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DIMINISHING OF TRUE POWER LOSS BY APIDAE ALGORITHM

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Abstract

In this paper, Apidae Algorithm (AA) is proposed for solving reactive power problem. Apidae Algorithm, inspired from the natural foraging behaviour of Apidae, & it has been utilized to solve the reactive power problem. The AA algorithm carry out the intensified neighbourhood search united with a random mode exploration search. Efficiency of the projected Apidae Algorithm (AA) is validated by evaluating in standard IEEE 118, 300 bus test systems. Simulated outcomes shows that active power loss has been reduced with variables are within the limits.

Keywords: Optimal Reactive Power; Transmission loss; Apidae algorithm.

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1. Introduction

Main aim of this work is to reduce the real power loss & to keep the variables within the limits. Till now various conventional techniques [1-6] have been applied to solve the problem. Major difficulties which have been found in conventional methods are overcome by using Evolutionary techniques [7-18]. But evolutionary algorithms are also stuck into local optimal solution. In this work Apidae Algorithm, is applied for solving reactive power optimization problem. Apidae Algorithm, inspired from the natural foraging behaviour of Apidae, & it has been utilized to solve the reactive power problem. The AA algorithm carry out the intensified neighbourhood search united with a random mode exploration search. Efficiency of the projected Apidae Algorithm (AA) is validated by evaluating in standard IEEE 118, 300 bus test systems. Simulated outcomes shows that active power loss has been reduced with variables are within the limits.

2. Problem Formulation

Objective Function

A. Real Power Loss

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

$$\mathbf{F = P_L = \sum_{k \in Nbr} g_k \left(V_i^2 + V_j^2 - 2V_iV_j\cos\theta_{ij}\right)} \quad (1)$$

B. Amplification of Voltage Profile

Voltage deviation given as follows:

$$\mathbf{F = P_L + \omega_v \times Voltage\ Deviation} \quad (2)$$

Voltage deviation given by:

$$\mathbf{Voltage\ Deviation = \sum_{i=1}^{Npq} |V_i - 1|} \quad (3)$$

C. Constraint (Equality)

$$\mathbf{P_G = P_D + P_L} \quad (4)$$

D. Constraints (Inequality)

In equality constraints are given by,

$$\mathbf{P_{gslack}^{min} \le P_{gslack} \le P_{gslack}^{max}} \quad (5)$$

$$\mathbf{Q_{gi}^{min} \le Q_{gi} \le Q_{gi}^{max}, i \in N_g} \quad (6)$$

$$\mathbf{V_i^{min} \le V_i \le V_i^{max}, i \in N} \quad (7)$$

$$\mathbf{T_i^{min} \le T_i \le T_i^{max}, i \in N_T} \quad (8)$$

$$\mathbf{Q_c^{min} \le Q_c \le Q_C^{max}, i \in N_C} \quad (9)$$

3. Deeds and Algorithm of Apidae

A colony of Apidae can exploit a huge number of food sources in big fields and they can fly up to 12 km to exploit food sources [19-26]. The colony utilize about one-quarter of its members as searcher Apidae. The foraging process begins with searching out hopeful flower patches by scout Apidae. The colony keeps a proportion of the scout Apidae during the harvesting season. When the scout Apidae has found a flower area, they will look further in hope of finding an even superior one. The scout Apidae search for the better patches randomly. The scout Apidae notify their peers waiting in the hive about the eminence of the food source, based amongst other things, on sugar levels. The scout Apidae dump their nectar and go to the dance floor in front of the hive to converse to the other Apidae by performing their dance, known as the waggle dance. The waggle dance is named based on the wagging run, which is used by the scout Apidae to communicate information about the food source to the rest of the colony. The scout Apidae presents the following information by means of the waggle dance: the quality of the food source, the distance of the source from the hive and the direction of the source.

Quantity of scout Apidae in the selected patches - *n*
Quantity of best patches in the selected patches - m
Quantity of elite patches in the selected best patches- e
Quantity of recruited Apidae in the elite patches -*nep*
Quantity of recruited Apidae in the non-elite best patches- *nsp*
The size of neighbourhood for each patch - *ngh*
Quantity of iterations- Maxiter
Variation between value of the first and last iterations- *diff*

Create the initial population size as *n*, *m*, *e*, *nep*, set *nsp*, *ngh*, *MaxIter,* and set the error limit as *Error*.
$i = 0$
Engender initial population.
Determine Fitness value of initial population.
Organize the preliminary population based on the fitness result.
While $i \leq maxIter\ or\ fitness\ value_i - fitnessvalue_{i-1} \leq Error$

i. $i = i + 1$;
ii. Prefer the elite patches and non-elite best patches for neighbourhood search.
iii. Employ the forager Apidae to the elite patches and non-elite best patches.
iv. Compute the fitness value of each patch.
v. Organize the results based on their fitness.
vi. Allocate the rest of the Apidae for global search to the non-best locations.
vii. Compute the fitness value of non-best patches.
viii. Organize the overall results based on their fitness.
ix. Run the algorithm until stop criteria met.

End

The primary move is to implement the shrinking approach. This approach works on a best site after a definite number of repetitions. The approach works until the repetition stops. If, in spite of the shrinking approach, the number of repetitions still increases for a definite number of iterations, then an augmentation approach is utilized. Finally, if the number of repetitions still increases for a number of iterations after the use of the augmentation approach, then that site is abandoned and a new site will be generated. Koc [24] utilized the following parameter for shrinking the neighbourhood size and site abandonment approach: neighbourhood size = *ngh*, the shrinking constant = *sc*, the abandoned sites = *aband_site*. In this study four more parameters are introduced. The first is the number of repetitions for each site, denoted as *keep_point*. The *keep_point* records the number of repetitions for all the repetitive results for best sites. The second parameter is called the "Repetition Number for the shrinking" is denoted as rep*_nshr*; the number of shrinking is the number of repetitions necessary to start the shrinking strategy, as given in Equations (10) and (11). The parameter is the "Repetition Number for the enhancement" is denoted as *rep_nenh*. This parameter defines the number of repetitions until the end of the shrinking process, and the beginning of the enhancement process as shown in Equations (10) and (12). The enhancement

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process works until the number of the repetitions is equal to the *rep_naban*, which denotes the "Repetition Number for the abandonment process". Hence a non-productive site is abandoned and it is stored in *aband_site* list. If there is no better solution than the abandoned site at the end of the searching process, this is the final solution.

$$new_{ngh} = \begin{cases} keep_{point} \leq rep_{nshr} & ngh \\ rep_{nshr} < keep_{point} \leq rep_{nenh} & R1 \\ rep_{nenh} < keep_{point} \leq rep_{naban} & R2 \\ rep_{naban} < keep_{point} & ngh \end{cases} \tag{10}$$

$$R1 = ngh - \left(ngh * \frac{(keep_{point} - rep\_nshr)}{100} * sc\right) \tag{11}$$

$$R2 = ngh + \left(ngh * \frac{(keep_{point} - rep\_nenh)}{100} * sc\right) \tag{12}$$

Simulation Results

At first IEEE 118 bus system [31] is used as test system to validate the performance of the proposed Apidae algorithm. Table 1 shows limit values.

Table 1: Limitation OF REACTIVE power sources

Bus number	5	34	37	44	45	46	48
Maximum value of QC	0.000	14.000	0.000	10.000	10.000	10.000	15.000
Minimum value of QC	-40.000	0.000	-25.000	0.000	0.000	0.000	0.000
Bus number	74	79	82	83	105	107	110
Maximum value of QC	12.000	20.000	20.000	10.000	20.000	6.000	6.000
Minimum value of QC	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 2 show the comparison of results.

Table 2: evaluation of results

Active power loss – Minimum & Maximum values	**Methodology - BBO [32]**	**Methodology - ILSBBO/ strategy1 [32]**	**Methodology ILSBBO/ strategy1 [32]**	**AA**
Minimum value	128.770	126.980	124.780	123.002
Maximum value	132.640	137.340	132.390	126.106
Average value	130.210	130.370	129.220	124.284

Finally, IEEE 300 bus system [31] is used as test system to validate the performance of the proposed Apidae algorithm. Table 3 shows the comparison of real power loss obtained after optimization.

Table 3: comparison of real power loss

Parameter	**Method EGA [30]**	**Method EEA [30]**	**Method CSA [29]**	**AA**
PLOSS (MW)	646.2998	650.6027	635.8942	627.1054

4. Conclusion

Apidae Algorithm, inspired from the natural foraging behaviour of Apidae, & it successfully solved the optimal reactive power problem. The AA algorithm carry out the intensified neighbourhood search united with a random mode exploration search. Efficiency of the projected Apidae Algorithm (AA) is validated by evaluating in standard IEEE 118, 300 bus test systems. Simulated outcomes shows that active power loss has been reduced with variables are within the limits. The simulation results presented in previous section prove the ability of AA approach to arrive at near global optimal solution.

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