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Improved ant colony algorithm in the distribution of reactive power compensation device and optimization

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Abstract :Ant colony algorithm is a kind of simulation of collaborative optimization algorithm of ants foraging, imitating ants dependence information communication and social behavior, showing in the agents, on the basis of the definition of a greedy method under the guidance of the catalytic process guide each agent. Put forward improved ant colony algorithm is applied to power system of reactive power optimization, to IEEE14 node system by simulation calculation, the optimal scheme of reactive power compensation, the optimization design and improvement of ant colony algorithm of the optimization results can be more effectively at or near the optimal.

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Keywords: Power; Ant colony algorithm; Reactive power compensation; Optimization; Improved ant colony algorithm

1. introduction

In the electric power load distribution transformers, such as motor, most belonging to perceptual load, which need to consume large amounts of reactive power, long-distance transmission, increased power loss. In the power of installation shunt capacitor such reactive compensation device, can provide the perceptual load of reactive power consumed, namely the reactive power compensation. In China, the lowest level distribution network loss, universal, low voltage qualification rate, in such circumstances, the distribution of reactive power optimization research has important practical significance.

The ant colony algorithm (ACA) is put forward in recent years to a new kind of simulated evolutionary algorithm, and finally after multiple iterative approximation problem with maximum probability of optimal solution. Ant colony algorithm is parallel to the positive feedback algorithm, has stronger robustness, easily with other methods. Compared with other intelligent optimization algorithm has global searching capability, simple programming, but generally takes a long time, can use to search. Based on IEEE14 node as an experimental system simulation system, reactive power compensation devices to bring real utility to power supply departments of persuasive power of reactive power compensation with the work.

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2. improvement of ant colony algorithm

2.1 ant colony algorithm

Ant colony algorithm is in the simulated annealing algorithm, tabu search algorithm and genetic algorithm, the artificial neural network algorithm and so on a series of heuristic search algorithm and an application of intelligent optimization problem in the heuristic random search algorithm, show in complex optimization problem of intelligent improved ant colony algorithm has a lot of advantages. Ant colony algorithm is based on the biological, when the ant search for food or in the nest in the path to the land, they left chemicals, namely, make certain information within the scope of the other ants can perceive and influence its behavior. When a path through the ant, leaving the pheromone more and more, so that the choice of the path of ants later higher probability, and increase the path to attract intensity, ant colony on the internal mechanism of formation of biological association, gradually formed a prior to their own unaware of the shortest route. Ant colony algorithm is required in each of the search space namely ant, an ant optimization function by a fitness value determined according to him, the ant is how much of the information surrounding the direction of their decision, ants and the road release information, to influence other ants.

2.2 Simple ant colony algorithm

Consider target function: $f_{\max} = \max \{f(x) | x \in B^L\}$, $B^L = \{0,1\}^L$, $0 < f(x) < +\infty$. Set t moments of

ant colony $A(t) = \{a_0(t), a_1(t), \dots, a_k(t) \dots a_N(t)\}$, $a_k(t) \in B^L$, N for ant colony optimization scale

definition, $X_k(A(t)) = a_k(t)$. For $x \in B^L$, the definition of $x = 0, 1$ (j j. 1. - 1, ...), the scope for $\{0,1\}$. Set

information collection $W(t) = \{w_{00}(t), w_{10}(t), \dots, w_{ij}(t), \dots, w_{0L-1}(t), w_{1L-1}(t)\}$, $i = 0, 1$, $j = 1, 2 \dots L - 1$.

(1) $t = 0$, constant;

(2) For $k = 1 \sim N$, $j = 1 \sim L - 1$ do $r_j(a_k(t))$, According to

$$\text{probability: } Pr_{ij}(t) = (1 - p_{mut}) \frac{(w_{ij}(t))^\alpha (E_{ij})^\beta}{(w_{0j}(t))^\alpha (E_{0j})^\beta + (w_{1j}(t))^\alpha (E_{1j})^\beta} + \frac{p_{mut}}{2}, \text{ Take it for } 0, 1, 0 < p_{mut} < 1.$$

E_{0j} and E_{1j} in j bits from respectively 0 and 1 static inspiration.

(3) For $i = 0 \sim 1$, $j = 0 \sim L - 1$, $a_0(t) = a_b(t)$, $b \in \{0, 1, \dots, N\}$, $w_{ij}(t) = w_{ij}(t)(1 - \eta)$, $0 < \eta < 1$, η is attenuation coefficients.

(4) For $k = 1 \sim N$, $j = 0 \sim L - 1$, $w_{r_j(a_k(t))j}(t+1) = w_{r_j(a_k(t))j}(t) + \delta / f(a_k(t))$, δ is constant.

(5) to $t = t + 1$, if t meet beforehand, given the maximum number of iterative optimization is not clear when or $f(a_0(t))$ output current, the optimal solution $a_0(t)$, Otherwise, to the second step.

2.3 Improved ant colony optimization algorithm

The ant colony algorithm and optimization process has three aspects: choice mechanism, update mechanisms and coordination mechanism. In the process of selecting mechanism, the ant colony algorithm through positive feedback optimal solution is the principle, strengthen if evolutionary eras to a certain degree, the premature stagnation phenomenon, and the optimal solution is local optimal, In the update mechanisms, most ant colony algorithms are neglected to understand.

In view of this, in the mathematical model of conventional by introducing "together" to measure the solution, thus even the strategy decision information updates every choice and the probability of path. If you have a test on the path of ants distribution is dispersive, together, thus difficult to strengthen lesser degree, so that the optimal information search slower, must strengthen the positive feedback information, make a few several excellent path with the larger probability is selected, when only the information updates, several more optimal path of information can get maximum enhanced. Conversely, when the test path when the ant on the distribution, large cluster degrees, causing premature and stagnation, intelligent optimization is to make solution, so you should let tend diversification of path has certain probability selected by dynamic adaptive, adjust and more information on the path is improved, and can effectively improve ant search speed of in the meantime also can avoid local optimization. Therefore, we

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