Real Power Loss Reduction by Cinnamon ibon Search Optimization Algorithm

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Abstract

In this paper Cinnamon ibon Search Optimization Algorithm (CSOA) is used for solving the power loss lessening problem. Key objectives of the paper are Real power Loss reduction, Voltage stability enhancement and minimization of Voltage deviation. Searching and scavenging behavior of Cinnamon ibon has been imitated to model the algorithm. Cinnamon ibon birds which are in supremacy of the group are trustworthy to be hunted by predators and dependably attempt to achieve a improved position and the Cinnamon ibon ones that are positioned in the inner of the population, drive adjacent to the nearer populations to dodge the threat of being confronted. The systematic model of the Cinnamon ibon search Algorithm originates with an arbitrary individual of Cinnamon ibon. The Cinnamon ibon search algorithm entities show the position of the Cinnamon ibon. Besides, the Cinnamon ibon bird is supple in using the cooperating plans and it alternates between the fabricator and the cadger. Successively the Cinnamon ibon identifies the predator position; then they charm the others by tweeting signs. The cadgers would be focussed to the imperilled regions by fabricators once the fear cost is more than the defence threshold. Likewise, the subterfuge of both the cadger and the fabricator is commonly used by Cinnamon ibon. The dispersion of the Cinnamon ibon

location in the solution area is capricious. An impulsive drive approach was applied when dispossession of any adjacent Cinnamon ibon in the purlieu of the present population. This style diminishes the convergence tendency and decreases the convergence inexorableness grounded on the controlled sum of iterations. Authenticity of the Cinnamon ibon Search Optimization Algorithm (CSOA) is corroborated in IEEE 30 bus system (with and devoid of L-index). Genuine power loss lessening is attained. Proportion of actual power loss lessening is amplified.

Keywords: Optimal reactive power, transmission loss, Cinnamon ibon.

1 Introduction

In power system lessening of factual power loss is a noteworthyaspect. Numerous mathematical procedures [1–6] and evolutionary approaches [9–16] are applied for solving Real power loss Reduction problem. Lee [1] has done the work on Fuel-cost minimization for both real and reactive-power dispatches. Deeb [2] proposed an efficient technique for reactive power dispatch using a revised linear programming approach. Bjelogrlic et al. [3] had done research on application of Newton's optimal power flow in reactive power control. Granville [4] solved optimal reactive dispatch through interior point methods. Grudinin [5] solved Reactive power optimization using successive quadratic programming method. Khan et al. [6] applied Distributed control algorithm for optimal reactive power control in power grids. Sahli et al. [10] applied Hybrid PSO-Tabu search for the optimal reactive power dispatch problem. Mouassa et al. [11] applied Ant lion optimizer for solving optimal reactive power dispatch problem in power systems. Mandal et al. [12] solved Optimal reactive power dispatch by quasi-oppositional teaching learning based optimization. Khazali et al. [13] solved Optimal reactive power dispatch based on harmony search algorithm. Tran et al. [14] Finding optimal reactive power dispatch solutions by using a novel improved stochastic fractal search optimization algorithm. Polprasert et al. [15] solved optimal reactive power dispatch using improved pseudo-gradient search particle swarm optimization. Thanh et al. [16] optimal Reactive Power Flow for Large-Scale Power Systems Using an Effective Metaheuristic Algorithm. Mahaletchumi Morgan, et al. [17] did Benchmark Studies on Optimal Reactive Power Dispatch (ORPD) Based Multi-objective Evolutionary Programming (MOEP) Using Mutation Based on Adaptive Mutation Adapter (AMO) and Polynomial Mutation Operator (PMO). Rebecca et al. [18] used Ant Lion Optimizer

for Optimal Reactive Power Dispatch Solution. Anbarasan et al. [19] solved Optimal reactive power dispatch problem solved by symbiotic organism search algorithm. Lenin K [26–29] solved the problem by using Greenland wolf, Acridoidea stirred artificial bee colony algorithm, Amplified black hole algorithm, Augmented Monkey algorithm. Aneke, et al. [30] solved Reduction of Power system losses in Transmission Network using Optimisaion Method. Yet many approaches failed to reach the global optimal solution. In this paper Cinnamon ibon Search Optimization Algorithm (CSOA)is applied to solve be hunted the Factual power loss lessening problem. Cinnamon ibon are birds that live in different climatic situations. Two categories of Cinnamon ibon are specified as fabricator and the cadger. The fabricator pursuit for the food possessions and the cadger is nurtured by the fabricator. The Cinnamon ibon birds in the dominance of the group are reliable toby stalkers and unfailingly endeavour to achieve an improved position. Cinnamon ibon ones that are positioned in the inner of the population, drive are adjacent to the nearer populations to dodge the threat of being antagonised. The methodical model of the Cinnamon ibon search Algorithm creates with an illogical individual of Cinnamon ibon. The fabricator Cinnamon ibon incorporates a superior level of energy filling, and Scavenging regions are distributed for the cadgers by them. The fabricators must discover the regions with fine (copious) food springs. Cadgers will be engaged to the threatened areas by fabricators, when the fear cost is more than the defence threshold. The complete population can be a fabricator by distinguishing virtuous food springs, seeing that the cadgers and fabricators' figures are stable. Cinnamon ibon populations with supplementary energy are assumed to be the fabricator. To get food and upper energy, certain hungry cadgers drive close to other locations. The cadgers trail the fabricator with an enhanced location of food springs. Concomitantly, certain cadgers attempt repeatedly to facsimile the fabricators activities and challenge for the food to enlarge the degree of the predation. The Cinnamon ibon Search Optimization Algorithm (CSOA) is a competingprocess that the populations with suitable price values guaranteeadditional prospect to find food in the solution region. A capricious drive approach was applied when deprived of any adjoining Cinnamon ibon in the locality of the existing population. This bravura decreases the convergence propensity and shrinkage the convergence unavoidability grounded on the meticulous sum of iterations. Sagacity ofthe Cinnamon ibon Search Optimization Algorithm (CSOA) is confirmed by corroborated in IEEE 30 bus system (with and devoid of L-index). Factual power loss lessening is attained. Proportion of factual power loss reduction is intensified.

2 Problem Formulation

Objective function of the problem is mathematically defined in general mode by,

$$Minimization \tilde{F}(\overline{x}, \overline{y}) \tag{1}$$

Subject to

$$E(\overline{x}, \overline{y}) = 0 \tag{2}$$

$$I(\overline{x}, \overline{y}) = 0 \tag{3}$$

Minimization of the Objective function is the key and it defined by "F". Both E and I indicate the control and dependent variables. "x" consist of control variables which are reactive power compensators (Q_c), dynamic tap setting of transformers – dynamic (T), level of the voltage in the generation units (V_g).

$$x = [VG_1, \ldots, VG_{Ng}; QC_1, \ldots, QC_{Nc}; T_1, \ldots, T_{N_T}] \tag{4}$$

"y" consist of dependent variables which has slack generator PG_{slack}, level of voltage on transmission lines V_L, generation units reactive power Q_G, apparent power S_L.

$$y = [PG_{slack}; VL_1, \ldots, VL_{N_{Load}}; QG_1, \ldots, QG_{Ng}; SL_1, \ldots, SL_{N_T}] \tag{5}$$

The fitness function (F_1) is defined to reduce the power loss (MW) in the system is written as,

$$F_1 = P_{Min} = Min \left[\sum_m^{NTL} G_m[V_i^2 + V_j^2 - 2 * V_i V_j cos \emptyset_{ij}] \right] \tag{6}$$

Number of transmission line indicated by "NTL", conductance of the transmission line between the ith and jth buses, phase angle between buses i and j is indicated by $\emptyset_{ij}$.

Minimization of Voltage deviation fitness function (F_2) is given by,

$$F_2 = Min \left[\sum_{i=1}^{N_{LB}} |V_{Lk} - V_{Lk}^{desired}|^2 + \sum_{i=1}^{Ng} |Q_{GK} - Q_{KG}^{Lim}|^2 \right] \tag{7}$$

Load voltage in kth load bus is indicated by V_{Lk}, voltage desired at the kth load bus is denoted by $V_{Lk}^{desired}$, reactive power generated at kth load bus generators is symbolized by Q_{GK}, then the reactive power limitation is given by Q_{KG}^{Lim}, then the number load and generating units are indicated by N_{LB} and Ng.

Then the voltage stability index (L-index) fitness function (OF_3) is given by,

$$F_3 = MinL_{Max} \tag{8}$$

$$L_{Max} = Max[L_j]; \ j = 1; N_{LB} \tag{9}$$

$$\begin{cases} L_j = 1 - \sum_{i=1}^{NPV} F_{ji} \dfrac{V_i}{V_j} \\ \\ F_{ji} = -[Y_1]^1[Y_2] \end{cases} \tag{10}$$

Such that

$$L_{Max} = Max\left[1 - [Y_1]^{-1}[Y_2] \times \frac{V_i}{V_j}\right] \tag{11}$$

Then the equality constraints are

$$0 = PG_i - PD_i - V_i \sum_{j \in N_B} V_j[G_{ij}cos[\emptyset_i - \emptyset_j] + B_{ij}sin[\emptyset_i - \emptyset_j]] \tag{12}$$

$$0 = QG_i - QD_i - V_i \sum_{j \in N_B} V_j[G_{ij}sin[\emptyset_i - \emptyset_j] + B_{ij}cos[\emptyset_i - \emptyset_j]] \tag{13}$$

Inequality constraints

$$P_{gslack}^{min} \leq P_{gslack} \leq P_{gslack}^{max} \tag{14}$$

$$Q_{gi}^{min} \leq Q_{gi} \leq Q_{gi}^{max}, \ i \in N_g \tag{15}$$

$$VL_i^{min} \leq VL_i \leq VL_i^{max}, \ i \in NL \tag{16}$$

$$T_i^{min} \leq T_i \leq T_i^{max}, i \in N_T \tag{17}$$

$$Q_c^{min} \leq Q_c \leq Q_C^{max}, i \in N_C \tag{18}$$

$$|SL_i| \leq S_{L_i}^{max}, \ i \in N_{TL} \tag{19}$$

$$VG_i^{min} \leq VG_i \leq VG_i^{max}, \ i \in N_g \tag{20}$$

Then the multi objective fitness (MOF) function has been defined by,

$$MOF = F_1 + x_i F_2 + y F_3$$

$$= F_1 + \left[\sum_{i=1}^{NL} x_v [VL_i - VL_i^{min}]^2 + \sum_{i=1}^{NG} x_g [QG_i - QG_i^{min}]^2 \right] + x_f F_3$$

$$(21)$$

Where real power loss reduction fitness function (F1), Minimization of Voltage deviation fitness function (F2) and voltage stability index (L-index) fitness function (F3) are added to construct the multi objective fitness (MOF) function

$$VL_i^{min} = \begin{cases} VL_i^{max}, VL_i > VL_i^{max} \\ VL_i^{min}, VL_i < VL_i^{min} \end{cases} \tag{22}$$

$$QG_i^{min} = \begin{cases} QG_i^{max}, QG_i > QG_i^{max} \\ QG_i^{min}, QG_i < QG_i^{min} \end{cases} \tag{23}$$

3 Cinnamon ibon Search Optimization Algorithm

Cinnamon ibon Search Optimization Algorithm is designed based on the natural actions of Cinnamon ibon. The systematic model of the Cinnamon ibon search Algorithm originates with an arbitrary individual of Cinnamon ibon. There is a race of the food possessions of the mates with further ingesting between the assailant birds with an augmentation in predation nature. Furthermore, the deposited energy in the Cinnamon ibon population is significant at the period of choosing the stalking approach by the Cinnamon ibon, whereas the Cinnamon ibon with inferior energy stockpile cadge.

The Cinnamon ibon birds in the superiority of the group are credible to be hunted by hunters and consistently attempt to accomplish a healthier position and the Cinnamon ibon ones that are positioned in the inner of the population, drive adjacent to the nearer populations to avoid the threat of being confronted. The systematic model of the Cinnamon ibon search Algorithm originates with an arbitrary individual of Cinnamon ibon. The Cinnamon ibon search algorithm entities exhibit the position of the Cinnamon ibon.

$$C = \begin{bmatrix} c_{1,1} & \cdots & c_{1,d} \\ \vdots & \ddots & \vdots \\ c_{n,1} & \cdots & c_{n,d} \end{bmatrix} \tag{24}$$

where n *and* d *specifies the number of Cinnamon ibon and decision parameters.*

Consequently, the fabricator Cinnamon ibon encompasses a greater level of energy loading, and Scavenging zones are distributed for the cadgers by them. The fabricators must find the zones with fine (abundant) food springs. The energy stockpile level is attained by the assessment of the population's price standards.

$$S_C = \begin{bmatrix} s([c_{1,1}, \ldots, c_{1,d}]) \\ s([c_{2,1}, \ldots, c_{2,d}]) \\ \cdot \\ \cdot \\ \cdot \\ s([c_{n,1}, \ldots, c_{n,d}]) \end{bmatrix} \quad (25)$$

Subsequently the Cinnamon ibon recognizes the hunter location; they appeal the others by peeping indications. The cadgers would be directed to the endangered regions by fabricators once the fear cost is more than the defence threshold. The entire population can be a fabricator by recognizing good food springs, seeing that the cadgers and fabricators' figures are steady. Cinnamon ibon populations with additional energy are presumed to be the fabricator. To get food and upper energy, certain hungry cadgers drive close the other locations. The cadgers trail the fabricator with an improved location of food springs. Concurrently, certain cadgers attempt frequently to duplicate the fabricators actions and contest for the food to augment the degree of the predation. The Cinnamon ibon Search Optimization Algorithm (CSOA) is a contending procedure that the populations with appropriate price values ensure extra prospect to find food in the solution zone. The fabricator gazes for food in a prolonged exploration zone range more than the cadgers. The position of the fabricator is systematically attained as follows,

$$C_{i,j}^{t+1} = \begin{cases} C_{i,j}^{t+1} \times exp\left(-\dfrac{i}{\alpha \times max.iteration}\right), & if \ Z_2 < DT \\ C_{i,j}^{t+1} + G \times H, & if \ Z_2 \geq DT \end{cases} \quad (26)$$

where $C_{i,j}^{t+1}$ *indicate the ith population in jth dimension,* $\alpha \in [0,1]$
GandH are distributed and dimension vector
Z_2 *specify the fear cost* $\in (0,1)$
DT is defence threshold $\in (0.5,1)$

At Present there won't be hunter in the confined area when Z_2 is lesser than DT, and the extensive exploration mode was assimilated by the

fabricator. Then specific populations ought to be recognising the hunter, once $Z_2 \geq DT$ and the entire populations essential to flutter to additional endangered zones rapidly. A small number of of the cadger populations chase the fabricators regularly, subsequently distinguishing the fabricator with good food, the cadger unswervingly drives nearby that position for the food. They can have the fabricator food if they are successful, otherwise, guidelines will be on. The rehabilitated position of the cadger is attained as follows,

$$
C_{i,j}^{t+1} = \begin{cases} G \times exp\left(\dfrac{C_{Poor}^{t} - C_{F}^{t+1}}{i^2}\right), & if \ i > n/2 \\ C_{F}^{t+1} + \left| C_{i,j}^{t} - C_{F}^{t+1} \right| \times B^{*} \times H & o.\omega \end{cases} \tag{27}
$$

where C_{F}^{t+1} *indicate the best location of fabricator*

$$
B^{*} = B^{T} \times \left(B \times B^{T}\right)^{-1} \tag{28}
$$

Initial positions of the Cinnamon ibon that recognize the threat are as described as below,

$$
C_{i,j}^{t+1} = \begin{cases} C_{best}^{t} + \beta \times \left| C_{i,j}^{t} - C_{best}^{t+1} \right| & if \ o_i > o_g \\ C_{i,j}^{t} + R \times \left(\dfrac{\left| C_{i,j}^{t} - C_{poor}^{t+1} \right|}{(o_i - o_\omega) + \varepsilon}\right) & if \ o_i = o_g \end{cases} \tag{29}
$$

where R is random $\in [0,1]$
o_i, o_g *and o_ω are price value, global optimal and poor fitness.*

The dispersal of the Cinnamon ibon position in the solution region is arbitrary. A capricious drive strategy was applied when deprived of any contiguous Cinnamon ibon in the vicinity of the current population. This style diminishes the convergence tendency and decreases the convergence inexorableness grounded on the controlled sum of iterations. At this time, to resolve this problem a regulating learning element utilized as follows,

$$
\text{cost value(cv)} = \frac{\left| o(C_{i,j}^{t}) - o(C_{best}^{t}) \right|}{o(C_{best}^{t}) + \varepsilon} \tag{30}
$$

where
$C_{i,j}^{t}$ specify the ith Cinnamon ibon population at 't'th iteration

$o(C_{i,j}^t)$ is cost value of ith Cinnamon ibon population at 't'th iteration

$o(C_{best}^t)$ is best cv of ith Cinnamon ibon population at 't'th iteration

Then the regulating learning element (rle) of ith Cinnamon ibon population at 't'th iteration is defined as follows,

$$rle_i^t = \frac{1}{1 + e^{-cv}}, \ cv \in (0, 2) \tag{31}$$

Consequently, the rehabilitated position of the fabricator, the cadger, and the prime positions of the Cinnamon ibon recognize about the threat is described as follows,

$$C_{i,j}^{t+1} = \begin{cases} rle_i^t \times C_{i,j}^{t+1} \times exp\left(-\dfrac{i}{\alpha \times \ max.iteration}\right), & if \ Z_2 < DT \\ rle_i^t \times C_{i,j}^{t+1} + G \times H, & if \ Z_2 \geq DT \end{cases} \tag{32}$$

$$C_{i,j}^{t+1} = \begin{cases} G \times exp\left(\dfrac{C_{Poor}^t - C_F^{t+1}}{i^2}\right), \ if \ i > n/2 \\ C_F^{t+1} + \left|rle_i^t \times C_{i,j}^t - C_F^{t+1}\right| \times B^* \times H \ \ o.\omega \end{cases} \tag{33}$$

$$C_{i,j}^{t+1} = \begin{cases} C_{best}^t + \beta \times \left|C_{i,j}^t - C_{best}^{t+1}\right| & if \ o_i > o_g \\ rle_i^t \times C_{i,j}^t + R \times \left(\dfrac{|C_{i,j}^t - C_{poor}^{t+1}|}{(o_i - o_\omega) + \varepsilon}\right) & if \ o_i = o_g \end{cases} \tag{34}$$

Also, the Procedure might be trapped in local solution. To avert the early convergence, an augmentation is defined as follows,

$$MS_i^t = C_{best}^t + SF_i^t \times (C_{p1}^t - C_{p2}^t); \ p1 \neq p2 \in [1, 2, 3, \ldots, n] \tag{35}$$

where MS_i^t is mutation strategy vector and SF_i^t is scaling factor

$$SF_i^t = SF^{preliminary} + (SF^{concluding} - SF^{preliminary}) \times \frac{o(C_{i,j}^t) - o(C_{best}^t)}{o(C_{poor}^t) - o(C_{best}^t)} \tag{36}$$

Engender the stream vector (SV) through crossover probability (CP) as follows,

$$SV_{ij}^t = (SV_{i1}^t, SV_{i2}^t, \ldots, SV_{id}^t) \tag{37}$$

$$SV_{ij}^t = \begin{cases} MS_{i,R}^t \ if \ R = R_o \ and \ Random\,(0,1) \leq CP, \\ \qquad C_{i,R}^t \ otherwise \end{cases} \tag{38}$$

where $R_o \in [1, 2, \ldots, d]$, $CP \in (0, 1)$

$$C_{i,j}^{t+1} = \begin{cases} SV_{i,j}^t \ if \ jo\left(SV_{ij}^t\right) < o\left(C_{i,j}^t\right) \\ C_{i,j}^{t+1} \ othetrwise \end{cases} \qquad (39)$$

a. Start
b. Initialization of population (fabricator and cadger)
c. Algorithm parameters are initialized
d. Cost value of each Cinnamon ibon computed

$$\text{cost value (cv)} = \frac{\left| o\left(C_{i,j}^t\right) - o\left(C_{best}^t\right) \right|}{o\left(C_{best}^t\right) + \varepsilon}$$

e. Update: fabricator position and cadger
f. Update the initial position of Cinnamon ibon

$$C_{i,j}^{t+1} = \begin{cases} C_{i,j}^{t+1} \times exp\left(-\dfrac{i}{\alpha \times \ max.iteration}\right), & if \ Z_2 < DT \\ C_{i,j}^{t+1} + G \times H, & if \ Z_2 \geq DT \end{cases}$$

g. Recognize the threat
h. Is end criterion met? If yes stop
i. Or else
j. Apply the regulating learning element (rle) *and mutation strategy*

$$rle_i^t = \frac{1}{1 + e^{-cv}}, \ cv \in (0, 2)$$

$$C_{i,j}^{t+1} = \begin{cases} rle_i^t \times C_{i,j}^{t+1} \\ \qquad \times exp\left(-\dfrac{i}{\alpha \times \ max.iteration}\right), & if \ Z_2 < DT \\ rle_i^t \times C_{i,j}^{t+1} + G \times H, & if \ Z_2 \geq DT \end{cases}$$

$$C_{i,j}^{t+1} = \begin{cases} G \times exp\left(\dfrac{C_{Poor}^t - C_F^{t+1}}{i^2}\right), & if \ i > n/2 \\ C_F^{t+1} + \left| rle_i^t \times C_{i,j}^t - C_F^{t+1} \right| \times B^* \times H & o.\omega \end{cases}$$

$$C_{i,j}^{t+1} = \begin{cases} C_{best}^t + \beta \times \left| C_{i,j}^t - C_{best}^{t+1} \right| & if \ o_i > o_g \\[3mm] rle_i^t \times C_{i,j}^t + R \times \left(\dfrac{\left| C_{i,j}^t - C_{poor}^{t+1} \right|}{(o_i - o_\omega) + \varepsilon} \right) & if \ o_i = o_g \end{cases}$$

$$MS_i^t = C_{best}^t + SF_i^t \times (C_{p1}^t - C_{p2}^t); \ p1 \neq p2 \in [1, 2, 3, \ldots, n]$$

k. Produce the stream vector (SV) through crossover probability (CP)

$$SV_{ij}^t = \left(SV_{i1}^t, SV_{i2}^t, \ldots, SV_{id}^t \right)$$

$$SV_{ij}^t = \begin{cases} MS_{i,R}^t \ if \ R = R_o \ and \ Random\,(0,1) \leq CP, \\ \qquad C_{i,R}^t \ otherwise \end{cases}$$

l. And Go to step d

m. End

4 Simulation Results

With considering L- index (voltage constancy),Cinnamon ibon Search Optimization Algorithm (CSOA) iscorroborated in IEEE 30 bus system [20]. Appraisal of loss has been done with PSO, amended PSO, enhanced PSO, widespread learning PSO, Adaptive genetic algorithm, Canonical genetic algorithm, enriched genetic algorithm, Hybrid PSO-Tabu search (PSO-TS), Ant lion (ALO), quasi-oppositional teaching learning based (QOTBO), improved stochastic fractal search optimization algorithm (ISFS), harmony search (HS), improved pseudo-gradient search particle swarm optimization and cuckoo search algorithm. Power loss abridged competently and proportion of the power loss lessening has been enriched. Predominantly voltage constancy enrichment achieved with minimized voltage deviancy. In Table 1 shows the loss appraisal, Table 2 shows the voltage deviancy evaluation and Table 3 gives the L-index assessment. Figures 1 to 3 gives graphical appraisal. Comparison done with Standard PSO-TS [10], Basic TS [10], Standard PSO [10], ALO [11], QO-TLBO [12], TLBO [12], Standard GA [13], Standard PSO [13], HAS [13], Standard FS [14], IS-FS [14] and Standard FS [16] algorithms.

Table 1   Assessment of factual power loss lessening

| Technique	Factual Power Loss (MW)
Standard PSO-TS [10]	4.5213
Basic TS [10]	4.6862
Standard PSO [10]	4.6862
ALO [11]	4.5900
QO-TLBO [12]	4.5594
TLBO [12]	4.5629
Standard GA [13]	4.9408
Standard PSO [13]	4.9239
HAS [13]	4.9059
Standard FS [14]	4.5777
IS-FS [14]	4.5142
Standard FS [16]	4.5275
CSOA	4.5002
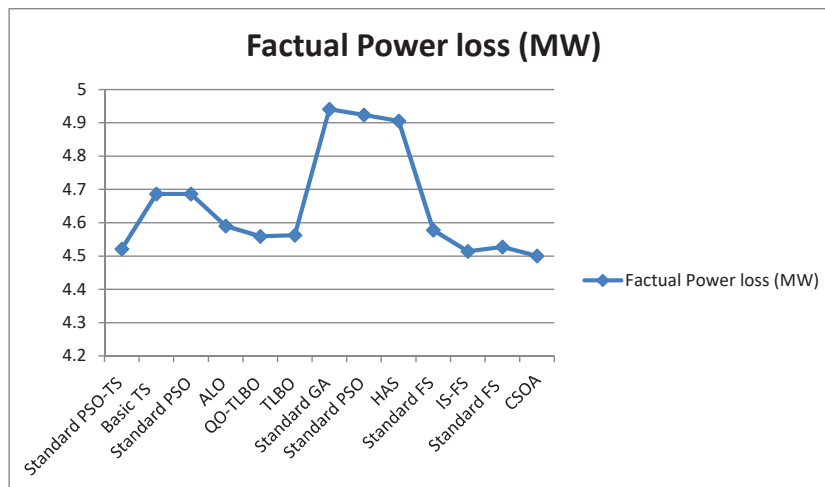
Figure 1   Appraisal of actual power loss.

Table 1 and Figure 1 show the appraisal of power loss with other standard methods 'in numerical and graphical format'.

Table 2 and Figure 2 show the appraisal of voltage deviation with other standard methods 'in numerical and graphical format'.

Table 2   Evaluation of voltage deviation

| Technique	Voltage Deviancy (PU)
Standard PSO-TVIW [15]	0.1038
Standard PSO-TVAC [15]	0.2064
Standard PSO-TVAC [15]	0.1354
Standard PSO-CF [15]	0.1287
PG-PSO [15]	0.1202
SWT-PSO [15]	0.1614
PGSWT-PSO [15]	0.1539
MPG-PSO [15]	0.0892
QO-TLBO [12]	0.0856
TLBO [12]	0.0913
Standard FS [14]	0.1220
ISFS [14]	0.0890
Standard FS [16]	0.0877
CSOA	0.0840
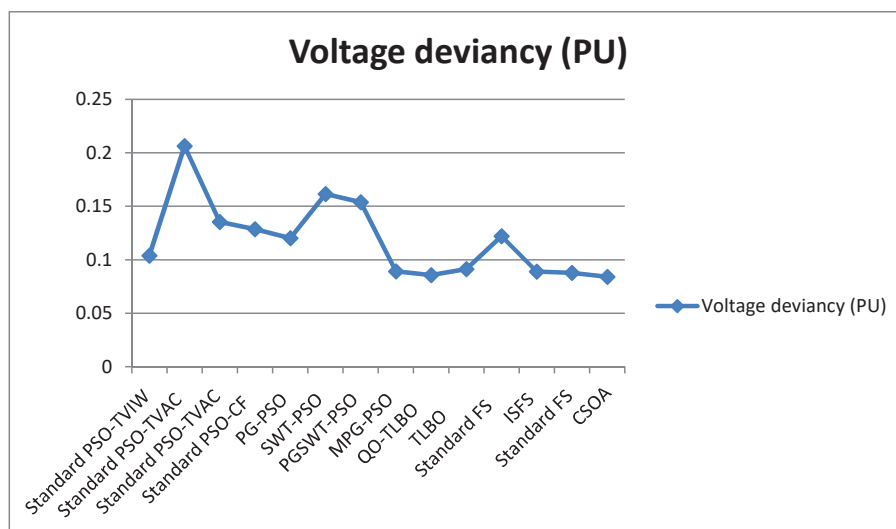
Figure 2   Appraisal of Voltage deviation.

Table 3 and Figure 3 show the voltage constancy with other standard methods 'in numerical and graphical format'.

Table 3   Assessment of voltage constancy

| Technique	Voltage Constancy (PU)
Standard PSO-TVIW [15]	0.1258
Standard PSO-TVAC [15]	0.1499
Standard PSO-TVAC [15]	0.1271
Standard PSO-CF [15]	0.1261
PG-PSO [15]	0.1264
Standard WT-PSO [15]	0.1488
PGSWT-PSO [15]	0.1394
MPG-PSO [15]	0.1241
QO-TLBO [12]	0.1191
TLBO [12]	0.1180
ALO [11]	0.1161
ABC [11]	0.1161
GWO [11]	0.1242
BA [11]	0.1252
Basic FS [14]	0.1252
IS-FS [14]	0.1245
Standard FS [16]	0.1007
CSOA	0.1003
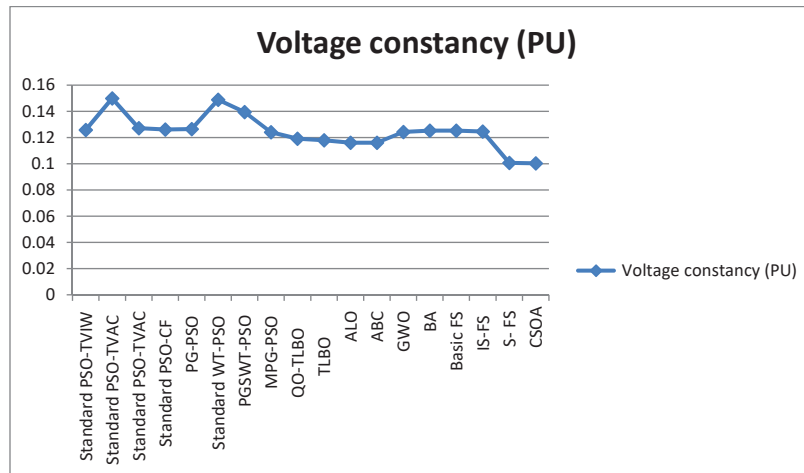
Figure 3   Appraisal of voltage constancy.

Then ProjectedCinnamon ibon Search Optimization Algorithm (CSOA) is corroborated in IEEE 30 bus test system deprived of L-index. Loss appraisal is shown in Table 4. Figure 4 gives graphical appraisal between the approaches with orientation to factual power loss. Comparison done with Amended PSO[24], Standard PSO [23], Standard EP [21], Standard GA [22], Basic PSO [25], DEPSO [25] and JAYA [25] algorithms.

Table 4   Assessment of true power loss

Parameter	Factual Power Loss in MW	Proportion of Lessening in Power Loss
Base case value [24]	17.5500	0.0000
Amended PSO[24]	16.0700	8.40000
Standard PSO [23]	16.2500	7.4000
Standard EP [21]	16.3800	6.60000
Standard GA [22]	16.0900	8.30000
Basic PSO [25]	17.5246	0.14472
DEPSO [25]	17.52	0.17094
JAYA [25]	17.536	0.07977
CSOA	14.10	19.6581
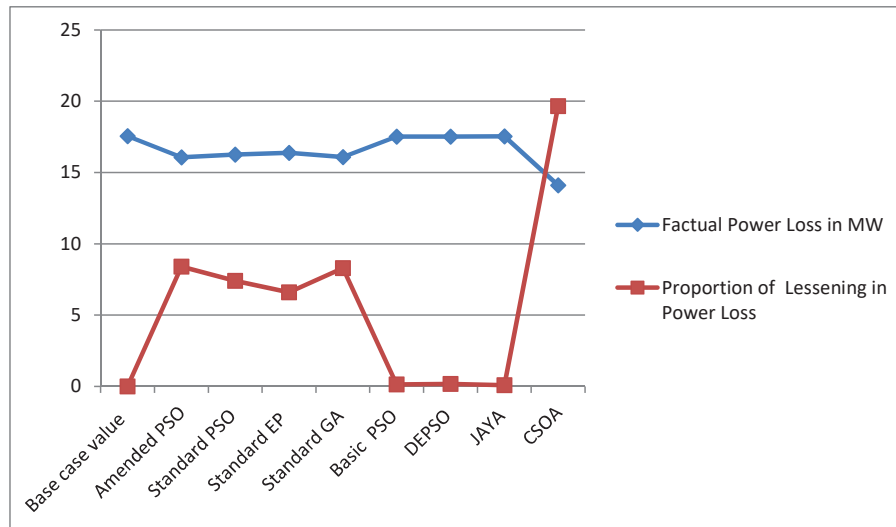
Figure 4   Appraisal of factual power loss.

Table 5   Convergence characteristics

IEEE 30 Bus System	Factual Power Loss in MW (With L-index)	Factual Power Loss in MW (Without L-index)	Proportion of Lessening in Power Loss (%)	Time in Sec (With L-index)	Time in Sec (Without L-index)	Number of Iterations (With L-index)	Number of Iterations (Without L-index)
CSOA	4.5002	14.10	19. 6581	15.16	12.19	20	18

Table 4 and Figure 4 show the appraisal of power loss (without L-index) with other standard methods 'in numerical and graphical format'. Table 5 shows the convergence characteristics ofCinnamon ibon Search Optimization Algorithm (CSOA).

5 Conclusion

Cinnamon ibon Search Optimization Algorithm (CSOA) condensed the factual power loss inventively. Proposed algorithm has been tested in IEEE 30 Bus system with and without considering voltage stability evaluation. So validity of the CSOA has been verified both in single and multi-objective mode. Cinnamon ibon Search Optimization Algorithm (CSOA) creditably abridged the power loss and proportion of factual power loss lessening has been elevated. Obtained Factual power Loss with and without L-index is 4.5002 (MW) and 14.10 (MW). The methodical model of the Cinnamon ibon search Algorithm creates with an illogical individual of Cinnamon ibon. The fabricator Cinnamon ibon incorporates a superior level of energy filling, and Scavenging regions are distributed for the cadgers by them. The fabricators must discover the regions with fine (copious) food springs. Cadgers will be engaged to the threatened areas by fabricators, when the fear cost is more than the defence threshold. The complete population can be a fabricator by distinguishing virtuous food springs, seeing that the cadgers and fabricators' figures are stable. Cinnamon ibon populations with supplementary energy are assumed to be the fabricator. To get food and upper energy, certain hungry cadgers drive close to other locations. The cadgers trail the fabricator with an enhanced location of food springs. Concomitantly, certain cadgers attempt repeatedly to facsimile the fabricators activities and challenge for the food to enlarge the degree of the predation. The dispersal of the Cinnamon ibon position in the solution region is arbitrary. A capricious drive strategy was applied when deprived of any contiguous Cinnamon ibon in the vicinity of

the current population. This style diminishes the convergence tendency and decreases the convergence inexorableness grounded on the controlled sum of iterations. Convergence characteristics show the better performance of the proposed CSOA algorithm. Valuation of power loss has been done with other regular reported algorithms. Proposed algorithm can be applied in image processing and Medical oriented analysis of disease identification.

In future this work can be extended and applied to unit commitment, Economic dispatch problem and contingency analysis.

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Biography

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