on Distribution theme for IEEE-69 bus that is shown in Figure. 2. The subsequent Figure. 6. show the voltage profile of AN IEEE-69 bus distribution system with none weight unit installation.

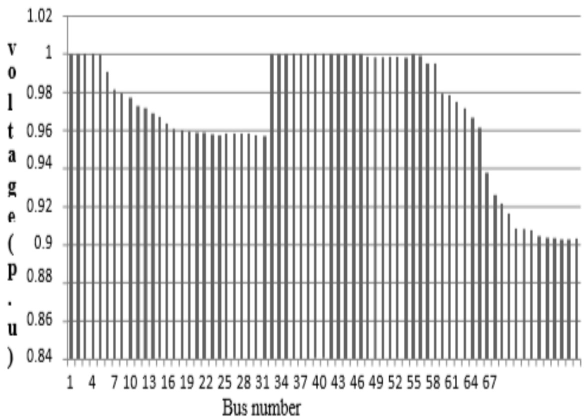

Figure 6: Voltage profile comparison of an IEEE-69 bus system without DGs

The following Figure. 7 shows the branch current magnitude of an IEEE- 69 bus distribution system without any DG installation.

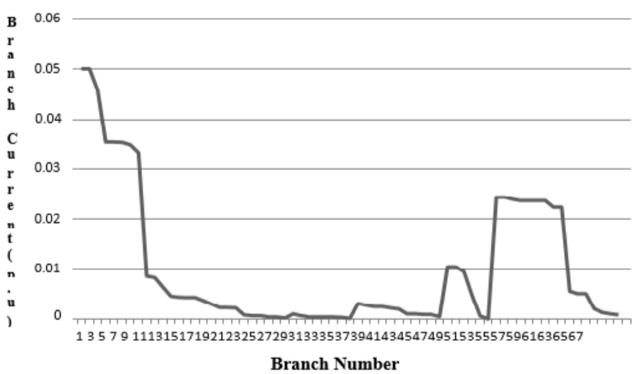

Figure 7: Branch current magnitude comparison of associate IEEE-69 bus system while not DGs

The total active and reactive power loss in IEEE 69-bus radial distribution system with none decigram installation is 242.95 kw and 109.74 Kvar severally. Because the power loss and also the voltage deviations square measure high it's desirable to use DGs within the distribution network reducing power loss and maintaining the voltage profile at intervals necessary boundaries. Allocating DGs randomly without using any optimization technique in the distribution system with random sizing may reduce the power loss but that is not the optimum result. So to get higher results it is critical to use associate optimization algorithmic rule to resolve the metric weight unit allocation drawback and also the optimization strategies will offer better results than the random allocation of DGs.

The IMOHS algorithmic program is employed to seek out the situation and size of DGs in distribution system. Total four DGs area unit taken within the system and their locations, ratings are unit shown in Table-VII.

Table-VII
Location and size of 4 DGs In IEEE 69-Bus Distribution System

Locations (Bus number)				Ratings (MW)				Total P loss(kW)	Total Q loss(kVar)
9	61	68	21	0.31	1.17	0.42	0.22	80.711	39.848

So by putting DGs at the higher than nominative locations with the required Ratings the Active power loss is reduced from 242.95 power unit to 80.711 power unit and Reactive power loss is reduced from 109.74 kVar to 39.846 kVar. The loss of power is noted additional in IEEE 69-bus distribution system compared to IEEE 33-bus distribution system as a result of the amount branches are additional in IEEE 69-bus distribution system.

Figure. 8 shows voltage profile comparison of associate IEEE 69-bus distribution system with four DGs put in and while not DGs. From the Figure. 8. it may be conclude that with the installation DGs will improve the voltage profile

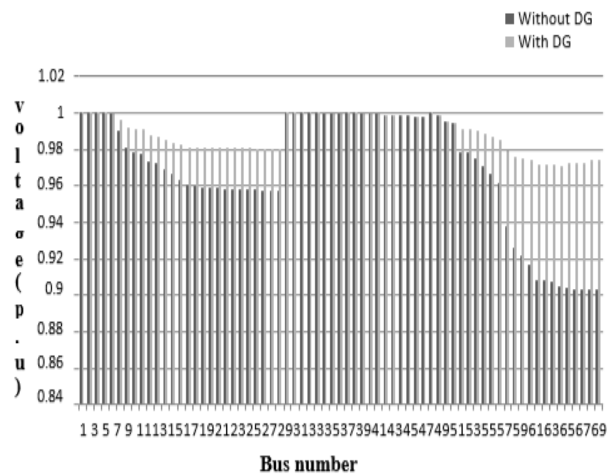

Figure 8: Voltage profile comparison of IEEE 69-bus system with four DGs and while not DG

Figure. 9. shows the Branch current magnitude comparison of associate IEEE 69- bus distribution system with four DGs put in and while not DGs. From Figure. 9. one can conclude that with the installation of DGs the branch currents can be reduced so that the power loss will reduces.

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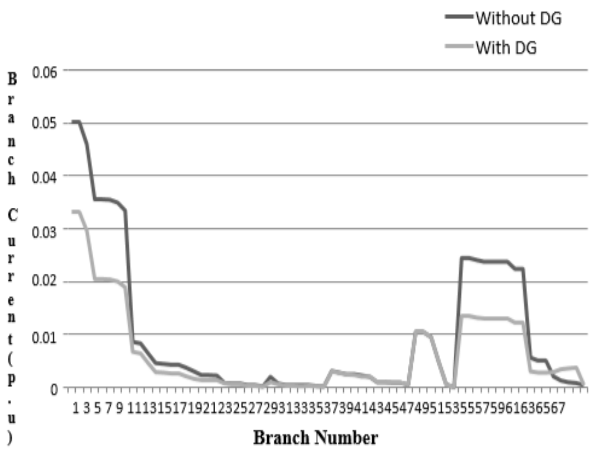

Figure 9: Branch current magnitude comparison of the IEEE-69 bus distribution system with four DGs and while not DGs

V. CONCLUSION

The installation of decigram units in power distribution networks is changing into a lot of outstanding; utility firms have begun to amendment their electrical infrastructure to adapt the decigrams because of the advantages of DG installation on their distribution systems. These edges embrace reducing power losses, rising voltage profiles, reducing emission impacts and rising power quality. Never the less, the achievement of such advantages relies heavily on DG unit capability and distribution systems installation.

Discussing about IMOHS method for management of DG power that is used, the IMOHS technique provides the optimum range of nodes for DG positioning and size. BIBC and BCBV load flow methodology have fixed the issue of load flow. This is based on two matrices (BIBC, BCBV which are created from the distribution system topological features. These two matrices are coupled in order to directly solve issues with load flow. The effectiveness of the approach is incontestable on the IEEE 33-bus and IEEE 69-bus radial distribution systems. When the DGs area unit connected to the theme, the simulation data indicates that a decrease in the active loss of energy in the distribution scheme is feasible. When the amount of DG sites is greater, the percentage decrease to DG rating is highest.

REFERENCES

[1] Dugan, T. & McDermott. (2002). Distributed generation. *IEEE Industry Applications Magazine, 8*(2), 19-25.
[2] C. Masters. (2002). Voltage rise: The big issue when connecting embedded generation to long 11kV overhead lines. *Power Engineering Journal, 16*(1), 5–12.
[3] N. Acharya, P. Mahat, & N. Mithulananthan. (2006). An analytical approach forDG allocation in primary distribution network. *International Journal of Electrical Power & Energy Systems, 28*(10), 669–678.
[4] T. Ackermann, G. Andersson, & L. Soder. (2001). Distributed generation: A definition. *Electric Power Systems Research, 57*(3), 195-204.
[5] C.J. Dent, L.F. Ochoa, & G.P. Harrison. (2010). Network distribution capacity analysis using OPF with voltage step constraints. *IEEE Transactions on Power Systems, 25*(1), 296–304.
[6] Z. W. Geem, J. H. Kim, & G. V. Loganathan. (2001). A new heuristic optimization algorithm: Harmony search. *Simulation, 76*(2), 60–68.
[7] S. Sivasubramani & K. S. Swarup. (2011). Environmental/economic dispatchusing multi-objective harmony search algorithm. *Electrical and Power Systems Research, 81*, 1778–1785.
[8] B. Huang, B. Buckley, & T.-M. Kechadi. (2010). Multi-objective feature selection by using NSGA-II for customer churn prediction in telecommunications. *Expert Systems with Applications, 37*, 3638–3646.
[9] P. Carvalho, P. Correia, & L. Ferreira. (2008). Distributed reactive power generation control for voltage rise mitigation in distribution networks. *IEEE Transactions on Power Systems, 23*(2), 766–772.
[10] Komail Nekooei, Malihe M. Farsangi, Hossein Nezamabadi-Pour, & Kwang Y. Lee. (2013 Mar). An improved multi-objective harmony search for optimal placement of DGs in distribution systems. *IEEE Transactions on Smart Grid, 4*(1), 557-567.
[11] Z. Bo & C. Yi-jia. (2005). Multiple objective particle swarm optimization technique for economic load dispatch. *Journal of Zhejiang University-Science A, 6*(5), 420-427.
[12] M. H. Moradi & M. Abedinie. (2010). A combination of genetic algorithm and particle swarm optimization for optimal DG sitting and sizing in distribution systems. In *Proc. International Power Energy Conference*, pp. 858–862.
[13] F. S. Abu-Mouti & M. E. El-Hawary. (2011). Heuristic curve-fitted technique for distributed generation optimisation in radial distribution feeder systems. *Generation, Transmission & Distribution, IET, 5*(2), 172-180.