Research on AGV Path Planning Method Based on Improved BAS Algorithm

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Abstract. In order to improve the speed of AGV and the ability to adapt to the environment, this article proposes an AGV path planning method based on an improved search algorithm for beetle, which is explained from three aspects: environmental modeling, path planning, and dynamic obstacle avoidance. The simulation results of path planning are based on the bas algorithm. The grid method environment simulation shows that the method has strong path search ability and strong obstacle avoidance function. It can plan out more quickly than other algorithms in very complicated obstacle environment. An optimized path for safety avoidance is proposed.

Keywords: AGV, Grid Method, Path Planning, Dynamic Obstacle Avoidance

1. Introduction

With the continuous development of artificial intelligence technology, the car is automatically guided (AGV) is playing an increasingly important role in modern intelligent industrial manufacturing. AGV has the advantages of stable transportation and accurate dispatch, which improves the efficiency of logistics transportation and saves the cost of freight transportation [1-2]. AGV's route planning technology is a necessary guarantee for the safe and efficient transportation of goods and is the basis for AGV to complete various tasks [3-4]. Path planning means that the AGV searches for an optimal path from the starting point to the ending point in the current environment that meets certain constraints and evaluation conditions, and can avoid obstacles [5-6]. According to the degree of known environmental information, path planning is divided into global path planning with known environmental information, unknown environmental information, and partially known local path planning. Now, there are huge of normally used global path planned methods for mobile robots, such as the traditional method grid method and artificial potential field method. Artificial potential field...
method, neural network method and genetic algorithm, etc., need to model obstacles in a certain space when solving the AGV path planning problem, and the path search efficiency is lower in practical applications. Although the RRT algorithm has strong obstacle avoidance ability. Timeliness is weak and search efficiency is low. Compared with other algorithms, Monochamus search only needs one individual, greatly reduces the amount of calculations. There is no need to model and analyze environmental obstacles in advance. You can plan the path by judging whether each step encounters obstacles to improved planning efficiency.

The beast search (BAS) used in this paper is a heuristic algorithm with strong robustness, fast randomness and no pre-processing. It can use directly perceived through senses programs to plan paths in complex environments. This intelligent algorithm can achieve efficient optimization without knowing the specific form of the function. That table improves the BAS algorithm and uses it for simulate and analyze the path planning of AGV.

![Encoded environment map](image1)

**Figure 1.** Encoded environment map

![Raster-based environment map modeling](image2)

**Figure 2.** Raster-based environment map modeling
2. Environment modelling based on grid method

The basis for AGV to move smoothly in the working environment is to know the specific positions of various obstacles in the environment. This requires modeling the working environment. This article uses the AGV's own sensors to search the outline and information of the working environment. Model it. The work space of AGV is divided into grids of equal size. The sensors detect the spatial distribution of each obstacle, and then use the binary "0" and "1" to represent the obstacle-free grid and the obstacle grid, respectively. The encoded environment map is shown in Figure 1. The grid numbering method and rectangular coordinate system method are two commonly used representation methods. This paper chooses the more intuitive Cartesian coordinate system modeling as shown in Figure 2.

3. BAS algorithm description

3.1. Basic principles of BAS algorithm

BAS bionic principle: When Monochamus is foraging, it adjusts the movement route to forage by judging the strength of food smell. The beetle has two whiskers. If the intensity of the smell felt by the left whisker is greater than that of the right, then the cow will fly to the left, otherwise it will fly to the right until it finds food. A simplified model of Monochamus foraging is shown in Figure 3.

(1) The orientation of the Monochamus head is arbitrary, and it can be represented by a random vector

\[ \mathbf{d} = \frac{\mathbf{r} \ast \mathbf{a} \ast (k \cdot 1)}{\| \mathbf{r} \ast \mathbf{a} \ast (k \cdot 1) \|} \]  

(1)

Where k is the spatial dimension.

(2) The original position of Monochamus.

The original position of the beetle is the original point where AGV is located.
(3) The positions of the beard and the beard.

\[ x_r = x + d \cdot \hat{b} / 2 \quad x_i = x - d \cdot \hat{b} / 2 \]  \hspace{1cm} (2)

In the formula, \( x_l \) and \( x_r \) represent the left and right whisker coordinates, \( x \) represents the center of mass coordinates, and \( d \) represents the distance between the two whiskers.

(4) For the path planning fitness function \( f \) to be optimized, find the fitness values of its left and right beards.

\[ \int r = \int (x_r) \int 1 = \int (x_l) \]  \hspace{1cm} (3)

(5) Update the position of the day bee.

If \( f_r > f_l \), the beetle moves \( \delta \) in the direction of the left whisker; otherwise, it moves \( \delta \) in the direction of the right whisker.

\[ x = x - \delta \cdot \hat{b} \cdot \text{sign}(\int (x_r) - \int (x_l)) \]  \hspace{1cm} (4)

Where \( \delta \) is the step size and is the sign function.

3.2. Improvement of bas algorithm

The BAS algorithm originally used only one individual to perform the search, because the orientation of the Monochamus head was random, and the search results were highly random. This article places multiple Monochamus every time the position of the Monochamus is updated. Compare to select the best result. Reducing the randomness makes the searched path smoother.

The original BAS algorithm's step size is a fixed value, the search accuracy and efficiency are relatively average, and even it will fall into local optimization. This article changed the step size. When it encounters an obstacle, the initial length is larger, and it is impossible to avoid encountering the obstacle. The step size will be smaller and smaller until it bypasses the obstacle. The flow chart of the improved BAS path planning is shown in Figure 4.

3.3. Path planning simulation based on improved BAS algorithm.

The improved BAS algorithm and the quantity of iterations are used to find a better path.

After 15 iterations, a smooth path was planned to avoid obstacles successfully, a successful hideout is planned. Avoid obstacles and smooth path in the random coordinates of the beetle, the next coordinate position is selected which is not in the obstacle and the fitness value is the smallest. The obstacle is detected when the number of iterations is 4. In obstacles, the step size is changed to avoid falling into the local second to none.
Environmental modeling

Initialization parameter

Update the longicorn left and right whisker position

PAGE IN BLOCK?

Y

N

More than one crane the optimum is

Calculate fitness values

Update longhorn location

The path is in in the block

N

OK

N

Y

Update search step length and required spacing

Get the optimal path

Figure 4. Path planning process based on improved BAS

4. AGV dynamic obstacle avoidance

Each AGV studied in this paper is a separate individual. The collision type is determined for other AGV or dynamic obstacles within its detection range at the same time, and the corresponding obstacle avoidance strategy is selected to complete the dynamic obstacle avoidance. AGV dynamic obstacle avoidance is divided into waiting strategy and path replanning strategy. Among them, waiting strategy is the set priority of the lower priority waiting first pass, and the path replanning strategy is the higher priority waiting. A lower priority replanning path. When the path is re-planned, the current node of the original path is added to the path planning based on the improved BAS algorithm to generate a new path. According to the actual situation shown in Figure 5, it is divided into three solutions: the
collision types are (a), (b), (e), and no collision occurs; the collision types are (c), (f), and the waiting strategy is selected; The collision types are (g) and (d), and the path planning strategy is selected.

![Figure 5. Type of collision](image)

5. Conclusion
This paper proposes a new AGV path plan method for the foundation of the improved BAS algorithm. The complexity of this algorithm will not be influenced by the number of environmental obstacles. Simulation results show which fast planning of the path. The planned path is not easy to fall into a local optimum, and a dynamic obstacle avoidance analysis is performed based on the planned static global path. However, there are also shortcomings.

Acknowledgement
Department of Education, Jiangxi Province Science and Technology Research Project (GJJ191226).

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