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# NOVEL ADVANCED CRICETOMYS EMINI OPTIMIZATION AND ENHANCED DICTYOSTELID ALGORITHM FOR ACTIVE POWER LOSS DIMINUTION AND VOLTAGE STABILITY ENRICHMENT IN ELECTRICAL DISTRIBUTION NETWORK

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**Abstract**

Advanced Cricetomys emini optimization (ACEO) algorithm and Enhanced Dictyostelid optimization algorithm (EDOA) are applied for active power loss diminution and voltage stability enrichment. Cricetomys emini in the breeding period, info about the pathway leading to the copious nutrition source is shared among the cluster members. In the exploration section if another Cricetomys emini objective functional value exceeds that of the fittest Cricetomys emini (α male), then the appropriate Cricetomys emini is updated and the locations of the other members in the cluster are accustomed based on the recently recognized fittest Cricetomys emini. In the exploitation section, breeding period differs from habitation to habitation and typically happens during the rainy period. Cricetomys emini optimization algorithm has been intermingled with Caelifera optimization algorithm to enhance competence of search and to evade the getting trapped in local optima Cricetomys emini males sense the breeding period and alienate themselves from the cluster in the breeding period. Dictyostelid algorithm is hybridized with Arctic tern optimization algorithm. By immigration Arctic tern will passage to further areas. Advanced Cricetomys emini optimization algorithm and enhanced Dictyostelid optimization algorithm are corroborated in 7 benchmark functions and IEEE 30, 57, 118 systems

**Keywords**

*Cricetomys emini, Caelifera, Dictyostelid, Arctic Tern, Eschrichtius robustus*

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**Introduction.** Advanced Cricetomys emini optimization (ACEO) algorithm and enhanced Dictyostelid optimization algorithm (EDOA) are applied for active power loss diminution and voltage stability enrichment [1–10].

Cricetomys emini optimization algorithm is designed based on the intellectual foraging activities of Cricetomys emini. Being extremely nocturnal, Cricetomys emini are logical ample to leave traces as they search through bamboos and grassland. Such traces would consequently clue to nutrition, water springs and lodging. The exploration segment is designed by imitating the Cricetomys emini's movement to dissimilar lodgings dispersed around their region to search and leave traces [11, 12]. It is assumed that the Cricetomys emini ($\alpha$ male) upholds information about these directions, and as an outcome, other Cricetomys emini's adapt their position rendering to this info. Cricetomys emini males are conscious about breeding period and discrete themselves from the cluster. The postulation is that as soon as the cluster is alienated during the breeding period, the searching happenings are focused inside regions of copious nutrition sources and this aspect assistances the exploitation in the procedure. At a location the target nutrition source is assumed to be available. The track to this nutrition source is known by Cricetomys emini ($\alpha$ male) and it passes this info to the rest of the members in the cluster. The location of the cluster members will be updated based on the information passed by the Cricetomys emini ($\alpha$ male). In the breeding period, info about the pathway leading to the copious nutrition source is shared among the cluster members. Cricetomys emini ($\alpha$ male) preserves the info about these traces, and other members in the cluster amend their location. If another Cricetomys emini objective functional value exceeds that of the fittest Cricetomys emini ($\alpha$ male), then the appropriate Cricetomys emini is updated, and the locations of the other members in the cluster are accustomed based on the recently recognized fittest Cricetomys emini in the exploration section. In the exploitation section, breeding period differs from habitation to habitation and typically happens during the rainy period. Cricetomys emini males sense the breeding period and alienate themselves from the cluster in the breeding period. As soon as the cluster is alienated, the searching actions are concerted inside regions with copious nutrition sources. Cricetomys emini optimization algorithm has been intermingled with Caelifera optimization algorithm to enhance competence of search [13] and to evade the getting trapped in local optima.

Dictyostelid algorithm is premeditated grounded on the activities of Dictyostelid [14]. Throughout the plasmodia phase, entities are roseate in flush; nonetheless these are more or less certainly not perceived. As soon as environments variation occurs, the entities amassed through biochemical gesticulating to custom an aethalium. These look as trifling bolster like splotches. The preservation of the lines in Dictyostelid needs to consume energy while this energy initiates from the liquid sustenance in the lines. As soon as the attained energy is loftier to the consumed energy, then these lines transformed to tetchier and the associated increases. Otherwise these lines will be annihilated.

The modification of the lines upshots in the disparity of the assigned liquid connected with every line. Through hybridization of Dictyostelid with Arctic tern optimization, EDOA is defined. Arctic tern optimization algorithm is based on normal performances of Arctic tern [15] and it has been emulated to model the procedure. *Eschrichtius robustus* optimization algorithm emulates the hunting performance of Eschrichtius robustus [16]. Performance of *Eschrichtius robustus* entails of the Wince, Hem in, and Corkscrew streamlining location. Double actions of Arctic tern are primarily employed to design the exploration and exploitation. Alike to the defined algorithms, many new techniques [17–20] are applied to solve various problems in science, engineering and technology.

**Problem formulation.** Active power loss diminution is demarcated as $\min \tilde{F}\left(\overline{g}, \overline{h}\right)$,

$$g = \left[ VLG_1, \ldots, VLG_{Ng};\ QC_1, \ldots, QC_{Nc};\ T_1, \ldots, T_{NT} \right];$$

$$h = \left[ PG_{slack};\ VL_1, \ldots, VL_{NLoad};\ QG_1, \ldots, QG_{Ng};\ SL_1, \ldots, SL_{NT} \right];$$

$$F_1 = P_{\min} = \min \left[ \sum_{m}^{NTL} G_m \left[ V_i^2 + V_j^2 - 2V_iV_j \cos \varnothing_{ij} \right] \right];$$

$$F_2 = \min \left[ \sum_{i=1}^{N_{LB}} \left| VL_k - VL_k^{desired} \right|^2 + \sum_{i=1}^{Ng} \left| QG_K - QK_G^{\lim} \right|^2 \right];$$

$$F_3 = \min L_{\max},\ L_{\max} = \max \left[ 1 - \left[ Y_1 \right]^{-1} \left[ Y_2 \right] \frac{V_i}{V_j} \right].$$

Parity constraints:

$$0 = PG_i - PD_i - V_i \sum_{j \in NB} V_j \left[ G_{ij} \cos\left[ \varnothing_i - \varnothing_j \right] + B_{ij} \sin\left[ \varnothing_i - \varnothing_j \right] \right];$$

$$0 = QG_i - QD_i - V_i \sum_{j \in NB} V_j \left[ G_{ij} \sin\left[ \varnothing_i - \varnothing_j \right] + B_{ij} \cos\left[ \varnothing_i - \varnothing_j \right] \right].$$

Disparity constraints: $PG_{slack}^{\min} \le PG_{slack} \le PG_{slack}^{\max}$. Reactive power generation: $QG_i^{\min} \le QG_i \le QG_i^{\max}$, $i \in Ng$. Load bus voltage: $VL_i^{\min} \le VL_i \le VL_i^{\max}$, $i \in NL$. Transformer tap setting: $T_i^{\min} \le T_i \le T_i^{\max}, i \in NT$. Switchable reactive power compensations: $QC^{\min} \le QC \le QC^{\max}$, $i \in NC$; $\left| SL_i \right| \le SL_i^{\max}$, $i \in NTL$. Generator bus voltage: $VG_i^{\min} \le VG_i \le VG_i^{\max}$, $i \in Ng$.

Multi objective fitness function:

$$F = F_1 + r_i F_2 + u F_3 = F_1 + \left[ \sum_{i=1}^{NL} x_v \begin{bmatrix} VL_i \\ -VL_i^{\min} \end{bmatrix}^2 + \sum_{i=1}^{NG} r_g \begin{bmatrix} QG_i \\ -QG_i^{\min} \end{bmatrix}^2 \right] + r_f F_3,$$

$$VL_i^{\min} = \begin{cases} VL_i^{\max}, \ VL_i > VL_i^{\max}; \\ VL_i^{\min}, \ VL_i < VL_i^{\min}, \end{cases} \quad QG_i^{\min} = \begin{cases} QG_i^{\max}, \ QG_i > QG_i^{\max}; \\ QG_i^{\min}, \ QG_i < QG_i^{\min}. \end{cases}$$

**Advanced Cricetomys emini optimization algorithm.** Cricetomys emini optimization algorithm is designed based on the intellectual foraging activities of Cricetomys emini. The exploration segment is designed by imitating the Cricetomys emini's movement to dissimilar lodgings dispersed around their region to search and leave traces. It is assumed that the Cricetomys emini ($\alpha$ male) upholds information about these directions, and as an outcome, other Cricetomys emini's adapt their position rendering to this info. Cricetomys emini males are conscious about breeding period and discrete themselves from the cluster. The postulation is that as soon as the cluster is alienated during the breeding period, the searching happenings are focused inside regions of copious nutrition sources and this aspect assistances the exploitation in the procedure. Population is created as

$$C = \begin{bmatrix} C_1 \\ \vdots \\ C_i \\ \vdots \\ C_N \end{bmatrix}_{N\times m} = \begin{bmatrix} c_{1,1} & \dots & c_{1,m} \\ \vdots & \ddots & \vdots \\ c_{N,1} & \dots & c_{N,m} \end{bmatrix},$$

where $C$ is population matrix; $N$ is population members; $m$ is variables; $c_{i,j} = lb_j + R\left( ub_j - lb_j \right)$;

$$ub_j, \ lb_j \text{ are limits, } R \in [0,1].$$

Objective functional value is computed as

$$F = \begin{bmatrix} F_1 \\ \vdots \\ F_i \\ \vdots \\ F_N \end{bmatrix}_{N\times 1} = \begin{bmatrix} F(C_1) \\ \vdots \\ F(C_i) \\ \vdots \\ F(C_N) \end{bmatrix}_{N\times 1}.$$

At a location the target nutrition source is assumed to be available. The track to this nutrition source is known by Cricetomys emini ($\alpha$ male) and it passes this info to the rest of the members in the cluster. The location of the cluster members will be updated based on the information passed by the Cricetomys emini ($\alpha$ male). In the breeding period, info about the pathway leading to the copious nutrition source is shared among the cluster members:

$$Z_{ij}^{new} = 0.70\,\frac{Z_{ij} + Z_{kj}}{2},$$

where $Z_{ij}^{new}$ is new location of the cluster members; $Z_{ij}$ is current location; $Z_{kj}$ is dominant male Cricetomys emini.

Cricetomys emini ($\alpha$ male) preserves the info about these traces, and other members in the cluster amend their location. If another Cricetomys emini objective functional value exceeds that of the fittest Cricetomys emini ($\alpha$ male), then the appropriate Cricetomys emini is updated, and the locations of the other members in the cluster are accustomed based on the recently recognized fittest Cricetomys emini in the exploration section: $Z_{ij}^{new} = Z_{ij} + B\left(Z_{kj} - qZ_{ij}\right)$, where $B \in [0, 1]$; $q$ is copious food source, $q = F_{Z_k} - current_{iter}\left(F_{Z_k} / \max iter\right)$;

$$Z_i = \begin{cases} Z_{ij} + B\left(Z_{ij} - \gamma Z_{kj}\right),\ F_i^{new} < F_i; \\ Z_{ij} + B\left(Z_{mj} - \delta Z_{kj}\right),\ \text{else}, \end{cases}$$

$\gamma = 2q\,\text{random} - q$; $\delta = 2q\sigma - q$.

In the exploitation section, breeding period differs from habitation to habitation and typically happens during the rainy period. Cricetomys emini males sense the breeding period and alienate themselves from the cluster in the breeding period. As soon as the cluster is alienated, the searching actions are concerted inside regions with copious nutrition sources: $Z_{ij}^{new} = Z_{ij} + B\left(Z_{kj} - \sigma Z_{mj}\right)$, where $Z_{mj}$ is randomly selected female location.

Cricetomys emini optimization algorithm has been intermingled with Caelifera optimization algorithm to enhance competence of search and to evade the trap in local optima. Social attributes and hunting technique of Caelifera has been scientifically designed in the procedure: $H_i = Q_i + B_i + Z_i$. Social attributes of Caelifera are defined as

$$Q_i = \sum_{\substack{j=1 \\ j \neq 1}}^{N} s\left(e_{ij}\right)\widehat{e_{ij}},$$

$$Q(r) = fa^{-r/t} - a^{-r}; \quad e_{ij} = \left|H_j - H_i\right|; \quad \widehat{e_{ij}} = \left(H_j - H_i\right)/e_{ij},$$

$$H_i = \sum_{\substack{j=1 \\ j \neq 1}}^{N} Q\left(\left|H_j - H_i\right|\right)\left(H_j - H_i\right)/e_{ij} - b\widehat{a_b} + I\widehat{a_c}.$$

Gravitational force of the Caelifera is defined as $B_i = -b\widehat{a_b}$. Air current defined as $Z_i = I\widehat{a_c}$. Swarm of the Caelifera:

$$H_e^i = d\left(\sum_{\substack{j=1 \\ j \neq 1}}^{N} d\,\frac{\max - \min}{2}\,Q\left(\left|H_j - H_i\right|\right)\left(H_j - H_i\right)/e_{ij}\right) + \widehat{M_e},$$

$$d = d_{\max} - t\,\frac{d_{\max} - d_{\min}}{t_{\max}}.$$

Nonlinear adaptive coefficient modernizing technique of random weight strategy is applied in the process as follows:

$$d = \begin{cases} d_{\max} - \left(d_{\max} - d_{\min}\right)k\left(1 + \left(\cos\left(\dfrac{P_i t}{t_{\max}}\right)\right)^2\right) t \le 0.5 t_{\max}; \\ d_{\max} - \left(d_{\max} - d_{\min}\right)k\left(1 - \left(\cos\left(\dfrac{P_i t}{t_{\max}}\right)\right)^2\right) 0.5 t_{\max} < t \le t_{\max}, \end{cases}$$

$k \in [0, 1]$.

In order to evade the local optima and expand the population diversity Cauchy mutation has been applied in the procedure:

$$F(h) = \frac{1}{\pi}\arctan(h) + 0.5.$$

Location of the $i$-th Caelifera is updated as $\widehat{M_e} = \widehat{M_e}\left(1 \tan\left[k\left(\mu - 0.5\right)\pi\right]\right)$. Better location replaces the old position as follows:

$$H_e^i = d\left(\sum_{\substack{j=1 \\ j \neq 1}}^{N} d\,\frac{\max - \min}{2}\,\frac{Q\left(\left|H_j - H_i\right|\right)\left(H_j - H_i\right)}{e_{ij}}\right) + \overline{M_e\left(1 \tan\left[k\left(\mu - 0.5\right)\pi\right]\right)}.$$

**ACEO algorithm**

a. Begin
b. Set the values
c. Create the population
d. Determine the objective functional value
e. Calculate the fitness value
f. Determine the Cricetomys emini ($\alpha$ male)
g. Identify the cluster members location
*h. Define exploration segment*
i. Determine the exploitation section
j. Define social attributes of Caelifera
k. Define Air current
l. Define the swarm of the Caelifera
m. Apply random weight strategy
n. Expand the population diversity
o. Location of the $i$-th Caelifera updated
p. Better location replaces the old position
q. $t = t + 1$
r. End

**Enhanced Dictyostelid optimization algorithm.** Dictyostelid optimization algorithm is grounded on the activities of Dictyostelid. Throughout the plasmodia phase, entities are roseate in flush; nonetheless these are more or less certainly not perceived. As soon as environments variation occurs, the entities amassed through biochemical gesticulating to custom an aethalium. These look as trifling bolster like splotches. The Dictyostelid amplification in the region is demarcated as $W_{ij} = P_{ij} / \left( M_{ij} \left( F_i - F_j \right) \right)$, where $P_{ij}$ is piloting feature; $M_{ij}$ is magnitude; $F_i$ is the force.

Incursion and exoneration vital to be exalted as $\sum\limits_{j \neq 1, 2} W_{ij} = 0.$

Interpreting the linking of Dictyostelid $\sum\limits_i S_{i1} + L_o = 0;$ $\sum\limits_i S_{i2} + L_o = 0,$ $L_o$ is liquid from the root knob.

Through the piloting modifications to epoch

$$\frac{d}{dt} P_{ij} = L\left( \left| W_{ij} \right| \right) - dP_{ij},$$

where $d$ is rate of decay.

Successively the force equation grounded of the stream is demarcated as

$$\sum_i \frac{P_{ij}}{D_{ij}}\left(F_i - F_j\right) = \begin{cases} 1 \text{ for } j = 1; \\ -1 \text{ for } j = 2; \\ 0 \text{ otherwise.} \end{cases}$$

The preservation of the lines in Dictyostelid needs to consume energy while this energy initiates from the liquid sustenance in the lines. As soon as the attained energy is loftier to the consumed energy, then these lines transformed to tetchier and the associated increases. Otherwise these lines will be annihilated. The modification of the lines upshots in the disparity of the assigned liquid connected with every line. Connotation amongst the liquid and the energy is demarcated as $U_1 = n\left(W\right)$.

Energy used up by the line is demarcated as $U_2 = m\left(P\right)$. Variation of linking is demarcated as $\Delta P = O\left(U_P\right)$.

*Liquid and line*. Dictyostelid to assemble to a constant form $\Delta P_{ij} = O\left(f\left(W_{ij} - m\left(P_{ij}\right)\right)\right)\Delta t,\ dP_{ij}/dt = O\left(f\left(W_{ij} - m\left(P_{ij}\right)\right)\right)$.

To conciliate the guideline of conservation of energy, it is assumed that the complete energy transported by the liquid in beginning from the opening knob to the peak knob is tenacious and has mediocrity to do with the course: $n\left(W_{ij}\right) = W_{ij}\left(F_i - F_j\right)/\left(F_o - F_p\right)$, where $F_o, F_p$ is openning and peak knop.

Indeed, the consumed energy is not only apropos with the assembly, then yet again congruently with the facet of the lines: $m\left(W_{ij}\right) = W_{ij}M_{ij}$.

Congruently, the significance of the energy on the modification of the linking is also appropriate with the facet of the line. The lengthened the line is, the additional energy it consumes:

$$m\left(U_p\right) = U_p / M_{ij};$$

$$\frac{dP_{ij}}{dt} = W_{ij}\left(F_i - F_j\right)/\left(M_{ij}\left(F_o - F_p\right)\right) - P_{ij}; \tag{1}$$

$$W_{ij}^{n+1} - W_{ij}^{n}/\left(\varphi t\right) = \left|W\right| - W_{ij}^{n+1}. \tag{2}$$

Arctic tern optimization (ATO) algorithm is based on rnormal performances of Arctic tern and by immigration Arctic tern will passage to further areas. As cluster Arctic tern will travel one spot to other spot:

$\overrightarrow{S_{st}} = H\left(\left(\overrightarrow{E_{st}}\right)T\right)$, $\overrightarrow{S_{st}}$ is specify the spot of the exploration representative; $\overrightarrow{E_{st}}$ is existing spot of the exploration representative; $T$ is present iteration.

Search representative drive actions in the specified exploration zone is described as

$$H = f_c - \left(T\left(\frac{f_c}{\max\ iter}\right)\right),$$

where $f_c$ is specifies the frecuency control; $T = i, 1, \ldots, \max\ iter$.

At that point the drive will be on the way to the utmost outstanding fortitude appropriate Arctic tern and it is described as $\overrightarrow{Q_{st}} = J\left(\left(\overrightarrow{E_{best}}\right)(T) - \left(\overrightarrow{E_{st}}\right)\right)$, where $\overrightarrow{Q_{st}}$ — specify appropriate spot of the exploration representative; $J$ is control parameter for exploration and exploitation $J = 2.00H^2R$. Here $R$ is random $\in [0, 1]$.

At that juncture the spot exploration representative will be rationalized with reverence to utmost outstanding exploration representative as follows: $\overrightarrow{ERD_{st}} = \left|\overrightarrow{S_{st}} - \overrightarrow{Q_{st}}\right|$, where $\overrightarrow{ERD_{st}}$ indicate the distance of the exploration representative.

Confronting performance of the Arctic tern has been emulated to design exploitation. Throughout the immigration also Arctic tern has the skill to amend the swiftness and slant of spasm en route for the target: $a' = r\cos d$, $b' = r\cos d$, $c' = rd$, $r = me^{dn}$, $r$ is radius of coiled drive, $0 \le d \le 2\pi$.

Consequently exploration representative's rationalized position is attained as follows: $\overrightarrow{E_{st}} = \left(\overrightarrow{ERD_{st}}a'b'c'\right) + \overrightarrow{E_{st}}(T)$.

*Eschrichtius robustus* optimization algorithm emulates the hunting performance of *Eschrichtius robustus* (performance of *Eschrichtius robustus* entails of the Wince, Hem in, and Corkscrew streamlining location): $\vec{E}(n+1) = \overrightarrow{E_P}(n) - \vec{T}U$, $\vec{U} = \left|W\overrightarrow{E_P}(n) - E(n)\right|$, $\vec{T} = 2t\vec{r} - \vec{t}$, $t = 2 - 2n / n_{\max}$; $\vec{W} = 2\vec{r}$.

*Review the Corkscrew locus. Eschrichtius robustus* and target in a corkscrew wrought drive and it described as follows: $\vec{E}(n+1) = \vec{Q}^{n^*}e^{wn^*} \times \cos(2\pi l) + \overrightarrow{E_P}(n)$, $\vec{Q}' = \left|\overrightarrow{E_P}(n) - \vec{E}(t)\right|$,

$$\vec{E}(n+1) = \begin{cases} \overrightarrow{E_P}(t) - \vec{T}Q \text{ if } p < 0.5; \\ \vec{Q}^{n^*}e^{wn^*}\cos(2\pi l) + \overrightarrow{E_P}(n) \text{ if } p \ge 0.5. \end{cases}$$

With reverence to quixotically designated *Eschrichtius robustus*; the spot of other *Eschrichtius robustus* are streamlined as follows: $\vec{Q} = \left| \vec{W} \overrightarrow{E_R} - \vec{E} \right|$, $\vec{E}(n+1) = \overrightarrow{E_R} - \vec{T} Q$.

By means of logistic map prominence, preliminary population spot of the *Eschrichtius robustus* is enriched by $E_{k+1} = \mu E_k (1 - E_k)$.

Local exploration proficiency and convergence meticulousness has been enriched by smearing inertia weight

$$\omega = \omega' - (\omega' - \omega'') \left( \frac{n}{n_{\max}} \right)^{1/n}.$$

Streamlining of the enriched spot is described as

$$\vec{E}(n+1) = \begin{cases} \overrightarrow{E_P}(n) - \omega^* \vec{T} Q & \text{if } p < 0.5; \\ \omega^* \vec{Q}^{n^*} e^{wn^*} \cos(2\pi l) + \overrightarrow{E_P}(n) & \text{if } p \geq 0.5. \end{cases}$$

The notion of crowding distance is smeared, to enrich the multiplicity and dispersal of the population: $cw_d = \sum_{o=1}^{O} f_o(i+1) - f_o(i-1)$.

Since the objective function equivalent to entity "*i*" then it desires to be regularized by altered elements

$$cw_d = \sum_{o=1}^{O} \frac{f_o(i+1) - f_o(i-1)}{f_{o\,\max} - f_{o\,\min}}.$$

Crowded appraisal operative is articulated as follows: $i \geq nj \ (\text{if } (i_r < j_r))$.

At that juncture the dispersed capricious quantity $(cq_i)$ is grounded on the laplacian and is created by

$$cq_i = \begin{cases} p - q \log_e (R(u_i)), (R(v_i)) \leq 2; \\ p + q \log_e (R(u_i)), (R(v_i)) > 2. \end{cases}$$

Producing of the progenies' are completed by (1), (2).

**EDOA**

a. Begin
b. Set the parameters
a. Amplify the Dictyostelid
b. Incursion and exoneration is analysed
c. Interpreting the linking of Dictyostelid
d. Execute the piloting modifications

a. Calculate the force of each knob
b. Find the connotation amongst the liquid and energy
c. Observe the rate of energy used up by the line
d. Define the disparity of linking
c. Identify the Dictyostelid assembly
d. Preeminent entity is selected as optimum spot
e. Existing position are rationalized
f. Locations of individual are updated
g. Verify the Eschrichtius robustus locations
h. Apply the Laplace cross over
i. Yield preeminent fitness functional value
j. Start the immigration performance
k. Start the confronting performance
l. Arctic tern employed to enhance the exploitation
m. Apply crowding distance
n. Compute the expanse
o. End for
p. $T \leftarrow T+1$
q. End

**Simulation study.** Advanced Cricetomys emini optimization algorithm and EDOA uses *MATLAB 2018* a programming, and all segments of the simulations have been executed on a PC with a 2.40 GHZ frequency CPU, and the installed memory (RAM) is 4.0 GB. The software used is *MATLAB 2018*, and the computer has a 2.67 GHz Intel Core i5 processor and 4 GB RAM. The results connecting to the performance for ACEO algorithm and EDOA are taken after numerous trials. In the simulation study, population size of 30 is considered, while the number of iterations is 500 in the tested systems.

Advanced Cricetomys emini optimization algorithm and EDOA are corroborated in 7 benchmark functions ($F_1$ — Parabola, $F_2$ — Ackley, $F_3$ — Rosen rock, $F_4$ — Generalized Griewank, $F_5$ — Hartman 3, $F_6$ — Six-hump camel-back, $F_7$ — Goldstein — Price) [17]:

$$F_1 = \sum_{i=1}^{D} x_i^2;\ F_2 = -20 \exp\left\{-0.2\sqrt{\frac{1}{D}\sum_{i=1}^{D} x_i^2}\right\} - \exp\left\{\frac{1}{D}\sum_{i=1}^{D}\cos\left(2\pi x_i\right)\right\} + 20 + e;$$

$$F_3 = \sum_{i=1}^{D-1}\left\{100\left(x_{i+1} - x_i^2\right)^2 + \left(x_i - 1\right)^2\right\};\ F_4 = \frac{1}{4000}\sum_{i=1}^{D} x_i^2 - \prod_{i=1}^{D}\cos\left(\frac{x_i}{\sqrt{i}}\right) + 1;$$

$$F_5 = -\sum_{i=1}^{4} c_i \exp\left[-\sum_{j=1}^{3} a_{ij}\left(x_j - p_{ij}\right)^2\right];$$

$$F_6 = 4x_1^2 - 2.1x_1^4 + (1/3)x_1^6 + x_1x_2 - 4x_2^2 + 4x_2^2;$$

$$F_7 = \left\{1 + \left(x_1 + x_2 + 1\right)^2 \left(19 - 14x_1 + x_1^2 - 14x_2 + 6x_1x_2 + 3x_2^2\right)\right\} \times$$
$$\times \left\{30 + \left(2x_1 - 3x_2\right)^2 \left(18 - 32x_1 + 12x_1^2 + 48x_2 - 36x_1x_2 + 27x_2^2\right)\right\}.$$

Outcomes are displayed in Table 1 and Fig. 1.

*Table 1*

**ACEO, EDOA outcome in 7 benchmark functions**

| Function | HGZO [17] | EAZO [17] | ACEO | EDOA |
|---|---|---|---|---|
| $F_1$ | 0.8874 | 0.0026 | 0.0039 | 0.0039 |
| $F_2$ | 0.0918 | 0.0125 | 0.0133 | 0.0133 |
| $F_3$ | 22.9814 | 16.5622 | 16.438 | 16.438 |
| $F_4$ | $1.1092 \cdot 10^{-2}$ | $3.459 \cdot 10^{-4}$ | $3.56 \cdot 10^{-4}$ | $3.56 \cdot 10^{-4}$ |
| $F_5$ | −3.8629 | −3.8629 | −3.8629 | −3.8629 |
| $F_6$ | −1.0318 | −1.0316 | −1.0324 | −1.0324 |
| $F_7$ | 3.0280 | 3.0130 | 3.0132 | 3.0132 |

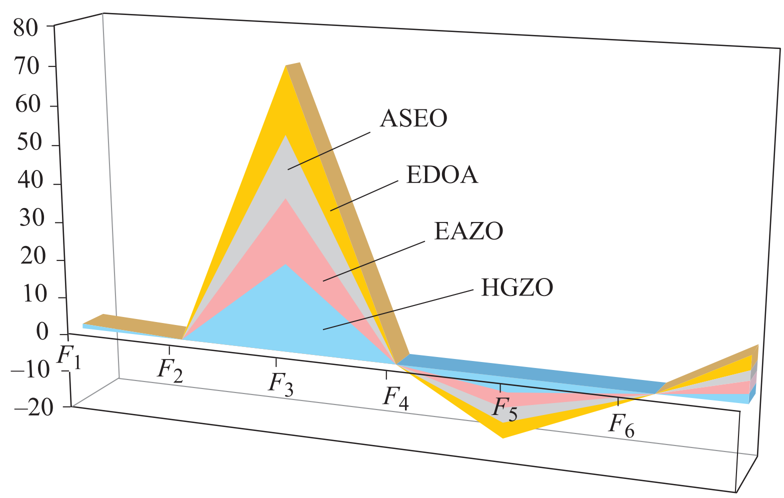


**Fig. 1.** ACEO, EDOA outcome in 7 benchmark functions

Advanced Cricetomys emini optimization algorithm and EDOA are validated in IEEE 30 bus system. Table 2 and Fig. 2, *a* illustrate the appraisal of outcomes.

*Table 2*

**Appraisal of outcomes (IEEE 30 bus)**

| Method | AL, MW | VE, PU | VT, PU |
|---|---|---|---|
| EQD [1] | 4.6482 | 0.0802 | 0.1004 |
| MCW [2] | 4.9448 | 0.1212 | 0.1232 |
| ETP [3] | 4.5677 | 0.1250 | 0.1135 |
| AVPO [4] | 4.5464 | 1.9889 | 0.1294 |
| GWOI [5] | 4.1781 | 0.4697 | 0.1323 |
| AMIA [6] | 5.6614 | 0.1536 | 0.2683 |
| PTS 1 [7] | 4.6304 | 0.1678 | 0.2524 |
| PHO [8] | 5.0763 | 0.6828 | 0.3297 |
| ACEO | 4.0079 | 0.0101 | 0.4334 |
| EDOA | 4.0052 | 0.0089 | 0.4379 |

Advanced Cricetomys emini optimization algorithm and EDOA are validated in IEEE 57 bus system. Table 3 and Fig. 2, *b* illustrate the appraisal of outcomes.

*Table 3*

**Appraisal of outcomes (IEEE 57 bus)**

| Method | AL, MW | VE, PU | VT, PU |
|---|---|---|---|
| SCD [1] | 21.9452 | 0.6012 | 0.0948 |
| BCW [2] | 23.3235 | 0.58553 | 0.2561 |
| PSH [8] | 25.4715 | 0.6828 | 0.3231 |
| ETS [9] | 25.4963 | 0.799021 | 0.3129 |
| ACEO | 20.201 | 0.4687 | 0.4549 |
| EDOA | 20.164 | 0.4662 | 0.4578 |

Advanced Cricetomys emini optimization algorithm and EDOA are validated in IEEE 118 bus system. Table 4 and Fig. 2, *c* illustrate the evaluation of results.

*Table 4*

**Appraisal of outcomes (IEEE 118 bus)**

| Method | RL, MW | VE, PU |
|---|---|---|
| GWU [10] | 128.137 | 1.12945 |
| BCW [2] | 123.511 | 1.21790 |
| PSH [8] | 130.324 | 1.26103 |
| ETS [9] | 131.845 | 1.26654 |
| ACEO | 120.964 | 1.20367 |
| EDOA | 120.529 | 1.20198 |

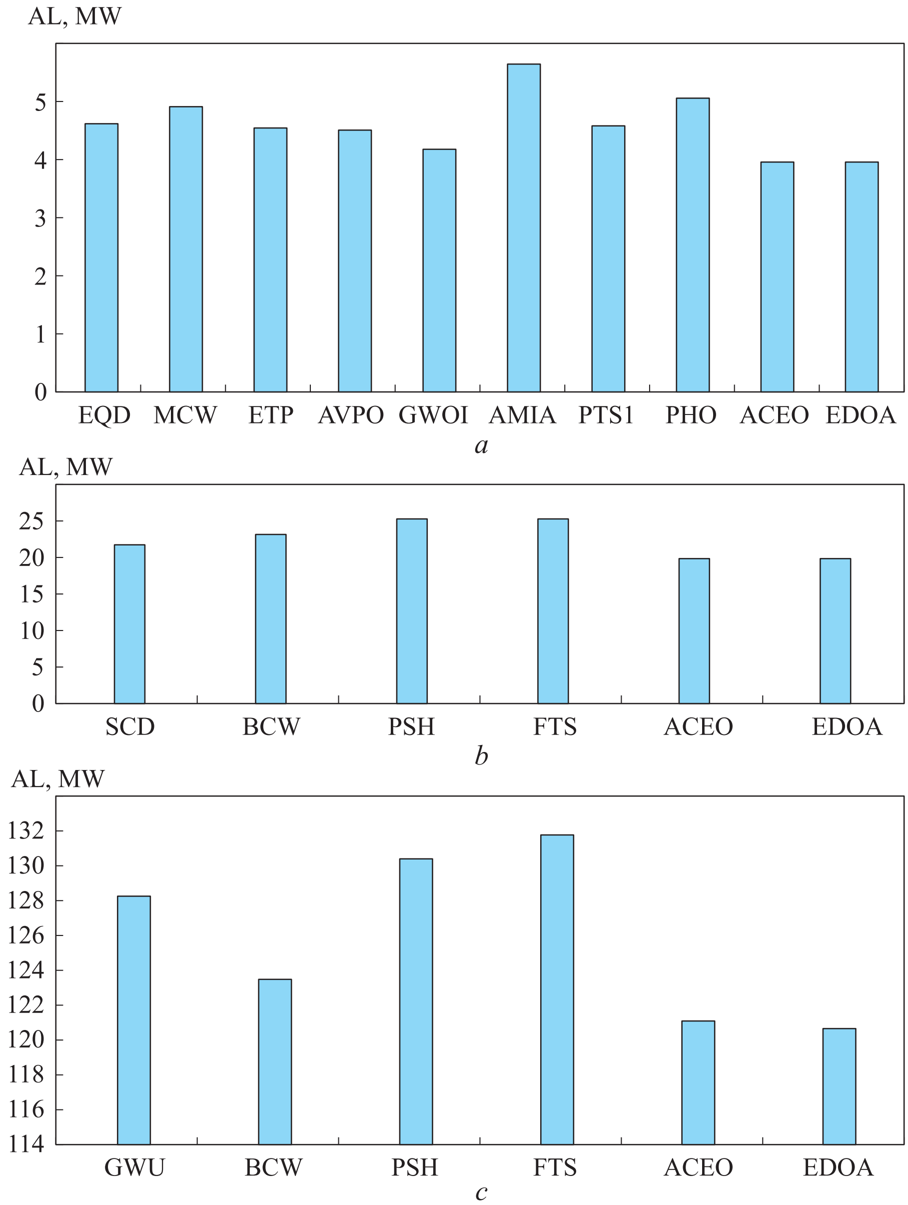


**Fig. 2.** AL (MW) result comparison IEEE 30 (*a*), 57 (*b*), and 118 (*c*) buses

Computation time of ACEO algorithm and EDOA are presented in Table 5.

*Table 5*

**ACEO, EDOA computation time, s**

| Method | Bus | | |
|---|---|---|---|
| | 30 | 57 | 118 |
| ACEO | 15.08 | 20.09 | 37.89 |
| EDOA | 14.87 | 19.94 | 37.62 |

**Discussion of results.** Advanced Cricetomys emini optimization algorithm and EDOA successfully tested in 7 benchmark functions. Both ACEO and EDOA algorithm efficiently solved the power loss reduction problem. Comparison has been done with standard reported algorithms. Validation done in standard IEEE 30, 57, 118 bus systems. Comparison results are shown in the Tables and Figures respectively.  Power loss reduction achieved with voltage stability expansion and deviation of voltage minimized. Obtained power loss value in IEEE 30 bus system are ACEO 4.0079 MW and EDOA 4.0052 MW. Attained power loss value in IEEE 57 bus system are ACEO 20.201 MW and EDOA 20.164 MW. Achieved power loss value in IEEE 118 bus system are ACEO 120.964 MW and EDOA 120.529 MW.

**Conclusion.** Advanced Cricetomys emini optimization algorithm and EDOA are applied for active power loss diminution and voltage stability enrichment solved the active power loss diminution problem competently. Cricetomys emini construct their lodging is dissimilar mode, around their region in dispersed level. Cricetomys emini leave the dissimilar lodgings to search by, means of following traces to preceding nutrition sources or searching for a fresh nutrition spring and leaving traces. In the exploitation section, breeding period differs from habitation to habitation and typically happens during the rainy period. Cricetomys emini males sense the breeding period and alienate themselves from the cluster in the breeding period. As soon as the cluster is alienated, the searching actions are concerted inside regions with copious nutrition sources. Cricetomys emini optimization algorithm has been intermingled with Caelifera optimization algorithm to enhance competence of search and to evade the getting trapped in local optima. Preservation of the lines in Dictyostelid needs to consume energy while this energy initiates from the liquid sustenance in the lines. As soon as the attained energy is loftier to the consumed energy, then these lines transformed to tetchier and the associated increases. Double actions of Arctic tern are primarily employed to design the exploration and exploitation. By immigration Arctic tern will passage to further areas. As cluster Arctic tern will travel one spot to other spot. Advanced Cricetomys emini optimization algorithm and EDOA are corroborated in 7 benchmark functions and IEEE 30, 57, 118 systems. Loss lessening has been attained and steadiness of the voltage has been improved substantially.

**Future scope of work.** In future ACEO algorithm and EDOA can applied to solve the real time problems in electrical power system. Equally ACEO and EDOA can be utilized in optimal design of products in industrial engineering.

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