1. INTRODUCTION

Reactive power optimization problem plays key role in protected & profitable operation of the power system. Numerous conventional methods [1-6] have been used already for solving the problem. A variety of drawbacks have been found in the conventional methods and mainly difficulty in handling the inequality constraints. Last two decades many evolutionary algorithms [7-14]. In this work Brachytrupes Algorithm (BA) has been utilized to solve the optimal reactive power flow problem. Brachytrupes are predominantly cylindrical, and vertically flattened one. Its head is sphere-shaped with extended slender antennae arise from cone-shaped scapes. Pronotum is trapezoidal in shape, vigorous, and well-sclerotinized. A pair of long cerci is present at the tip of the abdomen. Ovipositor shape is cylindrical, long, narrow, smooth and shiny in the female brachytrupes. Back pair of legs generally known as the femora are significantly enlarged for jumping. A number of moveable spurs are there in the hind legs. One or more tympani are present in the tibiae of the front legs which are used for the reception of sound. Projected algorithm presumes that the probability of a Brachytrupes sound for resentment is \( p \) which is between 0 and 1. Once a Brachytrupes makes sound for resentment, it is whispered that they randomly walk to another male Brachytrupes for brawl. The convincing Brachytrupes takes consign of the solution and eradicate the loser Brachytrupes. Female Brachytrupes are seduced by male Brachytrupes sound for mating while remaining male Brachytrupes will move away. Brachytrupes will mate and generate offspring. They progress to an innovative place, which means they are taken to enhanced location in the search space. Proposed Brachytrupes Algorithm (BA) has been validated in standard IEEE 57, 300 test systems. Real Power loss has been reduced when compared to other standard reported algorithms.

2. PROBLEM FORMULATION

Objective of the problem is to reduce the true power loss:

\[
F = P_L = \sum_{k=\text{Brac}} \beta_k \left( V_i^2 + V_j^2 - 2V_iV_j\cos\theta_{ij} \right)
\]

(1)

Voltage deviation given as follows:

\[
F = P_L + \omega \times \text{Voltage Deviation}
\]

(2)

Voltage deviation given by:

\[
\text{Voltage Deviation} = \sum_{i=1}^{\text{Npq}} |V_i - 1|
\]

(3)
Constraint (Equality)

\[ P_0 = P_b + P_l \]  (4)

Constraints (Inequality)

\[ P_{\text{gslack}}^{\min} \leq P_{\text{gslack}} \leq P_{\text{gslack}}^{\max} \]  (5)

\[ Q_{gi}^{\min} \leq Q_{gi} \leq Q_{gi}^{\max}, i \in N_g \]  (6)

\[ V_{li}^{\min} \leq V_i \leq V_{li}^{\max}, i \in N \]  (7)

\[ T_{i}^{\min} \leq T_i \leq T_{i}^{\max}, i \in N_T \]  (8)

\[ Q_{ci}^{\min} \leq Q_c \leq Q_{ci}^{\max}, i \in N_c \]  (9)

3. BRACHYTRUPES ALGORITHM

Brachytrupes are predominantly cylindrical, and vertically flattened one. Its head is sphere-shaped with extended slender antennae arise from cone-shaped scape. Pronotum is trapezoidal in shape, vigorous, and well-sclerotinized.

A pair of long cerci is present at the tip of the abdomen. Ovipositor shape is cylindrical, long, narrow, smooth and shiny in the female Brachytrupes. Back pair of legs generally known as the femora are significantly enlarged for jumping.

A number of moveable spurs are there in the hind legs. One or more tympani are present in the tibiae of the front legs which are used for the reception of sound.

On the body of Brachytrupes the wings are lie in flat mode and the fore wings are elytra made of tough chitin, stand-in as a protective guard for the soft parts of the body. In male Brachytrupes, stridulatory organ are present for the making of sound. Frequency and velocity of the sound is calculated. Secondly, when one Brachytrupes make sound for resentment other male Brachytrupes are beguile and other female Brachytrupes will move away. But All Brachytrupes will not make sound for resentment. Projected algorithm presumes that the probability of a Brachytrupes sound for resentment is p which is between 0 and 1. Once a Brachytrupes makes sound for resentment, it is whispered that they randomly walk to another male Brachytrupes for brawl. The convincing Brachytrupes takes consign of the solution and eradicate the loser Brachytrupes. Female Brachytrupes are seduced by male Brachytrupes sound for mating while remaining male Brachytrupes will move away. Brachytrupes will mate and generate offspring. They progress to an innovative place, which means they are taken to enhanced location in the search space.

3.1 Calculation of sound rate

The rate at which Brachytrupes makes sound is depend on relationship of air and temperature

\[ T_s = 49.80 + \frac{N_c-38.90}{3.85} \]  (10)

Number of sound per minute \( (N_s) \) is calculated with temperature \( (T_s) \)

\[ T_{cs} = 9.76 + \frac{N_c-38.90}{6.89} \]  (11)

At certain temperature \( T_c \) and \( T_f \) the sound rate is given by,

\[ N_s = (T_{cs} - 9.76) \times 6.89 + 38.90 \]  (12)  
\[ N_s = (T_f - 49.80) \times 3.95 + 38.90 \]  (13)

Brachytrupes sound is computed based on the sound \( N_s \) with respect to frequency \( F \) and velocity \( V \)

\[ F_s = N_s \times \gamma \]  (14)

\[ Vl = Fr \times \lambda \]  (15)

Each Brachytrupes step size of is computed as follows:

\[ \text{distance} = \frac{Vl}{Fr} \]  (16)

\[ \text{Step size} = \beta \times \text{distance} \times (\text{location} – \text{Best location}) \]  (17)

New-fangled position of the Brachytrupes is calculated by,

\[ \text{New fangled position} = \text{location} + \text{step size} \times \gamma \]  (18)

Step 1

By using equations; \( T_s = 49.80 + \frac{N_c-38.90}{3.85} \) or \( T_{cs} = 9.76 + \frac{N_c-38.90}{6.89} \) sound rate of each Brachytrupes will be computed.

By using equations; \( F_s = N_s \times \gamma \) and \( Vl = Fr \times \lambda \) Brachytrupes frequency, velocity will be computed.

By using equations; \( \text{distance} = \frac{Vl}{Fr} \) and \( \text{Step size} = \beta \times \text{distance} \times (\text{location} – \text{Best location}) \) step size will be computed.

By using the equation New fangled position = location + step size \( \times \gamma \) Brachytrupes new positions will be updated.

Revisit of Brachytrupes towards novel locations

End

Step 2

With respect to new location Male Brachytrupes randomly will pick a female Brachytrupes

A incise point will be chosen for the above procedure

Similar to a crossover in Genetic algorithm; genetic materials of both male and female Brachytrupes will be intermingled with reference to their incise point to generate two new-fangled offspring’s.

Fitness of the offspring will be computed

Movement towards the new locations by the offspring’s and the parents Brachytrupes

End

Step 3

Brachytrupes will walk to new locations when random \( > P \)

Fitness value of the Brachytrupes will be calculated in accordance to new locations

Best Brachytrupes will be chosen for further procedure

Movement towards the new locations by the Brachytrupes

End
3.2 Main procedure

Brachytrupes position will be located
Female Brachytrupes has to be chosen
Fitness value of each Brachytrupes has to be calculated
With respect to position choose the most excellent Brachytrupes \( f_{\text{best}}_{\text{Brachytrupes}} \)
Set \( g_{\text{best}}_{\text{Brachytrupes}} \) as the present \( f_{\text{best}}_{\text{Brachytrupes}} \) and in the preliminary generation \( g_{\text{best}}_{\text{Brachytrupes}} = f_{\text{best}}_{\text{Brachytrupes}} \)
While (stop criteria is not met)
Then
Sound for mating – (step1)
Male Brachytrupes to mate with female Brachytrupes – (step2)
Sound for resentment with probability \( P \) – (step3)
Fitness value will be calculated
From the innovative positions choose the \( f_{\text{best}}_{\text{Brachytrupes}} \)
Modify \( g_{\text{best}}_{\text{Brachytrupes}} \) with the present \( f_{\text{best}}_{\text{Brachytrupes}} \) .
When \( f_{\text{best}}_{\text{Brachytrupes}} > g_{\text{best}}_{\text{Brachytrupes}} \),
End while
Revisit to comprehensive best Brachytrupes at cessation
End

4. SIMULATION RESULTS

Performance of the proposed Brachytrupes Algorithm (BA) has been validated by tested in standard IEEE 57 bus system [15]. Total active and reactive power demands in the system are 1248.23 MW and 334.16 MVAR. Generator data for the system is given in Table 1. The optimum loss comparison is presented in Table 2. Figure 1 gives the comparison of active power loss.

Table 1. Generator data

<table>
<thead>
<tr>
<th>Generator No</th>
<th>Pgi minimum</th>
<th>Pgi maximum</th>
<th>Qgi minimum</th>
<th>Qgi maximum</th>
</tr>
</thead>
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<tr>
<td>1</td>
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<td>50.00</td>
<td>550.00</td>
<td>-50.00</td>
<td>155.00</td>
</tr>
</tbody>
</table>

Table 2. Comparison of losses

|-----------|------------|---------|----------|-----------|----------|-----------|----------|----|

Figure 1. Comparison of active power loss

Then the performance of the proposed Brachytrupes Algorithm (BA) has been tested in standard IEEE 300 bus system [15]. Table 3 shows the comparison of real power loss obtained after optimization. Figure 2 gives the comparison of real power loss.

Table 3. Comparison of real power loss

<table>
<thead>
<tr>
<th></th>
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</thead>
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<tr>
<td>PLOSS (MW)</td>
<td>646.2998</td>
<td>650.6027</td>
<td>635.8942</td>
<td>625.9864</td>
</tr>
</tbody>
</table>

Figure 2. Real power loss comparison

5. CONCLUSION

In this paper Brachytrupes Algorithm (BA) successfully solved the optimal reactive power problem. Projected algorithm presumes that the probability of a Brachytrupes sound for resentment is \( P \) which is between 0 and 1. The convincing Brachytrupes takes consign of the solution and eradicate the loser Brachytrupes. Female Brachytrupes are seduced by male Brachytrupes sound for mating while remaining male Brachytrupes will move away. Brachytrupes will mate and generate offspring. They progress to an innovative place, which means they are taken to enhanced location in the search space. Proposed Brachytrupes...
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REFERENCES


