THOMSON REUTERS ENDNOTE

[Sahu* *et al.*, 6(3): March, 2017]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

OPTIMIZATION TECHNIQUE BASED FOR OPTIMAL LOCATION OF FACTS DEVICES

Amit Kumar Sahu*, Prof. Kaushal Pratap Sengar
* Electrical Department, Technocrate Institudte Of Technology Bhopal Madhyapradesh, India

DOI: 10.5281/zenodo.438111

ABSTRACT

The problem of ameliorating the voltage and mitigating power loss in electrical networks is a task that ought to be solved optimally. In this paper a novel way for locating FACTS devices optimally in a multi machine power system employing Partial Swarm Optimization and Genetic Algorithm (GA) is presented. By assessing the proposed method, the location of FACTS controllers, different type and rated values can be optimized simultaneously. Also, the proposed approach goals to evaluate the number of devices and their ratings in optimal way with the help of the optimization technique with the thermal and voltage limits taken into consideration. Various conditions of loading in the power system are taken into account during this method. The exploration of the proposed approach is accomplished on the IEEE 40-bus system.

KEYWORDS: FACTS devices, PSO, GA, SVR, TSR, TCR, TSC, etc.

INTRODUCTION

The FACTS devices (Flexible AC Transmission Systems) brings up contemporary opportunities for regulating power and thus improving the utilizable capacity of transmission lines existing. In a meshed network, an optimal location of Flexible AC Transmission Systems devices permits to regulate its power flows and therefore to increase the load ability of the system. Generally it is observed that a fixed number of devices, which beyond this load ability can't be ameliorated. There exist three distinct classes of devices, along with specific characteristics, which have been adopted and modeled for steady-state analysis. These devices are applied in maximizing the power transmitted by the network by regulating the power flows. In the combinatorial analysis, for the given number of FACTS devices, finding optimal locations is becoming a problem. To resolve this kind of problems, Genetic Algorithms and PSO have chosen.

Most of the investigations over optimal FACTS device installation are intended towards technical, economic or covering both. The technical concerns involve the proposed method in practically installing different FACTS devices on different locations to recognize the increase of loadability. The genetic algorithm has been employed to pick up the suitable locations for the installation of FACTS to paramount the method security with improved loadability.

RELATED WORK

K. Krishnakumar,in this paper is presented optimization for control technique. The author in the paper genetic algorithm for solving problems related to aerospace. Genetic algorithm has evolved from Darwin's theory. GA the new populations are evolved due to the hybrid of individuals. In the technique of optimization technique is used for designing the lateral autopilot mechanism and wind shear controlling for control system. in the paper concluded that no solution based on derivative of problems or special changes. The GA provides versatile solutions for control systems [1].

Daisy X. M. Zheng,in this paper, applied Genetic Algorithm for cost cutting in the project. Day by day the cost reduction is an important parameter which requires correlation with time management. In the author tried to find equilibrium among Time-Cost. There are many Time Cost Optimization tools available but the author found genetic algorithm to be more effective and thus worked over Genetic Algorithm. Genetic Algorithm is applied on the multi objective power models. The GA is applied in such a way that the adaptive weights obtained from former power generation models are integrated and gives ideal point of desired pressure in the model. The desired results are obtained through simulation over MATLAB and results proved optimality of the model for multi objective having fixed duration of time and cost [2].

STATIC VAR COMPENSATOR

According to the IEEE definition, in Static Var Compensator (SVC) there is a shunt connected static var generator or absorber in which its output is regulated for trade off capacitive or inductive current to sustain and control characteristic values of the electrical power. The typical Static Var Compensator is classified as Thyristor-Controlled Reactor, Thyristor-Switched Reactor or Thyristor-switched capacitors. Figure 1 represents a Thyristor-Controlled Reactor single-phase equivalent circuit. In this circuit the shunt reactor is regulated dynamically from minimum to maximum value by the process of conduction control of the by-directional thyristor valves. This controlled action in the Static Var Compensator can be spoted as a variable shunt reactance settled due to the parallel connection of the shunt capacitive reactance XC and the effective inductive reactance XL controlled in the thyristor switching system.

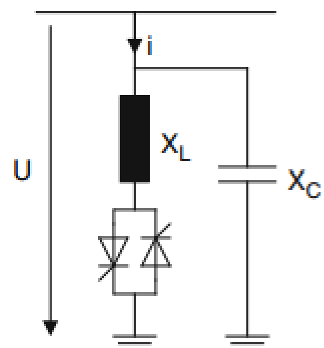

Fig. 1 Single-phase equivalent circuit of the shunt SVC (TCR)

GENETIC ALGORITHM

Genetic algorithm is an optimizer based on stochastic iterations that functions on the notion of the survival of the fittest, motivated by Charles Darwin, and assesses methods relies on the fundamental of natural genetics and natural selection to contrive search and optimization procedures that satisfies a predefined goal at its best. Genetic algorithms search the solution space of a function with the help of simulated evolution, i.e., the Survival of the fittest strategy. The fittest independent of any population who tends to procreate and survive to the next generation, thus improving the generation ahead. In the survival theory Inferior individuals by chance can survive and reproduce also. By traversing all fields of the state space exponentially Genetic algorithm can solve linear and nonlinear problems utilizing promising regions through mutation, crossover, and selection operation sued to individuals in the population. Genetic algorithms use principles of natural evolution. There are five salient features of (GA) as follow:

The important parameters of GA are:
Selection – Based upon the fitness criterion to pick the chromosome from a population to reproduce.
Reproduction – Propagation of individuals from one generation to the next.
Crossover – Operator transforms genetic material which is the features of an optimization problem. Single point cross over is used here.
Mutation – The reconstruction of chromosomes for single individuals. Mutation does not permit the algorithm to get stuck at local minimum.
Stopping criteria – When the number of cycles is reached to maximum, the iteration stops. The minimum Cost function and regarding chromosome string or the desired solution are finally attained.

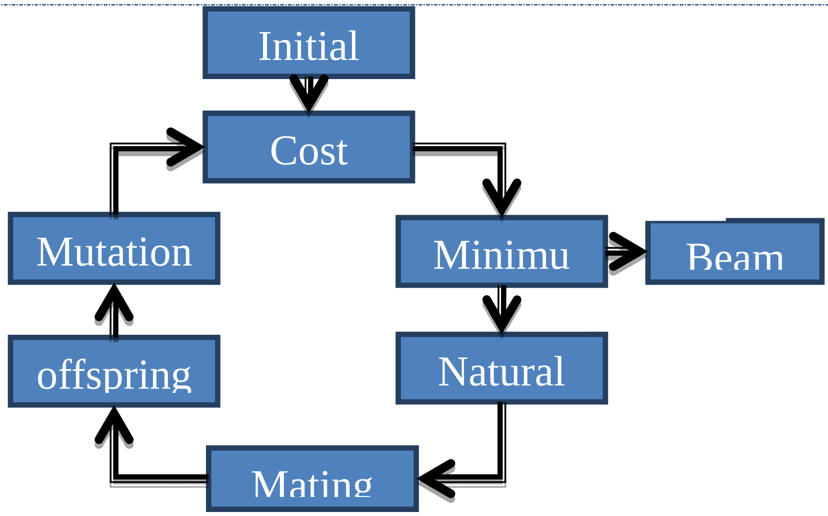

Fig: 2 Flowchart of Genetic Algorithm

OPTIMIZATION

Being an optimization tool PSO furnishes a search procedure based on population. In this method individuals called particles vary their position (state) with time. In a PSO system, particles fly around in a search space which is multidimensional. During gliding, each particle modifies its position according to its own experience (This value is called), and according to the experience of a neighboring particle (This value is called), utilizes the best position experienced by itself and its neighbor.

The implementation of PSO in optimal reliability planning model can be formulated. The non-linear optimization problem can be solved by employing the PSO algorithm as follows

Step 1: In this step initialization of the Particle Swarm Optimization parameters is done. Parameters involves:
Population size
Maximum number of generations,
Number of variables
C_1, C_2, W_{min} and W_{max} and the problem parameters like line data, bus data, upper and lower limits on forced outage rate of system components and system EDNS are read. First we decide the population size post find maximum number of generation.

Step 2: In this step the forced outage rate of components of the composite system as unknown state variable $X\ (j), j = 1 \ldots \ldots n$ is set.

Here, n is total number of generators and transmission lines in the system. State variable X(j) depend on the j and j vary from 1 to n.

Step 3: In this step, the generation counter t for generation of m particle is set i.e.

$$\{x_i(j), i = 1,2,3\ , \ldots \ldots m; j\}$$

Step 4: According to the objective function, formulate the fitness of each particle and check the restraint violations of each particle.

Step 5: Form set among each particle and allot g best from the p best set

Step 6: Update the generation counter.

Step 7: the velocity of i^{th} particle in the given j^{th} dimension is updated by using the global best and the individual best of each particle.

Step 8: Based on the updated velocities, each particle adjusts its positions as Xtþ1 i. If the particle oversteps its position limits in any dimensions then set its position at the suitable limit and do follow steps 4 and 5.

Step 9: When the stopping criteria is satisfied, either cease the algorithm or else go to step 6.

Results

In this paper, theFACTS device location considered Economicsaving function, which obtained by power lossreduction.In order to verify the effectiveness of the proposed method IEEE 40 bus system is used. Different

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

operating conditions are considered for finding the optimal choice and location of FACTS controllers.

Table: 1 Optimum Location

S. No.	Bus No.
1	1
2	3
3	5
4	10
5	13

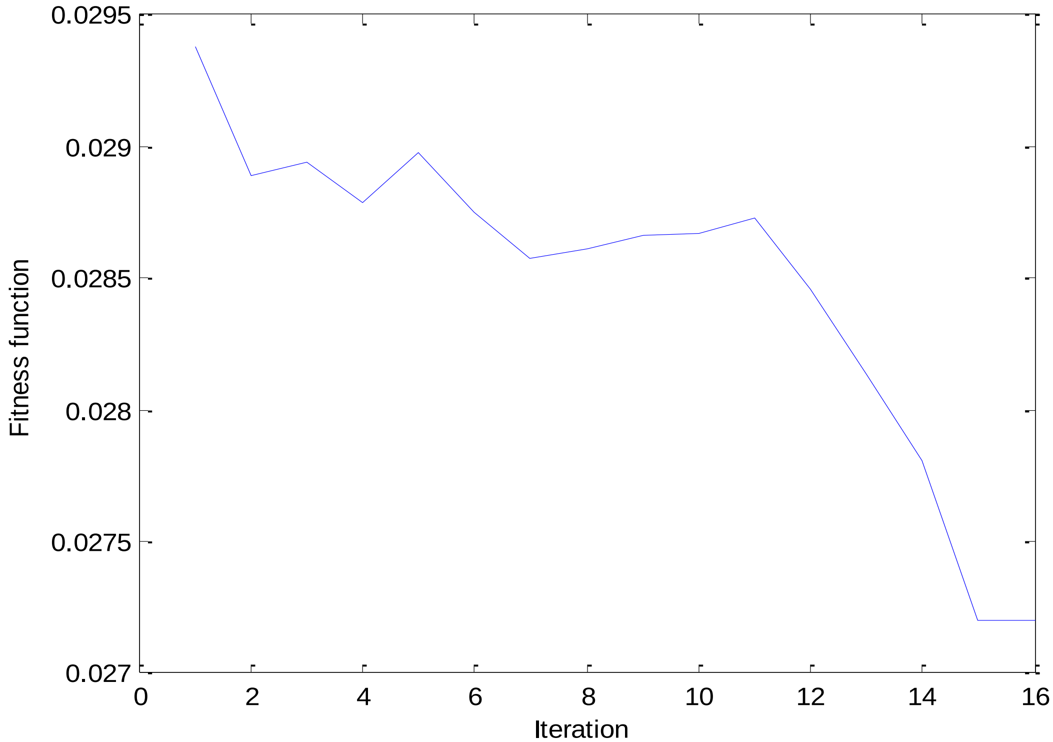

Fig: 3 Performance of Iteration Vs Fitness Function

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

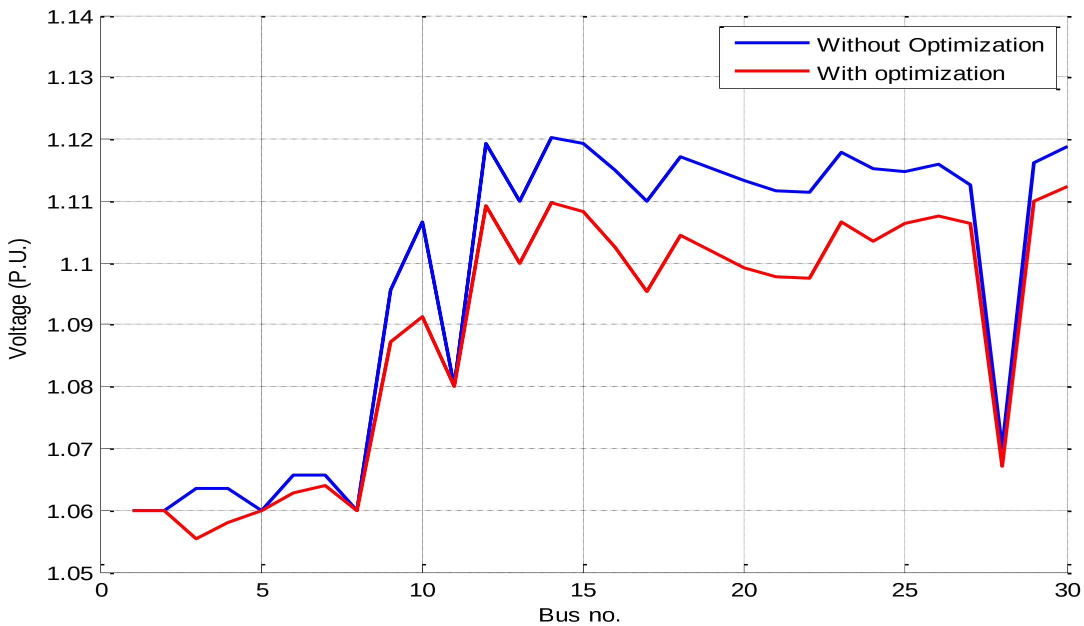

Fig: 4 Performance of Graph with and Without Optimization

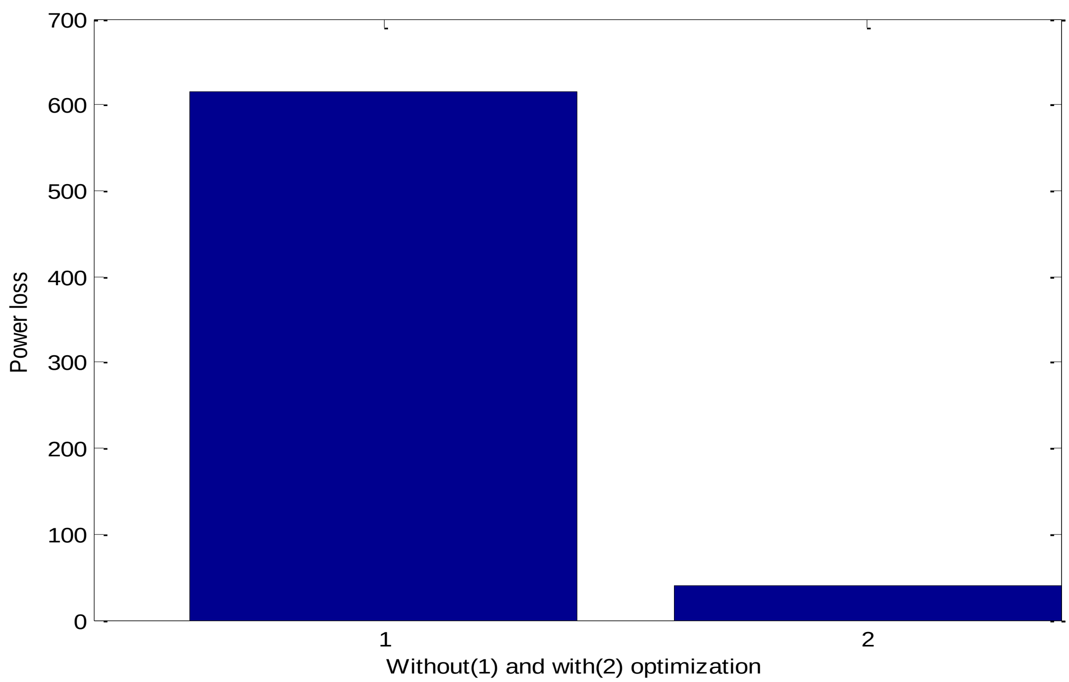

Fig: 5 Performance of GA Optimization

In this figure show in 5, power transmission loss with optimization method and without optimization, increase power loss problem batter then normal condition.

Table: 2 Increase value With Optimize and Without Optimize

S. No.	Power LossWith Optimization Value	Power Loss Without Otimization Value
1	100	600

CONCLUSION

In this approach Optimization algorihtm based optimal placement of FACTS devices in a transmission network is done for theincreased loadability of the power system as well as to minimize the transmission loss. It is clearly evident from the result that effective placement of FACTS devices in proper locations cansignificantly improve. This approach could be a new technique for the installation of FACTS devices in thetransmission scheme.

REFERENCES

[1] K. Krishnakumar; David E. Goldberg, "Control system optimization using genetic algorithms", June,1992.
[2] Daisy X. M. Zheng, S. Thomas Ng and Mohan M. Kumaraswamy, "Applying a Genetic Algorithm-Based Multiobjective Approach for Time-Cost Optimization", Journal of Construction Engineering and Management, April, 2004.
[3] Y. Abdelaziz, M. A. El-Sharkawy, M. A. Attia, "Optimal Allocation of TCSC Devices Using Genetic Algorithms", International Middle East Power Systems Conference, December 19-21, 2010.
[4] JigarS.Sarda, VibhaN.Parmar, DhavalG.Patel, LalitK.Patel, "Genetic Algorithm Approach for Optimal location of FACTS devices to improve system loadability and minimization of losses", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 1, Issue 3, September 2012.
[5] S. N.G. Hingorani and L.Gyugi, "Understanding FACTS –Concepts and Technology of Flexible Ac Transmission Systems", Standard Publishers Distributors, IEEE Press, New York, 2001.
[6] D. Gotham and G.T. Heydt, "Power Flow control and Power Flow Studies for Systems with FACTS devices", IEEE Transaction on Power Systems, vol.13,no.1 , pp. 60-65, 1998.
[7] H. A. Abdelsalam, etal, " Optimal location of the unified power flow controller in electrical power systems" Large Engineering systems Conference on Power Engineeringpp.41 – 46, 28-30 Jul. 2004.
[8] Taranto GN, Pinto LMVG, Pereira MVF, "Representation of FACTS devices in power system economic dispatch," IEEE Trans Power System, Vol. 2, pp. 6-572, 1992.