A PARTICLE SWARM OPTIMIZATION TECHNIQUE FOR ECONOMIC LOAD DISPATCH PROBLEM

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Abstract- Economic Load Dispatch (ELD) is one of significant optimization problem in the power system operation and control and it is the process of output power generated by the units to meet necessary power with minimum fuel cost. In this paper particle swarm optimization (PSO) effectively implemented to resolve the ELD problem with numerous non linear characteristics of practical generator. The proposed algorithm successfully implemented in MATLAB software and executed to solve the ELD problem with various constraints, results shows planned technique was definitely able of superior value of result, stable convergence characteristics and good computation efficiency for solving ELD problem. It is also verified and conducted that PSO is superior to the genetic algorithm (GA) method.
Keywords: Economic Dispatch (ELD), Particle Swarm Optimization (PSO), Genetic Algorithm (GA) method.

I. Introduction

Now a day's worldwide remarkable changes are ongoing in power systems operation in electrical supply system. The main purpose of system operator is to satisfy required power demand in the reliable, secure and economic way. The main aim of ELD is generation should be maintained in such a way to meet necessary power demand with least amount of fuel cost [1]. In the past many researchers have attempted to solve these problems by conventional techniques. The classical algorithms are applicable to linear characteristics of input and output with incremental fuel cost but practically ELD problem have non smooth fuel cost curve with constraints. So there is a need of recent heuristic methods such as practical swarm optimization. so pso method is implemented for solving ELD and results are compared with GA [2]. Each generator unit consumes fuel at a specific rate in million BTU per hour to generate power in watt. The input-output curve with fuel input in million BTU/hr.

2. GENETIC ALGORITHMS

Genetic Algorithm (GA) is the technique having some mechanics of biological evolution this random search technique was modeled. From the genetic evolution and nature selection the idea for model of GA is done. In GA first step is arbitrary selection of the initial searching point from the total exploration space. each point has one parameter hinted with string of bits. Each entity bit is called 'gene'. The string of genes is called 'chromosome', so for each point heir exist the chromosome. Set of chromosomes called as population and number of chromosomes called population size, string length nothing but number of genes in a string [4].For each chromosome leads to one solution.

3. PARTICAL SWARM OPTIMIZATION

Particle Swarm Optimization (PSO) optimization technique developed by Dr. Eberhart and Dr. Kennedy in 1995.this is the swarm intelligence technique based on social behavior for solving scientific and engineering problems [5]. It is modeled in multi-dimensional space have a particular position and velocity. Each individual particle represents a solution to a problem. It will give different solutions by changing the position and velocity in multi-dimensional space until computation limit exceeds. During journey, each particle adjust position by its own knowledge and neighboring particle experience will select the best position. In this three components will affect the velocity of particles those are inertial, cognitive and social.

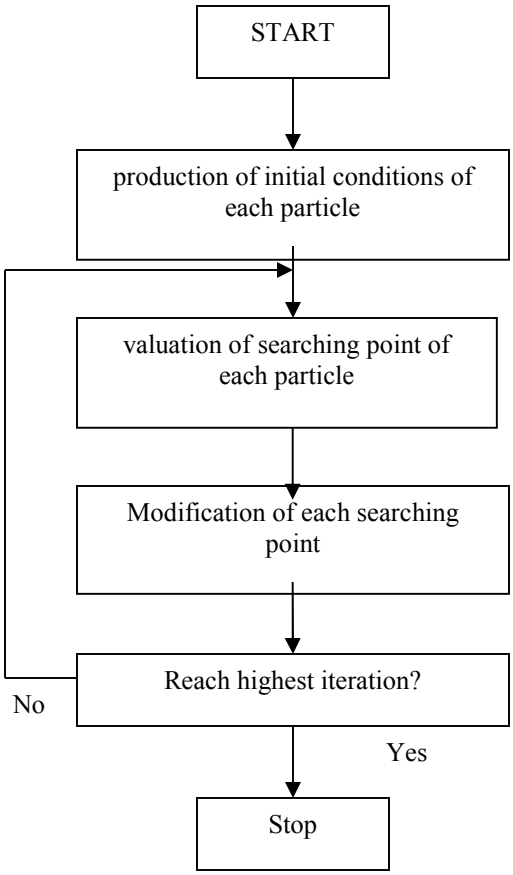


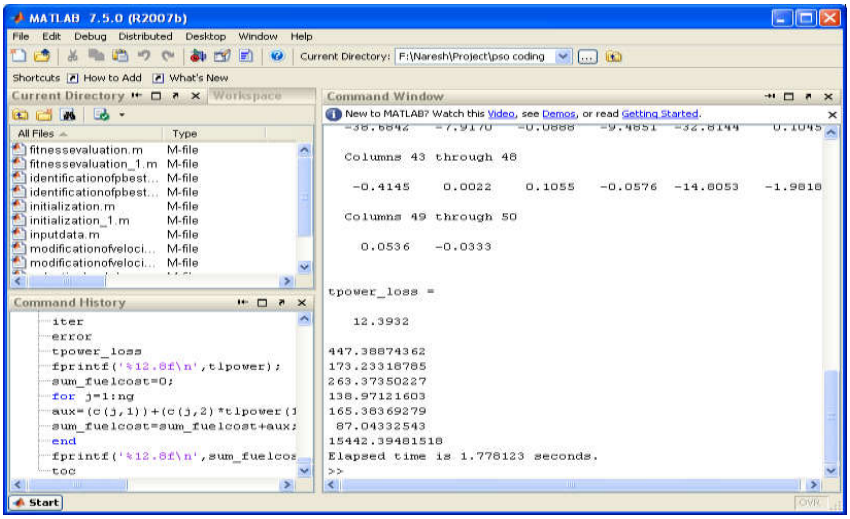
Fig.1 shows algorithm PSO for begins in MAT Lab.

The particles move around the multi-dimensional explore space till they discover the food (best solution) by taking decision depending on its previous best location and neighboring particle experience. All particles gradually decrease their speed until they come near zero speed at the global best [6]. The selection of coefficients in speed renew equations affects the convergence and the ability of the swarm to find the optimal solution. The main advantage of PSO over GA is it does not contain mutation and cross over. so running time for program and getting solution is less compare to GA.

4 SIMULATION RESULTS

In this paper the output powers are considered as a control variable for solving ELD with non smooth fuel cost function including transmission lines. The proposed algorithm is implemented in MATLAB (version 7.5b).The power system contains 6 generating units, 26 buses and 46 transmission line that are given in reference paper for solving economic load dispatch problem.

The loss coefficients matrix of power system network for drawing transmission line loss and satisfies the constraints written in MATLAB.



This power system contains six generator output. table 1 shows superlative solution of 6 unit system, table 2 shows comparison between two methods.

Output power of each unit	PSO Method	GA Method
Pg_1(MW)	447.1887	473.816
Pg_2(MW)	173.2331	176.632
Pg_3(MW)	263.3735	263.218
Pg_4(MW)	138.9712	134.282
Pg_5(MW)	165.3836	152.902
Pg_6(MW)	87.0433	73.1813
Output power of total units (MW)	1275.01	1277.06
Power loss (MW)	12.3932	13.0211
Total cost of Generation ($/h)	15442.39	15,458

Table: 1 Best Solution of 6-Unit System

Example	Method	Generation (Iterations)	20	50	100	200
6-Unit	PSO	Generation Cost($)	15144	15442.3	15441	15436
		CPU time (Sec.)	0.63	1.778	4.41	8.86
		CPU time/per-iteration (sec)	0.0601	0.00601	0.0601	0.0601
	GA	Generation Cost($)	15620	15608	15608	15605
		CPU time (Sec.)	4.34	10.49	21.31	42.07
		CPU time/per-iteration (sec)	0.22	0.22	0.22	0.22

Table:2 Comparisons Between Both Methods with 6-units

Generation Cost($)				Evaluation Value			
	Max.	Min.	Average	Max.	Min.	Standard Derivation	Average CPU
PSO	15,492	15,450	15,454	0.3611	0.3602	0.0002	14.89
GA	15,224	15,459	15,469	0.3609	0.1602	0.0570	41.58

Table 3 Comparisons between Both Methods

4.1 Comparison of Two Methods

4.1.1) Solution Quality: As seen in Tables 1,2 and 3 the PSO method can gives less production cost, good convergence property than GA method with enhanced quality in solution for six unit systems.

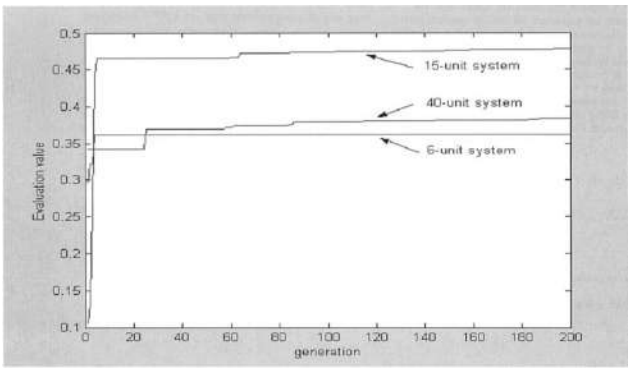


Fig.2 Convergence property using PSO method

4.1.2) Dynamic Behaviors Observation: The dynamic behavior of each individual in population can be observed from below figures. For a 6 unit system the GA method has fluctuations resulted from the mutation. But PSO method proved that it has better convergence efficiency.

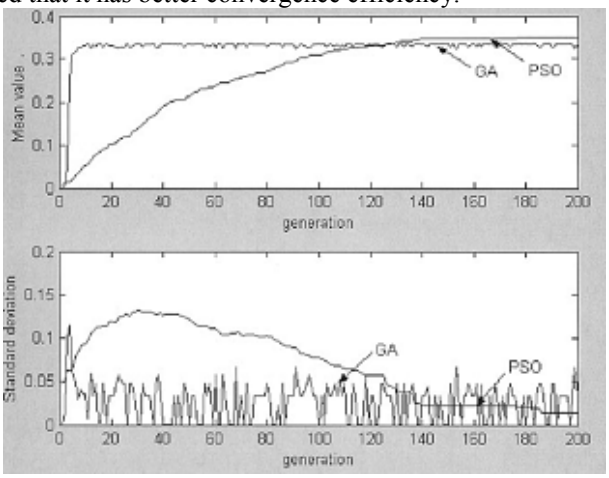


Fig.3 Tendency of both μ and σ using the two methods for 6 unit system

4.1.3) Computation Efficiency: the figure shows for 4 unit system the GA has premature convergence with small evaluation and standard deviation values and PSO method has enhanced convergence efficiency for solving ELD problems. The figure below dotted line shows GA results and thick line shows PSO results.

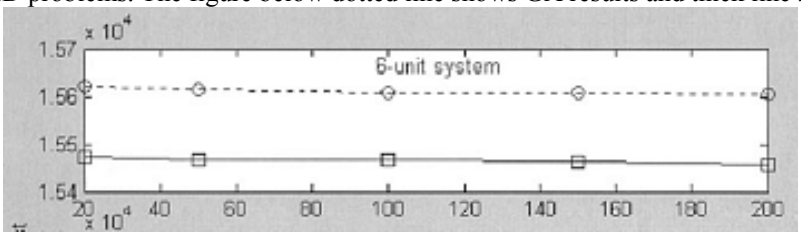


Fig.4 normal generation cost versus generation (iteration) for 6 unit system with dotted shows line GA and thick line shows PSO.

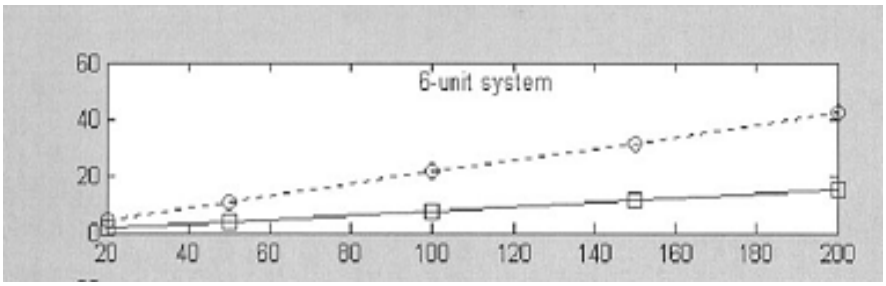


Fig.5 normal CPU time versus generation (iteration).with dotted shows line GA and thick line shows PSO.

CONCLUSION

In this paper, the PSO method was effectively implemented to solve economic load dispatch with non linear characteristics of generator. The proposed method was indeed capable of obtaining superior quality solution, stable convergence characteristics and good calculation efficiency. It is cleared from the outcome of the planned PSO method can avoid the short coming early convergence of GA method and can obtain elevated worth solution with better computation efficiency and convergence properly.

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