Library and strategy for the RobocupRescue Project

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Library and strategy for the RobocupRescue Project : Abstract

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Abstract. After a brief introduction to the RoboCupRescue simulation project, we present good technics to develop effective algorithms for the annual competitions. First, we describe a layer division of the program: three layers to easely divided the programmers' work. Then, we give the behaviour algorithms we have implemented in view of participating in the 2002 competition in Fukuoka. Finally, we present a comparison between the results obtained with our algorithms and those of the winner of the 2001 RoboCupRescue competition, YabAI.

The RoboCupRescue Simulation Project goal is to develop more efficient urgency mechanisms by simulation of an earthquake. It works on an artificial map (Fig. 1) which contains immobile objects like roads, buildings, etc. and mobile objects such as rescue agents and civilians. The rescue agents have their own capabilities : a police force can clear a road, a fire fighter brigade can extinguish a fire and an ambulance team can rescue an injured civilian. To be performant, the rescue agents have to work cooperatively, respecting the determined communications rules. For example, all rescue agents are allowed to broadcast and listen to only four messages each turn.

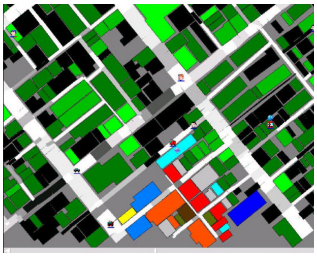

Fig. 1. RobocupRescue map.

The best way to develop cooperative agents in this research project is to divide the structure of the program into three different levels.

1. First, the low level layer which will provide the connection between the agents' module and the kernel and the data packaging for the LongUDP protocol. The main goal of this layer is to allow agents developers to work independently on the physical connection between the modules and the upper level algorithms conception. We divide again these algorithms in two groups.
2. The mid level layer contains the world data representation (the agents' memory) and all the agents' basic algorithms such as moving through the map, extinguishing fires or clearing roads.
3. And finally, the high level layer implements the cooperation between the agents and all their specific behaviours.

In this way, it is possible to elaborate more effective agents by working separately on each layer and once the low level layers are efficient, researchers can spend more time creating complex and powerful cooperative algorithms which are the *raison d'être* of the project.

Our agents team, called KADAI, is based on YabAI[3], winner of the 2001 RoboCupRescue competition. Our idea was to divide the map into sectors. The 10 police forces (PF) were distributed in 10 sectors, each responsible of its own sector. This repartition is very effective because the average time to clean a sector is one turn for cleaning and one turn for moving to next road. The map contains 820 roads, and a sector 82 roads. So, it takes 82 * 2 = 164 turns to clean the whole map! At half of the simulation, all roads are cleared.

For the fire fighter brigades (FB) it is very important to extinguish the buildings very rapidly and thus cooperatively to minimize the extinguishing time and the expansion of the fires. It is the reason why we chose to make two groups of five FB. So, they usually take one turn only to extinguish a building so that fire cannot spread.

The ambulance teams (AT) are divided into four sectors, and the fifth AT which is not in a sector carries the wounded civilians to the refuges, while the other four AT dig into the rubbish to save buried civilians.

We also made a comparative study, based on about 140 simulations, with results obtained by our team and the YabAI one (Fig. 2). The first graphic shows us the evaluation given by the simulator. This is the official value used for the determination of the best team[4]. The horizontal axis represents 5 sets of initial values for the simulation[1]. These sets are taken from the 2001 championship.

We can see on the graphics that our agents better minimize the overall damages. The number of victims and burned areas are shown in the second and third graphics. The fourth one shows us the number of messages exchanged between the agents. It shows a very big difference between the two teams : our agents use very few communications while doing a better job.

PF have an important role, since all other agents depend of clean roads for their efficiency. Our PF do not take time to elaborate a plan or to manage messages.

[1] initial position of agents, number and position of fires...

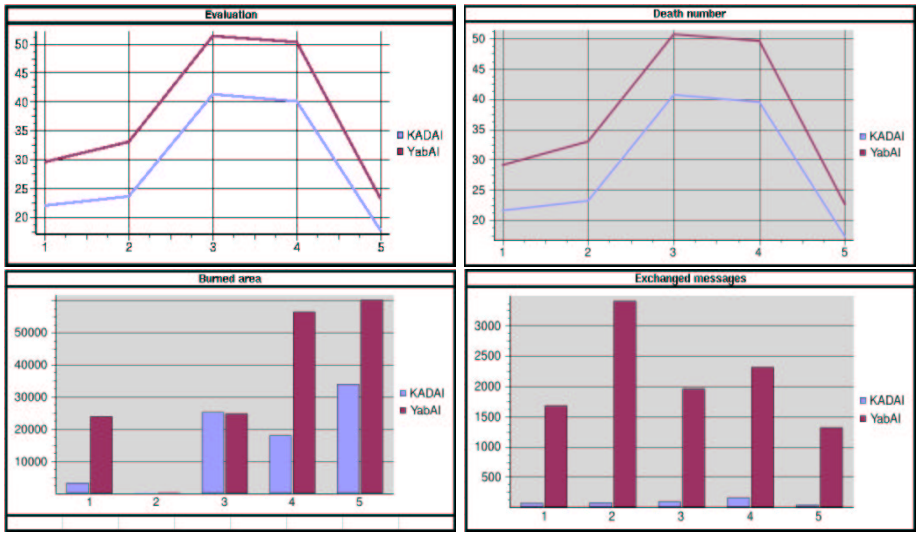

Fig. 2. Comparisons between YabAI and KADAI agents.

We only use communication to report the wounded civilians. As the AT are distributed by sectors, they do not need other information. And as only one AT carries wounded civilians, there is no collaboration problems to bring them to the refuges. Finally, as the FB can see fires from anywhere, they do not need information to coordinate.

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