

HYBRIDIZED PROSCOPIIDAE - MYRMELEONTIDAE AND PAMPAS FOX INSPIRED OPTIMIZATION ALGORITHM

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Abstract

In this paper Hybridization of Proscopiidae Optimization with Myrmeleontidae Algorithm (PM) and Pampas Fox inspired optimization (PFO) algorithm are applied to solve the tangible power Loss reduction problem. Proscopiidae optimization algorithm integrated with Myrmeleontidae optimization algorithm. Proscopiidae certainly move idealistically up until it reach a protected region and projected algorithm owns good exploration ability. Myrmeleontidae optimization algorithm owns better exploitation. In the exploration space Proscopiidae interrelate each other and identical number of Myrmeleontidae will be there in the exploration. In exploitation segment, movement of the Pampas Fox is towards the direction of the prey's sound. Population engendered randomly, partial iterations are applied in the exploration and exploitation segment. PM and PFO algorithms validated in IEEE 354 bus and 220 KV systems.

Keywords: Population; Hybridization; Fitness rate

Introduction

Tangible power loss lessening is crucial problem for safe and economic operation of system (Venkataramana *et al.*, 1987; Sharif *et al.*, 1996; Preedavichit *et al.*, 1997; Lai *et al.*, 2005; Duman *et al.*, 2012; Rayudu *et al.*, 2017; Souhil *et al.*, 2018; El-Ela *et al.*, 2019; Raghuwanshi, 2019; Nagarajan *et al.*, 2020; Trummal *et al.*, 2020; Ibrahim *et al.*, 2022; Kanagasabai, 2022; Kumar *et al.*, 2022; Lenin, 2022; Mohamed 2022; Saddique *et al.*, 2022; Sahoo *et al.*, 2022; Sidea *et al.*, 2022; Xiong *et al.*, 2022). It is exceptional by appropriate connection of the association of components used to deal with up the power flow with the goal of reducing the tangible

power loss. Numerous methodical approaches and algorithms are applied to solve the problem. In this paper Hybridization of Proscopiidae Optimization with Myrmeleontidae Algorithm (PM) and Pampas Fox inspired optimization (PFO) algorithm are applied to solve the Tangible Power Loss reduction problem. Proscopiidae certainly move quixotically up until it grasps a protected region and the Proscopiidae optimization algorithm (POA) owns the superiority of virtuous exploration. Regular actions of Myrmeleontidae have been emulated to formulate Myrmeleontidae optimization algorithm (MOA). In the exploration region Myrmeleontidae

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will pursuit the Proscopiidae which moves in whimsical way. Proscopiidae will move quixotically until a protected region has been managed. Extraordinary capability Myrmeleontidae will pursuit the Proscopiidae and roulette wheel selection technique smeared. In concluding part of stalking Myrmeleontidae tug the Proscopiidae completely into the shingle then Myrmeleontidae chomp the Proscopiidae. In the exploration space Proscopiidae interrelate each other and identical number of Myrmeleontidae will be there in the exploration. Pampas Fox leap to stalk the victim. As soon as prey identified, Pampas Fox attempts to quest for victim arbitrarily. Subsequently, Pampas Fox discovers the victim by audible range of sonography emitted from the prey. At that moment, Pampas Fox takes period in order to get to nearby to the victim. By heeding to the sonography (sound) of the victim and the period variance, the Pampas Fox can regulate the expanse amongst the aforementioned and the victim. Subsequently after defining the expanse, the Pampas Fox estimate the leap in order to clasp the victim. Walking is accomplished arbitrarily rendering to the least period and preminent location. Population engendered randomly, partial iterations are employed for exploration segment and remaining for exploitation segment. Fitness rate moves the exploration agents to evade local optima, since if the fresh location does not alter; the exploration segment disengages to permit other segments to be initiated. PM and PFO algorithms validated in IEEE 354 bus and 220 KV systems.

Problem formulation

Loss reduction problem is systematically delineated as,

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

$$L_{Max} = \text{Max}[L_j]; j = 1; N_{LB} \quad (2)$$

$$\begin{cases} L_j = 1 - \sum_{i=1}^{NPV} F_{ji} \frac{V_i}{V_j} \\ F_{ji} = -[Y_1]^{-1}[Y_2] \end{cases} \quad (3)$$

$$L_{Max} = \text{Max} \left[1 - [Y_1]^{-1}[Y_2] \times \frac{V_i}{V_j} \right] \quad (4)$$

Parity constraints

$$0 = PG_i - PD_i - V_i \sum_{j \in N_B} V_j \left[G_{ij} \cos[\emptyset_i - \emptyset_j] + B_{ij} \sin[\emptyset_i - \emptyset_j] \right] \quad (5)$$

$$0 = QG_i - QD_i - V_i \sum_{j \in N_B} V_j \left[G_{ij} \sin[\emptyset_i - \emptyset_j] + B_{ij} \cos[\emptyset_i - \emptyset_j] \right] \quad (6)$$

Disparity constraints

$$\begin{aligned} P_{gsi}^{\min} &\leq P_{gsi} \leq P_{gsi}^{\max} \\ Q_{gi}^{\min} &\leq Q_{gi} \leq Q_{gi}^{\max}, i \in N_g \\ VL_i^{\min} &\leq VL_i \leq VL_i^{\max}, i \in N_L \\ T_i^{\min} &\leq T_i \leq T_i^{\max}, i \in N_T \\ Q_c^{\min} &\leq Q_c \leq Q_c^{\max}, i \in N_C \\ |SL_i| &\leq S_{L_i}^{\max}, i \in N_{TL} \\ VG_i^{\min} &\leq VG_i \leq VG_i^{\max}, i \in N_g \end{aligned}$$

Hybridization of proscopiidae optimization with myrmeleontidae algorithm

Proscopiidae optimization algorithm (POA) has been mongrelized with Myrmeleontidae optimization algorithm (MOA). Proscopiidae certainly move quixotically up until it grasps a protected region and the Proscopiidae optimization algorithm (POA) owns the superiority of virtuous exploration. Regular actions of Myrmeleontidae have been emulated to formulate Myrmeleontidae optimization algorithm (MOA). Both POA and MOA has been amalgamated and named as PM algorithm. Proscopiidae Optimization Algorithm (POA) is designed based on the regular movements of Proscopiidae. Proscopiidae movement is by Common communiqué (C), Dynamism (D) and Airstream transport (T). The Location of Proscopiidae is defined as,

$$P_i = C_i + D + T_i \quad (7)$$

In the duration of Common communiqué action of Proscopiidae is described as,

$$C_i = \sum_{j=1}^N s(a_{ij}) \hat{a}_{ij} \quad (8)$$

Location of the Proscopiidae defined as,

$$X_i = \sum_{j=1}^N S(|X_j - X_i|) (X_j - X_i) / d_{ij} - g\hat{e}_g + U\hat{e}_w \quad (9)$$

Exploration and Exploitation is poised by,

$$P_a^i = b \left(\frac{\sum_{j=1}^N \frac{b \cdot \text{mh}_a - \text{nh}_a}{2} C}{(|P_j - P_i|)(P_j - P_i)/a_{ij}} \right) + \hat{O}_a \quad (10)$$

Population of the Proscopiidae is primed on the possibility of 0.5 (for Proscopiidae “i” in dimension “j”) by,

$$P_i^j(v) = \begin{cases} 1, & \text{if } Ra() > 0.5 \\ 0, & \text{otherwise} \end{cases} \quad (11)$$

Proscopiidae are demarcated as binary strings and the space between them is mathematically defined as follows,

$$|P_i - P_j| = aF(P_i - P_j) = \sum_{k=1}^D |P_{ik} \neq P_{jk}|$$

Once lone bit for two Proscopiidae in assured intervals at that time the Hamming space can be calculated by,

$$a_F(P_i - P_j) = \begin{cases} 0 & \text{if } P_{ia} = P_{ja} \\ 1 & \text{if } P_{ia} \neq P_{ja} \end{cases} \quad (12)$$

Space between two binary vectors is calculated by altering the value 1 or 0 as follows,

$$J(Space^a) = \begin{cases} 1, & \text{if } space^a > \frac{\max(space^a) - \min(space^a)}{2} \\ 0, & \text{if } space^a < \frac{\max(space^a) - \min(space^a)}{2} \\ \text{otherwise} & \begin{cases} 0, & \text{if } R() > 0.5 \\ 1, & \text{otherwise} \end{cases} \end{cases} \quad (13)$$

- a. Start
- b. Proscopiidae population initialized
- c. Objective solution is fixed
- d. Update the value of “b”
- e. Modernize the target value
- f. Space between two Proscopiidae is standardized
- g. Space value is calculated by
- h. Location vector is rationalized by
- i. Is all Proscopiidae locations are rationalized?
- j. If “yes” the streamline the objective vector rate
- k. Otherwise go to step ‘f’
- l. Is end condition grasped?
- m. if “yes” the output the preeminent solution
- n. else go to step “d”
- o. End

Proscopiidae optimization algorithm (POA) has been mongrelized with Myrmeleontidae optimization algorithm (MOA). In the exploration space Proscopiidae interrelate each other and identical number of Myrmeleontidae will be there in

the exploration. The whimsical walk of the Proscopiidae in the exploration is scientifically carved as,

$$\begin{aligned} m(t) &= [0, \text{entire}(2R(e_1) - 1), \dots, \text{entire}(2R(e_n) - 1)] \\ R(t) &= \begin{cases} 1 & \text{if } R > 0.5 \\ 0 & \text{if } R \leq 0.5 \end{cases} \end{aligned} \quad (14)$$

Whimsical walk has been reserved inside the frontier,

$$M_i^t = \frac{(M_i^t - r_i) \times (s_i - U_i^t)}{(s_i^t - r_i)} + U_i \quad (15)$$

$$M_i^d = b \left(\sum_{j=1}^N b \frac{UB_a - LB_a}{2} C(|M_j^a - M_i^a|) \frac{M_j - M_i}{a_{ij}} \right) \quad (16)$$

With orientation to the sum of iterations, an appropriate equilibrium has to be upheld between the exploration and exploitation.

$$\text{if } t \leq \frac{T}{2} \text{ then; } b_{max} - t \frac{m_j - m_i}{\frac{T}{2}}$$

$$\text{if } t > \frac{T}{2} \text{ then ; } B = (T - t + 1) \times \left(\frac{b \min}{T \times 10^t} \right)$$

Hybridization of proscopiidae optimization with myrmeleontidae algorithm (pm)

- a. Start
- b. Initialization of variables
- c. Population of the Myrmeleontidae and Proscopiidae are initialized
- d. While end condition is not satisfied
- e. Distance between the Proscopiidae is standardized
- f. Location of the existing exploration agent is rationalized
- g. By employing the roulette wheel selection technique an Myrmeleontidae will be selected
- h. Stimulate whimsical walk and it standardized
- i. Streamline the location of the Proscopiidae after the drive
- j. End for
- k. Once there is frontier defilement then the contemporary agent has been transported back
- l. Altogether the Proscopiidae fitness rate will be calculated
- m. With reverence to a Proscopiidae exchange the corresponding Myrmeleontidae
- n. Modernize the Myrmeleontidae

- o. Haphazardly streamline the location of the Proscopiidae
- p. End while
- q. Return with optimal value
- r. End

Pampas fox inspired optimization algorithm

Pampas Fox inspired optimization (PFO) algorithm is designed based on the searching actions of Pampas Fox while hunting the victim. Pampas Fox leap to stalk the victim. As soon as prey identified, Pampas Fox attempts to quest for victim arbitrarily. Subsequently, Pampas Fox discovers the victim by audible range of sonography emitted from the victim (prey). At that moment, Pampas Fox takes period in order to get to nearby to the victim. By heeding to the sonography (sound) of the victim and the period variance, the Pampas Fox can regulate the expanse amongst the aforementioned and the victim (García and Kittlein, 2005; Chatellenaz *et al.*, 2018). Subsequently after defining the expanse, the Pampas Fox estimate the leap in order to clasp the victim. Walking is accomplished arbitrarily rendering to the least period and preeminent location. Initially the Pampas Fox moves arbitrarily in the exploration region to determine the victim. Through sonography emitted from the victim (prey), Pampas Fox discover the victim and the arbitrary walk of the Pampas Fox is the exploration performance. Once the Pampas Fox hear sonography, which emitted from the victim (prey), then Pampas Fox move towards the prey and it is the exploitation segment. Pampas Fox as soon as move near to the prey, a leap will be performed depending on the movement of the prey (victim). Population engendered randomly, partial iterations are employed for exploration segment and remaining for exploitation segment. Fitness rate moves the exploration agents to evade local optima, since if the fresh location does not alter; the exploration segment disengages to permit other segments to be initiated.

Time and sound variation are computed in the exploitation segment,

$$\text{Expanse}_{iter} = \frac{\text{swiftness of sonography} * \text{period of sonography}_{iter}}{\text{period of sonography}_{iter}} \quad (17)$$

$\text{sonography} = 342.9 \text{ in air}$
 $\text{period of sonography} \in [0,1]$
 $iter \rightarrow 1 \text{ to } 500$

Grounded on the excellent location, the swiftness of the sonography is determined as follows,

$$\text{swiftness of sonography} = \frac{\text{Excellent location}_{iter}}{\text{period of sonography}_{iter}} \quad (18)$$

Expanse between the Pampas Fox and the victim (prey) is computed as,

$$E_{\text{Pampas Fox_Prey}_{iter}} = E_{iter} \times 0.50 \quad (19)$$

Subsequent to judgment of the expanse amongst Pampas Fox and the victim, the Pampas Fox prerequisites to discover a fresh location, consequently the Pampas Fox entails to leap and clasp the Prey (victim). Hence, Pampas Fox necessities to analyze the leap elevation sequentially,

$$\text{leap}_{iter} = 0.5 \times AG \times \text{period}^2 \quad (20)$$

$AG \rightarrow \text{acceleration due to gravity} = 9.81$

Then the fresh location of the Pampas Fox is computed when value “Z” exceeds 0.18 as follows,

$$Q_{(iter+1)} = \frac{\text{Expanse_Pampas Fox_Prey}_{iter} \times \text{leap}_{iter} \times a_1}{\text{leap}_{iter} \times a_1} \quad (21)$$

$$a_1 \in [0,1]$$

Location of the Pampas Fox is computed when value “Z” is below 0.18, then

$$Q_{(iter+1)} = \frac{\text{Expanse_Pampas Fox_Prey}_{iter} \times \text{leap}_{iter} \times a_2}{\text{leap}_{iter} \times a_2} \quad (22)$$

$$a_2 \in [0.19,1]$$

The values are picked based on the leap of the Pampas Fox in particular direction of north east or opposite to that direction. In the segment of exploration Pampas Fox examines arbitrarily rendering to the finest location of the Pampas Fox obtained so far. The Pampas Fox won't leap in this segment and in this phase it walks arbitrarily to discover the prey (victim) in the examination region. To endorse that Pampas Fox walks arbitrarily in the direction of the preeminent location, a least period parameter is used to regulate the examination. The period shift is calculated as follows,

$$\text{period shift}_{iter} = \frac{\text{Total}(\text{period}_{iter})}{\text{Magnitude}} \quad (23)$$

The least period parameter “b” is defined as,

$$b = 2 \times \left(iter - \left(\frac{1}{max_{iter}} \right) \right) \quad (24)$$

During the exploration segment Pampas Fox will explore new locations while moving towards the prey and it defined as,

$$Q_{(iter+1)} = Excellent\ Q_{iter} * Rand(1, magnitude \times b) \quad (25)$$

- a. Start
- b. Set the parameters
- c. Compute the fitness value
- d. if $Z > 0.18$, then
- e. Engender the period randomly
- f. Compute the expanse and speed of sonography
- g. $Expanse_{iter} = swiftness\ of\ sonography * period\ of\ sonography_{iter}$
- h. Compute the swiftness of sonography with period
- i. $swiftness\ of\ sonography = \frac{Excellent\ location_{iter}}{period\ of\ sonography_{iter}}$
- j. Calculate the distance between the Pampas Fox and prey
- k. $Expanse_Pampas\ Fox_Prey_{iter} = Expanse_{iter} \times 0.50$
- l. Compute the leap
- m. $leap_{iter} = 0.5 \times AG \times period^2$
- n. Calculate the fresh location of Pampas Fox
- o. $Q_{(iter+1)} = Expanse_Pampas\ Fox_Prey_{iter} \cdot leap_{iter} \times a_1$
- p. Else
- q. if $Z < 0.18$, then
- r. Engender the period randomly
- s. Compute the expanse and speed of sonography
- t. $Expanse_{iter} = swiftness\ of\ sonography * period\ of\ sonography_{iter}$
- u. Compute the swiftness of sonography with period
- v. Calculate the distance between the Pampas Fox and prey
- w. $Expanse_Pampas\ Fox_Prey_{iter} = Expanse_{iter} \times 0.50$
- x. Compute the leap
- y. $leap_{iter} = 0.5 \times AG \times period^2$
- z. Calculate the fresh location of Pampas Fox
- aa. $Q_{(iter+1)} = Expanse_Pampas\ Fox_Prey_{iter} \times leap_{iter} \times a_2$
- bb. Calculate the period shift

$$cc. period\ shift_{iter} = \frac{Total(period_{iter})}{Magnitude}$$

dd. Compute the new locations of Pampas Fox

$$ee. Q_{(iter+1)} = Excellent\ Q_{iter} *$$

$$Rand(1, magnitude \times b)$$

ff. Verify the limits

$$gg. t = t + 1$$

hh. Output the best solution

ii. End

Simulation study

PM and PFO algorithms are validated in IEEE 354 bus and 220 KV systems (El-Ela *et al.*, 2019). Table 1 and Table 2, Figures 1-4 shows the Tangible power loss and eccentricity estimation.

Table 1. Tangible loss, eccentricity assessment - IEEE 354

Method	Tangible Loss (MW)	Eccentricity (PU)
MHISAI (Nagarajan 2020)	337.374	0.4978
EMHISAI (Nagarajan 2020)	338.715	0.5117
MHIISA (Nagarajan 2020)	339.325	0.5216
EMHCLSO (Souhil <i>et al.</i> , 2018)	341.001	0.5354
EMHPSO (Souhil <i>et al.</i> , 2018)	341.123	0.6395
PM	323.378	0.4498
PFO	322.569	0.4412

Table 2. Tangible loss, eccentricity assessment - 220 KV

Method	Tangible Loss (MW)	Eccentricity (PU)
MHPSO (Mohamed 2022)	32.314	0.5800
EMHBBA (Mohamed 2022)	33.875	0.6327
EHBA (Mohamed 2022)	30.786	0.6751
PM	23.986	0.5627
PFO	22.879	0.5604

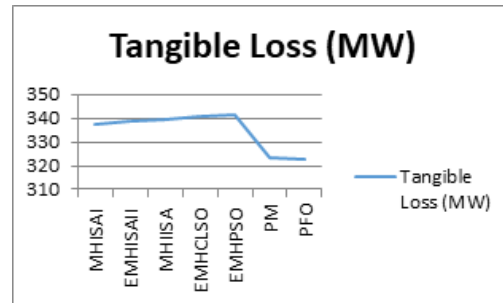


Figure 1. Comparison of Tangible loss (MW) (IEEE 354)

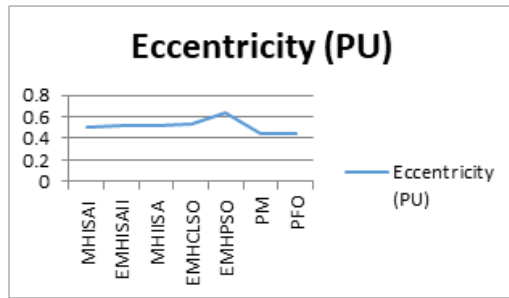


Figure 2. Comparison of eccentricity (PU) (IEEE 354)

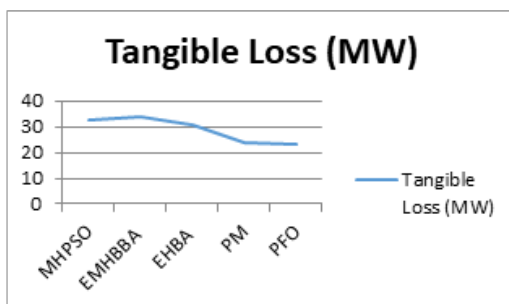


Figure 3. Comparison of Tangible loss (MW) (220KV)

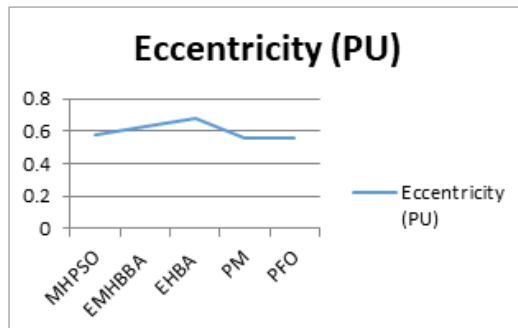


Figure 4. Comparison of eccentricity (PU) (220KV)

Tangible power loss (MW) obtained by the methods for practical 220KV system is MHP SO (Mohamed, 2022) -32.314, EMHBBA (Mohamed, 2022) - 33.875, EHBA (Mohamed, 2022) - 30.786, Projected Hybridization of Proscopiidae Optimization with Myrmeleontidae Algorithm (PM)- 23.986, and Pampas Fox inspired optimization (PFO) algorithm -22.879.

Conclusions

Tangible loss is reduced by Hybridization of Proscopiidae Optimization with Myrmeleontidae Algorithm (PM) and Pampas Fox inspired optimization (PFO) algorithm. In PMO approach, Proscopiidae optimization algorithm (POA) has been mongrelized with Myrmeleontidae optimization algorithm (MOA). Proscopiidae certainly move idealistically up until it reach a protected region and projected algorithm owns good exploration ability. Myrmeleontidae optimization algorithm owns exploitation. Roulette wheel selection technique applied in the procedure. In the exploration space Proscopiidae interrelate each other and identical number of Myrmeleontidae will be there in the exploration. In exploitation segment, movement of the Pampas Fox is towards the direction of the prey's sound. Population engendered randomly, partial iterations are applied in the exploration and exploitation segment. Exploration agent's moves based on the fitness rate to evade local optima and if the fresh location does not altered, then the exploration segment disengages to permit other segments will be initiated. PM and PFO algorithms validated in IEEE 354 bus and 220 KV systems. Tangible Power Loss Lessening has been attained.

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