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Mobile Robot Path Planning based on Parameter Optimization Ant Colony Algorithm

Wang Zhangqi ,Zhu Xiaoguang ,Han Qingyao [a]

School of Mechanical Engineering,North China Electric Power University.071003 Baoding, China

Abstract

The basic ant colony algorithm for mobile robot path planning exists many problems, such as lack of stability，algorithm premature convergence， more difficult to find optimal solution for complex problems and so on. This paper proposes improvement measures. Apply genetic algorithm to optimization and configuration parameters of the basic ant colony algorithm. Simulation results show that the improved optimal path length significantly less than the basic ant colony algorithm and volatility is smaller, stability significantly improves. The stability of improved ant colony algorithm is superior to the basic ant colony algorithm, verify the effectiveness of the improvement measures.

Keywords: Ant colony algorithm; Mobile Robot; Path planning; Genetic algorithm.

1. Problem description and definition

Mobile robot path planning is an important research field of robotics. It refers to that, the mobile robot in a work environment with obstacles, based on one or some optimization criterion, search for a motion path from the initial state to the target , state and the path is the optimal or near optimal, safe, obstacle avoidance[1].

Robot movement environment which is studied in this paper is known two-dimensional flat space, and don't take obstacles and the robot height information into consider. In the process of environment description, all the obstacles in the environment have done pretreatment which extend out each obstacles

[a] Wang Zhangqi. Tel.03127525043
E-mail address: zhuxiaog@sina.com

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of the maximum radius of a robot. This allows considering the robot as a particle, thus ensuring the safety and greatly reducing the complexity of path planning algorithms [2-3].

This study aims to:

- In the known static environment, find a collision-free path connect the start and the end.
- Obstacle avoidance, meanwhile make the length of the path as short as possible
- Algorithm's time complexity is as low as possible, good stability.

2. Environmental modeling

This article mainly uses grid method[4] to divide the robot environment, two-dimensional grid represents environment, and encodes the grid from top to bottom, from left to right.

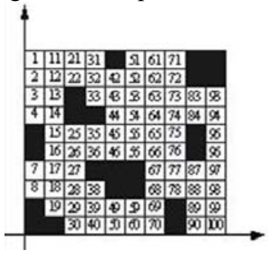

Fig. 1. Environmental modeling with grid method

As shown in Figure 1, the grid is divided into two kinds, One is free grid, represented by white; the other is obstacle grid, represented by black. Robot can only move in the free grid, and must avoid when encounter obstacles grid.

Robot must according to the environment map to create a corresponding matrix which represents the state of each grid (free grid or obstacle grid). Only this, Robot can understand the environment. In this environment expression matrix, free grid is represented by 1, and obstacle grid is represented by 0. Each obstacle can occupy a grid, or can occupy multiple grids, less than one grid is also expressed by one grid.

3. Description and simulation of the basic ant colony algorithm

According to the basic principles of ant colony algorithm and path planning requirements, the basic idea can be simply described as follows: firstly, Set the basic parameters of the ant colony algorithm, including Information inspiration factor α and hope inspiration factor β , pheromone intensity Q and evaporation coefficient ρ , etc. [5]Then put m ant at the starting point of the map(Number is 0), each ant take the starting point as the current node' applied probability selection function, select the follow-up node, if the follow-up node which is to be selected, include the end node (number is N), end this tour, get a complete path. After each ant end the travel, partially update pheromone, and compare with the current optimal path. If the path obtained is shorter than the optimal path, then replace the optimal path with the current path. When all N ants end the tour, do global pheromones update. At this point, one iteration completes NC increment. When the NC reaches the maximum, or algorithm stagnation, the algorithm is complete.

We apply the grid method to establish a 20 $\times$ 20 environmental map. Use the basic ant colony algorithm to simulate, the specific process is as follows:

- Parameter setting. all parameters which are to be selected, refer to empirical values, information inspiration factor α and hope inspiration factor β take the value 1, pheromone intensity Q takes the value 100. Evaporation coefficient ρ =0.2.