Mobile Robot Global Planning Based on Improved A* Algorithm Path Planning Research

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Binglin Li[1],Chunyu Tan, Yufeng Lian,Yong Shao and Hao Xu

[1]School of Electrical and Electronic Engineering, Changchun University of Technology, Changchun, Jilin, China.

Introduction

- The A* algorithm is a directional heuristic search algorithm and is one of the most commonly used algorithms in global static path planning, but traditional A* algorithm [1] has problems such as low search efficiency, easy to fall into local optimum and poor path smoothing in path planning problems. [2]
- By analyzing the advantages and disadvantages of the above improved algorithms, this paper proposes an improved A* algorithm.[3] The improved A* algorithm has shorter search time, fewer path inflection points, and higher path smoothing.[4]

Methodology

- To address the issue of reduced search efficiency encountered in the traditional A* algorithm, the weight coefficients of its heuristic function can be optimized. First, a weight coefficient w is introduced to the traditional A* algorithm to optimize it into an A* algorithm with changeable weights.
- Both traditional A* methods and enhanced A* algorithms can only provide theoretically ideal paths, and there are many unnecessary turning points in practical applications. For this reason the idea of corner optimization is introduced.
- The improved A* algorithm shortens the path search time and reduces the number of inflection points in the path, but the final generated path still has many sharp inflection points. For this reason, the dynamic window method is introduced for path smoothing.
- The following figure shows the exact steps to improve the A* algorithm.

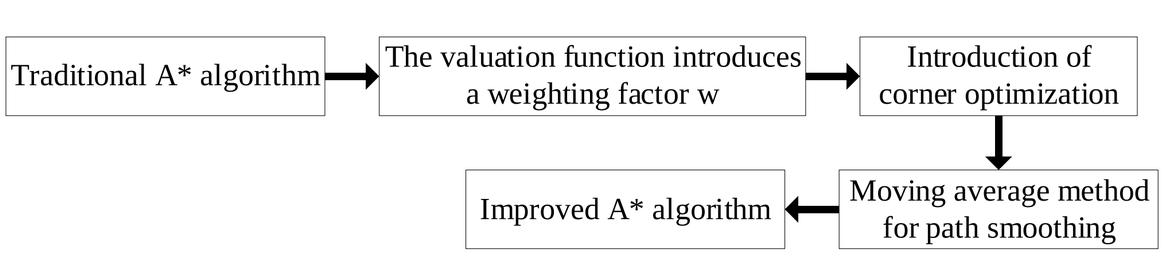


Figure 1. Improvement steps.

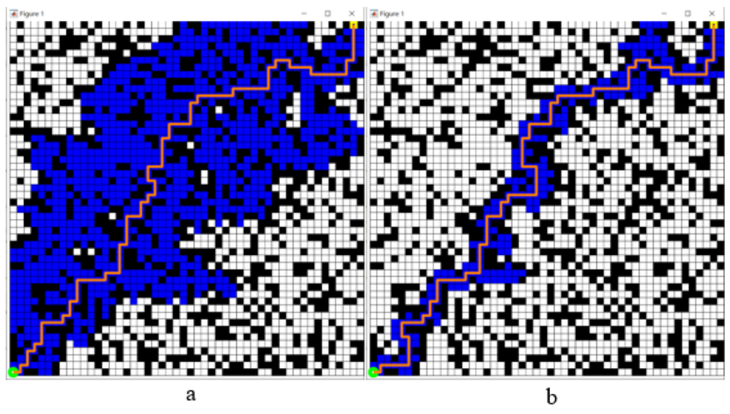
Results

1. Improvement of the Valuation Function

- The performance index of the valuation function under different weights is shown in Table 1, and the path planning effect is shown in Fig. 2. Figure 1(a) shows W(n) = 1, Figure 1(b) shows W(n) = 1.5, Figure 1(c) shows W(n) = 2, and Figure 1(a) shows W(n) = 4. It is easy to find that when W(n)=2.0, the performance index of the algorithm is the most balanced, so the subsequent research of this paper will be based on this weight for the subsequent improvement.

Table 1. Performance indicators of the algorithm.

Situation	Search Points	Search time	Path length
W(n)=1.0	979	10.88s	104
W(n)=1.5	256	2.35s	108
W(n)=2.0	254	2.31s	108
W(n)=4.0	257	2.13s	122



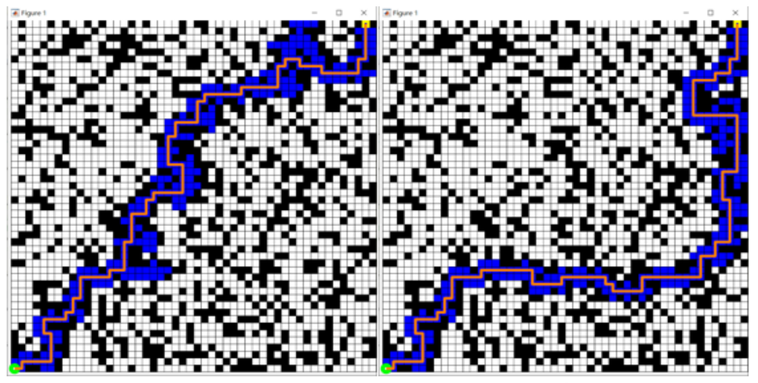


Figure 2. Effect of path planning with different weights.

2. Corner Optimization

- In order to verify the performance of the algorithm, the corner optimization process is performed on the map scene shown in figure 3(a) using the A* algorithm with the introduction of corner optimization, and the processed path is shown in figure 3(b). The comparison reduced the number of turns by 17, reducing the degree of curvature of the path without increasing the length of the original path.

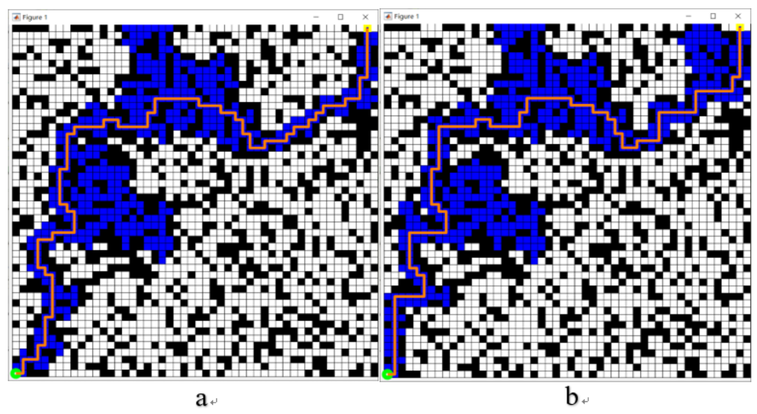


Figure 3. Impact of introducing corner optimization.

3. Path Smoothing Based on Moving Average Method

- The final smoothed path after introducing the moving average is shown in Fig. 4(b). Figure 4(a) shows the path planned by the traditional A* algorithm.

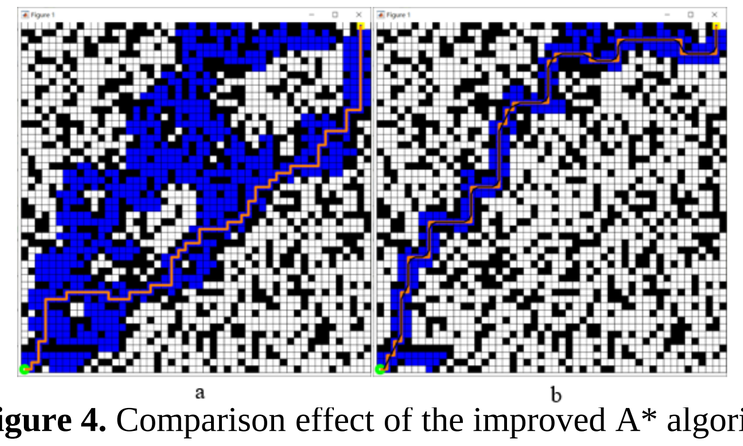


Figure 4. Comparison effect of the improved A* algorithm.

Discussion and Conclusion

1. Conclusion

- The improved A* algorithm plans out more efficient paths and smoother paths. It is more suitable for the application of mobile robots in the real working environment.

2. Supporting literature

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References

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