As per UGC guidelines an electronic bar code is provided to seure your paper

International Journal for Modern Trends in Science and Technology, 9(04): 391-395, 2023

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0904057
Available online at: http://www.ijmtst.com/vol9issue04.html

Optimal Load Dispatch using Teaching and Learning Based Optimization Algorithm

Ch.Ooha | V.Monika | P.Mahidhar | G.Eswar | K.Poorna Siva Sai Kumar

Department of Electrical and Electronics Engineering, Dr. YSR ANU College of Engineering and Technology, Guntur,India.

To Cite this Article
Ch.Ooha, V.Monika, P.Mahidhar, G.Eswar and K.Poorna Siva Sai Kumar. Optimal Load Dispatch using Teaching and Learning Based Optimization Algorithm. International Journal for Modern Trends in Science and Technology 2023, 9(04), pp. 391-395. https://doi.org/10.46501/IJMTST0904057

Article Info
Received: 19 March 2023; Accepted: 20 April 2023; Published: 23 April 2023.

ABSTRACT

We are all living in a modern world in which every human needs are fulfilled by electricity. We can't imagine our lives without electricity for even one day also, that much we are addicted to our modern lifestyle. When our needs grow simultaneously our generation of the electricityshould be high. We generate electricity mainly through Thermal(86%),Hydel(12.3%),Nuclear(10%),Wind(10%), and Geothermal, Tidal, Solar, Biomass for (3%). While installing those plants and distribute the electricity to various loads according to their demands, increases the "unit cost" . So we have to reduce that cost by using various methods, that is the main aim of this project. Economic Load Dispatch (ELD) means how the power demand distributes economically. There are several methods to reduce fuel cost . In which Conventional, Particle Swarm Optimization (PSO), Teaching – Learning based optimization(TLBO).Among those PSO ,TLBO gives better results as compared to conventional technique of using lambda iteration method. That's why we are using those techniques for three generator model and for higher generator model through Matlab Our Indian economic load dispatch is 15 min gap load forecasting.

KEYWORDS:ECONOMIC LOAD DISPATCH, OPTIMIZATION, COST FUNCTION

1. INTRODUCTION

With large interconnection of the electric networks, the energy crisis in the world and continuous rise in prices, it is very essential to reduce the running costs of electric energy. A saving in the operation of the power system brings about a significant reduction in the operating cost as well as in the quantity of fuel consumed. The main aim of modern electric power utilities is to provide high-quality reliable power supply to the consumers at the lowest possible cost while operating to meet the limits an constraints imposed on the generating units and environmental considerations. These constraints formulate the economic load dispatch (ELD) problem for finding the optimal combination of the output power of all the online generating units that minimizes the total fuel cost, while satisfying an equality constraintset of inequality constraints. Traditional algorithms like lambda iteration, base point participation factor, gradient method, and Newton method can solve this ELD problems effectively if and only if the fuel-cost curves of the generating units are piece-wise linear and monotonically increasing . Practically the input to output characteristics of the generating units are highly non-linear, non-smooth and discrete in nature owing to prohibited operating zones, ramp rate limits and multifuel effects. Thus, the resultant ELD becomes a challenging non-convex optimization problem, which is difficult to solve using the traditional methods. Methods like dynamic programming, genetic algorithm, evolutionary programming, artificial intelligence, and particle swarm optimization solve non- convex optimization problems efficiently and often achieve a fast and near global optimal solution. some drawbacks while selecting the parameters. It increases modifications and The proper tuning of the algorithm- specific parameters is a very crucial factor which affects the performance of the optimization algorithms. Considering this aspect, we have recently introduced the technique Teaching-Learning Based Optimization (TLBO) algorithm which does not require any algorithm specific control parameters. TLBO requires only common controlling parameters like population size and number of generations for its working. Thus, TLBO can be said as an algorithm-specific parameter-less algorithm.

STRUCTURE OF PAPER :

The paper is organized as follows: In Section 1, the introduction of the paper is provided along with the structure, important terms, objectives and overall description. In Section 2 we discuss economic load dispatch . In Section 3 we have the complete information about Teaching and learning based optimization technique . Section 4 shares information about Test system of 3 and 6 generating systemusing TLBO . Section 5 tells us about the methodology and the process AND Also shows result of the system . Section 6 tells us about the future scope and concludes the paper with acknowledgement and references.

OBJECTIVES

The main objective of economic load dispatch Using teaching and learning based algorithm aims to generate demanded energy with minimum cost. It dispatches the load among generators by decreasing fuel cost. Otherwise, thermal plants are used commonly in the world to generate energy and they cause to environment

2. RELATED WORK

1.ECONOMIC LOAD DISPATCH::

The economic load dispatch means the real and reactive power of the generator vary within the certain limits and fulfils the load demand with less fuel cost. The sizes of the electric power system are increasing rapidly to meet the energy requirement. So the number of power plants is connected in parallel to supply the system load by an interconnection of the power system. In the grid system, it becomes necessary to operate the plant units more economically.In Economic Load Dispatch, "load" means demand "dispatch" means distribution therefore "ELD" means distributing the load economically.It is a process of scheduling the required load demand among available generation units so that the overall cost of generation is minimizedThe factors influencing power generation at minimum cost are : operating efficiencies of generators fuel cost and transmission losses.The economic dispatch problem is concerned with finding how much power each unit should generate for a given demand, while minimizing the total operational costs, which are generally expressed in nonlinear form.

3. TEACHING AND LEARNING BASED OPTIMIZATION ALGORITHM

Teaching Learning Base Optimization is recommended by Rao and other colleagues based on Teacher and Learner Mechanism. TLBO is a meta heuristic population-based search algorithm like HSA, ANT Colony Optimization (ACO), Particle-swarm Optimization (PSO) and Artificial jBee colony (ABC). To resolve different optimization difficulties TLBO method is a simple mathematical model.

This paper talks about a new optimization algorithm called Teaching Learning Based Optimization (TLBO). According to TLBO algorithm, there are two ways for a leaning in gaining knowledge i.e., is

i. Due to teacher
ii. By interacting Among the learners

+

In this TLBO algorithm, the beginners called as population.

In TLBO, the deciding phase is the teacher phase and the solution is generated by it that is used for the learner's phase as inputs.

•TEACHING PHASE

Follower gains information from the guide and the mean outcome of class is expanded by guide by his skills. The main aim of the teacher is to increase the learner's knowledge and boost the percentage of exam clearing learners. All learners are not cleverness so, practically it is not possible. Consider,

Ti = Teacher at any iteration i Mi = Mean value

To more towards its own knowledge level, Ti makes the mean value Mi i.e., Ti chosen as Mnew.

Therefore, the best learner treated as teacher. The difference of current mean result of every subject and the equal result of the teacher for every subject is specified as, Difference = r*(Mnew-TFMi)

Here, TF=Teaching factor and it is specified as follows: TF=round*[1+round*(0.1) *{2-1}]

The existing solution is modified by this difference according to the following expression,
Xsol new=Xsol old +difference

•LEARNER PHASE

In learner phase, the teacher identified one intelligent and the knowledge of the learner is improved by sharing the knowledge with other learners. So, in this way both the learners are improving their knowledge. Then, compare the difference of mean value of two learners, at this stage better learner act as the teacher. The
learner phase is as follows,

Select two learners i ≠ j

Xsol new = Xsolold+r*(xi-xj) if f(xi)<f(xj)
Xsol new =Xsolold+r*(xj-xi) if f(xi)<f(xj)

4. IMPLEMENTATION OF TLBO:

STEP 1: Initialization of population.
STEP 2: Generating criterion of termination.
STEP 3: Govern the design variables mean value of each one.
STEP 4: Best solution is recognized and the variables are estimated.

STEP 5: Estimated variable values ae updated based on the available best solution using
Xsol new = Xsol old+ r*(Mnew - TFMi)

STEP 6: Check whether updated solution is better than current solution or not. If it is no rejects the updated solution. Continue with old solution.
STEP 7: If the updated solution beyond existing solution then we randomly select two set of solutions as Xi and Xj.
STEP 8: Two solutions are updated by considering Xi>Xj and Xj>Xi in two different ways.
STEP 9: Now compare the two different cases. If any case interrupts the limits rejected the solution whether the both solutions satisfy all the limits then consider the best solution among them.
STEP 10: Check whether the solution satisfies all the constraints or not.
STEP 11: If the solution does not satisfies then move to mean difference of design variables STEP 3.
STEP 12: Otherwise consider it as the global best solution.

In this application of Teaching Learning Based Optimization based ELD solution, all the cost curve function data is read, calculated the mean value of all generators based on the population used in this algorithm.

In this application of TLBO, the students are considered as economic load dispatch problem solutions. Here subject is considered as different constraints. The student able to satisfy minimum levels, which get the finest among the remaining students, then that student is treated as best and in this algorithm application the student is considered as the best solutions of ELD. The important aim of ELD is to minimize the cost function. So, from the obtainable values, the local minimum value is considered as started from this point. Once the teacher phase started, the knowledge levels of the learners are improved by the teacher (whether the available solution is satisfied or not when it is tested with all the constraints) and the new knowledge level (new solution) is applied by equation

Xsol new = Xsol old+ r*(Mnew - TFMi)

The new solution is applied from the teacher phase then all the possible solutions are applied by ending of teacher phase. Then the learners phase begins here, all the learners are interacting with each other (solutions that are available from teacher phase are compared).

When the maximum iterations are reached by the algorithm, the best learners become the teacher (among all the available solutions only one solution is treated as the best one like the global best solution by all the constraints satisfaction and minimum cost value comparision.

The TLBO algorithm is tested on the standard test system IEEE-30 bus system which consists of six number of generators in various locations in the network, each generator has its own cost coefficients and cost curve [9], [10], and [13]. The generator active power limitations are considered here as shown in table 1 along with price coefficients [3], [5]. #indicates the generator is in the working condition; sometimes generators are kept in banking mode and shunt-down when load demand is comparative less with the generated power as per historical data and load predications.

5. TEST SYSTEM

The Effectiveness of the proposed Algorithm is tested on two test power system of 3 & 6 generating system[IEEE 30 BUS SYSTEM].

CASE I: 3 UNIT SYSTEM:

The system contains 3 thermal unit ,the data given below

$F_1 = 0.00156\, P_1^2 + 7.92\, P_1 + 561$ R/h

$F2 = .00194\, P_2^2 + 7.85\, P_2 + 310$ R/h

$F3 = 0.00482 P_3^2 + 7.97\, P_3 + 78$ R/h

Where 'R' is the arbitrary money value.

The unit operating ranges i.e the minimum and maximum limits of the genrators given below

$100\ MW \leq P_1 \leq 600\ MW$;

$100\ MW \leq P_2 \leq 400\ MW$;

$50\ MW \leq P_3 \leq 200\ MW$;

CASE II : 6 UNIT SYSTEM:

The system contains 6 thermal unit ,the data given below The system tested consists of six-thermal units [25]. The cost coefficients of the system are given below in R/h.

$F_1 = 0.15240 P_1^2 + 38.53973\, P_1 + 756.79886$ R/h

$F_2 = 0.10587 P_2^2 + 46.15916 P_2 + 451.32513$ R/h

$F_3 = 0.02803 P_3^2 + 40.39655\, P_3 + 1049.9977$ R/h

$F_4 = 0.03546 P_4^2 + 38.30553\, P_4 + 1243.5311$ R/h

$F_5 = 0.02111 P_5^2 + 36.32782\, P_5 + 1658.5596$R/h

$F_6 = 0.01799 P_6^2 + 38.27041\, P_6 + 1356.6592$ R/h

The unit operating ranges i.e the minimum and maximum limits of the generators are given below

$10\ MW \leq P1 \leq 125\ MW$;

$10\ MW \leq P_2 \leq 150\ MW$;

$35\ MW \leq P3 \leq 225\ MW$;

$35\ MW \leq P_4 \leq 210\ MW$;

$130\ MW \leq P_5 \leq 325\ MW$;

$125\ MW \leq P_6 \leq 315\ MW$;

6. RESULT:

TABLE 1:

P.D	PG1	PG2	PG3	PG4	PG5	PG6	P.L	F.C
700	35.56	16.89	40.706	143.87	236.75	260.75	20.01	3728 8.4
800	38.24	27.89	41.09	153.857	240.94	288.04	25.04	4245 8.7
900	40.645	31.875	43.98	164.789	250.98	296.89	31.09	4567 8.08

Table 1-shows the results of the 6 unit systemhaving fuel cost ,power loss for different load demand.

CURVES FOR TLBO:

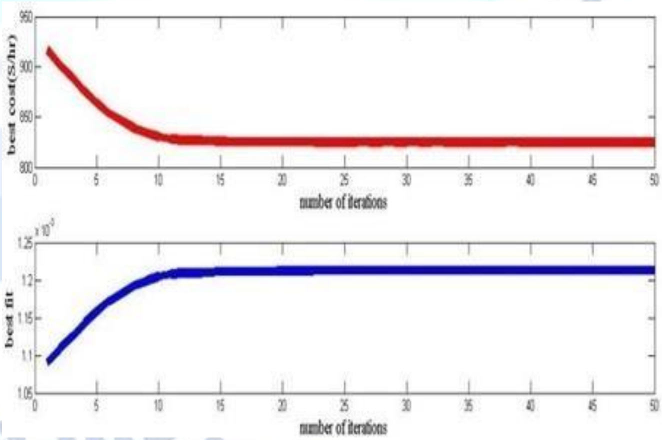

FIG-1. curve between fuel cost and no.of iterations for 283.5Mw load demand

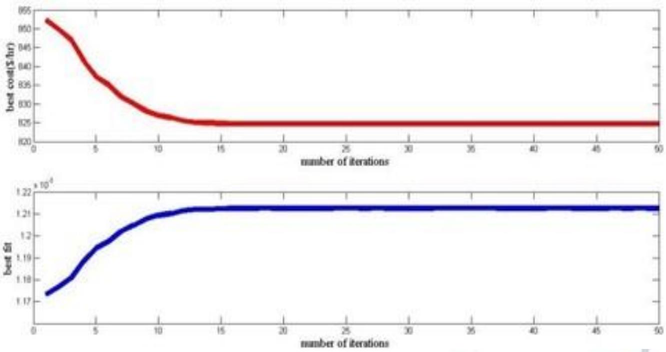

FIG-2. curve between fuel cost and no.of iterations for 300Mw load demand

7. FUTURE SCOPE AND CONCLUSION

TLBO method was employed to solve the ELD problem for two cases one three unit system and another six unit system. The algorithm showed superior features including high quality solution, stable convergence characteristics. The solution was close to that of the PSO method but tends to give better solution in case of higher order systems. The comparison of results for the test cases of three unit and six unit system clearly shows that the proposed method is indeed capable of obtaining higher quality solution efficiently for higher degree ELD problems. The convergence characteristic of the proposed algorithm 5 International Journal for Modern Trends in Science and Technology for the three unit system and six unit system is plotted. The convergence tends to be improving as the system complexity increases. Thus solution for higher order systems can be obtained in much less time duration than the PSO method. The reliability of the proposed algorithm for different runs of the program is pretty good, which shows that irrespective of the run of the program it is capable of obtaining same result for the problem. Many non-linear characteristics of the generators can be handled efficiently by the method. The PSO technique employed uses a inertia weight factor for faster convergence. The inertia weight is taken as a dynamically decreasing value from Wmax to Wmin at and beyond ITER max. Theconvergence characteristic of the method for varying ITERmax was analyzed..In PSO we are usually initialize constants but in some cases it may leads to divergence of output charactistics.In order to overcome this problem ,we have tried algorithm called TLBO.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

REFERENCES

[1] Power system Analysis –Hadi Sadat
[2] Power system Analysis by Nagrath and Kothari
[3] Paper journal-M. Anuj Gargeya, Sai Praneeth
[4] Pabba(GEETHAM UNIVERSITY,HYDERABAD)
[5] Wadhwa, C.L(2009).Electrical Power System.New Age publishers.
[6] Swarup K.S.,Rohith Kumar P.,A new evolutionary computation techniques for economic dispatch with security constraints";Electrical Power and Energy system 28(2006) pp273-283