Retraction

Retraction: Research on Robot Path Planning Based on Improved Ant Colony Algorithm under Computer Background (J. Phys.: Conf. Ser. 1992 032050)

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Research on Robot Path Planning Based on Improved Ant Colony Algorithm under Computer Background

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Abstract. With the development of artificial intelligence technology, the intelligent requirement of robot path planning (hereinafter referred to as PP) is higher and higher. Therefore, people gradually study the optimization of PP algorithm more and more mature. At present, the traditional robot has been unable to meet the requirements of task efficiency, which requires the robot to have the function of autonomous and safe path finding. Therefore, we must optimize the traditional PP algorithm, which can find a time-consuming and safe path in many feasible paths. Therefore, PP is the basis of the exploration task. Traditional ant colony algorithm (hereinafter referred to as ACA) has many problems, such as slow convergence speed, low efficiency, easy local optimization and other defects, which have many restrictions on robot PP. Therefore, this paper proposes an improved ACA (hereinafter referred to as IACA), which can optimize the path selection by improving pheromone. Firstly, this paper analyzes the TMR (hereinafter referred to as TMR) PP and the principle of IACA. Then, the PP of TMR is simulated and tested, which reduces the cycle times. Therefore, the IACA can effectively improve the search efficiency of the optimal path, which improves the overall performance of PP.

Keywords: Ant Colony Algorithm, Tmr, Path Planning, Optimal Path

1. Introduction
With the increasing demand for TMRs in many fields, the traditional PP can’t meet the needs of people for some dynamic paths [1]. Therefore, the research of PP has always been the focus of robot research. At present, many algorithms have been applied to different robots, which have been applied to UAV or TMR. Among them, ACA has many advantages in PP, such as good robustness, distributed computing and so on. Therefore, ACA has been applied in many robot PP fields, such as TSP, workshop scheduling, vehicle routing, robot PP and so on [2]. However, the traditional ACA still has some problems, such as slow convergence speed, low efficiency, easy local optimization and other defects, which need us to improve the traditional ACA. This paper selects an IACA, which fully reflects the randomness of the ACA. Therefore, the IACA can adapt to a variety of environments, which has stronger robustness and adaptability [3].
2. Research on PP of TMR

PP is one of the key technologies of robot navigation, which mainly includes inertial navigation, magnetic navigation and visual navigation. PP is a process of finding a collision free and smooth path in the presence of obstacles. Among them, changing the path needs to be as smooth as possible, which requires finding a collision free path from the starting point to the end point in a given environment [4]. There are many kinds of classification methods for TMR PP, which can set different algorithms according to different applications. At present, the commonly used classification methods can be divided into global PP and local PP, as shown in Figure 1.

![Figure 1. PP classification.](image)

3. Overview of ACA

3.1. Basic principle of ACA

Ants in nature find the shortest path from the target point by tacit cooperation in searching for food, building nests, migration and other activities. In the path selection, after random search at the beginning stage, the ant colony will basically gather in the shortest path, which depends on the pheromone released by the ant colony to guide the direction [5]. As the path length increases, the search time will also increase, which will reduce the pheromone concentration of the path. By judging the pheromone content, the ant colony can make a reference, which will continue to find the optimal path [6]. It is found that ants release a pheromone when they walk. When an ant comes across a crossroad that has not been crossed, it will choose a path randomly and leave pheromones related to the length of the path. When many ants go through the same path, the pheromone concentration on the path will increase, and the probability of subsequent ants choosing the path will increase. At the same time, when there are obstacles in the path of ants, ants can quickly find a new path [7]. The schematic diagram of ant colony search and walk selection is shown in Figure 2. Where G and K represent obstacles, L and M represent end points, and ants start walking at HI. Therefore, the ant colony has only two paths, namely HIGLM and HIKLM. The experiment shows that at the beginning, the same number of ants choose from two paths. After a while, more ants will take the nearest path [8].
3.2. Classical ACA function

In ACA, the most classical function is TSP model. TSP can be understood as follows. Know to traverse \( m \) cities, write the distance between any two cities as \( d_{ij} \), which can get a shortest path to traverse all cities without repetition. Suppose: \( n \) is the number of ants; \( d_{ij} \) is the length from city \( i \) to city \( j \). \( p^k_{ij}(t) \) is used to represent the probability of the \( k \)th ant moving from node \( i \) to node \( j \) at time \( t \). The function of classical ACA is shown in Formula 1.

\[
p^k_{ij}(t) = \begin{cases} \frac{\tau^a_{ij}(t)\eta^\beta_{ij}(t)}{\sum_{s \in \text{allowed}_k} \tau^a_{js}(t)\eta^\beta_{sj}(t)} & \text{if } i, j \in \text{allowed}_k \\ 0 & \text{otherwise} \end{cases}
\]  

Among them, \( \alpha \) is an information heuristic factor, \( \beta \) is the expected degree factor; \( \tau^a_{ij}(t) \) is the pheromone concentration; \( \eta^\beta_{ij} \) is the heuristic information of node transferred from \( i \) to \( j \); \( \text{allowed}_k \) is the set of feasible adjacency grid labels of ant \( k \).

3.3. IACA function

In this paper, the IACA function is mainly to optimize the pheromone update mode, which can optimize some shortcomings of pheromone concentration in iteration. The optimization of pheromone updating rules affects the ant colony's selection of the path. In the ACA, the pheromone updating method is shown in formula 2. In the process of ant search, pheromones on the path will be updated every step. Adjust the pheromone rules on the path \((i, j)\) at the time of \( t + n \).

\[
\tau^a_{ij}(t + n) = (1 - \rho)\tau^a_{ij}(t) + \Delta \tau^a_{ij}(t)
\] 

\[
\Delta \tau^a_{ij}(t) = \sum_{k=1}^{m} \Delta \tau^a_{ij}(t)
\]

\[
\Delta \tau^a_{ij}(t) = \begin{cases} \frac{Q}{L_o} & \text{if } (i, j) \in \text{allowed}_k \\ 0 & \text{otherwise} \end{cases}
\]
Among them, $\rho$ is the pheromone Volatilization Coefficient, $\Delta \tau_{ij}(t)$ is the increase of pheromone concentration on the path in this cycle, and the initial time is 0. $\Delta \tau_{ij}^k(t)$ is the amount of information left on the path by the $k$th ant in this cycle, and $L_b$ is the shortest path length found so far.

3.4. Ant colony path optimization steps
This paper developed the ant colony path optimization steps, as shown in Figure 3.

![Ant colony optimization steps](image)

**Figure 3.** Ant colony optimization steps.

4. Simulation experiment and result analysis
Through matlab2015 software, this paper checks the PP problem of the IACA. The experimental parameters are as follows: $\alpha_{\text{max}} = 4$, $\alpha_{\text{min}} = 1$, $\beta_{\text{max}} = 9$, $\beta_{\text{min}} = 4$, set $\rho$ is 0 to 0.9, ant number $M = 50$, maximum iteration $n_{\text{max}} = 100$, pheromone intensity $Q = 1$ and $W = 10$. In this paper, several running tests are carried out to obtain the optimal path, as shown in Figure 4.
5. Conclusion

PP is the most important research topic of TMR, which directly represents the intelligent degree of robot. By improving ACA, the robot can find a fast, convenient and efficient path, which can improve the efficiency and safety of the robot. By improving the pheromone updating method, this paper proposes a PP scheme, which reduces the search range of the optimal path. At the same time, the IACA reduces the number of cycles and time needed to find the optimal path.

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