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Application of the Improved Chaotic Ant Routing Algorithm into Radar system of Internet of Things

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***Abstract*: IOT is introduced into radar system to solve the problem of radar sensors optimized deployment. Each radar sensor is no longer about independent radar. Optimal radar placement is the challenging issue in radar system for target coverage problem. We have suggested a new technique called ICSAMA to identify the optimal sensor position to cover the entire targets. Furthermore, by redesigning the three processes of the MA, ICSAMA is presented to obtain the higher convergence accuracy and avoid falling into the local optimal solution. A comparison and analysis are conducted to demonstrate the performance and convergence precision of ICSAMA and the effects of the adjustable parameters on the algorithm. A mathematical model of radar sensors deployment is established based on the volume of the radar detection airspace, and three examples indifferent scenario simulated to verify the better performance of ICSAMA compared to the MA.**

***Keywords*: Radar sensors optimized, adjustable parameters.**

1. Introduction

As a new development of information technology in recent years, the internet of things (IOT) has received worldwide concern. Many IOT applications rely on embedded sensors to perform critical measurement tasks or are as an important part of control circuits. The development of sensors enables new applications, and radar sensors have become an important design unit in IOT and embedded design. Radar sensors network with IOT is a good approach for coping with the increasingly complex conditions of modern wars to deploy the radar sensors to improve the efficiency of the radar sensors network system is the original intention of the optimization. Radar sensors network can be implemented by simple rational allocation of existing radars and selecting radar sensors positions in a certain tactical background and selected theater.

There has been an increasing research focus on deploying radar sensors by the use of optimization algorithms. Optimal radar sensors locations can be achieved by use of the shuffled frog leaping algorithm. The genetic algorithm has been used to realize optimal deployment of radar sensors in static locations to obtain the best radar sensor ``four-counter'' ability. A speed variation mechanism is introduced into particle swarm optimization (PSO) and then, modified PSO is implemented to solve the radar sensors optimization deployment problem. However, the above-mentioned algorithms work well only for limited objective function dimensions. In other words, when the dimensions are relatively large, the mentioned algorithms fail in radar sensors deployment. To achieve the maximum returns with the minimal resource investment in the modern battle field, optimized deployment of radar sensors maximizes the role of each radar sensors and facilitates coordinated control of the entire system to accomplish the established tasks. The third aspect is the overlooking process, which uses an adaptive factor of trade-off between the visual field and duration to accelerate the local search rate.

2. Existing system

The MA's strong points and avoid its weaknesses, four aspects of the MA are modified as follows. The first aspect is the initial population generation using chaotic technology to retain the diversity of the population. The second aspect is the use of an adaptive factor to adjust the step length to improve the algorithm's precision in the climbing process. The third aspect is the overlooking process, which uses an adaptive factor of trade-off between the visual field and duration to accelerate the local search rate. The last aspect is the introduction of a learning factor and niche technology to the jumping process, which respectively, controls each monkey's learning strength for the sake of accelerating the convergence and avoiding homoplasy of the monkey population to globally optimize the solution. Therefore, ICSAMA is an improved version of the MA.

Many IOT applications rely on embedded sensors to perform critical measurement tasks or are as an important part of control circuits. The development of sensors enables new applications, and radar sensors have become an important design unit in IOT and embedded design. Radar sensors network with IOT is a good approach for coping with the increasingly complex conditions of modern wars to deploy the radar sensors to improve the efficiency of the radar sensors network system is the original intention of the optimization. Radar sensors network can be implemented by simple rational allocation of existing radars and selecting radar sensors positions in a certain tactical background and selected theater There has been an increasing research focus on the deploying of radar sensors by use of optimization algorithms. Locations of Optimal radar sensors can be achieved using the shuffled frog leaping algorithm. The genetic algorithm has been used to realize optimal deployment of radar sensors in static locations to obtain the best radar sensor ``four- counter'' ability. A speed variation mechanism is introduced into particle swarm optimization (PSO) and then, modified PSO is implemented to solve the radar sensors optimization deployment problem. However, the above-mentioned algorithms work well only for limited objective function dimensions. In other words, when the dimensions are relatively large, the mentioned algorithms fail in radar sensors deployment. To achieve the maximum returns with the minimal resource investment in the modern battle field, optimized deployment of radar sensors maximizes the role of each radar sensors and facilitates coordinated control of the entire system to accomplish the established tasks.

3. Problem statement

The Shortcomings of the MA is misplacing of route to target and tracing wrong place of target finding have been identified. These shortcomings include maintaining all MA parameters at their default values, the influence of the setting of MA parameters on its performance, long execution time, low convergence precision and slow convergence speed. Therefore, to further study the optimization mechanism of the MA, ICSAMA is proposed in this paper, which can overcome the above shortcomings and obtain the global optimal solution quickly and effectively.

4. Proposed system

Jumping ant routing based solution for the Optimal routing Problem has been implemented and investigated. Carrying out an extensive simulation for correctness of algorithm. It is observed that routing energy efficiency depends on the number of sources. The results of simulation reveal that this optimal routing algorithm save energy for moderate number of source nodes. The simulation results shows that, using spray and focus, the delay can be reduced compared to the existing techniques. Hence this "dual" mechanism improves energy efficiency and minimizes delay.

To improve the searching ability of the MA, individuals with the best positions are selected as the starting points and the learning factor is introduced into the jumping process. In addition, a niche technology is used to eliminate convergent individuals in the learning from optimal individuals. The learning factors allow most individuals in the population to learn from the optimal models. Therefore, homoplasy is formed and greatly reduces the diversity of the population. The niche technology replaces individuals within the niche radius with random individuals to avoid excessive convergence and maintain diversity.

A. Ant routing algorithm

Ant Routing Algorithms are inspired by the behavior of real ant colonies. Many studies have discussed the use of this algorithm to solve various problems. Since it is reliable, survivable and dynamic, the optimum solution for this algorithm is determined by creating artificial ants. The artificial ants search the solution space as real ants search their environment for food. The probabilistic movement of ants in the system allows the ants to study new paths and to re-explore old visited paths. The strength of the pheromone deposit directs the artificial ants towards the best paths, while the pheromone evaporation lets the system forget old information and avoid quick convergence to sub-optimal solutions.

1) Route discovery

Ants are classified as forward, backward and guide ants. Forward and backward ants are responsible for collecting path information and updating pheromone. A guide ant constructs an optimal path when all the backward ants have arrived at source a node, or when the network topology has changed. Every node also has a pheromone.

2) Forward ant

Every node in the network can be considered as a source, destination or intermediate node. A node that wants to find a path to a destination sends forward ants to search for this destination and obtain path information. When a forward ant is generated by source node, it adopts the pheromone table to obtain the next visiting node and record the path information. According to the routing principle, the next visiting node of an ant depends only on the probability in the pheromone table. In the proposed algorithm, ants prefer to move to a node that has not been visited. Such behavior is introduced to prevent ants from being enticed into the same route, thus losing the advantage of explored.

3) Backward ant

When the backward ant is received, if this node is intermediate node of the backward ant's stack, then the node collects the grade from the backward ant's stack and then updates the pheromone table using the grade of the backward ant, and sends the ant to the next intermediate node. If the node is an internal node, then the node looks up the routing table and transmits the ant to the next destination. The backward ant is killed when it arrives at the source node.

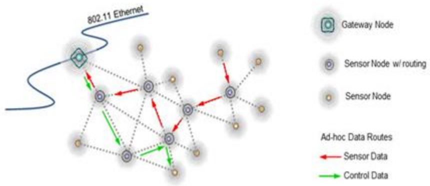

Fig. 1. Mesh topology: node connection

5. Conclusion

Jumping ant routing based solution for the Optimal routing Problem has been implemented. Extensive simulation is carried out for correctness of algorithm. It is observed that routing energy efficiency depends on the number of sources. The results of simulation reveal that this optimal routing algorithm save energy up to 45% for moderate number of source nodes. The delay can be reduced to 20 times compared to the existing techniques. Hence this “dual” mechanism improves energy efficiency and minimizes delay style.

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