Optimal Power Flow Analysis of Ieee 30 Bus System Using Pso And Ga Techniques

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Abstract- *This paper focuses on application of Particle swarm optimization techniques and Genetic algorithm to IEEE 30 bus system. Economic operation and planning of electric power generation system has always been an important aspect in Electric Power Industry. The classic problem is the economic load dispatch of generating systems to achieve minimum operating cost. OPF programs based on mathematical programming approaches include not only the robustness of optimization methodology, but also the power system modeling. Here, an attempt has been made to find out the OPF by using PSO using the data of six generating units. The performance is studied on IEEE 30 bus system, by considering real power generation and bus voltages as control variables. Generators with quadratic cost characteristics have been used. All the techniques are implemented in MATLAB environment. PSO is applied to find out the minimum cost which is finally compared with Genetic Algorithm. When the results are compared with the traditional technique, PSO seems to give a better result with better convergence characteristic. [30]*

Keywords- optimal power flow, fuel cost minimization, particle swarm optimization, genetic algorithm.

I. INTRODUCTION

Energy plays a vital role in any nation's development and Industrialization. The OPF has been developed a long time ago when Carpenter introduced a generalized formulation of the economic dispatch problem including voltage and other operating constraints. This formulation was later named the Optimal Power Flow problem (OPF) [15].A wide variety of classical optimization techniques have been applied in solving the OPF problems considering a single objective function. All these conventional

optimization methods have many disadvantages associated with them such as insecure convergence, disadvantages associated with the piecewise quadratic cost approximation and may even fail to converge due to in appropriate initial conditions for Newton based method. The evolutionary computation techniques can be constructed to cope effectively with the above difficulties. Evolutionary programming technique may provide more rapid and robust convergence on many function optimization problems. The reason, behind the scheme is that an evolutionary optimization algorithm is unlikely to be the best optimization procedure for any specific function in terms of efficiency convergence rate, solution accuracy, etc.As the power industrial companies have been moving into a more competitive environment, OPF has been used as a tool to define the level of the inter-utility power exchange .

II. PROPOSED OPF PROBLEM FORMULATION

As any optimization problem, the OPF problem is formulated as a minimization or maximization to a certain objective function in which it is subjected to a variety of equality and inequality constraints. The equality constraints of the OPF reflect the physics of the power system. The physics of the power system are enforced through the power flow equation which require that the net injection of the real and reactive power at each bus to be zero. The inequality constraints of the OPF reflect the limits on physical devices in the power system as well as the limits created to ensure system security.

III. PARTICLE SWARM OPTIMIZATION

Particle Swarm Optimization (PSO) is a relatively new evolutionary algorithm that may be used to find optimal (or near optimal) solutions to numerical and qualitative problems. Particle Swarm Optimization was originally developed by James Kennedy and Russell Eberhart in 1995, and emerged from earlier experiments with algorithms that modeled the flocking behavior seen in many species of birds [6].In simulations, birds would begin by flying around with no particular destination and spontaneously formed flocks until one of the birds flew over the roosting area. Due to the simple rules the birds used to set their directions and velocities, a bird pulling away from the flock in order to land at the roost would result in nearby birds moving towards the roost. Once these birds discovered the roost, they would land there, pulling more birds towards it, and so on until the entire flock had landed. The PSO algorithm for solving the OPF problem with an objective function of Minimization of generation fuel cost is shown in fig 1. [7]. PSO can solve problems with high quality solutions within shorter calculation time and stable convergence characteristics [10].

IV. OBJECTIVE FUNCTION

Objective function used in this case consists of active and reactive power production cost produced by generators. Consider a network that in it N and Ng are number of buses and number of generator buses respectively[27].

$$C=\sum_{i\varepsilon Ng}[CGPi(PGi)+CGQi(QGi)] \quad ....(1)$$

Subject to equality and inequality constraints,

Where,

PGi & QGi real and reactive power generation at ith bus
PDi & QDi real and reactive power demand at ith bus
CGPi (PGi) active power cost function in ith bus
CGQi (QGi) Reactive power cost function in ith bus

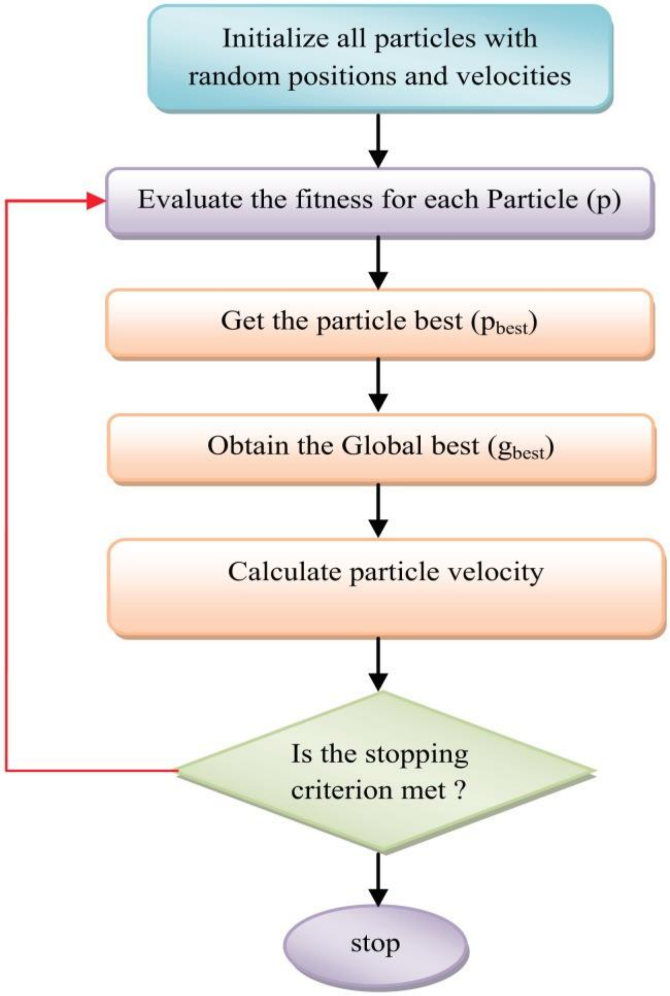

Fig 1. PSO algorithm

V. GENETIC ALGORITHM

Genetic algorithm (GAs) were invented by John Holland in the 1960s and were developed with his students and colleagues at the University of Michigan in the(70s). Holland's original goal was to investigate the mechanisms of adaptation in nature to develop methods in which these mechanisms could be imported into computer systems. GA is a method for deriving from one population of "chromosomes" (e.g., strings of ones and Zeroes, or bits) a new population. This is achieved by employing "natural selection" together With the genetics inspired operators of recombination (crossover), mutation, and inversion. Each chromosome consists of genes(e.g. bits), and each gene is an instance of a particular allele(e.g,0 or 1).The selection operator chooses those chromosomes in the population that will be allowed to reproduce, and on average those chromosomes that have a higher fitness factor(defined below),produce more offspring than the less fit ones. Crossover swaps subparts of two chromosomes, roughly imitating biological recombination between two single chromosome organisms; mutation randomly changes the allele values of some locations (locus) in the chromosome; and inversion reverses the order of a contiguous section of chromosome [28].

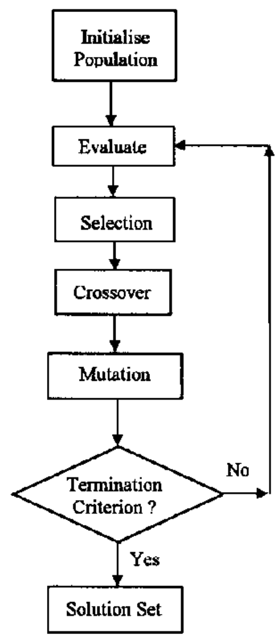

Fig. 2 Flowchart of genetic algorithm

VI. RESULT

The IEEE-30 bus system is used throughout this work to test the proposed algorithm. Throughout all cases, the IEEE-30 bus system base MVA has assumed to be 100 MVA. The results obtained using the proposed algorithm is compared with Genetic algorithm. For studies population size is considered as 100.The results are summarized in table .The objective function used in this case consists of active and reactive power production cost produced by generators.

Objective Function	PSO	GA
Rs/hr	822.93	823.88

Table 1. Result

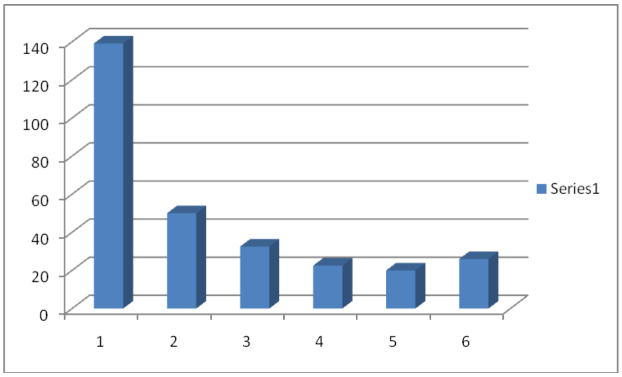

Fig.3 Generation of IEEE-30 bus generating units

The best generation of IEEE-30 bus generating units is presented in the Fig.3.

VII. CONCLUSION & FUTURE SCOPE

In this work, the formulation and implementation of solution methods to optimize the cost function of thermal generating units in IEEE 30 bus system using Genetic Algorithm and Particle Swarm Optimization is carried out. Particle swarm optimization can be used to solve many of the same kind of problems as Genetic algorithm. PSO algorithm is easy to apply and simple since it has fewer number of parameters to deal with comparing to other modern optimization algorithms. It is Efficient in global search. Further, particle swarm system has memory, which genetic algorithm does not have. Change in genetic population results in restructuring of previous knowledge of the problem. The effectiveness of the developed program is tested for IEEE 30 bus system. The results obtained by these methods are compared with each-other.PSO algorithm is easy to apply and simple since it has fewer number of parameters to deal with comparing to other modern optimization algorithms. It is Efficient in global search.

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