

RoboCup Rescue Simulation League



CSU_Yunlu

From Central South University

Participated in Robocup since 2003



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Improvements

• This time we mainly optimized and improved the PF's clearing options, AT's rescue strategy, FB's fire-seeking method and target selection. The new priority strategy makes the removal of obstacles more efficient and effective. The multi-conditional judgment of saving people increases the probability of rescue and increases the efficiency of rescue. We have improved the FB's fire-seeking approach so that fires at any location can be quickly discovered. And we use the results of the convex hull calculation as the target choice, which can control the fire well.



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Clustering

• In the rescue environment in RoboCup Rescue Agent Simulation, every map consists of thousands of nodes. In order to help the agents enhance the efficiency of searching the whole map, we need a clustering module to divide the whole map into clusters. Each cluster can be seen as a smaller map, and the complexity of getting the information of each cluster is reduced greatly.

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Clustering

• How to determine the number of clusters and the cluster to which the entity belongs is the most important thing.





Using DBSCAN can more accurately divide clusters, but the shape is more complicated, and sometimes it will cause some problems for police clearance.

Our method

Clustering

- We use K-means algorithm and optimize it by canopy algorithm.
- The Canopy algorithm is used for rough clustering to obtain k center points, and then K-means algorithm will be used. K-means has weak anti-interference ability. But Canopy can help resist interference.

Pros and Cons

Clustering

- Our proposed approach makes the selection of the initial cluster center and clustering number more reasonably to some extent. It will improve the accuracy and efficiency of the algorithm even in some extreme cases.
- However, the selection of two thresholds affects the execution efficiency of the algorithm and classification accuracy directly. The selection of thresholds depends mainly on subjective experience or trial. In order to get a better result, we must adjust two thresholds constantly.



Path Planning

- The pathplanning strategy is to help the agent and the citizen find the optimal path.
- The purpose is to make their movements more efficient and enable them to reach their destination faster.





The A* algorithm adds heuristic information into the Dijkstra algorithm, which greatly reduces the number of nodes to be processed, thus greatly improving efficiency.

Communication

• Communication is an important factor for disaster relief. The information that an agent can obtain is limited. Sharing the information with other agents can improve the efficiency of rescue task. The key to communication lies in how to properly deal with the communication within partitions and the communication among partitions.



Communication

Communication

- Communication Within Partitions
- Communication Among Partitions

Search

• Strategy of search is important for overall rescue. How to quickly and accurately find the target is the most important part of the search strategy.

Ambulance Team



Search for human



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Pros and Cons

Search

- Advantages:

 It can know the specific situation of the area where the agent is located.
- Disadvantage:

 The area without the agent will be searched after a long time,.



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Police Force

- The PF's target is to clear the road for other agents, so the efficiency of clearing the barrier is the key to the strategy.
- How to improve efficiency and guarantee the quality at the same time is what we should think about.



Other team

• MRL : Guideline[4]



Guideline improves the efficency of the PF obviously.





Our method

 Multiple police agents will simultaneously clean up roadblocks on a section of road to achieve rapid cleaning.



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Police Force

1. First clear the corresponding roadblock according to the priority strategy

2.Multiple police agents will simultaneously clean up roadblocks on a section of road to achieve rapid cleaning

3. The current area is cleaned up, and randomly go to nearby clusters to find roadblocks.







Pros and Cons

- Advantages:

 Clear fast
 PF is not easily caught by obstacles
- Disadvantage:
 1.Focus on local area, ignore the global area



Ambulance Team

- The task of the ambulance team is to rescue, treat the trapped wounded and transport them to the refuge quickly and effectively.
- Which object to choose for rescue is the most critical issue.







• SEU-Unibot :

calculate the death time of a civilian T1
 calculate the time to remove buriedness T2
 calculate the time on road T3
 When T1>T2+T3, (T1+T3) as degree of priority.

T₁,T₂ and T₃ are not accurate.







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Pros and Cons

- Advantages:

 Clear target selection
 Do the effective choice at the moment
- Disadvantages:

1.Focus on local area, ignore the global area2.Did not take into account the situation in the next few cycles



Fire Brigade

- The purpose of setting this strategy is to better control the fire and reduce casualties.
- How to choose the building to be extinguished is the most important





In reactive planning, the module gets all the buildings in extinguish range that are on fire and chooses randomly one of them actually.

It may cause failure to control fire.

Our method

Fire Brigade

1. For each cluster, acquire a collection of all burning buildings that can be perceived, abstracting each building into a single point

2. Use the convex hull algorithm to form a convex hull for this point set

3. Each cycle, randomly assign a position of the convex hull to the nearest agent









Convex hull calculation





Distinguish

Convex hull algorithm

Graham scan

- Take the point with the smallest coordinate Y as P_0

Use P0 as the origin of the coordinate system, and sort the other points by the polar angle



Start from P_0P_1



Calculate $P_0P_1 \times P_1P_2$



Backtracking



And so on, until return to P_0

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Results

Team	Kobe			
	100	200	300	
My team	199.897	198.324	195.573	
Unibot	199.900	198.889	192.195	
Sample	192.911	170.213	145.661	

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Results

Team	Paris*			
	100	200	270	
My team	278.112	220.144	160.268	
Unibot	280.143	219.564	142.84	
Sample	250.313	198.032	117.026	

* means we have modified the map.

Results

Team	Berlin*			
	100	200	290	
My team	489.111	432.911	360.751	
Unibot	499.234	433.111	359.844	
Sample	490.121	431.123	350.211	

* means we have modified the map.

Conclusions

- Different agents have different responsibilities and behaviors, so the priorities of tasks are different. We should design different strategies for different agents for an efficient solution. At the same time, we can't ignore the cooperation between agents. Effective cooperation strategies can generate greater benefits.Communication is the foundation of cooperation, so we try to use a reasonable communication strategy to improve the score. But what we did is not very good.
- In the future, we plan to absorb the advantages of other team, and then improve our strategies.

References

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