NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY
[IJIERT]
ISSN: 2394-3696
VOLUME 2, ISSUE 4, APR.-2015

AN EFFICIENT COUPLED GENETIC ALGORITHM AND LOAD FLOW ALGORITHM FOR OPTIMAL PLACEMENT OF DISTRIBUTED GENERATORS

Rashed Mobin
Department Of Electrical Engineering.,Meghnad Saha Institute Of
Technology,Kolkata,India

Mr.Ambarnath Banerji(HOD)
Department Of Electrical Engineering.,Meghnad Saha Institute Of
Technology,Kolkata,India

Utsav Das
Department Of Electrical Engineering.,Meghnad Saha Institute Of
Technology,Kolkata,India

ABSTRACT

A genetic algorithm is used in conjunction with an efficient load flow programme to determine the optimal locations of the predefined DGs with MATLAB & MATPOWER software. The best location for the DGs is determined using the genetic algorithm. The branch electrical loss is considered as the objective function and the system total loss represent the fitness evaluation function for driving the GA. The load flow equations are considered as equality constraints and the equations of nodal voltage and branch capacity are considered as inequality constraints. The approach is tested on a **9 &14** bus IEEE distribution feeder.

INTRODUCTION

Connection of distributed generation (DG) fundamentally alters distribution network operation and creates a variety of well-documented impacts with voltage rise being the dominant effect, particularly in rural networks. With the increasing levels of generation to be accommodated, planning and design of distribution networks will need to change to harness approaches that use information and communication technology to actively manage the network

Distributed generators are, by definition, small size generators, which can come from traditional or some revolutionary technologies (e.g., fuel cells, micro-CHPs, photovoltaic panels). Integration of DG with power networks (Grid) requires consideration of some issues in terms of numbers and the capacity of the DGs, the best location, the type of network connection, etc. Their benefits to networks are reduction in losses, providing higher reliability and increase in load ability and improved voltage profile. Their drawback is in issues such as various stability problems and the change in protection grading, etc. Furthermore, the installation of DG units at non-optimal places can result in an increase of power losses and hence increase of costs.

It is clear that while each of the broad approaches identified above offers advantages in terms of examining one of the problems, no approach in the literature can truly provide both optimal siting *and* sizing of DG across an entire network for a given number of DG units, without the requirement of predetermining capacities or locations. Here, a method is presented that combines the analytical accuracy of OPF with the ability of the genetic algorithm to efficiently search a large range of location combinations. Although this comes at the expense of requiring predefinition of the number of DG units, this allows exploration of a range of interesting problems

Advantages of GAs are their ability to avoid being trapped in local optima and also their expected number of function evaluations before reaching the optimum is significantly reduced compared with exhaustive search methods.

Here an attempt is made to discuss the identification of the DG placement for the reduction of the total real power losses in the distribution system through a developed GA in conjunction with an efficient load flow programme within MATLAB environment.

Here, the objective function, which calculates the total losses of power, is considered the fitness function and the equations of load flow considered as equality constraints and the equations of nodal voltage and branch capacity are considered as inequalities constraints.

LOAD FLOW

Load flow analysis of distribution systems has not received much attention unlike load flow analysis of transmission systems. However, some work has been carried out on load flow analysis of a distribution network, but the choice of a solution method for practical systems is often difficult. Generally, distribution networks are radial with a small X/R ratio. Because of this, distribution networks are not suited for solving such networks with Newton-Raphson or fast decoupled load flow methods

In this approach, the voltage magnitude at the buses, real and reactive power flowing through lines, real and reactive losses in lines, and total losses in the system are calculated and it is assumed that the three phase radial distribution networks are balanced and can be represented by their equivalent single line diagrams.

For practical calculations, we have the following equations:

$$I(1) = \frac{|V(1)| \cdot \angle\delta(1) - |V(2)| \cdot \angle\delta(2)}{R(1) + jX(1)} \quad (1)$$

$$P(2) - jQ(2) = V^*(2) \cdot I(1) \quad (2)$$

where

$V(1), \delta(1)$ voltage magnitude and angle of node (1)

$V(1), \delta(1)$ voltage magnitude and angle of node (2)

$P(2), Q(2)$ is the total real and reactive power loads fed through node (2).

It means, the sum of real (reactive) power loads of all the nodes beyond node (2) plus real (reactive) power of node (2) itself plus the sum of real (reactive) power losses of all branches beyond node (2).

$$I(1) = \frac{|V(1)| \cdot \angle\delta(1) - |V(2)| \cdot \angle\delta(2)}{R(1) + jX(1)} \quad (1)$$

$$P(2) - jQ(2) = V^*(2) \cdot I(1) \quad (2)$$

where

$V(1), \delta(1)$ voltage magnitude and angle of node (1)

$V(1), \delta(1)$ voltage magnitude and angle of node (2)

$P(2), Q(2)$ is the total real and reactive power loads fed through node (2).

It means, the sum of real (reactive) power loads of all the nodes beyond node (2) plus real (reactive) power of node (2) itself plus the sum of real (reactive) power losses of all branches beyond node (2).

GA FOR DGs PLACEMENT

The use of GA for DGs placement requires the determination of six steps as illustrated below

Step l :Representation

The representation scheme determines how the problem is structured in the GA and also determines the genetic operators that are used (between the two different representations: a float and a binary GA)

Step 2: Initialize population

The GA must be provided with an initial population. The basic call for this function is given by the MATLAB command called (initialize). This creates a matrix of random numbers with the number of rows equal to the population size and the number columns equal to the number of rows plus one.

Step 3 :Selection

In this step, one choice is made from the three implemented selection functions (roulette wheel, normalised geometric select and tournament).

Step 4: Reproduction

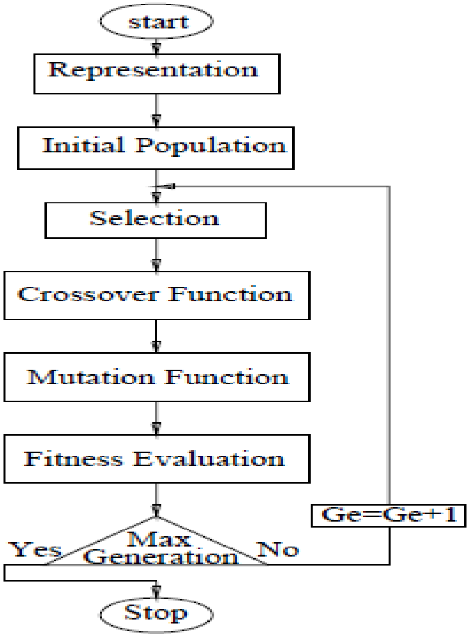
To produce the new solutions, two operators, crossover and mutation, are used.

Step 5 :Fitness evaluation

The total system losses were used as the fitness evaluation function, which is an output of the load flow software tool described in Section 2.

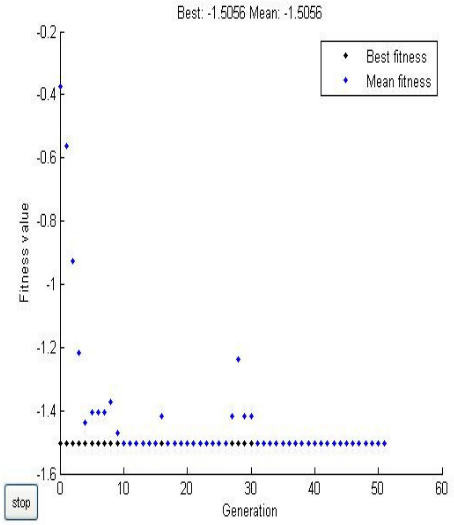
Step 6: Termination

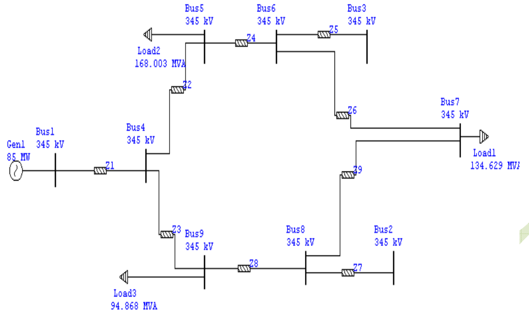
The termination function determines when to stop the simulated evolution and return the resulting population. A maximum generation criteria is used to stop the simulation.

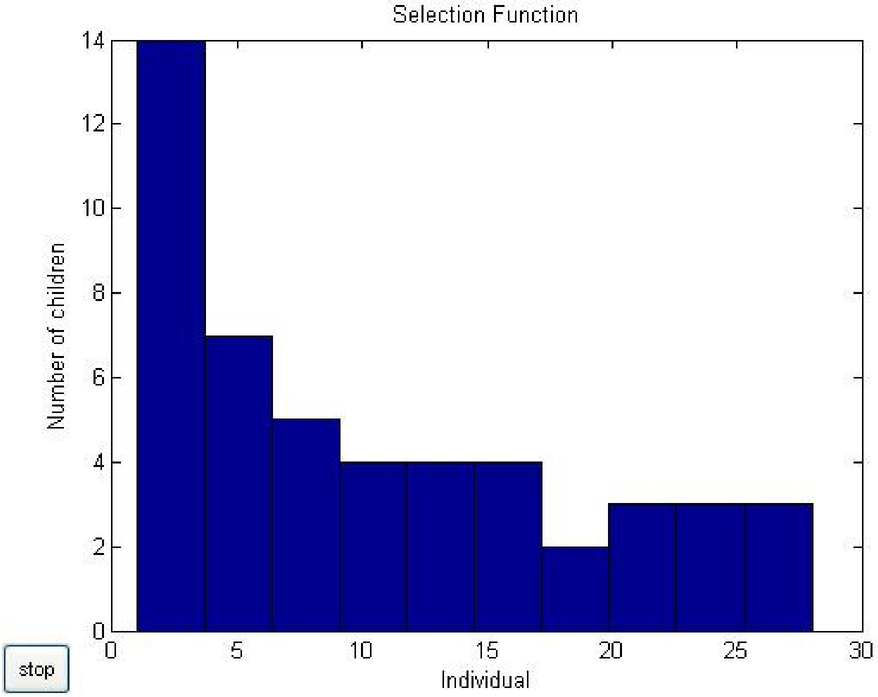


CASE STUDY

The work was carried out for a IEEE 9 bus system by using matpower,GA tool box and others softwares.







BRANCH	WITHOUT DG	WITH DG
		Nodes 1 7 9
	Voltage V(pu)	Voltage V(pu)
1	1	1
2	0.817	1.043
3	0.828	1.051
4	0.913	1.01
5	0.855	1.01
6	0.828	1.051
7	0.801	1.043
8	0.817	1.043
9	0.838	1.003

VOLTAGE OF BRANCHES

BRANCH	WITHOUT DG		WITH DG
	P(MW)	POWER INJECTION	P(MW)
1	327.92		68.66
2	147.32		53.95
3	52.53		-36.54
4	0		0
5	51.05		-37.14
6	-49.46		25.69
7	0		0
8	-49.8		25.64
9	-175.99		-14.69

POWER INJECTION

BRANCH	P(MW) WITHOUT DG	Q (MW)	P(MW) WITH DG	Q(MW)
1	0	81.82	0	2.87
2	4.785	25.9	0.497	2.69
3	1.485	6.47	0.596	2.6
4	0	0	0	0
5	0.507	4.3	0.169	1.43
6	0.338	2.86	0.052	0.44
7	0	0	0	0
8	1.193	6	0.324	1.63
9	4.609	39.18	0.025	0
TOTAL	**12.917**	**166.52**	**1.664**	**11.88**

TOTAL LOSSES TABULATION

From the results it can be observed that using distributed generators the total power loss has been reduced. The active power is reduced from **8.543 to 1.664 i.e., 80.52 % losses reduction** and the reactive power is reduced from 166.52 to 11.88 ie **92.86 %** reduction.

BUS 1	BUS 2	BUS 3	BUS 4	BUS 5	BUS 6	BUS 7	BUS 8	BUS 9		POWER LOSSES	
1	1	1	0	0	0	0	0	0		4.95470158	
1	1	0	1	0	0	0	0	0		3.907972	
1	1	0	0	1	0	0	0	0		2.770643	
1	1	0	0	0	1	0	0	0		4.921616	
1	1	0	0	0	0	1	0	0		5.30912	
1	1	0	0	0	0	0	1	0		7.021909	
1	1	0	0	0	0	0	0	1		3.046834	
1	0	1	1	0	0	0	0	0		4.422235	
1	0	1	0	1	0	0	0	0		4.134531	
1	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**		**8.543124**	
1	0	1	0	0	0	1	0	0		5.842195	
1	0	1	0	0	0	0	1	0		5.400015	
1	0	1	0	0	0	0	0	1		3.117107	
1	0	0	1	1	0	0	0	0		7.213207	
1	0	0	1	0	1	0	0	0		4.848058	
1	0	0	1	0	0	1	0	0		3.906668	
1	0	0	1	0	0	0	1	0		4.772461	
1	0	0	1	0	0	0	0	1		7.299286	
1	0	0	0	1	1	0	0	0		3.683721	
1	0	0	0	1	0	1	0	0		2.363856	
1	0	0	0	1	0	0	1	0		2.765858	

1	0	0	0	1	0	0	0	1		3.49245	
1	0	0	0	0	1	1	0	0		5.561506	
1	0	0	0	0	1	0	1	0		5.152932	
1	0	0	0	0	1	0	0	1		3.001599	
1	0	0	0	0	0	1	1	0		4.638628	
1	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**		**1.664186**	
1	0	0	0	0	0	0	1	1		2.982716	

GENERATOR PRESENT = 1

NO GENERATOR = 0

The above table that with changing the position of 3 generator in a 9 bus system the power loss for different position of generator are different.

Thus by selecting the best case ie with generator on bus 1,7,9 the total loss is greatly reduced.

CONCLUSION

This projet has presented a novel approach in determining suitable locations (nodes) in the system under investigation for the three DGs instalation and sizing for loss minimisation using efficient coupled GA and the load flow method. The proposed method has been tested on a 9 bus system. The results suggest that the active power losses are reduced from **8.543 to 1.664 i.e., 80.52 % losses reduction**

Genetic control parameters (i.e., pm, pc, population size and number of generation) play an important role in the performance of the GA and some permutations and combinations of these parameters need to be tested to get the best performance. The proposed convergence criteria can provide acceptable accuracy in overall results.

Using this approach and genetic algorithm all of power system problem can be solved.

We can find out the Generator Maintenance scheduling with transmission constraints can be worked out using this approach.

REFERENCES

1. Mardeneh, M,Gharenpetin, G.B;"*Sitting and sizing of D.G units using Genetic Algorithm and optimal power flow based technique*.
2. G.PHarrison, A.Piccplo "*Exploring the trade offs between incentives for distributed generation Developer and DNO''s. IEEE Trans. Power system.*
3. J. Chipperfield and P. J. Fleming1 , *The MATLAB Genetic Algorithm Toolbox.*
4. Das, D., Kothari, D.P. and Kalam, A. (1995) *'Simple and efficient method for load flow solution of radial distribution networks', Electrical Power & Energy Systems, Vol. 17, No. 5.*
5. Nara, K., Shiose, A., Kitagawa, M. and Ishihara, T. (1992) *'Implementation of genetic algorithm for distribution systems loss minimum reconfiguration', IEEE Transactions on Power Systems, August, Vol. 7, No. 3.*