Robocup 2013 – Rescue Simulation League
Team Description Paper
<Eskilas>

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Abstract. This paper describes Eskilas team algorithms and solutions to Rescue Agent Simulation. The Hierarchical Clustering algorithm is used for police forces. The fire brigades use Convex-Hull algorithm for their decision. Genetic algorithm is used for ambulance teams. The communication system of the team has improved and also center base radar has been developed for agent's decision.

1. Introduction

Robocup Rescue Simulation agent competition consists of a disaster management simulation with multi-tasking agents (Fire brigades, Fire Stations, Police Forces, Police Offices, Ambulance Teams and Ambulance Centers). In addition to be one of the best test beds for agent coordination, there are many other challenges such as development of agent communication protocols for limited communication and noisy message arrivals, multi-agent path planning, scheduling, optimization, etc.

2. Review of the Robocup Rescue Simulation Platform

Earthquake is one of the most destructive natural disasters and it kills many people every year. Rescue Simulation Competitions took place in 2001 after the earthquake in Kobe, japan in order to reduce infecting damage on future earthquakes.
There are agents that are dealing with this problem: Firefighters, Ambulances, Polices. Works that should be done are such as: open paths, rescue city civilians, extinguish fires, etc.

3. Agents

There are three kinds of agents: fire brigades, police forces and ambulance team agents. Each one of them has its own job, property and problems. The goal is to manage these agents in a way that will reduce the loss of people and civilians in the city. The algorithms and solutions to problems of each kind of agents are explained here.

3.1. Ambulance Team Agent

The aim of the whole game is to save more people and ambulances have this duty. To achieve this goal we need to have a good matching of ambulances to humans. Therefore, ambulances use a genetic algorithm to get the good matching of ambulances to humans.

3.1.1. Genetic Algorithm

As mentioned before, the genetic algorithm is used in order to find a very good way of matching of ambulances to humans. The matching of one ambulance to one human (probably no humans which means the ambulance doesn't need to rescue any humans) is modeled into a gene and a set of genes will be our chromosomes. First, some random initial chromosomes will be produced. The next generations will be produced with selecting some parents using the Roulette Wheel parent selection; then the cross overs and mutations occur. Also some of bad chromosomes will be removed because the more chromosomes are there the more process they take. Some important factors which will affect the efficiency of matching are described.

Time to Death (TD): This parameter is a property of civilians which indicates the time remained to the civilian's death. The estimation of this property will be computed when at least there are two cycles in which the civilian's properties are observed and it will be calculated regarding the change of civilian's damage, Hp, fire. If a matching have less total TD, the matching is more effective because some more important civilians are selected.

Time to Rescue (TR): This variable is an estimation of the necessary time to reach the civilian, unbury it and transfer the civilian to refuge. The less amount of TR in the matching indicates that the less amount of time is wasted, so the matching is more effective.

Number of Rescued Humans: This parameter describes the number of humans in the matching who will be rescued. TD and TR will be used to check whether the human will be rescued before the human's death or not. The more the number is, the more effective the matching is.

3.2.Police Force

When the game starts, some roads are going to be blocked by blockades. These blocks in roads disables fire brigades and ambulances to do their job and decreases their performance. Because clearing the blockades is time consuming, the ways polices clear and the way they clear the blockades is important.

3.2.1. Target Grouping

Among all the possible targets agents and refuges have more priority. In order to have a better matching of police forces to our targets, all of the targets will be classified into some clusters which are made by using Hierarchical Clustering algorithm.

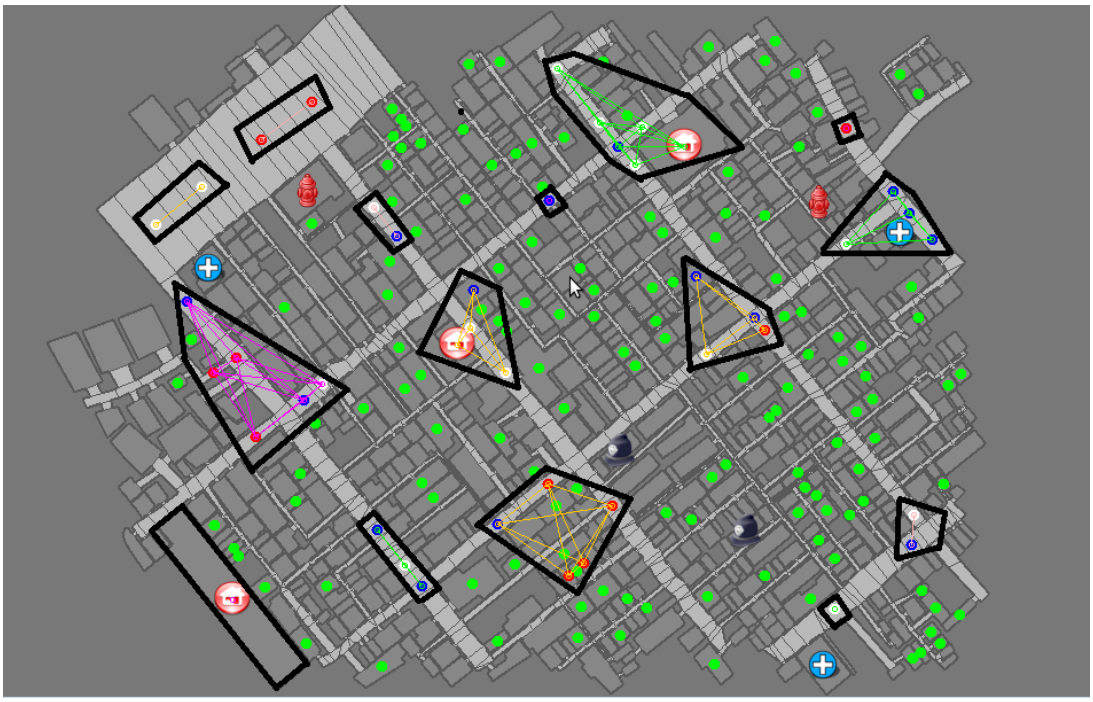

Fig. 1: The answer of Hierarchical Clustering in Kobe Japan

3.2.2. Target Matching

Matching of polices to the described clusters is an important part of police forces' job. To have a good matching between these clusters and police forces, the problem was modeled into a weighted complete bipartite graph (one part of vertices of the graph are police forces and the other ones are clusters). A greedy algorithm was used to choose some edges of the graph in a way that all of the clusters have a charged police to open it.

3.2.3. Opening Fire Zones

Another important part of police forces' job is to help fire brigades to extinguish burning buildings with clearing some necessary roads. The police forces create fire blocks as fire brigades do. Police forces will be matched to fire blocks and then they will clear all the path blocked in the fire block.

3.3 Fire Brigade Agent

Fire Brigade's job is to control buildings in fire this indicates many jobs such as: preventing fire from expanding, prevent and control fire of buildings that have buried humans in them. The most important dilemma is that a fire brigade should extinguish buildings and control fire from which road[s].

3.3.1 Create Fire Blocks

Fire Brigades first create fire blocks in order to choose their target. Fire blocks are some neighbor buildings that are produced using DFS algorithm. These blocks can help fire brigades in choosing their targets which are first a fire block then a road to go for extinguish.

3.3.2 Convex Hull Algorithm

Fire Brigades use convex hull algorithm in two steps: (Both steps use Graham's Scan as an algorithm to find convex hull)

1. Using convex hull algorithm in order to find convex buildings of a fire block.
2. Using convex hull algorithm for finding convex roads which at least have a convex building of block in sight.

The first step is a simple use of the algorithm and finds the convex of block's buildings.

The second step uses the convex hull algorithm to find convex roads that we can see block's building[s] from but the point is these roads aren't appropriate roads for extinguish so in order to find the appropriate roads there is another work will be described in next part.

3.3.3 Finding Outer Roads

Previous paragraph described usage of convex hull algorithm in finding fire block convex in-sight roads and also mentioned that the result is not appropriate. So in order to find better roads fire brigades create outer roads for a fire block. Outer roads are computed in this way: roads that are in the nearest path between two convex in sight roads. These roads are more appropriate.

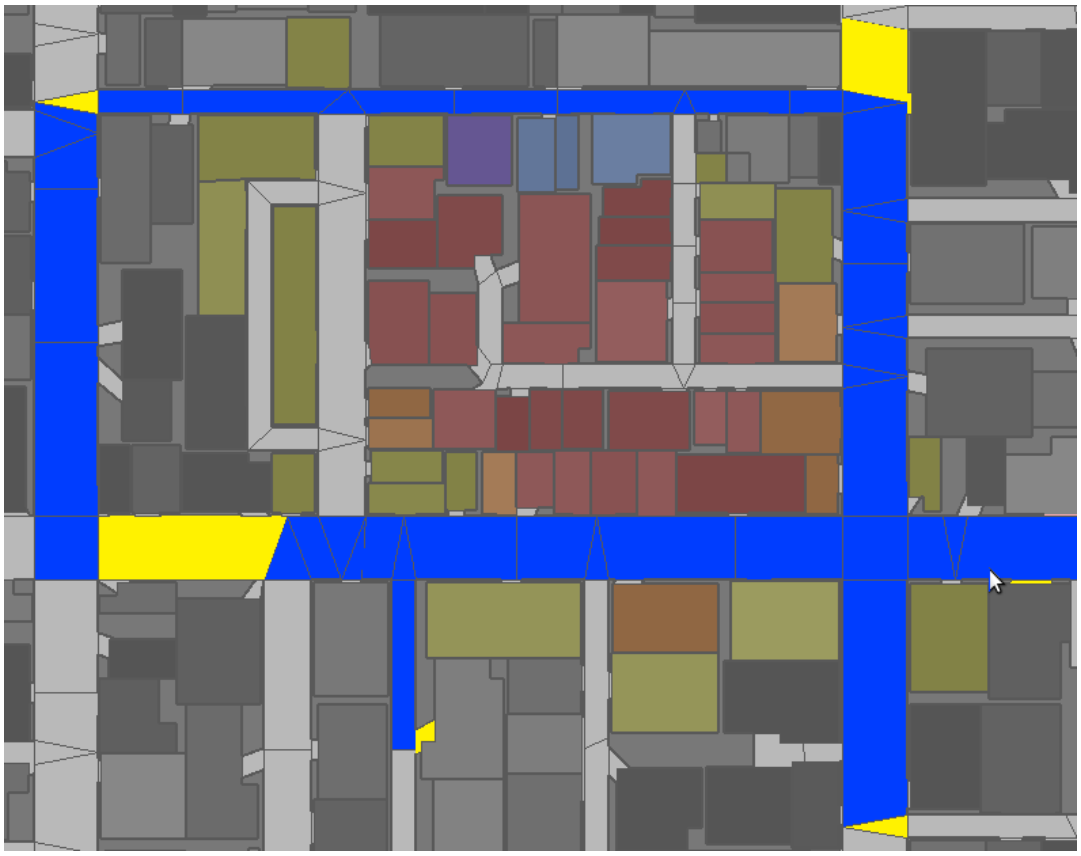

Fig. 2: A fire block with convex in sight roads (Yellow ones) and outer roads (blue ones) in VC

4. Radar

Communication System is used to share the information between the Agents. The way of sharing messages is a very important issue. An effective Communication System is so flexible that can adopt itself to any circumstances (i.e. high noise and low band-width). That is why we divided the Communication System into 2 Modes by considering factors such as the number of Channels, their bandwidth and also the number of available subscriptions. Here we explain the method of Mode choosing and sharing the information.

4.1. Normal Radar Mode

In Normal Radar Mode radar channels are used for updating information of all agents. There are three sub-modes in this mode:

1. Sending data in one channel:
   Civilians, Buildings and Roads data are sent in one channel
2. Sending data in two channels:
   First channel will contain Civilians and Buildings data and the second channel contains Roads data.
3. Sending data in three channels:
   Each one of the types of information will be sent in separate channels.

4.2. Center Base Mode

In Normal Mode all agents will have all of the information but each one of them decides separately. This kind of decision can be uncooperative in most cases, but a one-person-deciding is cooperative at most times. For this way of decision a center based radar is used in which the centers or the captains (when there are no available centers). The two important factors which brought the idea of center base radar to the way of decision were: 1. The Cooperation 2. The ability of using more algorithms which costs a lot of time e.g. the genetic algorithm used for the ambulances.

5. World Model and World Graph

The World Model and World Graph are mainly the ones used in the ESKILAS-2011 but there have been developments in both of them especially the passing structure of world graph has improved a lot and also some bugs are debugged.

6. References

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