OPTIMIZATION OF MODES OF ELECTRIC POWER SYSTEMS BY THE ALGORITHM OF ARTIFICIAL BEE COLONY

Afzalbek Bozorov Turg'unaliyevich
Teacher of Electrical Engineering subjects at Tashkent
District Vocational school No.1.

ABSTRACT

Optimal planning of modes of electric power systems (EPS) is a complex problem of nonlinear mathematical programming with many different constraints in the form of equalities and inequalities. Therefore, its solution by traditional algorithms is often associated with some simplifications, which generally lead to a decrease in the effect of optimization.

Key words: electric power system, optimization, planning, artificial bee colony, limitations.

Optimization of short-term regimes of electric power systems (EPS) refers to complex problems of nonlinear mathematical programming with many simple and functional restrictions in the form of equalities and inequalities. Therefore, its solution for modern EPS is often associated with a number of difficulties, determined by the complexity of taking into account functional limitations in the form of inequalities and the need to approximate the real energy characteristics of stations. Accordingly, the issues of improving the existing methods and algorithms for solving this problem [1, 2] in the direction of improving their computational capabilities remain relevant tasks.

The artificial bee colony algorithm was first developed by D. Karaboga [3]. It mimics the intelligent behavior of honey bees in order to achieve an optimal solution to various optimization problems. The algorithm is based on the behavior of bees - to collect nectar from natural food sources around the hive.

In the artificial bee colony algorithm, the position of food sources represents possible candidates for solving the optimization problem and the amount of nectar that determines the profitability of the corresponding probable solution. In this algorithm, the number of worker bees equals the number of food sources around the hive. If a worker bee cannot improve its solution within a certain time, then it becomes a scout bee, the main purpose of which is to improve the search capability of the algorithm. Scout bees perform a random search process to discover new food sources.

A colony of artificial bees consists of two groups called worker and non-worker bees. Non-working bees consist of observer bees and scout bees. The main steps of the algorithm are as follows:

1) Randomly selected positions of the food source are initialized according to the following formula:

$$X_{ij} = X_j^{min} + R \cdot \left(X_j^{max} - X_j^{min}\right), \quad (1)$$

where $X_i = \{x_{i1}, x_{i2}, \ldots\ldots\ldots, x_{iD}\}$, $i = 1, 2, \ldots\ldots\ldots, N_S$, $j = 1, 2, \ldots\ldots\ldots, D$; N_S is the number of food sources; D is the number of unknown variables; R is a random variable uniformly distributed in the interval [0, 1]; X_j^{min}, X_j^{max} - lower and upper boundary values of the j-th unknown variable. After initialization, the population of food sources (solutions) is subjected to repeated cycles of the search process by worker bees, observer bees and scout bees. The suitability of each food source is then calculated.

2) Each worker searches the neighborhood of its current food source to determine a new food source, which is determined by the formula

$$V_{ij} = X_{ij} + \alpha_{ij} \cdot \left(X_{ij} - X_{kj}\right), \quad (2)$$

where $k \in \{1, 2, \ldots\ldots, N_S\}$, $j \in \{1, 2, \ldots\ldots, D\}$- randomly chosen indices (in this case $k \neq i$) ; α_{ij} is a randomly chosen real number uniformly distributed in the interval [-1, 1], which is the monitored food sources near X_{ij} and represents the bee’s visual comparison of two food positions.

If the new position of the food source, obtained by formula (2), goes beyond the boundary values, then it is corrected according to the following condition:

$$X_i = \begin{cases} X_i^{\max} & \text{if } X_i > X_i^{\max}, \\ X_i^{\min} & \text{if } X_i < X_i^{\min}. \end{cases}$$

3) After generating a new food source, the amount of nectar in it is estimated and material selection will be made. If the nectar quality for the new food source is better than the current position, the worker leaves its current position and moves on to the new source. Otherwise, the bee keeps its current position.

4) The observer bee selects a food source based on the nectar received as information from the worker bee. The probability of choosing the i -th food source is determined by the following formula:

$$P_i = \frac{F_i}{\sum_{j=1}^{N_S} F_j}, \quad (3)$$

where F_i, F_j - fitness functions of the i -th and j -th positions of food sources.

Table 1. The result of the optimal load distribution of the power system between calculated TPP algorithm of artificial bee colonys.

TPP number , i	1	2	3	4	Total
CHP load , P_i, MW	452.16	70.00	702.45	475.39	1700.00
Consumption conv . fuel , B_i, tce /h	155.97	32.00	205.13	139.38	532.48
Relative increase in consumption cond . fuel , b_i, toe / MWh	0.334	0.334	0.334	0.334	

REFERENCES:

1. Автоматизация диспетчерского управления в электроэнергетике / Ed. Yu.N.Rudenko and V.A.Semenov . – M.: MPEI Publishing House, 2000.
2. Nasirov T.Kh., Gayibov T.Sh. Теоретические основы оптимизации режимов энергосистем. - T .: " Fan va texnologiya ", 2014.
3. Karaboga D. and Akay B., "A comparative study of artificial bee colony algorithm", Applied Mathematics and Computation, 2009. Vol. 214, P. 108-132.