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ROLE OF GENETIC ALGORITHM IN CONGESTION MANAGEMENT: A REVIEW

[1]Ashish Vijayvargiya

[1] M.Tech Scholar, Department of Electrical & Electronics Engineering, Amity University, NOIDA

Abstract: Congestion management is a major challenge in front of system operators particularly in deregulated system. Now a day's power system is undergoing the process of deregulation everywhere to fulfill the increased demand, by inducing competition in electricity market and for the better utilization of distributed generating units. Various conventional and latest optimization techniques like nonlinear programming (NLP), dynamic programming (DP), quadratic programming (QP), Lagrange relaxation method, genetic algorithm (GA), ant colony optimization (ACO), bee colony optimization (BCO) etc. have been implemented for the solution of nonlinear congestion management problems. This paper summarizes various congestion management techniques using Genetic Algorithm (GA) technique and its various versions; the comparison with other techniques is also given.

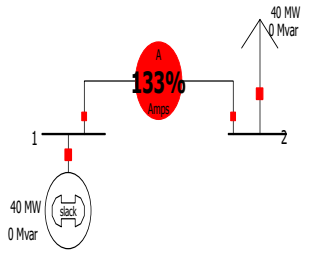
Keywords – Congestion management, Genetic Algorithm, Optimization,

I.INTRODUCTION

In electricity market environment there is always a possibility of sudden change in load flow patterns due to unplanned power exchanges, under such conditions transmission lines may operate close or even beyond their operating limits and lead to transmission congestion. To relieve the lines from congestion and to ensure the reliable operation of power system appropriate congestion management technique must be adopted. For this purpose several optimization techniques have been adopted to obtain the optimal solution of the complex congestion management problem. In this paper a brief review on congestion management techniques based on PSO and it's comparison with other techniques is given.

II. CONGESTION IN LINE

Below figure shows a two bus system of 40MW generator and 40 MW load with a congested line as it is loaded to 133% of its MVA rating. Congestion in a line occurs when it operating close or beyond its MVA rating.



III. PROBLEM FORMULATION

Congestion management problem formulation involves formulation of objective function either as single objective [2] or multi-objective [3] function such as minimization of congestion cost, maximization of social welfare, minimization of installation cost of FACTS devices etc. Such objective functions have to be optimized by using appropriate optimization technique by keeping the constraints within the limits.

IV.GENETIC ALGORITHM

In other words, Genetic Algorithm [5]-[7] is a search technique which is used for computing to find out estimated or exact solution for optimization and search problems [8]. GA technique is based on the principle of natural genetics and natural selection [1]-[7]. GA is categorized as a global search heuristics and it uses techniques inspired by evolutionary biology such asselection, inheritance, mutation and crossovers are the specific class of Evolutionary Algorithms (EA)[7].A

computer simulation is implemented in GA, in which a population of abstract representations (called the chromosomes) of candidate solutions to an optimization problem evolves towards better solutions. Traditionally, solutions are expressed in binary as strings of 0's and 1's, but different encodings are also acceptable [7]-[9]. Usually the evolution starts from a randomly generated individual population and happens in generations [12]. The fitness of each individual in the population is calculated in every generation, multiple individuals are randomly selected from the current population (depending upon their fitness), and modified (possibly randomly mutated and recombined) to create a new population [4]-[8]. In the next iteration the new population is used in algorithm. Commonly, the algorithm ends when maximum number of generations has been developed, or for the population a satisfactory fitness level is reached. Due to maximum numbers of generations the algorithm terminates, a satisfactory solution may or may not have been reached [5].

Genetic algorithm proceeds to initialize a population of solutions randomly after having the genetic representation and fitness function defined, and then improve it by repetitive application of crossover, mutation, selection operators and inversion [7]-[9]. The fitness function is defined over the genetic representation and calculate the quality of the represented solution. A fitness function always depends on the problem. One wants to maximize the total value of the object that can be put in a knapsack of some fixed capacity in the knapsack problem for instance [4]-[10]. An illustration of a solution which can be an array of bits, where each bit shows a different object, and the value of the bit (0 or 1) represents. Whether or not the object is in the knapsack. All the representations are not valid, as the object size may be more than the capacity of the knapsack. The fitness of the solution is the total values of all the objects in the knapsack if the representation is valid for 1 or otherwise 0 [12]-[15].

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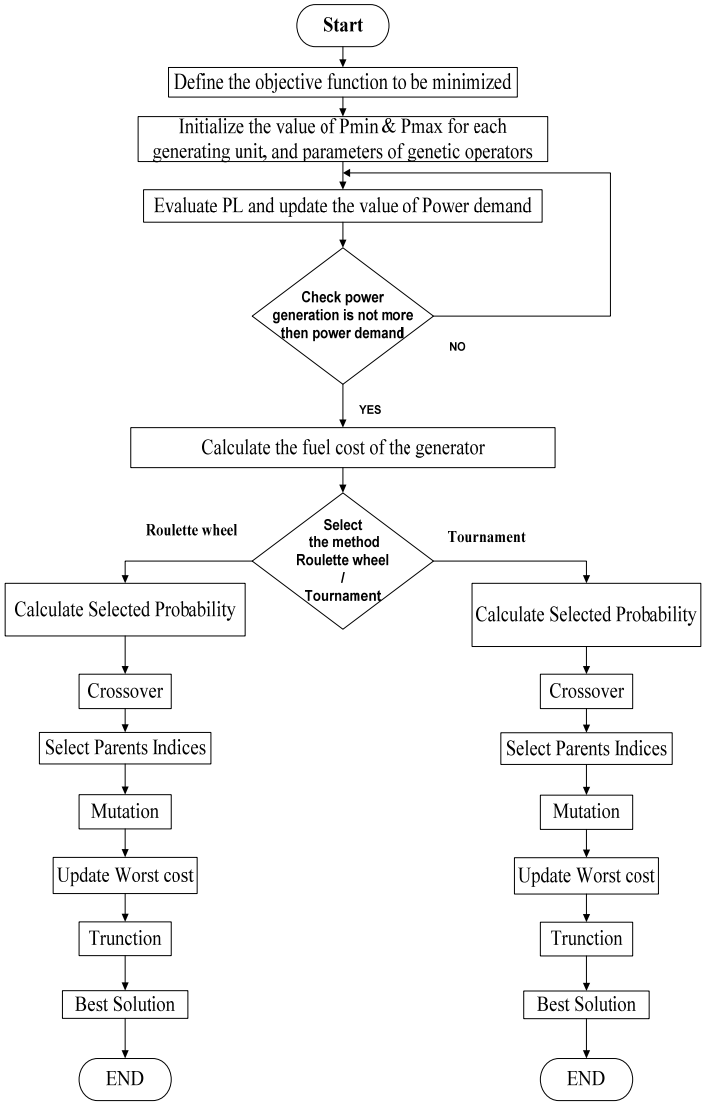

Figure 3: Flow Chart of Genetic Algorithm

V. LITRETURE SURVEY

S. Charles Raja and B.V. Manikandan [22]used PSO is used to unravel multi-objective problem formulation for CM. In this paper generator rescheduling is articulated as an optimization hitch with the aim of attainingsmallest rescheduling cost and proposed objective of accomplishingsmallest amountof active power loss. The cluster / zone originated approach is implemented for generator rescheduling in most receptive zone. In first objective function the cost of rearranging of active power of generators is minimized and in second objective function loss minimization is considered. The TCDFs are determined to form the congestion gatherings or zones.

S. K. Joshi and K. S. Pandya [23] adopted PSO algorithm to curtail the total generating cost considering installation cost of thyristor controlled series compensator (TCSC) by optimal TCSC position. The problem formulation objective function consists of bid function generator bus (seller bus) and bid function of consumer bus (buyer bus) and installation cost of TCSC. The constraints calculated are equal opportunity and disparity constraints. Equity requirements containsreal and responsive power dependability limitations while imbalance imperative fused of genuine and receptive power creation limits, voltage limits, reactance limits and operating range of TCSC.

J. Hazra and Deva P. Seetharam [24] proposed a PSO founded CM technique which works in two folds first step is to reduce congestion by the worth of rescheduling of generation, in second step is load shedding by shortening the effect on incomes and clients. The problem preparation involves three objective functions that are minimize congestion, minimize cost of operation and

minimize cascading risk. The objective functions are focus to constraints such as load-generation balance, physical and operating limits of generators. The exceptional feature of the paper is to diminish cumulative risk of cascading failures.

B.V.Manikandan et al. [25] gives relationship between cluster-zone method and relative electrical distance method for overload alleviation. In cluster/zone method generators in the most delicate zone are measured for rescheduling if congestion happens even after rescheduling of generators load curtailment if done for this, PSO is implemented as solution algorithm in this method. In RED method power flow tracing algorithm is used. The two methods are compared on the basis of parameters like Rescheduling cost, system cost, losses, and voltage stability.

Masoud Mohammad et al. [26] implemented PSO and GA to regulate the optimal location of UPFC for CM and presented a comparative analysis of both methods. The objective function in formulating problem embraces of cost of power production and cost of congestion. The limitations considered are voltage limit and power generation constraints.

J. Hazra and A. K. Sinha [13] implemented PSO with dynamic velocity controlling to obtain better convergence for the result of multi-objective optimum power flow. The problem formulation comprises of two objective functions, minimization of rate of generation and minimization of polluted gas emission subject to constraints.
Sandip Chanda and Abhinandan De [5] used PSO algorithm for the clarification of penalty based congestion constrained optimum power flow (OPF) problem. In this paper a line loading indexing scheme is proposed to recognize the congested lines in the system. The objective function of the suggested algorithm consists of penalty for voltage, penalty for line loss and penalty for congestion. The objective function is bound by power balance constraints, generator output constraints, voltage constraints and transmission constraints.

B. Sujatha, N.kamaraj [6] The problem formulation provides objective function which curtails the total cost sustained for adjusting real power generation of the contributing generators and the various constraints represents final powers as a function of market reimbursement values. upper and lesser parameters for real and reactive power of generators, upper and lower leap for real power alteration of the participating generators, detrimental and incremental alteration in real power of generator line loading limit, worse and superior leap for load bus voltages. In this paper a penalty based methodology is used which builds individual objective function with is diminished by unconstrained optimization algorithm.

J. Hazra and A. Sinha [27] implemented a comparative study of four differential evolutionary processes,bacteria foraging optimization, GA, and PSO for explaining the economic transmit trouble. The ELD problem is considered with valve point loading effect and is expressed as objective function to reduce the total generation price subject to real and reactive power stability and generation constraints. After comparing the results it is decided that PSO performs better than other methods for a chosen set of parameters.

J Vijaya Kumar et al. [28] presented the bidding approach with CM as an optimization problem. PSO is implemented for the clarification of proposed problem. In first step, the model of bidding scheme without line flow constraints has expressed, in second step the regulation of bidding approach has done to make the most of the social welfare. On the basis of simulation outcomes of the test system it is finished that PSO gives better results as compared to GA.

VI. CONCLUSION

In the paper a comprehensive survey of various congestion management techniques is presented to get the comparison between the performances of the above said techniques. Various optimization techniques like GA PSO etc are gaining importance now a days an can be implemented in any complex engineering problems. Similarly in managing congestion of transmission lines evolutionary optimization techniques can be implemented so get optimum solution.

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