Soft Computing Approach for Economic Load Dispatch

Puneet Kaur

M. Tech Scholar, Department of Information Technology, Guru Nanak Dev Engineering College, Ludhiana, India

---

ABSTRACT

Application of Optimization Techniques are backbone of engineering systems and its contribution is the need of current system and engineers need to browse this area in short and long term planning scenarios. Contemporary techniques based on evolutionary computing, artificial intelligence, search method locate their path in the area of economic load dispatch planning to reach global optimal solution for this multi-decision, multi-objective combinatorial problem subjected to different constraints. Many algorithms suffer from global convergence problem. To vanish this drawback, Genetic algorithm Neural Network (GANN) has been proposed in this paper to solve economic dispatch problem. The suggested technique is tested on IEEE 30 bus system. Test results are compared with other techniques presented in literature.

Index Terms: Genetic Algorithm (GA), Economic Dispatch (ED), Neural Network (NN).

I. INTRODUCTION

The economic dispatch (ED) problem is the corner stone in today's power system. The purpose of the ED is to find the optimum generation among the existing units, such that the total generation cost is minimized while simultaneously satisfying the power balance equations and various other constraints in the system. Below are the suggested techniques in the literature - Amudha A. et al [1] solved unit commitment problem using worst fit algorithm considering the effect of reserve. Bavafa M. et al [2] implemented a hybrid approach based on Lagrange algorithm with evolutionary and quadratic programming for short thermal unit commitment. Catalao J.S. et al [3] proposed a profit based unit commitment with constraints of emission limitation. Chang G.W. et al [4] proposed a mixed integer linear programming method for unit commitment optimization. Christober C. et al [5] coined an algorithm based on genetic algorithm to minimize the total operating cost. Christober C. et al [6] proposed a neural network based tabu search for unit commitment optimization which is more efficient than conventional tabu search. Christober C. et al [7] presented approach based on evolutionary programming simulated annealing method considering cooling and banking constraints for cost minimization. Fei L. and Jinghua .[8] designed algorithm based on local search which combines interior search method for large power system. Ganguly D. et al[9] proposed a new genetic approach based on parallel system to handle impossible solution in an organized fashion for thermal unit commitment. Barquin J. [10] proposed an algorithm for self unit commitment for day ahead market based on simple bids. Iguchi M. and Yamashiro S. [11] implemented an efficient scheduling method for hydro-thermal units considering the account of transmission network. It consists of different stages and constraints are relaxed at every stage and transmission losses are calculated at every stage. Im T.S and Ongsakul W. [12] implemented an Ant colony search algorithm based on new co-operative agent approach for economic dispatch and unit commitment. It uses the combination of dynamic programming with economic dispatch and comparison with Lagrange algorithm has been done. Navpreet Singh Tung et al [1314,15,16] introduced various unit commitment aspects.

II. PROBLEM FORMULATION

The ED problem may be expressed by minimizing the fuel cost of generator units under constraints.[13-16] Depending on load variations, the output of generators has to be changed to meet the balance between loads and generation of a power system. The power system model consists of n generating units already connected to the system.

The ED problem can be expressed as.

A. Fuel Cost Model

$C(P_{Gi})=\Sigma(a_i*P_{Gi}{}^2+ b_i*P_{Gi} +c_i)Rs$ where i=1…..N

B. Constraints
- $\Sigma P_{Gi}-P_D-P_L=0$
- $P_{Gi,min}\leq P_{Gi}\leq P_{Gi,max}$ where i=1,2……N

C. Minimization

Total Operating Cost=C

D. Transmission Losses

$$P_L = \sum_{i=1}^{N}\sum_{j=1}^{N} P_{Gi}B_{ij}P_{Gj} + \sum_{i=1}^{N} B_{0i}P_{Gi} + B_{00}$$

III. Proposed Techniques

A. Genetic Algorithm

Genetic Algorithm (GA) is a search directed algorithm inspired by survival of the fittest among string structures to form a search algorithm. [5] To achieve solution of optimization problems, GA has been explored recently and shown to be effective at exploring a complex space in an adaptive way, guide by the biological evolution mechanisms of reproduction, crossover and mutation.

Flow Chart of GA
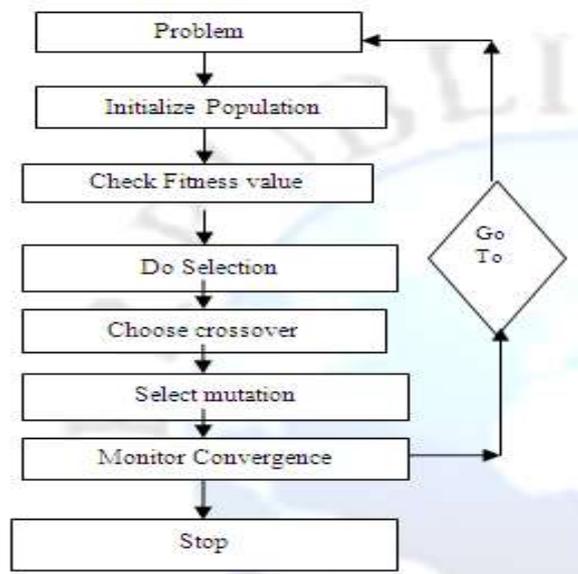
B. ARTIFICIAL NEURAL NETWORK

ANN,[17,18], is a mathematical model inspired by biological neural networks. The motivation for the development of neural network originated from the thought to implement an artificial system that could perform intelligent tasks similar to those performed by the human brain. It is a modeling tool that is able to capture and represent complex input output relationships. In most cases a neural network is an adaptive system, between inputs and outputs, to find patterns in data. Neural network resemble the human brain in the following two ways:

1) A neural network acquires its knowledge through learning.
2) A neural network's knowledge is stored within interneuron connection strengths known as synaptic weights A neural network consists of an interconnected group of artificial neurons, and it processes information using a connection approach.

C. GANN

GANN evolution is inspired genetic operators, fitness function and stopping criteria. The genetic operators namely; two–point crossover and uniform mutation are utilized [6,17,18]. The fitness function of GANN is chosen to be

minimized. Convergence of the function is ensured and computation is stopped when the fitness variation in consecutive iteration is insignificant.

- Pseudo code

1. Initialize the random population
2. Develop input and target vectors
3. Map chromosomes from the population to the network
4. Simulate the network
5. Measure the fitness function
6. Increase the number of hidden neurons until a best fit population is obtained
7. Do crossover on the population
8. Get the best population, choose parent and mutate
9. Stop if the condition is met.
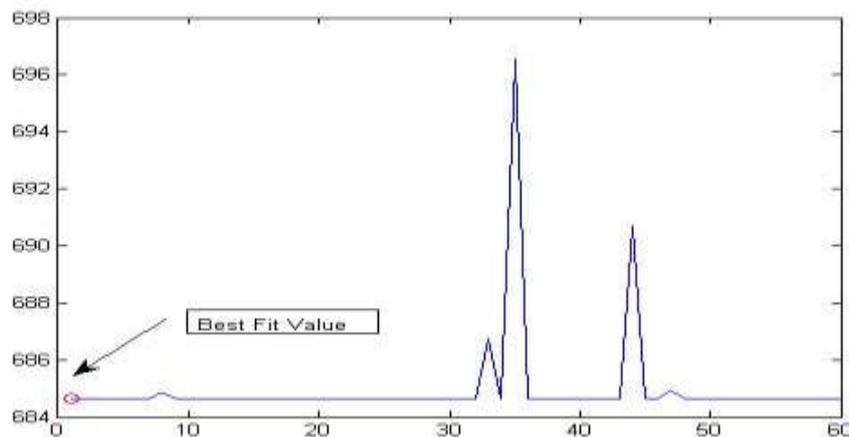
IV. SIMULATION RESULTS

This proposed approach is checked on IEEE 30 bus system [19]. Simulation results are achieved and compared with other technique presented in literature.

Table 2. Results comparison with other technique [19]

Hours	Cost ($/hr)GANN	Cost ($/hr) SFLA
6	15756	17196
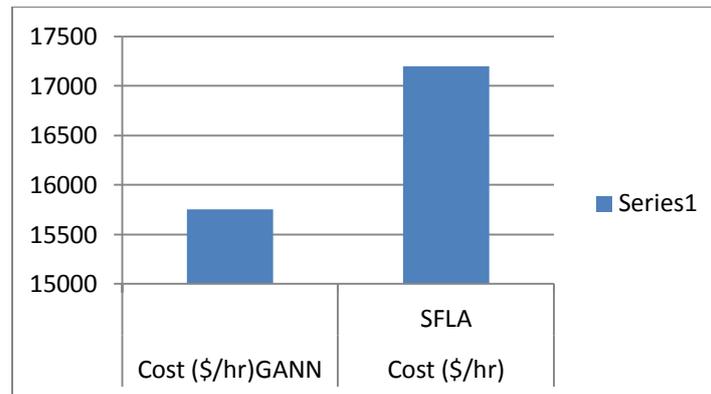
Fig. 2: Comparison of Total operating Cost

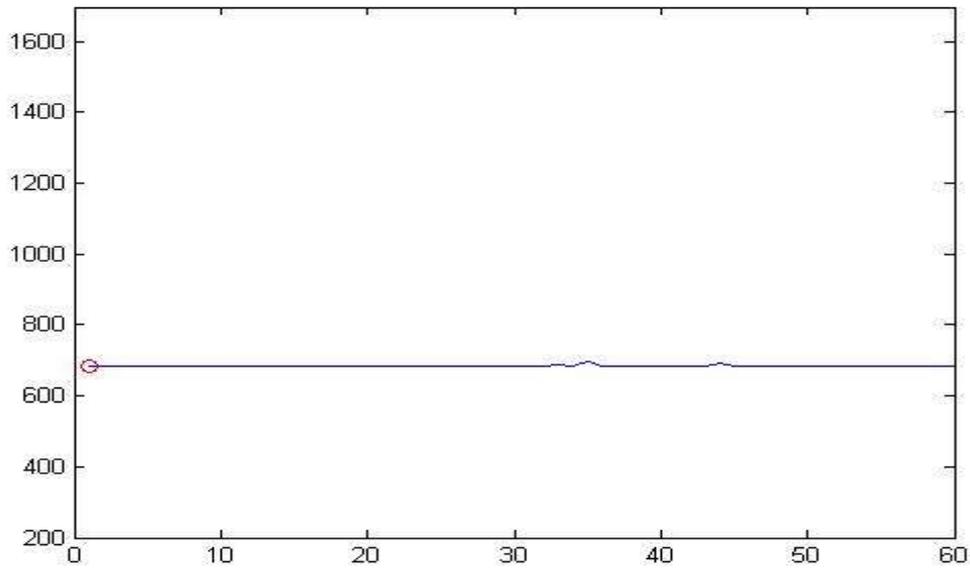**Fig. 3: Best fitness Value with Generation in feasible region.**
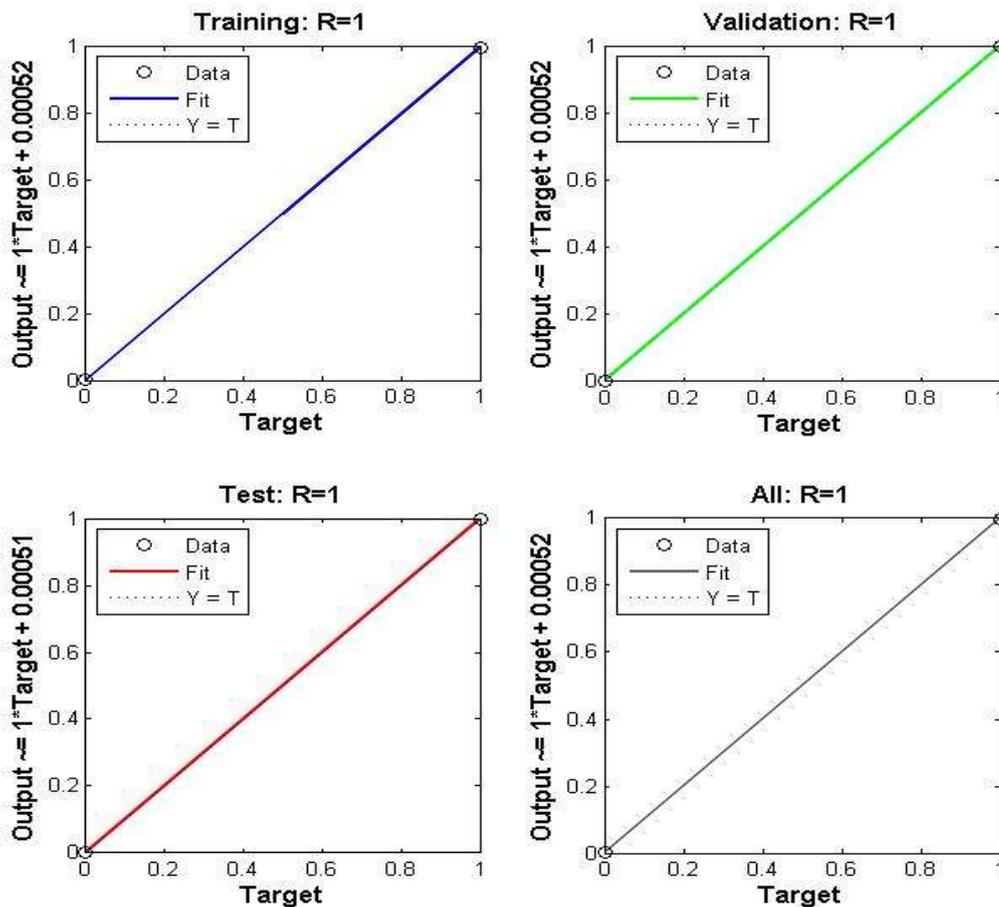
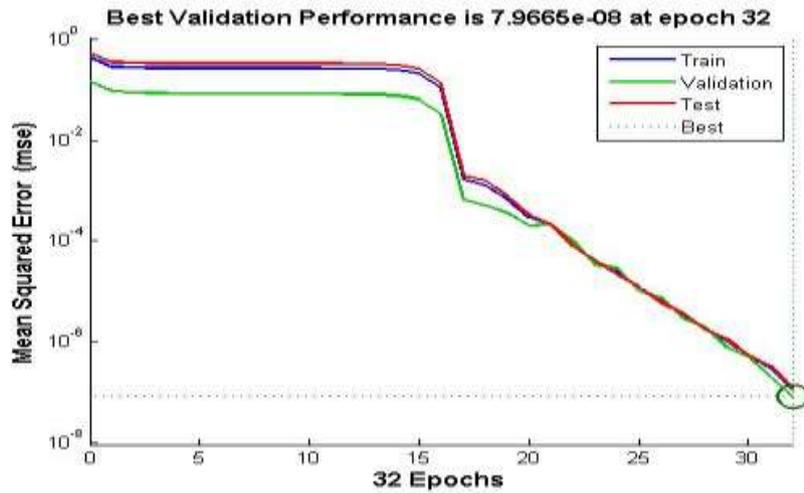**Fig. 4 Best fitness Value with Generation**

Fig 5.Regression Analysis
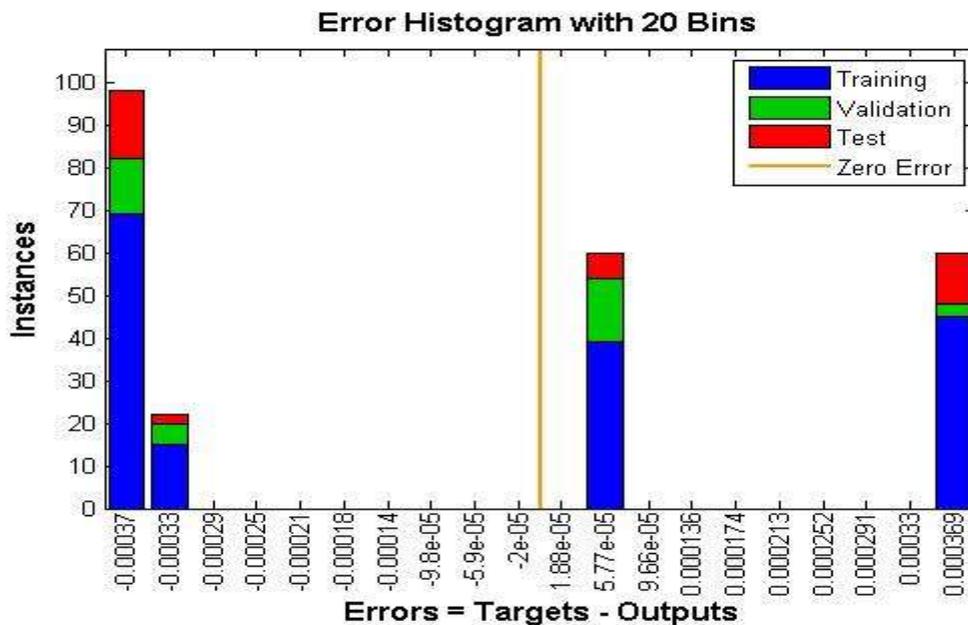
Fig 6. Mean Square Error

Fig 7. Histogram

CONCLUSION

In the current research, an application of GANN has been applied successfully for economic power dispatch problem. Proposed technique is tested on IEEE 30 bus system. Test results reveal the minimum operating cost. A comparison has been made other technique presented in literature. It out-performs other techniques presented in literature. Hence, GANN algorithm is more robust and lead to optimal solution in economic power dispatch problem.

FUTURE SCOPE

Future research involves the formulation and development of other hybrid algorithm to achieve optimal solution.

ACKNOWLEDGEMENT

REFERENCES

[1]. Amudha, A.,Christopher, C. and Rajan, A.(2011) "Effect of reserve in profit based Unit Commitment using Worst Fit algorithm" ,Proceedings of IEEE, pp 1-7, 2011.

[2]. Bavafa, M., Monsef, H. and Navidi, N.(2009) "A new hybrid approach for Unit Commitment using Lagrangian Relaxation combined with Evolutionary and Quadratic Programming", Proceedings of IEEE, pp 1-6.

[3]. Catalao, J.S, Mariano, S.S, Mendes, V.F., Ferreira, L.M.(2007) "Profit-Based Unit Commitment with emission limitations: A Multi-objective approach", Proceedings of Power-Tech , pp 1417-1422.

[4]. Chang , G.W. ,Tsai, Y.D. ,Lai, C.Y. and Chung, J.S.(2002) "A practical mixed integer Linear Programming based approach for Unit Commitment", Proceedings of IEEE, pp 1-5.

[5]. Christober, C.,Rajan, A.,Mohan, M.R. and Manivannan, K.(2002) "Improved Genetic Algorithm Solution to Unit Commitment Problem" ,Proceedings of IEEE, pp 255-260.

[6]. Christober, C.,Rajan, A.,Mohan, M.R. and Manivannan, K.(2006) "Neural based Tabu Search Method for solving Unit Commitment Problem", Power system Management and Control , pp 180-185.

[7]. Christober, C. and Rajan, A., "An Evolutionary Programming based Simulated Annealing method for Unit Commitment problem with Cooling - Banking constraints", Proceedings of IEEE INDICON, pp 435-440, December 2004.

[8]. Fei, L. and Jinghua, L.(2009) "A solution to the Unit Commitment problem based on Local Search method" ,International Conference on Energy and Environment Technology, pp 51-56.

[9]. Ganguly, D., Sarkar, V. and Pal, J.(2004) "A new Genetic approach for solving the Unit Commitment problem ",Proceedings of POWERCON, Singapore, pp 542-547, November .

[10]. Gonzalez, J.G. and Barquin, J.(2000) "Self-Unit Commitment of thermal units in a competitive electricity market", Proceedings of IEEE, pp 2278-2283.

[11]. Iguchi, M. and Yamashiro, S.(2002) "An efficient scheduling method for weekly Hydro-Thermal Unit Commitment", Proceedings of IEEE TENCON, pp 1772-1777.

[12]. Im, T.S. and Ongsakul, W.(2003)"Ant Colony search algorithm for Unit Commitment" ,Proceedings of ICIT – Marivor , Slovenia, pp 72-77.

[13]. Navpreet Singh Tung et al "Unit Commitment Dynamics-An Introduction", International Journal of Computer Science & Information Technology Research Excellence , Vol. 2, Issue 1, pp 70-74,Jan - Feb 2012.

[14]. Navpreet Singh Tung et al "Unit Commitment in Power System-A Review", International Journal of Electrical and Power Engineering, Vo.6,Issue.1, pp: 51-57,2012.

[15]. Navpreet Singh Tung and Sandeep Chakravorty "Active Power Dispatch Planning using Differential Evolution" Journal of Industrial and Intelligent Information Vol. 2, No. 3,pp 200-204, September 2014. doi: 10.12720/jiii.2.3.200-204

[16]. Navpreet Singh Tung and Sandeep Chakravorty, "Active Power Dispatch Planning using Pattern Search," International Journal of Electrical Energy, Vol. 2, No. 3, pp. 216-220, September 2014. doi: 10.12720/ijoee.2.3.216-220.

[17]. M. Nirmla Devi et al "Modeling and Analysis of Neuro–Genetic Hybrid System on FPGA" Electronika IR Electrotechnika, 2009, No. 8 (96).

[18]. Abhishek Saxena et al "Neuro Genetic Hybrid Approach for Rainfall Forecasting" International Journal of Computer Science and Information Technologies, Vol. 5 (2) , 2014, 1291-1295.

[19]. Mrs.J Mary Anita et al "Solution of Unit Commitment Problem Using Shuffled Frog Leaping Algorithm" IOSR Journal of Electrical and Electronics Engineering (IOSRJEEE), Volume 1, Issue 4 (July-Aug. 2012), PP 09-26.