The communication reduction approach of the 'UvA Rescue C2003'-team

S.B.M Post, M.L. Fassaert, and A. Visser

Computer Science Department, University of Amsterdam, Kruislaan 403,
1098 SJ Amsterdam, the Netherlands
Tel: ++ 31 20 525 7532 - Fax: ++31 20 525 7490
{sbmpost, mfassaer, arnoud}@science.uva.nl
http://www.science.uva.nl/~arnoud/research/roboresc/

Abstract. The 'UvA Rescue C2003'-team is participating in the 'Rescue Simulation League' in the RoboCup competition in Padua. In this article we will explain our approach to cope with the limited communication between the centers and the agents in the disaster area. Our approach has two components. On the one hand, we introduce teams with an information manager. The manager will update the center with summaries, enriching the model with information from other teams. On the other hand, each team will build a common knowledge model. Based on the common knowledge, the agents are able to predict the behavior of their teammates, which enables the possibility to cooperate without explicit communication ...

1 Introduction

The RoboCupRescue Project is built upon the success of the Soccer Competition. Both projects provide a testing ground for research and advances in robotics and artificial intelligence. The University of Amsterdam is participating in the Soccer Competition since Paris, 1998 [1]. This year we extend our interest in 'Rescue Simulation League'. This area fosters interesting research questions. Compared to the Soccer Competition, the teams of agents that have to be coordinated are more heterogenous of nature. Further, the situation awareness is more difficult, because there are never enough rescue agents in the field to get a complete overview of the situation.

2 Common Knowledge

The first goal is to create operational agents that can operate decently with limited coordination by the centers. Unfortunally, real large catastrophes lead not only to thousands of deaths or injured people, but also hit the communication infrastructure as well. To cope with the scarce communication between the center and the agents in the field, we introduce communication groups, with communication managers. The members of a communication group will give priority to messages of group members. For those messages to be meaningful, the group members should be in the same region of the map, so they can exchange local information, which all members can use to think at a local level.

The notion of a 'communication tree' with 'communication groups' and 'communication managers', enables us to get what we want. This is illustrated by figure 1.

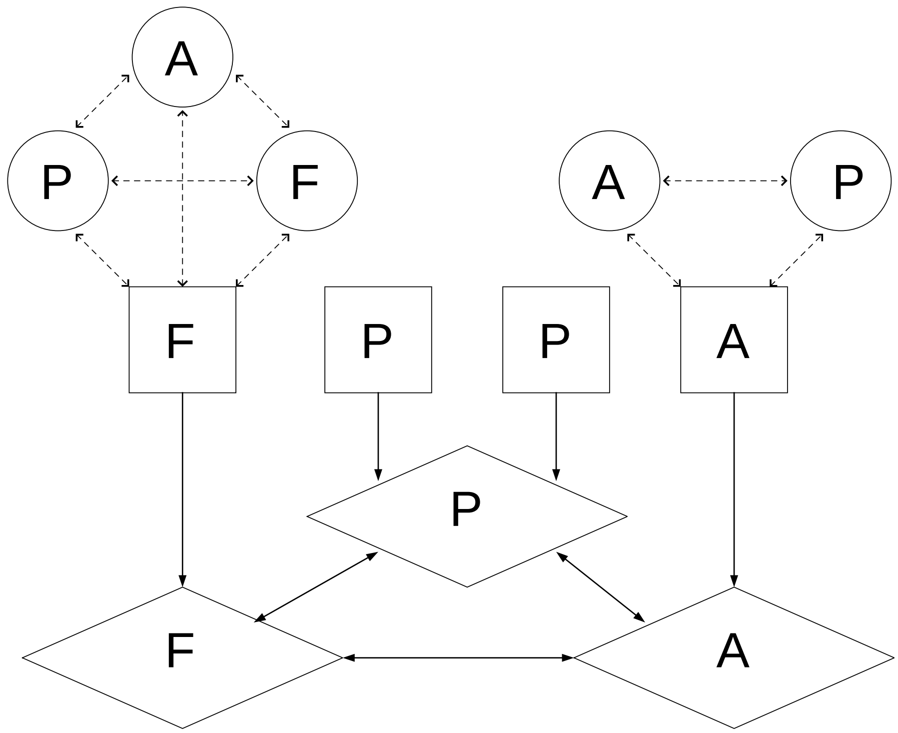

Fig. 1. Communication model: diamond=Center; circle=Agent; square=Communication manager; A=Ambulance; P=Police;F=Firebrigade; dotted line=spoken information; solid line=radiocommunication; S=summary

The communication managers are responsible to summerize the team model to their centers. The centers respond with overall decisions and relevant summeries of other teams. To test the performance of the common knowledge approach, we only have to sever the link between the centers and the communication managers, and evaluate the behavior. The hard part will be to define what decent behavior is. This definition is not directly related to the overall score of the system. We will define uncoordinated behavior as the frequency of failed tasks by the platoons. A policeplatoon that arrives at a road only to find that it was cleared by someone else, a firebrigade that can not reach the fire, an ambulance that tries to rescue a civilian agent that has already died, those are all signs of disorganization. We expect that a team that operates on a problem area alone will perform almost the same with or without coordination from the centers, because that is how we designed the system, but serious problems might arise when two teams operate in the same place.

3 Situation Awareness

Our second goal was making sure that the information provided by the proposed communication system is precise and fast enough to base decisions on. Our goal is to translate the information gathered in the field to a world model that is usable by any form of a decision making process and is as good a mapping of the actual situation as possible. The worldmodel is based on summaries of what agents encounter in the field so it will not be a perfectly detailed model, nor should it be. Cutting down on the number of variables in the world will make the job of the decision making process easier. It is also a more realistic simulation of what goes on in a real disaster control center.

To measure this we have to compare the combined worldmodels of all agents in the field with the summarized worldmodel in the centers and count the number of differences at every iteration. It is expected that the error due to communication lag will be large in the first few iterations of the simulation because the difference between the global worldmodel of the center the local worldmodel of the fieldagents will be large. When this difference becomes less the communication lines will become more readily available and the error in the center's worldmodel will asymptotically decrease.

4 Conclusion

We have analyzed problem areas in the design of a multi-agent system for the RoboCupRescue simulator environment. We have extended the formation of teams by assigning the role of information manager to one of the teammembers, who is responsible for the interface to the center. Inside a team a more detailed common knowledge model is shared, which is used to predict the behavior of the teammates. In this article we have already indicated the measures to performance of this solution. With this research we will cooperate in this year competition on this area, the RoboCup Rescue Simulation League.

Acknowledgements

This paper is based on preliminary research of the RCRSS and ADK done by: S.B.M. Post, K. Luikx, J. Uijlings, R. Geertzema and V. Mahabir

References

1. E. Corten and F. Groen. Team description of the UvA Team. In RoboCup-99 Team Descriptions for the Simulation League, pages 149-153. Linkoping University Press, 1999.
2. T. Morimoto
`http://ne.cs.uec.ac.jp/~morimoto/rescue/manual/manual-0_00alpha1.ps.gz`
3. Simulator files:
`file://simulator/kernel/System.cxx`
`file://simulator/kernel.RescueSystem.cxx`
`file://simulator/traffic_morimoto/traffic/README.txt`
4. J. Kok, M.Spaan, N.Vlassis. Multi-robot decision making using coordination graphs, Department of Autonomous systems, University of Amsterdam.
5. Michael Bowling's Agent development kit
`http://www-2.cs.cmu.edu/~mhb/research/rescue/`
6. 1. J.Kok, R.deBoer, and N.Vlassis. Towards an optimal scoring policy for simulated soccer agents, in M.Gini, W.Shen, C.Torras, and H.Yuasa, editors, Proc. 7th Int. Conf. on Intelligent Autonomous Systems, pages 195-198, Marina del Rey, California, March 2002. IOS Press.

Stef Post is a computer science student at the University of Amsterdam. Because of his large experience with programming he documented and verified most of the simulator details. He currently focusses on the communication model of our agents.

Maurits Fassaert is an artificial intelligence student at the University of Amsterdam. He is specialized in neural computing and genetic programming, but has gained knowledge of designing multi-agent systems while making a commercial realtime strategy computer game. He now combines these fields of expertise to design the common knowledge behaviour of our agents.

Arnoud Visser studied physics at the University of Leiden, The Netherlands, where he performed investigations in the field of non-linear optics. At the University of Amsterdam since 1991, he participated in several international projects (ESPRIT, ESTEC) concerning robotics for the Computer Science Department. He is interested in architectures for collabrative decision making of Intelligent Systems.