RoboCup 2018 – TDP Rescue Agent Simulation MRL (Iran)

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Abstract

In this paper we are going to describe our approaches for RoboCup 2018 competitions. According to the use of ADF, we plan to bring our proved ideas that form our legacy code to the new structure. For 2017 competitions we brought most of the basic ideas such as path planning and clustering but for this year we have concentrated more on agents, specially fire brigade agents. Our preliminary experiments show the improvements in compare to the latest implementations for the 2017 competitions.

1 Introduction

MRL team has participated in RoboCup Rescue Simulation competition since 2004 and during these years multiple innovative and efficient approaches have been presented from path planning and clustering algorithms to different agent strategies. Since last year ADF [1] has been introduced as the main framework for agent development and all teams have to develop their codes using it. To make the most use of the power of the new framework, the only possible solution for us was to adapt our strategies to it. Thus, we started to derive the basic and most important algorithms from our previous implementations into the new code structure [2]. We succeeded in being prepared for the competition using those basic algorithms [3] [4]. Consequently, we reached the first place at preceding competition. For this year, we decided to continue our way to bring the other important and useful ideas from our previous implementations into this new code structure. So we focused on fire brigade agents and planned to re-implement our most important approaches like Strategy Management and Direction Based Action Strategy. Strategy Management can help agents to decide when to select a specific strategy in a specific situation and Direction Based Action Strategy is about selecting an important side of an uncontrollable fire cluster to control it from spreading to that side. In the next sections we are going to introduce mentioned ideas together with some images and experimental results.

2 Modules

Modules play an important role in ADF because they provide fundamental functionalities for agent strategies. So the last year we implemented the most important ones like a modified version of K-Means algorithm [5] for clustering and A* [6] for path planning. This year we have no plan to have specific modification or new implementation for these kinds of modules but we may have some for the competition and it depends on the process of our preparation.

3 Strategies

As it is stated before in the introduction section, our improvements and developments for this year is focused on using previous experiences and ideas we reached during last events. Considering this idea, we decided to concentrate more on our Fire brigade agent.

3.1 Fire Brigade

Based on the experiences, the cluster of multiple buildings on fire can be a problem, and selecting a proper approach for FB agents is the most important challenge. There can be two possible and major approaches for fire brigade agents face in this situation; One is about putting the whole fires out and the other one is controlling the cluster from spreading over the whole city. But the important question is how we can distinct these two situations. We found the solution using an inequality. The bellow inequality is an optimistic approach for the mentioned problem, that is, we try to find out whether it is possible for fire brigade agents to extinguish target buildings from their tanks without any movement (without going to refuges and coming back) or not.

$$\frac{CE}{MaxFBs} < NFB * TC$$

Here in this inequality, CE is the cluster energy which is the sum of energy in each building on fire in the cluster what we gain from our fire estimator [7]; Max FBs is the maximum number of possible fire brigade agents for a scenario; NFB is the number of fire brigade in the current scenario and TC is the tank capacity of agents. Considering this inequality, it is time to attack from all sides to extinguish the buildings as fast as possible. Figure 1 shows this situation. On the other hands if the inequality does not apply, it means even optimistically we cannot extinguish the whole fires so we have to find another solution, which can be controlling the fire. But the main question here is which side of the fire is the most important side of it. To address this issue we split the map into different regions considering the target cluster of fires as one of them then we value the remaining regions by some specific parameters such as total area of buildings, number of gas stations, number of civilians and so on. Figure 2 shows the idea.

Simply the region with the highest value is considered as the important side to keep away from fire spread, then agents draw an imaginary line (white line) from the center of the target fire cluster to the center of the selected region and after that two segments (green dash lines) with a specific angle in between are considered to find the proper building to extinguish. To summarize the proposed approach, you can see the bellow steps:

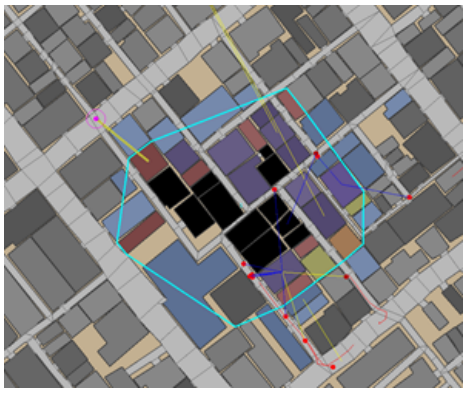


Figure 1: Extinguishing fires in the cluster from all sides

	Map				
Team	**Paris2**	**berline2**	**ISTANBUL3**	**VC3**	**EINDHOVEN3**
MRL New	68.86	139.90	213.34	204.12	128.54
MRL 2017	16.94	100.56	183.31	180.31	109.7

Table 1: Comparison of MRL new strategy and MRL latest implementations for RoboCup 2017.

1. Make a cluster of fiery buildings
2. Find the border buildings [6]
3. Split the city into multiple regions
4. Value each region
5. Find border buildings of the cluster based on the most valuable region

4 Preliminary Results

To evaluate our approaches, we have tested them on different scenarios against our own previous approaches in the last event. Figure 3 and Table 1 shows the result.

5 Conclusions

Most of this year preparation processes are concentrated on fire brigade agents where we used an inequality to determine the fire cluster situation and decide accordingly. These improvements are based on our last year implementations which were mainly about bringing the most proven approaches to the ADF code structure. As what preliminary experiments showed us, the direction approach fits properly for the controlling situation so we plan to improve its performance as our main approach by the beginning of the competitions.

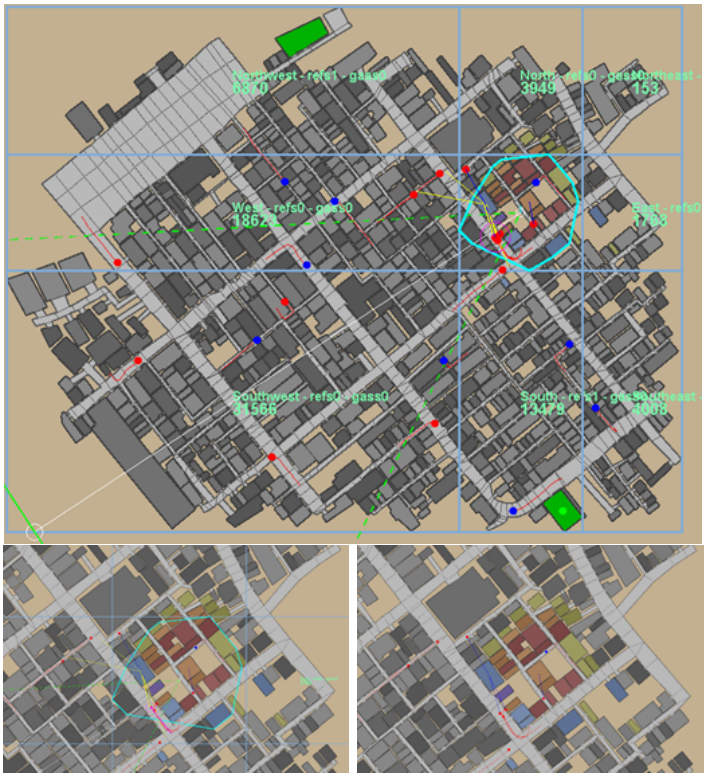
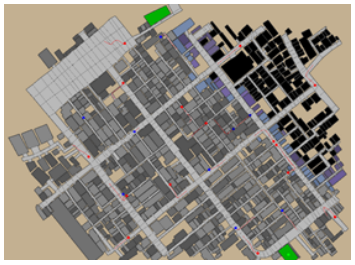
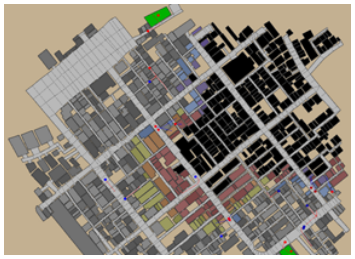


Figure 2: This figure shows the process to find the important side of the cluster to control



(a)



(b)

Figure 3: figure a shows the result of using direction in compare to figure b where does not use direction approach

References

[1] Github: ADF Project,
`https://github.com/RCRS-ADF/RCRS-ADF`

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[3] Deldar Gohardani, P., Rostami, S., Mehrabi, S., Ardestani, P., Taherian, M. *Rescue Simulation Team Description*. MRL, Iran, 2015.

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[5] Steinbach, M., Karypis, G. and Kumar, V. *A Comparison of Document Clustering Techniques, University of Minnesota*. Technical Report, 2000.

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`https://en.wikipedia.org/wiki/A*search_algorithm`

[7] DeldarGohardani, P., Mehrabi, S., Ardestani, P., Jazeb Nikoo, E., Rostami, S., Taherian, M. *Rescue Simulation Team Description*. MRL,Iran, 2016.