Manipulator Path Planning Based on Improved Hybrid Algorithm

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Abstract: The Hybrid algorithm improved algorithm optimizes the distribution the initial information concentration of the ant colony algorithm under the condition that the global information is known. Inducing the ant colony to search for the path in the direction in which the final path from the start point to the end point exists. After selecting excellent individuals, they will undergo changes and mutations to change certain genes on the individual to form new individuals which can improve the quality of the solution.

It improved method shortens the time that required for the algorithm to search early and speeds up the convergence of the algorithm. The aspect in combination with intelligent algorithms, this paper combines genetic algorithm and ant colony algorithm.

It improves the search ability of the algorithm, so as to improve the problem of the algorithm in the local optimum.

1. Introduction

With the continuous development of science and technology, road planning technology has been continuously improved, resulting in the need to work in a more complex and diverse environment. To do this, it need a route planning algorithm so that we can respond quickly to complex environmental changes.

(1) In the case of knowing the working environment of the robot in advance, the ant colony can be searched in one direction from the starting point to the end point by changing the initial pheromone concentration distribution of the ant colony algorithm, thus speeding up the convergence speed of the algorithm and optimizing the original distributed.

(2) The algorithm is a mixture of ant colony algorithm and genetic algorithm modification. In order to improve the performance of the ant colony algorithm, in the iterative optimization process of each ant colony algorithm, that is, in the process of ant colony search, a genetic algorithm is introduced in each node, and the highest probability of each node is selected to enter the next one. node.

(3) The genetic algorithm is a new algorithm formed by the combination of the artificial potential field algorithm and the offset mechanism. First, it convert the environment image into a raster image and add an offset mechanism during the initial population generation process. Then, the artificial potential field algorithm and the offset mechanism are added to the operator of the cross mutation. The method controls the genetic parameters of the algorithm, and simulates the map model through the improved genetic algorithm and finds its solution.

2. Mobile Robot Path planning Overview

Route planning is one of the important technologies of robots[1]. How the robot travels from a specific starting point to the destination is a problem that the route plan needs to solve. Path

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planning is accurately defined as: The robot starts from the beginning of the environment according to specific evaluation indicators (shortest time, next direction, etc.), and there are a certain number of obstacles (static obstacles and dynamic obstacles). A sensible way to collide, find the end point and obstacles [2,3]. The schematic diagram of the path planning is shown in Figure 1. The black square in the lower left corner indicates the starting point position, the black rectangular square in the upper right corner is the end position, and the black area in the middle is the obstacle of various shapes.

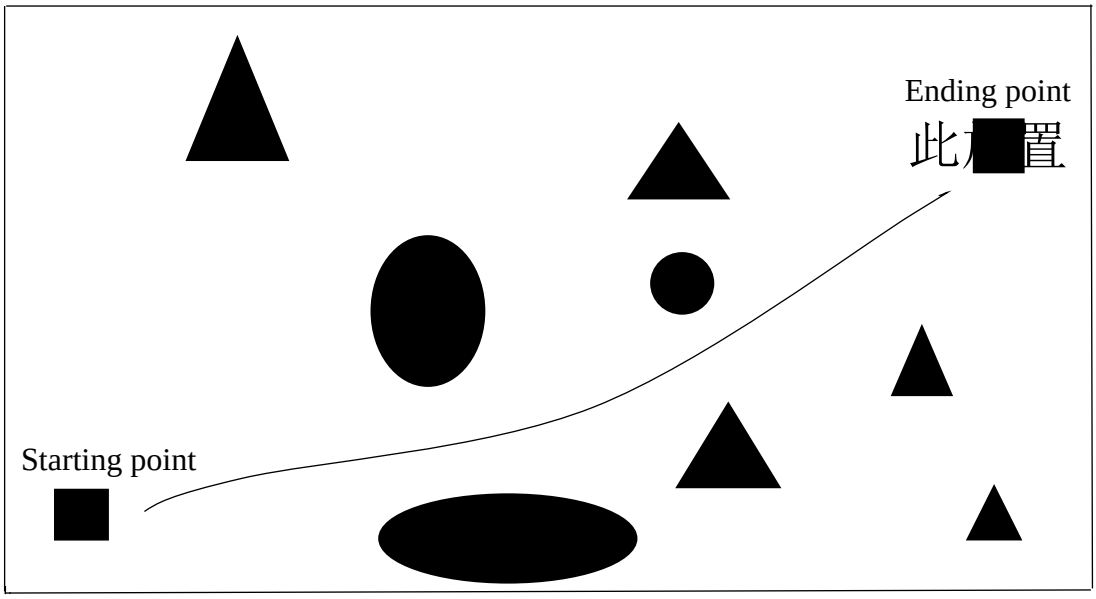

Figure 1. Schematic diagram of path planning

The path planning of the robot has the following characteristics[4]:First of all, the process of moving a robot from the starting point to the target point often has some randomness and uncertainty. Secondly, with the expansion of the application range of the robot, the complexity of the environment around the robot is increasing, and the robot needs to be in the path planning process. Perform complex calculations in. Again, path planning typically has several target constraints, such as shortest time, highest security, and shortest path, and these objects have limitations, and eventually the outer dimensions, moving speed, and mobile robot motion acceleration are moving. The efficiency of robot path planning can have an impact.

2.1. Path Planning Based on Environment Model.

The method first needs to model the operating environment of the mobile robot[5-6], and the method can be further divided according to whether the robot can know the application environment and the degree of knowability. Path planning based on environmental model

2.1.1. Global path planning method

(1) In the topology method, the moving range of the robot is divided into free space, semi-free space and defective space. Based on the connections of these spaces, a topological network can be established. When path planning is performed in a topology network, the actual path is obtained by finding the topology path. The movement deviation that occurs can be ignored during path planning. This method is suitable for the occasions where the obstacles are sparse, but the method also has some shortcomings, such as high complexity of building the topology network, difficulty in maintenance at the later stage, and poor flexibility.

(2) The viewable method ignores the size and shape of the mobile robot and treats the robot as a particle[7]. First create an environment model, use the optimization algorithm to clear the redundant path of the model, and find the shortest path from the starting point to the target point. The method is convenient to implement, simple in calculation, and suitable for the case where the environment complexity is not high and the obstacle is relatively sparse, but the method has poor flexibility, and

if the obstacle shape is circular, the method cannot be used for modeling, and further, the method It is not safe in the route planning of the robot, and it may cause the robot to collide with the obstacle at any time. Figure 1-2 is a diagram of each node showing a black area representing an obstacle, where node 6 is the visible point of node 3 at node 6, node 1 has an internal visible node and an external visible node, node 4 and node 6 It is external. For nodes, node 7 is an internal visual node.

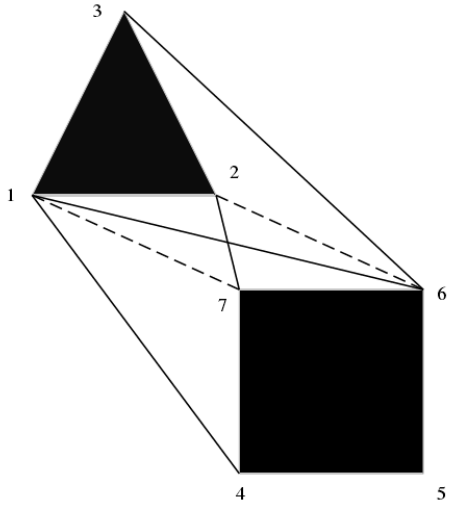

Figure 2. Node view

(3) The free space method divides the operating environment into accessible space and impassable space. Whether the spatial division is reasonable has a great impact on the path efficiency of mobile robots. Path planning is carried out in the network connectivity diagram in free space. The method is aimed at calculating the farthest path from the obstacle. The algorithm is flexible and versatile. Even if the environment starting position and the position of the sunmark change, the environment model does not need to be rebuilt, but when the environment complexity is high, The complexity of the algorithm also increases. This method is suitable when the robot moves slowly and does not require high positioning.

2.1.2. Local path planning method

Local trajectory planning means that the robot moves from the starting point to the destination point with a specific strategy depending on whether the operating environment is completely or partially unknown. In this case, the robot mainly detects the environment through various sensors (ultrasound, radar, etc.) carried by itself, combines the collected information, and continues to obtain accurate information about the regional environment.

Khatib et al people described the artificial potential field method. Based on this scheme, the artificial potential field method has been rapidly developed and is widely used to solve the path planning problem of mobile robots. The basic idea of the method is as follows: Although the robot is regarded as a magnet, the operating environment is a space where gravity and the repelling field coexist, the gravitational field is generated at the position of the target point and diffuses layer by layer, the manipulator can be pulled to the target position, and the obstacle in space The object creates a repulsive force that diffuses for each layer to repel the moving body and force the robot away from the obstacle. Although the artificial potential field method has a high execution speed and is suitable for static local route planning, it has the problem of tending to fall to a local minimum point and there is a problem of target unreachability.

In order to solve the path planning problem of mobile robots, the fuzzy algorithm must first obtain the surrounding environment information of the robot and obfuscate its information. The method has strong adaptability and can respond promptly to the change of the operating environment. However, this method has strong dependence on path planning experience. When there are many obstacles and complicated road conditions, the calculation will become cumbersome and the calculation amount will be increase.

2.2. Improvement of ant colony algorithm.

In the continuous investigation of the ant colony algorithm. There are some obvious problems with the algorithm: First, the ant colony algorithm has a long search time. The second is that after the ants in the ant colony search to a certain extent, some ants find a better path. Assuming that if this path is not the best, the ant colony is no longer Explore, but stay in the case of local optimum. Third, the ant colony algorithm has a positive impact on the optimization of discrete individuals. Under such circumstances, the solution to the optimization problem of continuous space such as current planning cannot be directly applied.

The above has already described many shortcomings of the classical ant colony algorithm, so the ant colony algorithm should be improved. There are two ways to improve [8]. One is to optimize the set values of parameters in the ant colony algorithm, including the number of ant groups, the pheromone importance factor, the heuristic function importance factor, the pheromone volatilization factor, and the information. The total amount of these factors is released; the second is that the ant colony algorithm and other algorithms are optimized and combined to form a new hybrid algorithm. The improvement of these two algorithms has achieved good results under the verification of the researchers [9,10].

Firstly, the initial pheromone concentration of the ant colony algorithm is improved, and the pheromone concentration in the direction from the initial point to the end point is better than other directions, so as to achieve the purpose of speeding up the convergence of the initial ant colony algorithm. In addition, the pheromone update method is improved, and the pheromone update method of the traditional ant colony algorithm is changed [11]. In this way, some defects and problems of the ant colony algorithm in the iterative pheromone concentration update are optimized. In turn, the optimization of the ant colony algorithm is implemented. Another way is to use the genetic algorithm's mutation factor to genetically operate the initial solution in the initial iterative population of the ant colony algorithm. In this case, the initial solution will be more excellent, and iterative through these excellent solutions. process. The genetic mutation algorithm adds artificial potential field algorithm, improves the fitness function and genetic operator, improves the search efficiency of genetic algorithm, and achieves a higher convergence speed.The genetic algorithm is improved as follows:

2.3. Cross strategy.

The cross is to exchange genes in two individuals to generate the next generation of individuals. However, the traditional cross-cutting strategy is not applicable to the path planning problem, and the length of the path may be greatly increased. Therefore, the traditional cross-cutting strategy has been modified in this paper: (1) first select two chromosomes; (2) pair two Individual random selection of intersections; (3) Judging the distance between two intersections: When the distance is less than a certain value, the genes are directly exchanged; otherwise, the two path points are used as the starting point and the end point, and the artificial potential field algorithm is introduced. To perform a local path search, and then integrate the searched path into two individuals to obtain a new individual.

2.4. Mutation strategy.

This algorithm needs to improve the mutation genetic algorithm mutation operation, because the individuals generated by random mutation are not necessarily legal. The main method is to judge the feasibility of the path point after the mutation, and then perform the offset operation according to the feasibility judgment, so that the path point is feasible.

3. Conclusion

(1) Analyzed the general methods of route planning, advantages and disadvantages, and research status of route planning technology.

(2) There are two improvements in the improvement of the ant colony algorithm. One is to

improve the algorithm by changing the parameters of the algorithm, and the other is to complement the advantages by combining with other intelligent algorithms. Referring to the work of previous researchers, this paper uses a combination of two algorithms to improve the ant colony algorithm.

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