Computer Application of Game Map Path Finding Based on Fuzzy Logic Dynamic Hierarchical Ant Colony Algorithm

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Abstract. Ant colony algorithm has a wide range of application value in robot path planning. When the robot encounters obstacles, it can find the optimal path in the model space according to relevant performance indexes, and the collision times from the starting point to the target position are the least. In this paper, the research significance of ant colony algorithm in game map path finding is briefly discussed, and the application of ant colony algorithm in map path finding is explained for readers’ reference.

Keywords: Logic Dynamic Classification, Ant Colony Algorithm, Mobile Robots, A Two-Dimensional Space

1. Introduction
The path planning of mobile robot can be divided into global path planning and local path planning. Through reasonable application of ant colony algorithm, robot transformation can be optimized to avoid obstacles while reducing time [1-3]. The following is a description of the game map path finding of ant colony algorithm.

2. The research significance of fuzzy logic dynamic hierarchical ant colony algorithm on game map path finding
With the development of computer, electronics and information technology, great changes have taken place in modern mobile robots and unmanned aerial vehicles. With the increasing difficulty and danger of the task, it is more and more difficult to realize the navigation task of mobile robot or unmanned aerial vehicle by manual operation. Therefore, how to bestow intelligence on mobile robots and unmanned aerial vehicles to achieve autonomous navigation and control has been paid much attention by researchers at home and abroad [4-6]. As one of the key technologies for autonomous navigation of mobile robots and unmanned aerial vehicles, path planning has become a hot research topic at home and abroad. This topic mainly studies the path planning problem of mobile robot in plane environment.

Path planning technology has been widely used in navigation systems of aircraft, surface ships, ground vehicles and robots. Robot path planning problem is an important research field of robotics, it requires that the robot based on the principles of certain optimization (such as energy consumption, the smallest and shortest route travel time is the fastest, etc.), our country although in intelligent mobile
robot research has made some achievements, such as land and flying robot navigation, autonomous robots and autonomous underwater vehicle, etc., but because in the field of intelligent mobile robot research in China starts late, the research and application have lagged behind the western developed countries, and some aspects have not reached the practical. Therefore, the research on path planning algorithm of mobile robot has certain theoretical value and engineering application significance.

3. The application of ant colony algorithm in map path finding

3.1. Basic principles of ant colony algorithm
Inspired by the collective behavior of real ant colonies in nature, Italian scholar M. Orgo first proposed a new optimization algorithm ant colony algorithm based on ant population in 1991, and solved some combinatorial optimization problems with this method. The concept of artificial ant is proposed in the ant colony algorithm. The artificial ant has two characteristics, which is an abstraction of the behavioral characteristics of real ants. The most critical part of the foraging behavior of ant colony is given to the artificial ant. Artificial ants, like real ants, are a group of individuals who cooperate with each other to get better results. Artificial ants have the same task as real ants, which is to find the shortest path. Artificial ants use pheromones for indirect communication just like real ants.

3.2. Principles of ant colony algorithm

3.2.1. Sequential operation
For sequence of multiple ant colony algorithm, is to carry out a reasonable ant colony is divided into two major components, and put two big ant colony placed in the start and end, respectively, in accordance with the order to implementation of the ant colony algorithm, can also according to the hierarchical design thought placed each ant colony in the planning of layer, each layer can hold.
Rows have differentiated functions. Therefore, these two design methods can realize the information exchange between populations according to the pheromone matrix.

3.2.2. Parallel operation
In the parallel operation of the multi-ant colony algorithm, each ant colony will run simultaneously, and the information exchange strategy between each ant colony is the prerequisite guarantee for the implementation of the parallel multi-ant colony optimization algorithm, which is mainly reflected in the frequency, manner, and content of the information exchange. The famous Ellabib proposed the information exchange strategy of the multi-ant colony algorithm, and further evaluated each exchange strategy accurately according to the search diversity. After the information exchange strategy of the parallel ant colony algorithm is proposed, various groups adaptively choose the information exchange objects reasonably according to themselves, and then accurately determine the actual time of information exchange according to the actual distribution of solutions.

To ensure a balance between convergence speed and diversity. After the information is exchanged, an adaptive updating strategy is adopted to carry out pheromone updating based on pheromone uniformity, to better reduce the occurrence of adverse phenomena such as early maturation of ant colony algorithm and local convergence.

3.3. Robot path planning based on improved ant colony algorithm

3.3.1. Establishment of colony pheromones
The robot's working environment is a two-dimensional known static space. Raster method is adopted to model the environment because of its simple coding and easy implementation. In order to improve the efficiency of searching optimal path and the quality of path planning of ant colony algorithm, the safety and low power consumption of robot path planning are combined. In the basic ant colony algorithm for the establishment of initial favorable pheromone matrix, the initial concentration of
pheromones is uniformly distributed, leading to the possibility that the ants may choose to walk in the area opposite to the target point in the early stage of search, which leads to a longer search time and a longer found path. In order to solve the blindness of the initial search algorithm and the slow convergence rate of the algorithm. The favorable information matrix is proposed to make the initial pheromone concentration distributed in a differentiated way, avoid blind search, reduce the search range, and shorten the search time. First, connect the starting point and the target point, and preplan a path. Under the influence of obstacles in the grid environment, the optimal path fluctuates near the pre-planned path, and the initial pheromone concentration takes the pre-planned path as the center and presents a Gaussian distribution to both sides.

3.3.2. Robot path planning implementation of ant colony algorithm
The steps of robot path planning for ant colony algorithm are as follows:

Step 1: Given the static two-dimensional space, establish a raster map, set the raster sequence number, and select the starting point and target point.

Step 2: Parameter initialization, set the number of ants m, the maximum number of iterations Nmax, as well as pheromone heuristic factor, expected heuristic factor, pheromone volatile factor, initial pheromone balance factor, path balance factor, and corner balance coefficient.

Step 3: Put ant M (m=1, 2, m) at the starting position, and put the initial point into the tabu table.

Step 4: Calculate the probability of feasible node according to the transition probability formula, use roulette to find the next accessible node, add it to the tabu table, and then update the path length.

Step 5: Judge whether the ant has reached the target point E. If so, record the grid number and path length of the ant. If the target point is not reached, repeat step 4) until the target point E is found. If an ant K search is stalled, it is handled according to the ant fallback strategy. When all ants have searched, go to step 6.

Step 6: Determine if the maximum number of iterations is Nmax. If the algorithm reaches the maximum number of iterations, the shortest path length of the current ant colony search results will be output; otherwise, the tabu table will be cleared and N=N +1 will be set. Go to Step 3 and continue the search path until the maximum number of iterations is Nmax. When the algorithm is finished, the length of the current search shortest path will be output. During the test, the parameters are set according to Table 1.

| The ant population | Basic ant colony algorithm | This paper algorithm |
|--------------------|---------------------------|----------------------|
| Pheromone stimulating factor | to 1 | |
| Expect stimulating factor | 7 | |
| Initialization pheromone balance | - | 600 |
| Path balance factor | 0.3 | |
| Corner balances efficient | 1.5 | |
| Global pheromone volatilization | 0.7 | 0.7 |

3.3.3. Simulation and analysis
The path planning method of improved ant colony algorithm was simulated and verified by MATLAB. The raster method was used for environmental modeling, and the path planning methods of the basic ant colony algorithm and the prime factor adaptive ant colony algorithm were compared with the improved ant colony algorithm proposed in this paper under two experimental environments respectively (Table 2 shows the comparison of simulation results).


Table 2. Comparison of simulation results.

| Algorithm                        | Basic ant colony algorithm | This paper algorithm |
|----------------------------------|-----------------------------|----------------------|
| Shortest path length /cm         | 32.4                        | 29.2                 |
| System operation time /s         | 3.5                         | 1.5                  |
| Number of inflection points      | 17                          | 9                    |
| The number of iterations         | 29                          | 14                   |

A 30*30 complex environment with U-shaped and H-shaped obstacles was selected to verify the applicability of the improved algorithm. To ensure the reliability of the algorithm, the number of ants was increased to 100, and the maximum number of iterations was increased to 150. U-shaped obstacle has a long search optimal path, and the algorithm is difficult to find the optimal solution. In summary, the search direction can be quickly locked in the early stage, the search efficiency is greatly improved, the number of inflection points greatly reduces the smooth search path of the algorithm, and the risk of robot operation and energy loss caused by turning can be reduced.

4. Conclusion
To sum up, by understanding the working mechanism of ant colony algorithm, ant colony algorithm can be integrated into the manufacturing of robots, which is conducive to the optimization of robot movement. In addition, through the study of the convergence of ant colony algorithm and other algorithms, can carry on the complementary and ant colony algorithm, finally achieve the purpose of the improve optimization ability, implementation in the mobile robot path planning in the use of ant colony algorithm advantage fully, to promote the orderly work of mobile robot path planning to lay a solid foundation.

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