A New Metaheuristic Inflation Data for Real & Reactive Power Generator Restraints

S. Parthiban, P. Karthikeyan, P. Poongodi and P. Balamurugan

Abstract--- *To enhance the real and reactive power of the generator vary with in the certain limit and fulfills the load demand with less fuel cost, such as power balance. A divergent of the basic PSO method, is determined by incorporating chaotic sequences to enhance its consummanation. Two different example problems comprising 6 and 15 generating units are solved to demonstrate the effectiveness of the specific task. The results of CPSO are compared with GA and PSO techniques. The generation costs is lower, New method can result in great economic effect. For ELD problems, the CPSO method is more feasible and effective alternative approaches than the traditional particle swarm optimization algorithm.*

Keywords--- *Economic Dispatch, Metaheuristic Methods, Chaotic PSO Algorithm, Power Generation Dispatch, Chaotic Sequences.*

I. INTRODUCTION

ELD problems have complex and nonlinear characteristics with equality and inequality constraints. The purpose of ELD is to determine the optimal combination of power generations that minimizes the total generation cost while satisfying the constraints. In recent years, a lot of researches have been done and various mathematical programming optimization methods have been employed for solving ELD problems.

The prevalent mainstream techniquess bring in the rectilinear programming algorithm [1], quadratic programming algorithm [2], non-linear programming algorithm [3], dynamic programming algorithm [4,5], Lagrangian relaxation algorithm [6,7] etc. mean while individual have some defects: this should create huge blunders to use the rectilinear or linear programming algorithm to regulate the model of ED; for the boxlike programming and patchy programming algorithms, the empiric function should be looped and differentiable. This proposed method is combine both the best or good particals in the metaheuristic optimization algorithm.

Now a days most probably development of artificial intelligence technology used to solve the ELD dilemma, such as the genetic algorithm (GA) [8–10], improved GA [11], neural networks [12,13], pretended hardening and tabu search techniques [14].To find the solution for the ELD problem of units with valve point defects efficiently, a composite proposal methodology combining sequential quadratic program and partial swarm optimization techniques. This is the method has been proposed for current scenario for economic load dispatch.

CPSO approach for rectifying the ELD dilemma in an analysis of power system have been imported. In general real or practical power system operation, the current techniquess calculated the nonlinear characteristics of a

S. Parthiban, Department of Electrical and Electronics Engineering, Nandha College of Technology, Erode. E-mail: parthiba.eee@gmail.com

P. Karthikeyan, Department of Electrical and Electronics Engineering, Nandha College of Technology, Erode. E-mail: carthikn@gmail.com

P. Poongodi, Department of Electrical and Electronics Engineering, Nandha College of Technology, Erode. E-mail: ppoonga17@gmail.com

P. Balamurugan, Department of Electrical and Electronics Engineering, Nandha College of Technology, Erode. E-mail: bala1983nandha@gmail.com

Received: 16 Sept 2019 | Revised: 18 Oct 2019 | Accepted: 15 Nov 2019

particular generator for such as been ramp rate controls or limitss and restricted in the area of functional area. It demonstrated for two power systems. The performance of the CPSO approach based ELD problem is compared with GA and PSO in the aspects of solution quality and computation efficiency. For the ELD problem, the final outcomes of simulating the software shown that the proposed method have best confluence effects and can attain the minimum generation cost than the existing methods like GA and PSO.

II. ELD FORMULATION

The empiric of ELD complication is to catch an optimal power generation schedule while derogate fuel cost and also satisfying various power system operating constraints.

III. CHAOTIC PARTICLE SWARM OPTIMIZATION

A. General PSO Technique

Particle swarm optimization (PSO) is one of the best empirical optimization algorithms for swarm of particles. The clean PSO repose of a mass of particles propelling in the dimensions of D for possible solution in the occur of dilemma. Individual particle implants the applicable observation concerning the decision variables D and is connected with a strongest that producing an evidence of it is consideration in the primary or objective particle of space. Individual particle has i has a position X i = [X i, 1, X i, 2 ….X i, D] and a flight velocity V i = [V i, 1, V i, 2……V i, D] . To boot, a swarm comprise every particle i own good or best position pgood i = (pgood i, 1, pgood i,2, ……., pgood i, D) found so far and a global good particle position ggood = (ggood i, ggood i, ……., ggood D) determined for entire all the particles in the swarm so far.

The normal pratical usage of standard PSO algorithm can be defined as for the calculation of expression,

$$V_{i,d}^{k+1} = W \times V_{i,d}^{k} + C_1 \times rand_1 \times (pgood_{i,d}^{k} - X_{i,d}^{k}) + C_2 \times rand_2 \times (ggood_{d}^{k} - X_{i,d}^{k}) \quad (1)$$

$$X_{i,d}^{k+1} = X_{i,d}^{k} + V_{i,d}^{k+1} \quad (2)$$

$$i = 1, 2 \ldots\ldots\ldots, n;\ d = 1, 2 \ldots\ldots\ldots\ldots, D$$

Where W is a factor of weight; c1 is a apprehension acceleration factor; c2 is a amusing acceleration factor; rand1 and rand2 are two mediate or medium accurate numbers for linerly appropriated between the values of 0 and 1; Vi, d k is the orginal change of velocity of particular particle i at the rate of iteration k; X i, d k is the dth position of dimension each and every particle i at iteration k; pgood i, dk is the dth dimension for the real good position of particle i until iteration k; ggood dk is the dth dimension of the good particle in the swarm at iteration k.

The t variation in time for weighting function was normally imported in for which W is given by

$$W = W\,max - (W\,max - W\,min) \times Iter / Iter\,max \quad (3)$$

Here W min and W max are finall and initial weight of the particle accordingly, Thus the parameter W regulates the trade-off between the global and the local exploration abilities of the swarm. A huge inertia weight smooth expedition, while a small one tends to smooth profiteering.

B. Proposed CPSO Technique

One of the simplest dynamic systems evidencing chaotic behavior is the iterator called the logistic map, whose equation is described as follows:

$$f_k=\mu.f_{k-1}.(1-f_{k-1}) \quad (4)$$

where μ is a control parameter and has the real value between [0,4]. In this paper, the new weight is determined as multiplying Eq. (5) by Eq. (6) in order to increase the global searching capability as follows:

$$W_{new} = W \times f \quad (5)$$

This method compares scheme statistics for 6-units and also for various values are evaluated compare to conventional methods. This paper deals with better solution for particle swarm optimization techniques

Whereas, the conventional weight reduces monotonously from Wmax to Wmin, the weight reduces and oscillates continuously for total iteration as shown in Fig. 1.

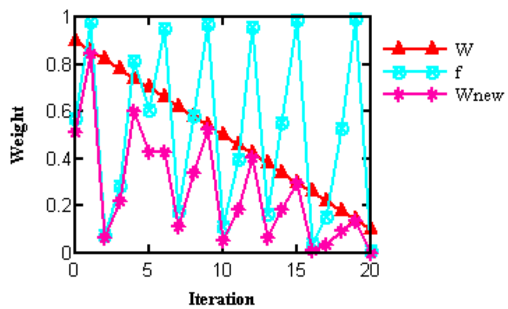

Fig. 1: Correlation of weights by each approach

IV. CPSO PROCESS FOR ELD PROBLEM

CPSO method to solve ELD problems with restraint is established to get a great quality solution. The CPSO method is used to determine the best generation power of every unit, thus reducing the total generation cost. The proposed CPSO design not only enrich the definitive PSO design but also fasten new plan to find the improved result than PSO design by affix the chaotic continuance for weight parameter.

V chronology

To confirm the capability of the agreed ELD trouble using CPSO method, two analysis including 6- unit scheme and a 15-unit scheme are selected. In these method, the ramp rate limits and prohibited zones of the units are taken into account in the practicably. The results by CPSO method are analogy with GA and PSO method. The plans are implemented in Matlab.Test system 1

A. Evaluation structure 1

The proffer structure is enforced on a small test structure consisting of 6 generating units with a capacity demand of 1263 MW. The structure data of this method is mentioned in Table 1. Table 3 illustrate the best propagation schedule and total propagation outlay obtained by GA, PSO and CPSO access. It is derive from the Table that the proffer CPSO advent equip lesser fuel cost than the other advent. Moreover, the probality results of the minimum, maximum and mean fuel cost acquire by various methods are compared. From Table 4, it is evident that the proffer CPSO advent defeat the other accession.

Table 1: Scheme statistics for 6-units

Unit(i)	Pi^{min}	Pi^{max}	**a_i**	**b_i**	**c_i**	P^{UR}	P^{DR}	Pi^{prev}	**POZs**
1	100.02	500.02	240.02	7.02	0.0071	80.02	120.01	440.02	[210.02,240.01],[350.01,380.04]
2	50.04	200.04	200.04	10.03	0.0096	50.04	90.03	170.04	[90.04,110.01],[140.04,160.03]
3	80.01	300.04	220.02	8.54	0.0091	65.03	100.04	200.02	[150.04,170.03],[210.02,240.04]
4	50.03	150.03	200.04	11.02	0.0091	50.02	90.03	150.03	[80.03,90.04],[110.04,120.04]
5	50.02	200.02	220.04	10.6	0.0081	50.04	90.02	190.04	[90.04,110.02],[140.03,150.04]
6	50.04	120.04	190.01	12.01	0.0076	50.03	90.04	110.02	[75.02,85.04],[100.02,105.04]

Table 2: Scheme statistics for 15-units

Unit(i)	Pi^{min}	Pi^{max}	**a_i**	**b_i**	**c_i**	P^{UR}	P^{DR}	Pi^{prev}	**POZs**
1	150.04	455.8	671.7	10.2	0.000298	80.02	120.04	400.4	
2	150.03	455.8	574.4	10.3	0.000184	80.02	120.02	300.2	[185.02,225.04],[305.01,335.02],[420.01,450.4]
3	20.01	130.8	374.8	8.89	0.001127	130.04	130.01	105.4	
4	20.02	130.8	374.8	8.89	0.001126	130.04	130.01	100.1	
5	150.04	470.8	461.2	10.5	0.000204	80.04	120.04	90.2	[180.4,200.4],[305.4,335.4],[390.3,420.3]
6	135.04	460.7	630.4	10.7	0.000302	80.07	120.03	400.4	[230.4,255.4],[365.2,395.4],[430.2,455.4]
7	135.02	465.8	548.7	9.75	0.000365	80.07	120.03	350.1	
8	60.05	300.8	227.4	11.4	0.000337	65.06	100.01	95.4	
9	25.04	162.7	173.9	11.7	0.000806	60.04	100.01	105.1	
10	25.7	160.8	175.6	10.8	0.0012033	60.07	100.01	110.4	
11	20.6	80.7	186.4	10.6	0.0035867	80.07	80.05	60.3	
12	20.8	80.8	230.7	9.95	0.0055133	80.08	80.05	40.2	[30.02,40.04],[55.05,65.02]
13	25.4	85.7	225.9	13.2	0.0003713	80.04	80.05	30.02	
14	15.56	55.6	309.4	12.4	0.0019291	55.04	55.1	20.01	
15	15.4	55.6	323.4	12.6	0.0044477	55.04	55.1	20.11	

Table 3: Good solution for 6-unit system

Unit (MW)	**GA**	**PSO**	**CPSO**
P_1	473.8066	447.5970	434.3350
P_2	178.7363	173.4221	173.4276
P_3	261.2089	262.4745	273.2358
P_4	133.2826	138.0594	129.0132
P_5	150.9039	164.4761	178.6051
P_6	75.1812	86.1280	86.7625
P_L	13.1217	13.9584	13.9562
Minimum cost ($/hr)	15,458	15,454	15,448

Table 4: Results attain by various methods for 6-unit system

Compared items	**GA**	**PSO**	**CPSO**
Max. cost	15525	15493	15491
Min. cost	15,458	15,451	15,448
Mean cost	15468	15456	15448
CPU time (sec)	41.88	14.88	17.24

Table 5: Good solution for 15-unit system

Unit (MW)	GA	PSO	CPSO
P_1	415.31	439.12	454.99
P_2	359.72	407.97	380
P_3	104.42	119.63	129.99
P_4	74.98	129.99	129.99
P_5	380.28	151.07	169.568
P_6	426.79	459.99	460
P_7	341.32	425.56	429.98
P_8	124.79	98.56	78.1358
P_9	133.14	113.49	52.374
P_{10}	89.26	101.11	157.564
P_{11}	60.06	33.91	79.92
P_{12}	50.0	79.96	79.906
P_{13}	38.77	25.0	25.633
P_{14}	41.94	41.41	16.539
P_{15}	22.64	35.61	15.3854
P_L	38.2782	32.4306	31.964
Minimum cost ($/hr)	33113	32858	32766

Table 6: Results attain by various methods for 15-unit system

Compared items	GA	PSO	CPSO
Max. cost	33337	33339	33324
Min. cost	33115	32858	32766
Mean cost	33228	33039	33028
CPU time (sec)	49.34	26.59	28.36

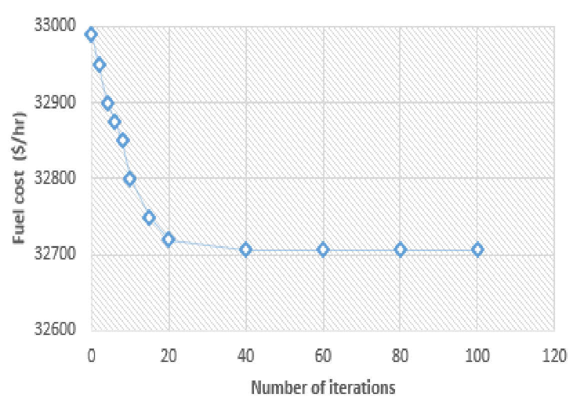

Fig. 2: Concurrence tendency of CPSO for 15-unit system

B. Evaluation structure 2

In system 2 CPSO algorithm is adapted on a huge test system reposing of the 15 generating units. The transmission losses and crooked operating zone are examined. The total load demand of the system is 2634 MW. The generator consents, sufficiency cap ramp rate limits and barred zones are given in Table 4. The optimal generation schedule, cost and power loss obtained by the proposed CPSO approach are compared with GA and PSO approaches in Table 5.Besides, the statistical outcomes of 50 self reliant trials for the 15-unit system are tabulated in

Table 6. The provisional outcomes certainly show that the expected CPSO access is proficient of generating bigger quality solution compare to other evolutionary methods.

The concurrence aspect of CPSO is portraying in Fig. 2. It is seen from Fig. that CPSO concurrence more quickly. It is cleared from Tables 2 and 5 that the cost found from CPSO is the lowest among the GA and PSO approaches. As from Tables 3 and 6, the average CPU time of the CPSO approach is more than those of the PSO in both the test systems. This approach because the CPSO technique involves most chaotic local search procedures in all generation.

V. CONCLUSIONS

The current method has been enforced in two power systems and related with GA and PSO methods. Lot of nonlinear characteristics of the generator such as ramp rate limits and restricted zones are taken in the part of practical generator operation in the proposed CPSO method. Relating with GA and PSO methods, the fuel economy of the generator found by CPSO method is minimized. The CPSO concurrences faster. The cost found from CPSO is the minimum among the GA and PSO techniques. The outcomes seen that the current methods are useful and efficiency for ELD problems, which are huge scale constrained nonlinear optimization problems.

REFERENCES

[1] Jabr Rabih A, Coonick Alun H, Cory Brian J. A homogeneous linear programming algorithm for the security constrained economic dispatch problem. *IEEE Transactions on Power Systems* 2000;15(3):930–7.

[2] Fan JiYuan, Zhang Lan. Real-time economic dispatch with line flow and emission constraints using quadratic programming. *IEEE Transactions on Power Systems* 1998;13(2):320–6.

[3] Nanda J, Hari Lakshman, Kothari ML. Economic emission load dispatch with line flow constraints using a classical technique. *IEE Proc Generat Transm Distrib* 1994;141(1):1–10.

[4] Liang Zi Xiong, Glover Duncan. A zoom feature for a dynamic programming solution to economic dispatch including transmission losses. *IEEE Transactions on Power Systems* 1992;7(2):544–7.

[5] Barcelo Wayne R, Rastgoufard Parviz. Dynamic economic dispatch using the extended security constrained economic dispatch algorithm. *IEEE Transactions on Power Systems* 1997;12(2):961–7.

[6] Lee FN, Breipohl AM. Reserve constrained economic dispatch with prohibited operating zones. *IEEE Transactions on Power Systems* 1993;8(1):246–9.

[7] El-Keib AA, Ma H, Hart JL. Environmentally constrained economic dispatch using the Lagrangian relaxation method. *IEEE Transactions on Power Systems* 1994;9(4):1723–7.

[8] Walters David C, Sheble Gerald B. Genetic algorithm solution of economic dispatch with valve point loading. *IEEE Transactions on Power Systems* 1993;8(3):1325–8.

[9] Bakirtzis A, Petridis V, Kazarlis S. Genetic algorithm solution to the economic dispatch problem. *IEE Proceedings on Generation, Transmission and Distribution* 1994;141(4):377–82.

[10] [Chen Po Hung, Chang Hong Chan. Large-scale economic dispatch by genetic algorithm. *IEEE Transactions on Power Systems* 1995;10(4):1919–26.

[11] Sheble Gerald B, Brittig Kristin. Refined genetic algorithm-economic dispatch example. *IEEE Transactions on Power Systems* 1995;10(1):117–8.

[12] Su Ching Tzong, Chiou Gwo Jen. A fast-computation Hopfield method to economic dispatch of power systems. *IEEE Transactions on Power Systems* 1997;12(4):1759–64.

[13] Yalcinoz T, Short MJ. Neural networks approach for solving economic dispatch problem with transmission capacity constraints. *IEEE Transactions on Power Systems* 1998;13(2):307–13.

[14] Lin Whei Min, Cheng Fu Sheng, Tsay Ming Tong. Nonconvex economic dispatch by integrated artificial intelligence. *IEEE Transactions on Power Systems* 2001;16(2):307–11.

[15] Eberhart Russell C, Kennedy James. Particle swarm optimization. *IEEE International Conference on Neural Networks* 1995; vol. IV:1942–7.

[16] Nandagopal S., Arunachalam V.P., Karthik S."A novel approach for inter-transaction association rule mining, *Journal of Applied Sciences Research* VOL, 8, Issue 7, 2012.
[17] Kannan R., Selvambikai M., Jeena Rajathy I., Ananthi S. Rasayan, A study on structural analysis of electroplated Nano crystalline nickel based thin films, *Journal of Chemistry,* Vol 10, issue 4, 2017.
[18] Arunvivek G.K., Maheswaran G., Senthil Kumar S., Senthilkumar M., Bragadeeswaran T. Experimental study on influence of recycled fresh concrete waste coarse aggregate on properties of concrete. *International Journal of Applied Engineering Research*, Vol 10, issue 11, 2015
[19] Krishna S.K., Sathya M. Usage of nanoparticle as adsorbent in adsorption process. *A review International Journal of Applied Chemistry,* vol 11, Issue 2, 2015.
[20] Sudha S., Manimegalai B., Thirumoorthy P. A study on routing approach for in-network aggregation in wireless sensor networks, *International Conference on Computer Communication and Informatics: Ushering in Technologies of Tomorrow, Today, ICCCI* 2014.
[21] Satheesh A., Jeyageetha V. Improving power system stability with facts controller using certain intelligent techniques, *International Journal of Applied Engineering Research*, Vol 9, no 23, 2014.
[22] Ashok V., Kumar N, Determination of blood glucose concentration by using wavelet transform and neural networks, *Iranian Journal of Medical Sciences,* Vol 38, Issue 1, 2013.
[23] Somasundaram K., Saritha S., Ramesh K, Enhancement of network lifetime by improving the leach protocol for large scale WSN, *Indian Journal of Science and Technology,* Vol 9, Issue 16, 2016.
[24] Jayavel S., Arumugam S., Singh B., Pandey P., Giri A., Sharma A. Use of Artificial Intelligence in automation of sequential steps of software development / production, *Journal of Theoretical and Applied Information Technology,* Vol 57, Issue 3, 2013.
[25] Ramesh Kumar K.A., Balamurugan K., Gnanaraj D., Ilangovan S, Investigations on the effect of flyash on the SiC reinforced aluminium metal matrix composites, *Advanced Composites Letters,* Vol 23, Issue 3, 2014.
[26] Suresh V.M., Karthikeswaran D., Sudha V.M., Murali Chandraseker D, Web server load balancing using SSL back-end forwarding method. *IEEE-International Conference on Advances in Engineering, Science and Management*, *ICAESM-2012*, 2012.
[27] Karthikeswaran D., Sudha V.M., Suresh V.M., Javed Sultan A, A pattern based framework for privacy preservation through association rule mining, *IEEE-International Conference on Advances in Engineering, Science and Management, ICAESM-2012*, 2012.
[28] Senthil J., Arumugam S., Shah P, Real time automatic code generation using generative programming paradigm, *European Journal of Scientific Research,* vol. 78, issue 4, 2012.
[29] Vijayakumar J., Arumugam S, Certain investigations on foot rot disease for betelvine plants using digital imaging technique, *Proceedings - 2013 International Conference on Emerging Trends in Communication, Control, Signal Processing and Computing Applications, IEEE-C2SPCA*", 2013.
[30] Vijayakumar J., Arumugam S. Odium piperis fungus identification for piper betel plants using digital image processing, *Journal of Theoretical and Applied Information Technology,* vol 60, issue 2, 2014.
[31] Manchula A., Arumugam S, Face and fingerprint biometric fusion: Multimodal feature template matching algorithm, *International Journal of Applied Engineering Research,* vol 9, issue 22, 2014.
[32] Ramesh Kumar K.A., Balamurugan K., Arungalai Vendan S., Bensam Raj J, Investigations on thermal properties, stress and deformation of Al/SiC metal matrix composite based on finite element method. Carbon - Science and Technology, Vol 6, Issue 3, 2014.
[33] Kanchana A., Arumugam S, Palm print texture recognition using connected-section morphological segmentation, *Asian Journal of Information Technology* Vol 6, Issue 3, 2014.
[34] Padmapriya R., Thangavelu P, Characterization of nearly open sets using fuzzy sets, *Global Journal of Pure and Applied Mathematics,* vol 11, issue 1, 2015.
[35] P.B. Narandiran, T. Bragadeeswaran, M. Kamalakannan, V. Aravind, Manufacture of Flyash Brick Using Steel Slag and Tapioca Powder. *Jour of Adv Research in Dynamical & Control Systems*, Vol. 10, No. 12, 2018, 527-532
[36] R. Girimurugan*, N. Senniangiri, K. Adithya, B. Velliyangiri, Mechanical Behaviour of Coconut Shell Powder Granule Reinforced Epoxy Resin Matrix Bio Composites, *Jour of Adv Research in Dynamical & Control Systems,* Vol. 10, No. 12, 2018, 533-541.