RoboAkut 2005 Rescue Team Description

H. Levent Akin, Utku Tatlidede, and Baris Eker
Boğaziçi University, Department of Computer Engineering, 34322 Bebek, Istanbul,
TURKEY
{akin}@boun.edu.tr

Abstract. RoboAkut is a simulated task based multi-agent rescue team. There is a hierarchy among agents, and agent coordination is centralized. Each agent is capable of deciding for itself when there is no support from other agents. The agents make use of the sensory information they obtain to learn the state of the environment, and consequently to decide on the actions to perform.

1 Introduction

RoboAkut is one of several projects carried out in the Artificial Intelligence Lab of the Computer Engineering Department of Bogazici University. RoboAkut has participated in the RoboCup Rescue Simulation League 2002, 2003 and 2004. In these competitions the agents were developed mainly using reinforcement learning. However, reliance on only reinforcement learning leads to poor performance since it is difficult to have the necessary number of simulations to train the agents from scratch. In this years approach, we try to allocate tasks from centers to Platoons in the general case, however the platoon agents are also designed to behave autonomously. They are autonomous since they sometimes need to deal with complex tasks, like extinguishing fires in a region. We implemented a auction mechanism for ambulances and fire brigades. The performance of auction implementation is highly correlated with which parameters are chosen for cost calculation and how these parameters are calculated.

2 General Structure

The implemented multi-agent rescue team incorporates cooperation, hierarchy among agents and autonomy. The agents of the team can be classified into two groups in terms of their social roles: platoon agents and dispatcher agents. Dispatcher agents are responsible for keeping their world information up to date, and assigning jobs to platoon agents. Platoon agents are responsible for bringing reorders to the disaster site. The agents can also be classified into three groups in terms of their jobs: Police, firefighter, and ambulance. Ambulances aim to rescue injured civilians and bring them to refuges, firefighters extinguish fires, and police officers clear blocked roads. For police case, the center tracks the polices and the job is assigned to the nearest one.
3 Ambulance Team

Ambulance Team starts exploring the buildings that are assigned by their center at the beginning of the simulation. If they find a buried civilian or civilians, they start saving the one that has the highest priority and reports all of them to the ambulance center. The priority of the civilian depends on the agent type first. Our agents have the highest priority. Among the civilians, the one that has the lowest estimated life time (hp/damage) has the highest priority.

Ambulance teams get some messages from their center during simulation. If they get an auction opening message they respond to this message by sending their costs related with the job(s). There may be more than one job in the center's message. Ambulance agent also may send the response for more than one auction in a message. We believe that the most important part in the auction implementation is determining correct cost parameters and calculating them as exactly as possible. Currently, our agents calculate their reaching cost by finding shortest path to the target. All agents have the same cost for finishing cost. It seems useless, but we hold it for future use. In the future, we plan to end auction in a way that also considers collaboration of multiple agents. We do not use the job left cost currently, and if an agent has a job with owner role it does not give bids for auctions.

As clearly known, a job is typically finished earlier when more agents work on it. In the auction mechanism, only one bidder wins. However, we believe that if an agent is not dealing with a job it can help to it. To implement this mechanism, we assigned roles to agents. The agent that gives the highest bid gets the job having "owner role". This type of agents has to inform the center by sending a job acceptance message. After ending the auctions in hand, the center assigns "helper role" to agents that are not busy. They deal with the job and respond to the open auction messages by bidding. If they win an auction, they leave their helper role at a point and get the owner role for another auction. The agents that have owner roles do not respond to the auction opening messages.

4 Ambulance Center

Ambulance center divides the disaster world into regions and assigns these regions to the ambulances by sending the coordinates of them. Each agent explores the region that is assigned to itself. The center holds the list of civilians reported by platoon agents. This list is updated when a "report civilian" message comes from platoons. If the reported civilian is not in the list, it is added. If it is not a new one, its information is updated. At every clock tick, the center opens auctions for the civilians that have no auctions belong them. Next it scans the civilians that have auctions. If it has waited enough for the auction, it concludes the auction by giving the "owner role" to the one having the lowest cost. Then, some number of agents having next highest bids gets helper role. The center waits for a few clock tick for confirmation message from "owner". If the confirmation message comes, the civilian is removed from list. If no message comes, the auction is re-opened.
5 Fire Brigades

Fire brigades have some common properties with the ambulance teams. They also start with exploring the region. It is very important to extinguish the fires as early as possible. Because, after some point, the number of affected buildings increase almost exponentially, but the number of agents remain constant, so it becomes much more harder to control the fire. Therefore, fire brigades aim to reach fires as early as possible and control them. We use auction mechanism for fire brigades also, however we do not open auction for each building. Fire needs much more quicker response than civilians and opening and result auction for each building do not meet this requirement and is not feasible when it is considered that message sending/receiving is limited. In the light of these explanations, firebrigades are not assigned directly to a building but to a region represented by a target building. The assigned firebrigades are responsible from all the buildings in some neighbourhood of this building. If the fire is in the early stage, then all the firebrigades assigned deal with the building. If the fieryness property of the target building becomes 2, this means fire will start spreading to neighbours. After that stage, only the owner deals with the target building. The others deal with newly started fires if exist. If there are no new fires they continue with target building. The firebrigades start to extinguish buildings according to their starting time. The center also assigns an index to each helper firebrigade. If the index assigned is 1, then agent deals with the most recent fire. If the index assigned is 2, then it deals with the next most recent fire, and so on. When, they extinguish the fires that they know, they explore the region to check if there is any other fire that they are not aware of.

6 Fire Station

Fire station tries to allocate tasks to firebrigades in the region level and provides communication with other types of agents when necessary. When a building in fire is reported, it is added to the building list. If there is a representative building reported previously for the region that the new building is in, it is omitted. At each time tick, auction opened for each building received. Additionally, the fire station sends a "clear region" message to the police agents. Because it is very important that the fire region is clear in terms of blocked roads in order fire brigades to reach the target. After waiting for an auction for some clock tick, it ends the auction according to sent bids by fire brigades. The one having the highest bid is assigned as the owner and some number of agents are assigned as helpers. This number is highest during the beginning of the simulation, because the number of fires is low at the beginning and more agents can be assigned as helpers.

7 Police Agents

Police agents deal with the jobs assigned by the police center. They either deal with clearing the region assigned by the center or they work on clearing roads
reported by the center individually. They hold their current role (clearing region or clearing individual roads) and two separate lists for the blocked road list and a list for all roads in a region if it is assigned. They explore the roads in these lists according to their role. If there are no roads remaining in these lists they start exploring around. Police agents send confirmation messages when they receive "clear region" message and send "clear region finished" message when they have finished clearing region. In this way, the center knows which police agent is dealing with and does not send road clearing job to the one that has the region clearing role.

8 Police Center

Police agents dispatch the incoming messages related with blocked roads from other centers in a controlled fashion. Since the police agents report their position in each clock tick, the center knows the position of every police agent. By using this information, the police center assigns roads to the nearest police agent. The same case also applies in the region clearing case. The region is assigned to the two police agents that are nearest to the representative building. The center waits for the confirmation message for the clear region message. If it can not get a confirmation message in a predetermined time, it assigns another free agent. The police center holds the number of polices assigned as region clearer. Clearing region requests come from fire brigades. In order to be able to also response to the requests coming from ambulance teams at most half of the police agents can be assigned as region clearer. Others deal with clearing individual roads.

9 Messages

This year, we use a common structure for each of our agents for message sending. Since, the number of messages sent and received in a clock tick is predetermined, the messages that are sent and received should be selected carefully. Important messages should not be omitted from agents as much as possible. To meet these requirement MessageSender class, holds the list of messages to be sent according to their priorities. The priority of the message is determined by its type. The agent that wants to send a message gives the message, message type and number of sending. We believe that sending some very important messages more than one time may be necessary, because receiving agent may omit some messages. This number is determined by the sender agent. This class also controls the maximum number of sendable messages in a clock tick. By holding the messages in a list, we do not need to leave some messages unsent due to message limit. If we have more message than the maximum sendable number, we send the remaining messages in next clock tick.

References