CSU_YUNLU

RoboCup Rescue Simulation League

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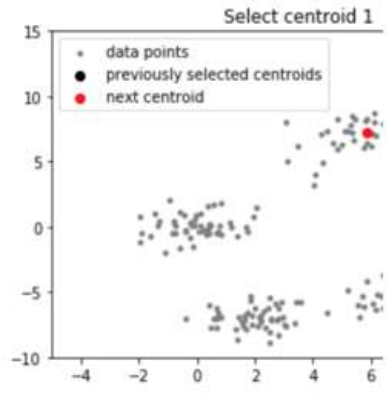
CSU_YUNLU

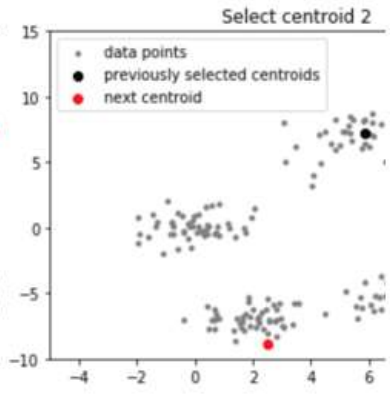
Introduction

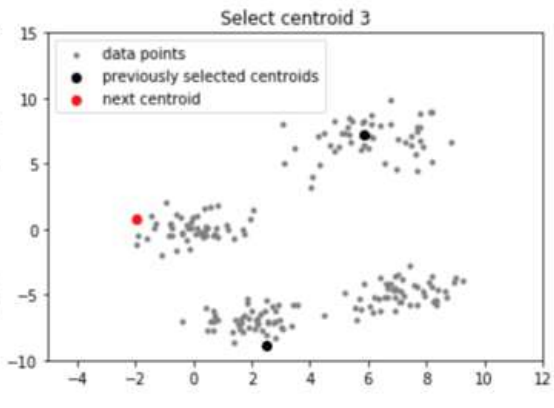
Team CSU_Yunlu has been participating in the RoboCup rescue simulation competition since 2006. In addition, we have achieved good results in RoboCup 2017,2019,2020,2021 and 2022. We hope to optimize our strategy and improve the performance of our team based on the strategies we have in previous years.

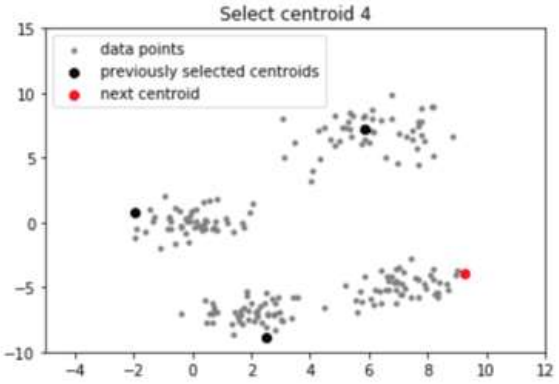
Modules

Clustering | clustering algorithm,the main features



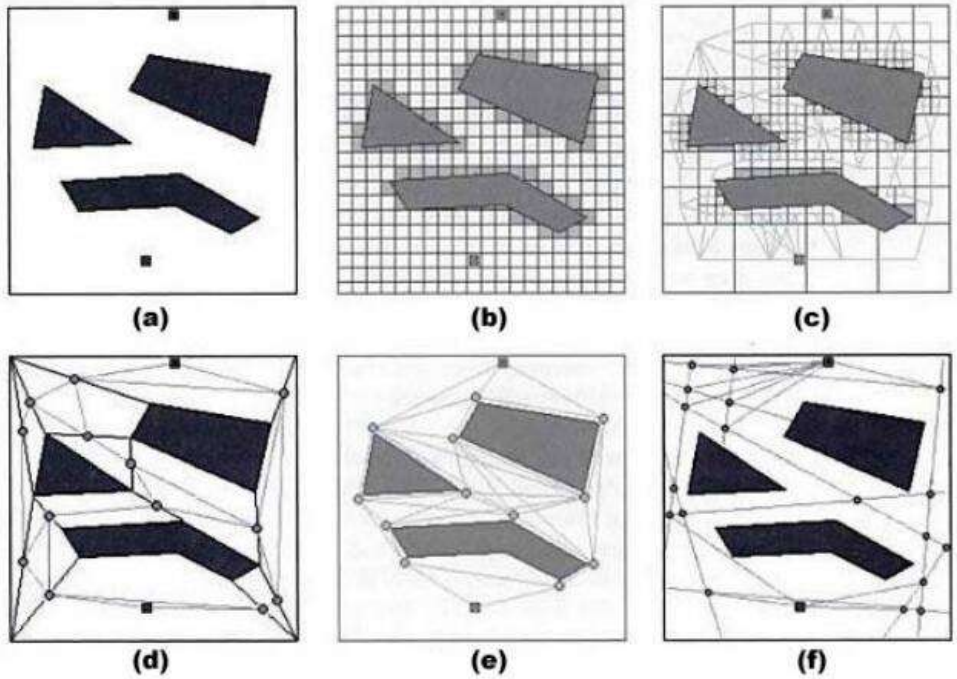






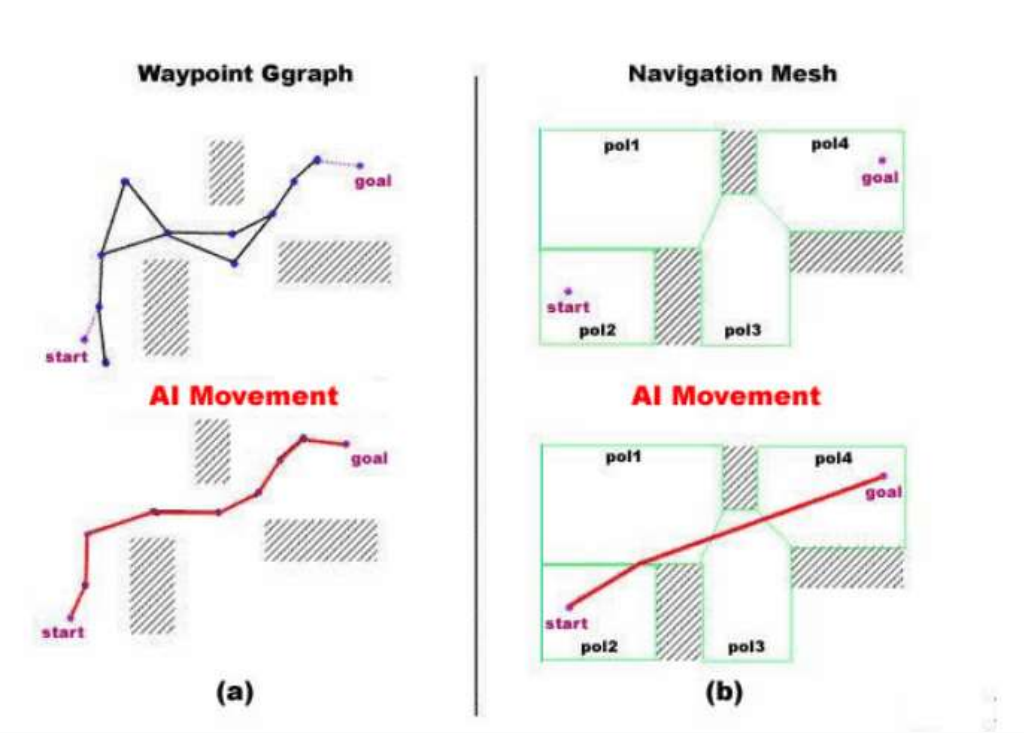
We use **K-means++** algorithm to deal with the clustering generation problem.The initial k center point can be better determined by a method similar to roulette probability. K-means++ algorithm can enhance the optimization efficiency of the algorithm and save the running time.

Path Planning | path planning, the main features



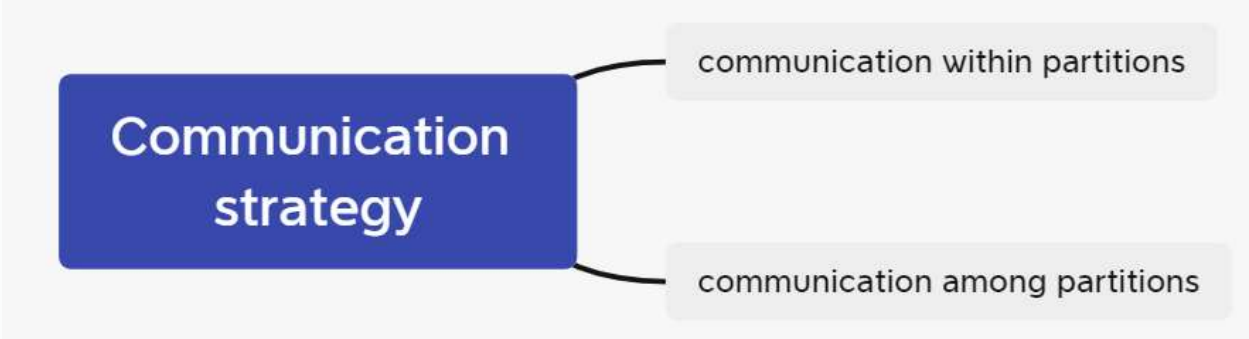
(1)**A* algorithm** is a faster algorithm to calculate the shortest path so far. But it is only a better algorithm in most cases, that is, it can only find the better solution, but often not the optimal solution.However, due to its high efficiency, it has a wide range of applications.

Path Planning | path planning, the main features



(2) However, the key of A* algorithm is how to select the evaluation function. The closer to the correct valuation function, the faster the correct solution can be obtained, but the completely correct valuation function is generally not available. Therefore, the A* algorithm can not guarantee the correct solution every time.

Communication | communication algorithm,the main features



The communication strategy is generally divided into communication within partitions and communication among partitions.

Communication | communication algorithm,the main features

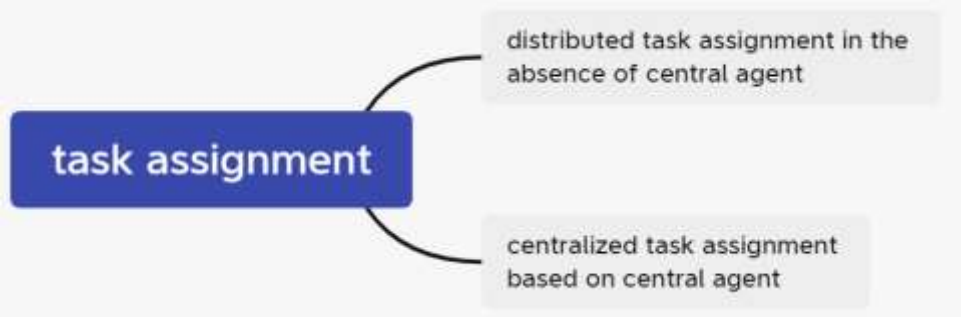
Advantages:
(1)Ensuring that the message is delivered in place.
(2)Using the spread strategy ensures that the message is spread rapidly.
(3)Ensuring that more important message will be responded more quickly.

Disadvantages:
(1) A large number of message senders will reduce the message
(2) processing efficiency.
(3) Increase the judging cost.

Strategies

Police force

The police office target allocation implementation and strategy



For **task allocation**, we divide the task assignment into two categories: **distributed task assignment in the absence of a central agent** and **centralized task assignment based on the central agent**. According to these two categories, we propose a task assignment strategy based on task priority and the Hungarian algorithm.

Police force

The police office target allocation implementation and strategy

To improve the efficiency of rescue, police agents are supposed to clear the blockades in each part of the map in the shortest time. Thus, a dynamic adjustment system with **static assignment** is proposed.Static assignment is to make decisions based on a priori knowledge of the system; its purpose is to schedule a collection of tasks, so they have **the minimum execution time** in each target. Specifically, static assignment is to assign police agent to its nearest partition according to the principle of proximity and the initial location on the map.

$$n = \left[\frac{Area_p}{Area_t} \cdot (N_{pf} - N_{ap}) \right]$$

The number of police agents in each partition is determined by **the ratio of the partition area and the entire map area**, as shown above.

Police force | Guideline Model

(1) Obtain the road area where the agent is located, denoted as source Area.

(2) Get the connection boundary of the next region adjacent to the Source and path, denoted as edge. Get the middle of the boundary,call it middle.

(3) Make three straight lines: the connection line from the location of the agent to the boundary center point, the connection line from the location of the agent to the center of the road area where the agent is located, and the connection line from the road center to the boundary center, respectively denoted as agentEdgeLine, agentAreaLine and areaEdgeLine;

(4) Compare the size of θ and α, if $\alpha < 80$ and $\theta > 80$, the intelligent body position is the starting point of the guideline; Otherwise, the starting point is still the center of the road area where the agent is located.

Police force

Guideline Model

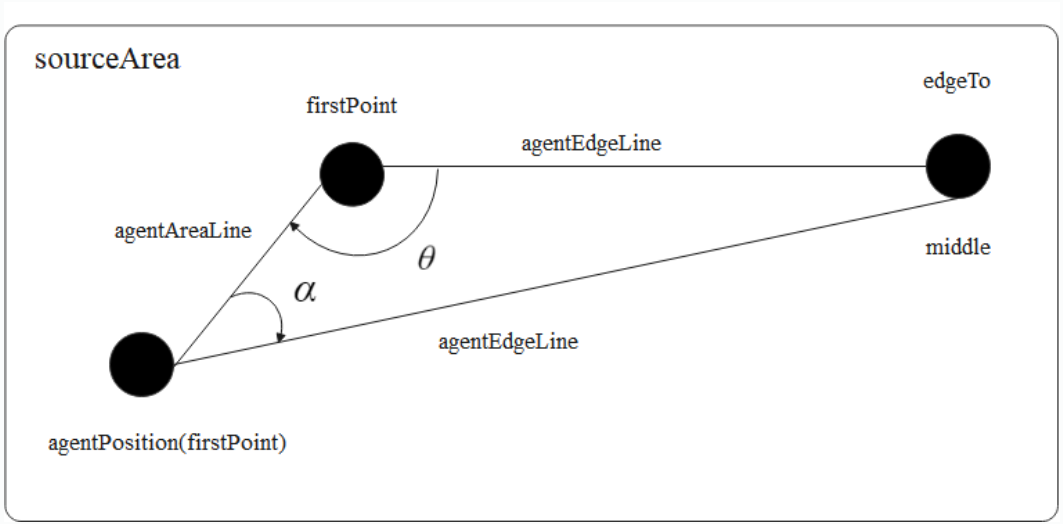


Fig. 1: The starting point of the path bootstrap

Police force | Guideline Model

(1) traverse from the first road area to the penultimate area of the entire path.

(2) determine the starting point of the current region and the midpoint of the adjacent boundary between the current region and the next region.

(3) establish the regional guidance line from the starting point to the middle point of the boundary, and add it to the list of path guidance lines.

(4) take the middle point of the current boundary as the starting point of the next regional guideline.

(5) repeat steps 2 to 5.

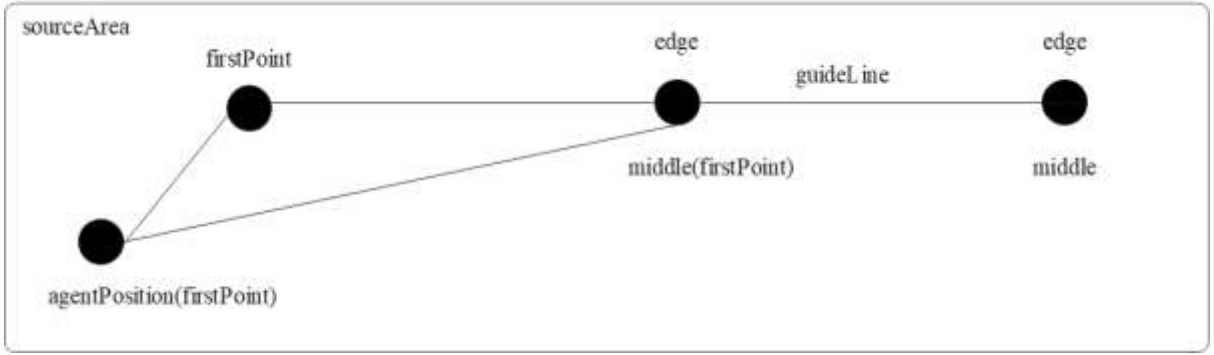


Fig. 2: The intermediate connection process of the path guideline

Ambulance team

The ambulance team target allocation implementation and strategy

In order to make doctors treat as many patients as possible and find more victims, we optimized the doctor's decision-making and cooperation with peers:

(1) Classify the rescue objects, then set the priority depends on the injured person’s current health point(HP) as well as their distance, and select the rescue objects according to the priority.

(2) After the target is established, the rationality of the target is judged according to the information obtained.

(3) Strengthen the cooperation ability of agents: through communi-cation and cooperation, a doctor nearest to the injured residents will be selected to rescue.

Ambulance team

The ambulance team target allocation implementation and strategy

(4) When no injured person is waiting for rescue, the doctor will search the building according to certain strategies, and inform the police to clear the road block if it is found.

(5) When doctors search for shelter after loading humans, they judge the time to arrive at the shelter and the sum of waiting time to ensure that the injured can get the fastest rescue.

(6) In calculating the rescue time, the correction time will be increased according to the calculation time. For example, when the subject is next, the correction time is zero. Through which can we ensure that all subjects use the same treatment method.

Fire Brigade

The fire brigade target allocation implementation and strategy

In order to ensure that the Fire Brigade spends as much time as possible rescuing buried civilians rather than finding more civilian victims, we have optimized the Fire Brigade strategy:

(1) We prioritize the wounded by distance first, then discard those who have died or cannot be saved.

(2) After the target is established, the rescue time is estimated according to the burial depth. Then comprehensively consider the target's blood volume and the distance from the shelter to determine whether the target can be rescued.

Fire Brigade

The fire brigade target allocation implementation and strategy

(3) When no injured person is waiting for rescue, the Fire Brigade will search

(4) Strengthen the cooperation ability of agents， a citizen is rescued, and the citizen's signal is sent.

(5) If the Fire Brigade can't find anyone buried, they go into the building and found who in need of help.

Evalution

Results

Map / Team	Vc2	Sydney1	Istanbul1	Eindhoven1	Total
AIT-Rescue	44.26	15.11	44.25	12.33	115.95
Ri-one	40.95	11.70	42.37	11.23	106.25
CSU-YUNLU	54.62	19.78	45.37	15.74	135.51

Conclusions | summarize the main contributions and conclusions

Different agents have different responsibilities and behaviors, so the priorities of tasks are different. Path Planning and Clustering are the most basic and important modules, so finding a better way to achieve them is a constant topic. We should design different strategies for different agents to achieve an efficient solution.

At the same time, we cant ignore the coopera-tion 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.

Conclusions | summarize the main contributions and conclusions

In the coming period, we plan to absorb the advantages of other team agents, and then improve our strategies. Also, we will try to introduce more advanced methods and we will improve the behavior of some agents in the future, too.

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Thanks for listening

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