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Research Article

Smart Power Evolution of Food Refrigerated based on Particle Swarm Optimization Algorithm

[1]Chen Zhongbin, [1]Deng Fangming, [2]Liu Yijian and [1]Wei Baoquan
[1]School of Electrical and Electronic Engineering, East China JiaoTong University, Nanchang,
[2]School of Electrical Engineering and Automation, Hefei University of Technology, Hefei, China

Abstract: Particle Swarm Optimization (PSO) algorithm is a new evolutionary computation technique. This article has conducted the thorough research to the PSO algorithm, analyses the algorithm principle, basic steps, application steps and parameter settings and other content. This study introduces the idea of random inertia weight and the discrete PSO algorithm is improved, which makes it easy to jump out of local optima and discrete optimization problem. The establishment of the best repair path and the best routing model of electric power communication network, the improved algorithm is applied to power communication network management in the two aspects, it can quickly find the optimal path and the routing request, prove the feasibility and effectiveness of PSO algorithm for solving the discrete problem. The establishment of the optimal route choice model, based on local search and memory unit in the algorithm, the optimal route selection program using the improved PSO algorithm simulation, the results show the effectiveness of the PSO algorithm for solving the discrete problem and potential.

Keywords: Particle swarm optimization, power communication network, total quantity of knowledge

INTRODUCTION

The development of electric power communication network put forward new requirements for network management, put forward a challenge to the network management in the past, a new generation of management in electric power communication network provides a new research topic (Eberhart and Kennedy, 1995). How to build an electric power communication network can meet the requirements of the network management system development, or what principles to the various network management system, management system and the telecom management network to select the more adapt to the network management system in electric power communication network of our own, is a problem worthy of attention (Gungor and Lambert, 2006).

The distribution of physical structure of electric power communication network and the current business needs, should be a reasonable distribution of routing, routing and transmission path selection and its service quality to meet the requirements for access to business and ensure the efficient use of network resources (Nikolaos and Theodore, 2007; Bayod-Rújula, 2009). Circuit routing management is an important content of network management of electric power communication network which is responsible for the circuit resource management in communication network, including resources, communications network in the channel and transmission circuit, 2M circuit and the audio circuit over business resource management and choose the best route to improve the electric power communication network quality of service, network load balancing the people began to try to use a variety of methods to improve and strengthen the management of the network of the electric power communication network. In recent years, people put forward a communication model of any cast, which is a source and a set of goals in a given network, for the arrival of the routing path from source point, it provides a valuable reference for the management of the electric power telecommunication network (Qi *et al*., 2005; Luder, 1974).

In our study, the discrete PSO algorithm is improved, which makes it easy to jump out of local optima and discrete optimization problem. According to the application field of power telecommunication network management and the characteristics of particle swarm optimization algorithm, based on improved particle swarm optimization algorithm will be applied to power communication network management. In order to improve the efficiency of network management of electric power communication network; particle swarm optimization algorithm was used to select the best repair path and the best route to improve the

Corresponding Author: Deng Fangming, School of Electrical and Electronic Engineering, East China JiaoTong University, Nanchang, China

service quality of network management. According to the two aspects of the power communication network and management, the best repair path and selecting the best route according to the selected mathematical model and simplify.

MATERIALS AND METHODS

The research status of power communication network: According to the transmission equipment, switching equipment and the terminal equipment to the intelligent, domestic electric power communication network integrated direction, progress of construction of electric power communication network infrastructure, diversity transmission mode, in order to make the network equipment to better communication network interconnection in order to complete the communication needs of specific and special requirements on communication index to meet the power system, several companies of domestic research and development of beneficial to the electric power communication network management (Cai *et al*., 2005). Electric power communication network management system was in Beijing Power Supply Bureau, the establishment of network communication equipment in each model by using the method of hierarchical structure model. The provision of relationship was between the different connection devices, the use of circuit configuration information between cable and equipment connection (Zhao and Mark, 2005).

Particle swarm optimization algorithm has been put forward from more than ten years ago, but it has been widespread concern. Based on the basic PSO algorithm, the improved PSO algorithm in various meaningful have emerged, such as PSO algorithm, PSO algorithm, adaptive immunity, hybrid PSO algorithm, PSO algorithm is very suitable for solving multi-objective optimization, continuous function optimization problems and other applications. There are PSO algorithm is used to solve discrete optimization problem, for example, is used to solve the TSP problem, combinatorial optimization problem of task allocation problem. But PSO algorithm is started in our country, with the development of improved algorithm and its application field is more and more widely, this study applied to power communication network management is also a meaningful attempt for the improvement and development of the algorithm itself and the electric power communication network management will play a positive effect (Kim *et al*., 2010; Lien *et al*., 2008).

The mathematical representation of particle swarm optimization algorithm: As described by mathematics: the assumption that in a N dimensional search space, a M solution of potential problems represent a population of particles, the particle I in N dimensional space position is expressed as a vector $Xi = (x_1, x_2,\ldots, x_N)$

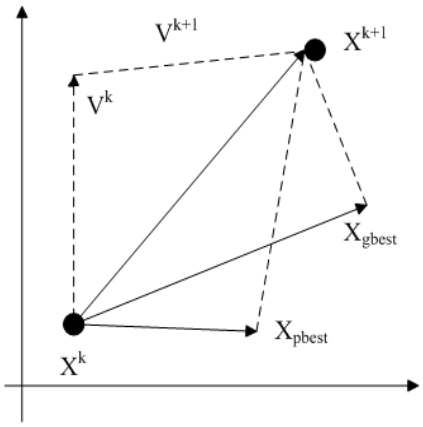

Fig. 1: Particle motion diagram

Flight speed is represented as a vector $Vi = (v_1, v_2,\ldots, v_N)$.

For the K iteration, each particle in PSO is in accordance with the change of type:

$$v_{id}^{k+1} = wv_{id}^{k} + c_1 rand() \times (p_{id}^{k} - x_{id}^{k}) + c_2 rand() \times (p_{gd}^{k} - x_{id}^{k}) \quad (1)$$

$$x_{id}^{k+1} = x_{id}^{k} + v_{id}^{k+1} \quad (2)$$

Figure 1, in the two dimensional space as an example to describe the particle according to Eq. (1), (2) the principle of moving from position Xk to Xk+1.

Particle during the flight, a comprehensive analysis of their own and other particles flying experience to constantly adjust the direction and speed of their advance, forming groups of optimizing the positive feedback mechanism, so that the whole community is generated from disorder to order in the solution space of evolution. All particles are adapted to calculate the corresponding objective function value and based on its evaluation of the merits of the particles, the particles gradually driven near optimum area, the final search to the optimal solution. Typically the particles will follow the current optimal particles move.

Improved method of particle swarm optimization algorithm: Inspired by the local PSO and the genetic algorithm, the replication and recombination in the genetic algorithm which called reproduction method is applied to the global version of PSO, the method to select the certain probability of P particles, these particles in the update is not according to the standard PSO approach (according to the particle itself to find the optimal solution and the find the solution to the particle velocity and position update itself), but to the selected particle father generation, position and speed to generate new particles according to the following formula:

$$\begin{aligned} Child_1(Xi) &= p^* Parent_1(Xi) + (1.0 - p)^* Parent_2(Xi) \\ Child_2(Xi) &= p^* Parent_2(Xi) + (1.0 - p)^* Parent_1(Xi) \end{aligned} \quad (3)$$

Table 1: 5 Benchmark functions used to test and their parameters

Function name	Dimension	Search space
$f_1(x)=\sum_{i=1}^{n} x_i^2$	20	[-100, 100]
$f_2(x)=\sum_{i=1}^{n}\left(\sum_{j=1}^{i} x_j\right)^2$	20	[-100, 100]
$f_3(x)=\sum_{i=1}^{n}\lvert x_i\rvert+\prod_{i=1}^{n}\lvert x_i\rvert$	20	[-10, 10]
$f_4(x)=-20*\exp(-0.2*\sqrt{\frac{1}{n}\sum_{i=1}^{n} x_i^2})$ $-\exp(\frac{1}{n}\sum_{i=1}^{n}\cos(2\pi x_i))+20+e$	20	[-32, 32]
$f_5(x)=\sum_{i=1}^{n}(x_i^2-10\cos(2\pi x_i)+10)$	20	[-5.12, 5.12]

$$Child_1(Vi)=\frac{parent_1(Vi)+parent_2(Vi)}{\left|parent_1(Vi)+parent_2(Vi)\right|}*\left|parent_1(Vi)\right| \quad (4)$$

$$Child_2(Vi)=\frac{parent_1(Vi)+parent_2(Vi)}{\left|parent_1(Vi)+parent_2(Vi)\right|}*\left|parent_2(Vi)\right| \quad (5)$$

In PSO, the search interval of each dimension is separately between the value of [0.2, 0.6], [0.8, 1.6] and [2.8, 3.45]. 1.375. In this study, all the simulation mean value is 10, the evolution of 150000 times. In order to evaluate the DBPSO optimization performance, 5 benchmark function simulation of DBPSO algorithm was used Table 1, the test function dimension unified value of 30 and compare the optimization performance with the standard PSO algorithm and NMPSO algorithm DBPSO.

Cooperation and competition among the particles were as follows: all particles constantly contribute their information to the advantage of the population constitutes the most public of the advantages to assist other members of the flight and the common search for efficiency and improve the overall level of knowledge. This updated information in the form of public-point broadcast notification of all particles, all particles can be timely informed of the latest information. Meanwhile, the inter-particle and compete to contribute their best advantage to replace the population in the most advantages to become the winner of the population. In addition, no external particle also has a shared history of individual merit, which is driven by its attempt to get rid of the entire control, also affects the particle next flight.

Set the population size are N and all the individuals of the population are m hexadecimal code of n bits. Algorithm of all approximate solution as a point of the state space in S1 and intermediate groups all approximate solution as a point of the state space in S2. When there is no need to distinguish between S1 and S2, you can use the S state space representation. Si said the S in the I state, Vni represents a random variable V in the state of Si in the n generation. Let f (.) is the objective function to be optimized; its domain can be defined for I, f (at) the global optimal solution set:

$$S=\{x\in I \mid f(x)=\max_{x_i\in i} f(x_i)\} \quad (6)$$

Proof:

$$\text{Set } S_i=(x^0,x^1,...,x^{N-1})\in S^1 \quad (7)$$

Let:

$$f(s_i)=(f(x^0),f(x^1),...,f(x^{N-1})) \quad (8)$$

If $f(s_i) = f(s_j)$ or the first component of $(f(s_i) - f(s_j))$ is positive, then let $s_i \geq s_j$.

Furthermore $\beta = \{i|s_i \geq s_j, \forall s_j \in S^1\}$, we can know from all above reasons,

If $i \in \beta$, then $S_i = (x^0, x^1,....,x^{N-1})$ can meet the follow formula:

$$f(x^0)=f(x^1)=...=f(x^{N-1})=f^* \quad (9)$$

RESULTS AND DISCUSSION

Global version: Particles in the search process, tracking two extreme value, its extreme value p best and g best populations of the global extreme value, called the global version of PSO (global version), the global model, the topological structure was shown in Fig. 2.

According to the global and local search mechanism model can be seen, the convergence speed and the ability to jump out of local optimum difference. Because of the global model of all particles, the particles to share information, the optimal convergence trend is very significant, so the global model usually converge to the local structure of the advantages of speed is fast, but it is easy to fall into local minimum, the performance of the entire population to converge to a good first solution. Local model allows the optimal

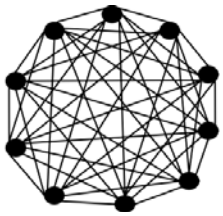

Fig. 2: Global version

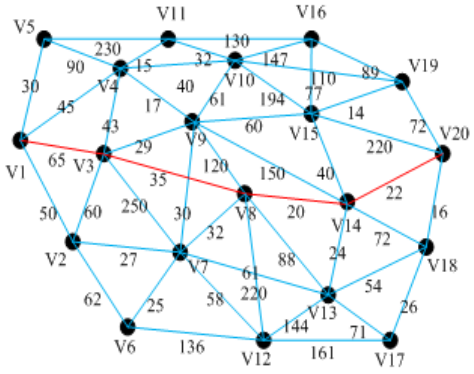

Fig. 3: Optimization routing of electric power communication network

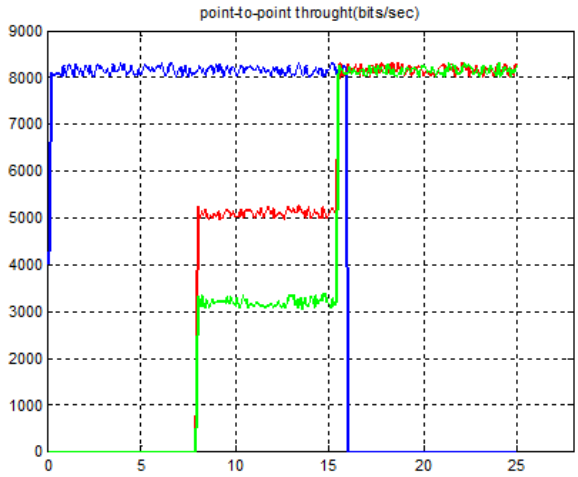

Fig. 4: The blue curve shows the node2-> hub flow, the red curve represents the node2-> node1 traffic, green curve represents the node2->node3 flow

position of particle and its neighbors to the current search and mutual influence, even worse than the value of the value of the population, can make the poor individuals evolve into better individual, not easy to fall into local optimum, but it takes a long time to converge to the optimal solution.

Application of particle swarm algorithm in routing the electric power communication network: Routing is a fundamental problem in geographic information system, is a process of decision support. Route selection is usually based on the electronic map database, implemented by the routing algorithm, graph theory, operational research, involving network and dynamic programming knowledge. In the electric power communication network routing, the optimum geometric distance, usually refers to the cost of the smallest weight, in order to convenient, can also be used to refer to a variety of distance weights, then the best route is the shortest path. The optimal routing problem can be used in the communication network topology structure and the communication routing in communication networks. In the station and channel cost is known, how to connect the network of minimum cost planning; determine the communication network topology structure how to choose the best communication route between the station and alternate routes to meet certain requirements, including the methods of the switching frequency and other indicators, all belong to the optimal routing problem.

In order to solve the problem of network management of power communication network routing problem, we put the bandwidth, switching frequency, line needs to consider the use rate, distance and cost constraints, to quantify the link weights by Cij, to the simulation test, we use the following network structure, node with V1~V20 that the number represents the link the weights of the edges, the comprehensive consideration of various factors to quantify the value of. Simulation results achieved was shown in Fig. 3, this case also shows that the PSO algorithm is effective to solve the discrete problem.

Figure 4, the red curve represents a single node 2 hub power network traffic between hub traffic, node2 a blue line represents the star network; green curve represents the traffic between the node1, node2.

As shown in Fig. 5 in less than 500s. During normal operation of the network, star shaped network on the main path of flow and nodes contract rate has been, for 8000bps. At this point the data packet without backup path forwarding, traffic on the backup path is 0. At this time network sales ete delay and monolayer artificially cobweb model, were maintained at around 64ms. At this time, the star network communication performance and artificially cobweb model similar.

However, once breaking the case, the algorithm will quickly converge to the global optimum. Collaboration and competition PSO algorithm optimization rely particles between itself and no mutation mechanism, so once the local extreme constraints being difficult to break free. If at this time without the help of an external force, then the local maxima algorithm will become the final solution results. The mutation mechanism is often played such a break standstill and directing the solution space particle swarm into action in other regions.

For each object in the T-1 time, the deterministic in some sports constraints define it with the t moment an object corresponding to the cost function. Tracking is designed in the corresponding relationship between all

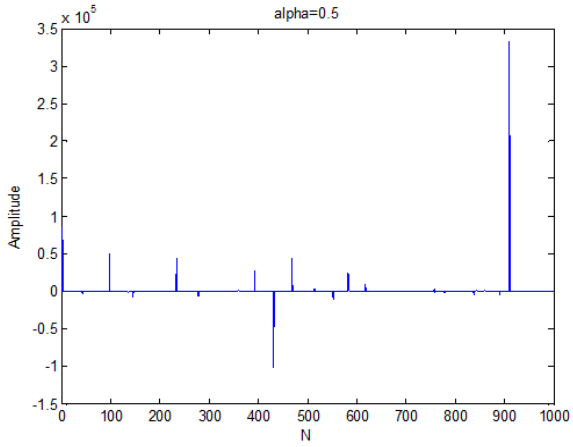

Fig. 5: The blue curve represent the flow of node1-hub1 node1-hub2

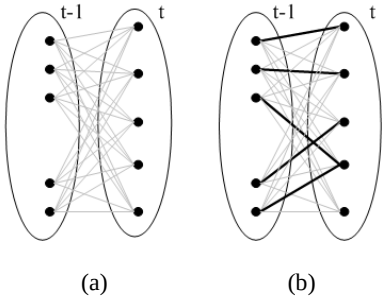

Fig. 6: Tracking is designed in the corresponding relationship between one-to-one correspondence

(Fig. 6a) to get a one-to-one correspondence between the (Fig. 6b), there are usually makes the corresponding value of the cost function method for solving minimum Hungary algorithm and greedy search algorithm.

CONCLUSION

This study is mainly to solve another application of the PSO algorithm, is used to optimize the best route selection of electric power communication network. The optimal routing algorithm is discussed, summarizes the common routing algorithm and its classification. Select the model of the electric power communication network routing, aiming at this problem, the improvement of PSO algorithm based on local search and memory unit and simulate the actual routing is realized to select the best route, to verify the effectiveness of the PSO algorithm to solve this problem.

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