

NOVEL QUANTUM-BASED CERATITIS AND TETRAPTURUS GEORGII OPTIMIZATION ALGORITHMS FOR REAL POWER LOSS REDUCTION

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Abstract

In this paper, the Quantum-based Ceratitis Optimization (QCO) algorithm and Tetrapturus georgii optimization (QTO) algorithm are applied for solving the loss shrinking. The Ceratitis Optimization algorithm is premeditated on the systematic engagements of Ceratitis and in the red to splendid view and countered considerate activities Ceratitis diet is assimilated. The tetrapturus georgii optimization algorithm is modeled based on the stalking deeds of Tetrapturus georgii and it's gluttonous, quest the Etrumeus in a constellation manner. Quantum mechanics has been combined with Ceratitis Optimization (QCO) algorithm and the Tetrapturus georgii optimization (QTO) algorithm. In the quantum process, topographies out do the equivalent enactment with the convinced period as they route in a credible powdered of the median.

Keywords: Reactive, Transmission loss, Quantum, Ceratitis, Tetrapturus georgii

Introduction

Several mathematical approaches (Montoya *et al.*, 2020a, 2020b) and algorithms (Mei *et al.*, 2018; Zelan *et al.*, 2019; Ebeed *et al.*, 2020; Thang *et al.*, 2020; Saddique *et al.*, 2020) are applied to solve the loss-lessening problem. In this paper, the Quantum-based Ceratitis Optimization (QCO) algorithm and Tetrapturus georgii optimization (QTO) algorithm are applied for solving the loss shrinking. The Ceratitis Optimization algorithm is premeditated on the systematic engagements of Ceratitis and in the red to splendid view and countered considerate activities Ceratitis diet is assimilated. Every Ceratitis realm track from its location and alertness will be in the route of diet. Unrelated sorts of stench are compared, and the primary wherewithal zone will be elected.

Crucial alertness is indicated as the finest surviving position. By stench and delirium the Ceratitis will route to the matchless position. The tetrapturus georgii optimization algorithm is modeled based on the stalking deeds of Tetrapturus georgii and it's gluttonous, quest the Etrumeus in a constellation manner. Systematic concerts of Tetrapturus georgii have been imitated to model the procedure. A contender interpretation in the suggested process is Tetrapturus georgii and the populace in the examination region is comprehensively impelled. The Quantum mechanics (Edalatpanah *et al.*, 2014a, 2014b, 2019; Eyo, 2020; Das, 2022; Nivetha *et al.*, 2022) has been combined with Ceratitis Optimization (QCO) algorithm and Tetrapturus georgii

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optimization (QTO) algorithm. In the quantum process, topographies outdo the equivalent enactment with the convinced period as they route in a credible powdered of the median.

Problem Formulation

Loss minimization is demarcated by

$$\text{Min } \tilde{F}(\bar{g}, \bar{h}) \quad (1)$$

$$M(\bar{g}, \bar{h}) = 0 \quad (2)$$

$$N(\bar{g}, \bar{h}) = 0 \quad (3)$$

$$g = [VLG_1, \dots, VLG_{Ng}; QC_1, \dots, QC_{Nc}; T_1, \dots, T_{Nt}] \quad (4)$$

$$h = [PG_{slack}; VL_1, \dots, VL_{Nload}; QG_1, \dots, QG_{Ng}; SL_1, \dots, SL_{Nt}] \quad (5)$$

$$\text{Multi objective fitness (MOF)} = F_1 + r_1 F_2 + u F_3 = F_1 + \left[\sum_{i=1}^{NL} x_v [VL_i - VL_i^{min}]^2 + \sum_{i=1}^{NG} r_g [QG_i - QG_i^{min}]^2 \right] + r_f F_3 \quad (6)$$

$$VL_i^{minimum} = \begin{cases} VL_i^{max}, & VL_i > VL_i^{max} \\ VL_i^{min}, & VL_i < VL_i^{min} \end{cases} \quad (7)$$

$$QG_i^{minimum} = \begin{cases} QG_i^{max}, & QG_i > QG_i^{max} \\ QG_i^{min}, & QG_i < QG_i^{min} \end{cases} \quad (8)$$

Quantum based Ceratitis and Tetrapturus georgii Optimization Algorithms

Quantum mechanics (Kamel *et al.*, 2020) has been combined with Ceratitis Optimization (QCO) algorithm and Tetrapturus georgii optimization (QTO) algorithm. The wave efficacy in the Quantum mechanics is delineated as,

$$|\Psi|^2 \cdot da \cdot db \cdot dc = Qu \cdot da \cdot db \cdot dc \quad (9)$$

where Ψ indicate probability density

The periodliable Schrodinger equivalence (Kamel *et al.*, 2020) is employed to assess the surgevalue and it's demarcated as,

$$i\hbar \partial / \partial t \cdot \Psi(a, t) = Htr \cdot \Psi(a, t) \quad (10)$$

where Htr specify the Hamilton operative (Kamel *et al.*, 2020).

$$Htr = -\hbar^2 / 2m \cdot \Delta^2 + V(a) \quad (11)$$

Ceratitis Optimization algorithm is premeditated on the systematic engagements of Ceratitis and in the redto splendid view and countered considerate activities Ceratitis diet is assimilated. Crucial alertness is indicated as the

finestsurvivingposition. By stench and delirium the Ceratitis will route to the matchless position.

$$C_j \in [\min_j, \max_j], j = 1, 2, 3, \dots, n \quad (12)$$

Pondering of stench in the optimization is perform as amalgamated task,

$$Fi(C); C = (c_1, c_2, \dots, c_n) \quad (13)$$

Confines are set and main domicile is,

$$\begin{cases} C_p = \min + (\max - \min) * r \\ D_p = \min + (\max - \min) * r \end{cases} \quad (14)$$

Renewed position of Ceratitis is formed,

$$\begin{cases} C_i = C_p + r \\ D_i = D_p + r \end{cases} \quad (15)$$

By prime position the area is calculated as,

$$P_i = \sqrt{C_i^2 + D_i^2} \quad (16)$$

Reigning cost (Q_i) of the stench pondering is the conjoint of the zone, and then the stench pondering (V_i) is accomplished as,

$$\begin{cases} Q_i = 1 / zone_i \\ V_i = f(Q_i) \end{cases} \quad (17)$$

The minimum stench pondering rate and ambition to the equivalent position is quantified as,

$$\begin{cases} [SO, SI] = C \text{ in } (V) \\ \begin{cases} C_p = C(SI) \\ D_p = C(SI) \end{cases} \end{cases} \quad (18)$$

where SO is super stench, SI is super index

In the prime level exploration of diet in plentiful ways and these engagements is compared similar spreading in the level,

$$\begin{cases} \begin{cases} C_p = r(level) \\ D_p = r(level) \end{cases} \\ position_p = \begin{cases} \sqrt{C_i^2 + D_i^2} \text{ if } C_i + D_i > 0 \\ -\sqrt{C_i^2 + D_i^2} \text{ if } C_i + D_i < 0 \end{cases} \\ SO_p = F(position_p) \end{cases} \quad (19)$$

Drive will be in plentiful ways in searching of diet and in the principal phase, the spring may be trifling,

$$\begin{cases} \begin{cases} D_t(i) = C_p(i) + \Delta_y(i) \cdot r \\ D_t(i) = D_p(i) + \Delta_x(i) \cdot r \end{cases} \\ position_p = \begin{cases} \sqrt{C_i^2 + D_i^2} \text{ if } C_i + D_i > 0 \\ -\sqrt{C_i^2 + D_i^2} \text{ if } C_i + D_i < 0 \end{cases} \end{cases} \quad (20)$$

$$s_m^t(i) = C_t(i) - C_{t-1}(i); i = 1, 2, \dots, N \quad (21)$$

In the plane trivial steps (tr_s) and vast steps (vt_s) are recognised as,

$$\Delta_t(i) = (vt_{s_t}(i) - tr_{s_t}(i)) * \left[e^{\frac{s_{t-1}(i) - tr_{s_{t-1}}(i)}{vt_{s_t}(i) - tr_{s_t}(i)} - 1} \right] + tr_{s_t}(i) \quad (22)$$

$$f(c) = \frac{1}{\sqrt{2\pi}} e^{-(c - \Delta_t)^2} \quad (23)$$

Ramp weakens gradually by,

$$R_t(i) = \frac{Tt * \|C_t(i) - C_{t-1}(i)\|}{\sum_i \|C_t(i)\|} \quad (24)$$

$$U(i) = \frac{R(i)}{\sum_i R(i)} \quad (25)$$

$$tr.s_t = C_t - C_{t-1} \quad (26)$$

Exploration procedure is specified as,

$$\begin{cases} C_{t+1} = C_t + \delta \cdot tr.s_t \cdot r \\ D_{t+1} = D_t + \delta \cdot tr.s_t \cdot r \end{cases} \quad (27)$$

$$\delta = \delta_{max} \cdot e \left(\log \left(\frac{\lambda_{min}}{\lambda_{max}} \right) \cdot \frac{t}{t_{max}} \right) \quad (28)$$

Proceeding to iteration($\forall$), the Ceratitisswill go for cooperative exploration and as soon as iteration quantity reached the $\forall$ then Reminiscence progress way will be on.

$$f(c) = \begin{cases} 0 & c < \varphi \\ [tr \cdot 2 \cdot \left(\frac{1}{1+e^{\frac{c-\varphi}{\Delta}}} - \frac{1}{2} \right)] c \geq \varphi \end{cases} \quad (29)$$

Quantum based Ceratitis Optimization (QCO)

- a. Start
- b. Set the parameters
- c. Engender the population
- d. Positionappraisal
- e.
- f.
$$\begin{cases} C_p = r(level) \\ D_p = r(level) \\ position_p = \begin{cases} \sqrt{C_i^2 + D_i^2} \text{ if } C_i + D_i > 0 \\ -\sqrt{C_i^2 + D_i^2} \text{ if } C_i + D_i < 0 \end{cases} \\ SO_p = F(position_p) \end{cases}$$
- g. $iter = 0$
- h. $SO = F(R_t)$
- i. $while iter < \varphi$
- j. $s_m^t(i) = C_t(i) - C_{t-1}(i); i = 1, 2, \dots, N$
- k.
$$\Delta_t(i) = (vt_{s_t}(i) - tr_{s_t}(i)) * \left[e^{\frac{s_{t-1}(i) - tr_{s_{t-1}}(i)}{vt_{s_t}(i) - tr_{s_t}(i)} - 1} \right] + tr_{s_t}(i)$$

- l.
$$\begin{cases} D_t(i) = C_p(i) + \Delta_y(i) \cdot r \\ D_t(i) = D_p(i) + \Delta_z(i) \cdot r \\ position_p = \begin{cases} \sqrt{C_i^2 + D_i^2} \text{ if } C_i + D_i > 0 \\ -\sqrt{C_i^2 + D_i^2} \text{ if } C_i + D_i < 0 \end{cases} \end{cases}$$
- m. $[OS, SI] = F(position_{iter})$
- n. $if OS < SO then SO = OS$
- o. $C_p = C(SI)$
- p. $D_p = D(SI)$
- q. End if
- r.
$$R_t(i) = \frac{Tt * \|C_t(i) - C_{t-1}(i)\|}{\sum_i \|C_t(i)\|}$$
- s.
$$U(i) = \frac{R(i)}{\sum_i R(i)}$$
- t. $if r < U(i) then C(i) = r (area)$
- u. End if
- v. End
- w. $while iter < \Delta$
- x. $|\Psi|^2 \cdot dx \cdot dy \cdot dz = Quantum \cdot dx \cdot dy \cdot dz$
- y. $Hr = -h^2/2m \cdot \Delta^2 + V(x)$

$$\begin{cases} C_p = r(plane) \\ D_p = r(plane) \end{cases}$$
- z.
$$position_p = \begin{cases} \sqrt{C_i^2 + D_i^2} \text{ if } C_i + D_i > 0 \\ -\sqrt{C_i^2 + D_i^2} \text{ if } C_i + D_i < 0 \end{cases}$$

$$SO_p = F(position_p)$$
- aa. $tr.s_t = C_t - C_{t-1}$
- bb.
$$\begin{cases} C_{t+1} = C_t + \delta \cdot tr.s_t \cdot r \\ D_{t+1} = D_t + \delta \cdot tr.s_t \cdot r \end{cases}$$
- cc. $[OS, SI] = F(position_t)$
- dd. $if OS < SO then SO = OS$
- ee. $C_p = C(SI)$
- ff. $D_p = D(SI)$
- gg. End if
- hh.
$$R_t(i) = \frac{Tt * \|C_t(i) - C_{t-1}(i)\|}{\sum_i \|C_t(i)\|}$$
- ii.
$$U(i) = \frac{R(i)}{\sum_i R(i)}$$
- jj. $if r < U(i) then C(i) = r (area)$
- kk. End if
- ll. End
- mm. $Until iter = max.gen$
- nn. End

A contender interpretation in the suggested process is Tetrapturus georgii and populace in the examination region is comprehensively impelled.

In the probingsector,

$$Tg_{i,k} \in \Gamma(i = 1, 2, \dots, m) \quad (30)$$

where $\llbracket Tg \rrbracket_{(i,k)}$ indicate the Tetrapturus georgi position

$$Tg_p = \begin{bmatrix} Tg_{1,1} & Tg_{1,2} \cdots Tg_{1,d} \\ Tg_{2,1} & Tg_{2,2} \cdots Tg_{2,d} \\ \vdots & \vdots \cdots \vdots \\ Tg_{m,1} & Tg_{m,2} \cdots Tg_{m,d} \end{bmatrix} \quad (31)$$

Elucidation aptness degree calculated as,

$$Tg_p = \begin{bmatrix} f(Tg_{1,1} & Tg_{1,2} \cdots Tg_{1,d}) \\ f(Tg_{2,1} & Tg_{2,2} \cdots Tg_{2,d}) \\ \vdots & \vdots \cdots \vdots \\ f(Tg_{m,1} & Tg_{m,2} \cdots Tg_{m,d}) \end{bmatrix} = \begin{bmatrix} F_{Tg1} \\ F_{Tg2} \\ \vdots \\ F_{Tgm} \end{bmatrix} \quad (32)$$

EtrumeusSchool is amalgamated in the process and in the inspection planetary it also whirling. At that time the Etrumeusplace and aptnessis foundby,

$$E_p = \begin{bmatrix} E_{1,1} & E_{1,2} \cdots E_{1,d} \\ E_{2,1} & E_{2,2} \cdots E_{2,d} \\ \vdots & \vdots \cdots \vdots \\ E_{m,1} & E_{m,2} \cdots E_{m,d} \end{bmatrix} \quad (33)$$

$$E_p = \begin{bmatrix} f(Tg_{1,1} & Tg_{1,2} \cdots Tg_{1,d}) \\ f(Tg_{2,1} & Tg_{2,2} \cdots Tg_{2,d}) \\ \vdots & \vdots \cdots \vdots \\ f(Tg_{m,1} & Tg_{m,2} \cdots Tg_{m,d}) \end{bmatrix} = \begin{bmatrix} F_{Tg1} \\ F_{Tg2} \\ \vdots \\ F_{Tgm} \end{bmatrix} \quad (34)$$

The place of the superiorTetrapturus georgii and the debilitatedEtrumeuswhich possess the matchlessaptnessdegree in the ith iteration is designated as $U_{(s_Tg)}^i$ and $U_{(in_E)}^i$.

Renewedplace of Tetrapturus georgiientitled as,

$$U_{Tg}^i = U_{s_Tg}^i - \Delta_i \times \left(r(0,1) \times \left(\frac{U_{s_Tg}^i + U_{in_E}^i}{2} \right) - U_{pr_Tg}^i \right) \quad (35)$$

$$\Delta_i = 2 \times r(0,1) \times g.h - g.h \quad (36)$$

$$g.h = 1 - \left(\frac{Tg}{Tg+E} \right) \quad (37)$$

Renewedplace of Etrumeus is,

$$U_{f_E}^i = r \times (U_{s_Tg}^i - U_{pre_Tg}^i + Tg.P) \quad (38)$$

$$Tg.P = l \times (2 \times iter \times \varepsilon) \quad (39)$$

By $Tg.P$ number of Etrumeuswill transform the site(α) and factor(β),

$$\alpha = E \times Tg.P \quad (40)$$

$$\beta = Pa \times Tg.P \quad (41)$$

Possibilities of shootingrenewedvictim is demarcated as,

$$U_{Tg}^i = U_P^i \text{ iff } (E_i) < f(Tg_i) \quad (42)$$

Quantum based Tetrapturus georgii optimization (QTO) algorithm.

- a. Start
- b. Set parameter values
- c. Engender the population
- d. Calculate the fitness degree
- e. Pick unmatchedTetrapturus georgii and the debilitatedEtrumeus
- f. *while (end condition is not met)do*
- g. $\Delta_i = 2 \times r(0,1) \times g.h - g.h$
- h. Tetrapturus georgiiposition is streamlined
- i. $U_{Tg}^i = U_{s_Tg}^i - \Delta_i \times \left(r(0,1) \times \left(\frac{U_{s_Tg}^i + U_{in_E}^i}{2} \right) - U_{pr_Tg}^i \right)$
- j. End for
- k. $|\Psi|^2 \cdot dx \cdot dy \cdot dz = Quantum \cdot dx \cdot dy \cdot dz$
- l. $Hr = -h^2/2m \cdot \Delta^2 + V(x)$
- m. $Tg.P = l \times (2 \times iter \times \varepsilon)$
- n. *if* $Tg.P < 0.5$, then
- o. $\alpha = E \times Tg.P$
- p. $\beta = Pa \times Tg.P$
- q. Position of nominated Etrumeus is streamlined
- r. $U_{f_E}^i = r \times (U_{s_Tg}^i - U_{pre_Tg}^i + Tg.P)$
- a. End if
- b. Computeaptnessdegree of Etrumeus
- c. $U_{Tg}^i = U_P^i \text{ iff } (E_i) < f(Tg_i)$
- d. $Q_Z^i = Q_P^i \text{ iff } (D_i) < f(Z_i)$
- e. Eliminate the startled Etrumeus
- f. Reorganize the optimum Tetrapturus georgii and Etrumeus
- g. End if
- h. End while
- i. Reoccurrence of premiumTetrapturus georgii
- j. End

Simulation Study

Projected Quantum based Ceratitis Optimization (QCO) algorithm and Tetrapturus georgii optimization (QTO) algorithm are corroborated in IEEE and Practical system - WDN 220 KV. Tables 1. and 2. and Figures 1. 2. 3. and 4. Show the evaluation. Proposed Quantum based Ceratitis Optimization (QCO) algorithm and Tetrapturus georgii optimization (QTO) algorithm

are reviewed in practical system - WDN 220 KV (Adel Abou El-Ela *et al.*, 2019). Table 3. and Figure 5. give the valuation.

Table 4. and Figure 6. Show the time taken for Proposed Quantum based Ceratit Optimization (QCO) algorithm and Tetrapturus georgii optimization (QTO) algorithm.

Table 1. Loss evaluation (IEEE 300 bus system)

Method	Power Loss (MW)	VD (PU)
MDLISAI (Nagarajan <i>et al.</i> , 2020)	396.983	5.9324
MDLISAI (Nagarajan <i>et al.</i> , 2020)	397.236	5.9416
IPRSA (Nagarajan <i>et al.</i> , 2020)	397.902	5.9613
MODEALO (Souhil <i>et al.</i> , 2018)	398.853	6.0169
QCO	390.019	5.7512
OTO	390.008	5.7506

Table 2. Loss evaluation (IEEE 354 bus system)

Method	Power Loss (MW)	VD (PU)
MDLISAI (Nagarajan <i>et al</i> 2020)	337.374	0.4978
MDLISAI (Nagarajan <i>et al</i> 2020)	338.715	0.5117
IPRSA (Nagarajan <i>et al</i> 2020)	339.325	0.5216
MDFAHCLSO (Souhil <i>et al.</i> , 2018)	341.001	0.5354
SMPPSO (Souhil <i>et al.</i> , 2018)	341.123	0.6395
QCO	336.052	0.4529
QTO	336.041	0.4522

Table 3. Loss appraisal and Power aberration evaluation

Method	Loss (MW)	VD (PU)
BSCPSO (Mohamed, 2022)	32.314	0.5800
BBICBA (Mohamed, 2022)	33.875	0.6327
IMPBBA (Mohamed, 2022)	30.786	0.6751
QCO	29.119	0.5839
QTO	29.108	0.5835

Table 4. Time taken for Quantum based Ceratit Optimization (QCO) algorithm and Tetrapturus georgii optimization (QTO) algorithm

Method	300 bus T (S)	354 bus T (S)	WDN 220 KV T (S)
QCO	75.59	85.67	24.81
QTO	75.48	85.62	24.79

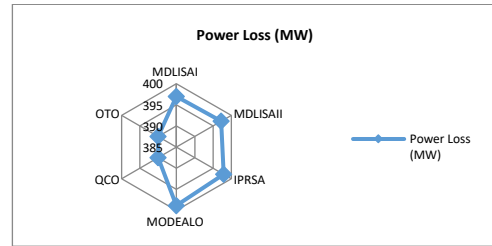


Figure 1. Evaluation of loss (IEEE 300 bus system)

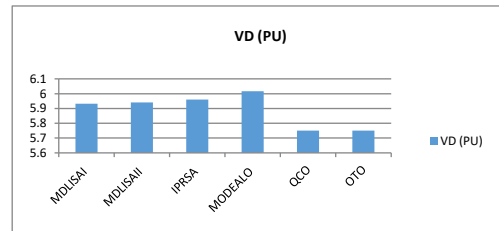


Figure 2. Evaluation of power deviance (IEEE 300 bus system)

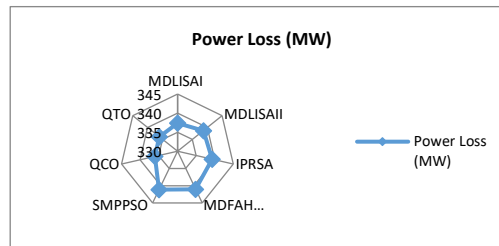


Figure 3. Appraisal of power loss (IEEE 354 bus system)

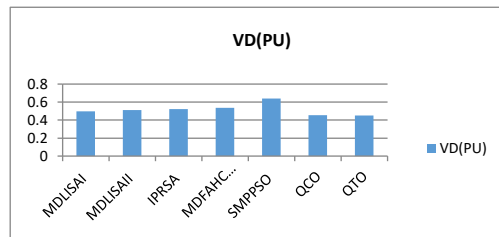


Figure 4. Evaluation of power deviance (IEEE 354 bus system)

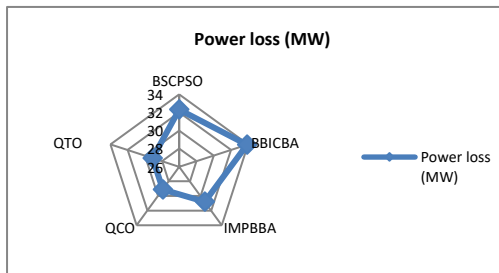


Figure 5. Evaluation of power deviance (IEEE 354 bus system)

Conclusions

Quantum based Ceratitis Optimization (QCO) algorithm and Tetrapturus georgii optimization (QTO) algorithm efficiently solved the loss shrinking problem. Ceratitis Optimization algorithm is premeditated on the systematic engagements of Ceratitis and in the red to splendid view and countered considerate activities Ceratitis diet is assimilated. Every Ceratitis realm track from its location and alertness will be in the route of diet. Unrelated sorts of stench are compared, and the primary wherewithal zone will be elected. Systematic concerts of Tetrapturus georgii have been imitated to model the procedure. A contender interpretation in the suggested process is Tetrapturus georgii and populace in the examination region is comprehensively impelled. Quantum mechanics has been combined with Ceratitis Optimization (QCO) algorithm and Tetrapturus georgii optimization (QTO) algorithm. In quantum process, topographies outdo the equivalent enactment with the convinced period as they route in a credible powdered of median.

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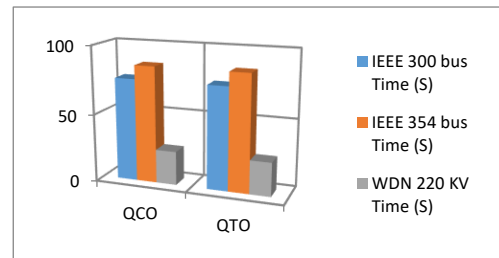


Figure 6. Time taken for Quantum based Ceratitis Optimization (QCO) algorithm and Tetrapturus georgii optimization (QTO) algorithm