Proposal: Rescue Simulation Agent Competition
- from Test Bed of Multiagent System to Practical Application -

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Abstract. One decade has passed since Rescue Simulation League started. The paradigm of agent based disaster and rescue simulation has aroused the interests of researchers and others. Various systems and many papers have been presented. Rescue simulation system has been improved by every year agent competition, and the issues to be challenged have made clear.
This report summarizes the past of RSL and proposes new style of Rescue simulation league. I am glad that this report will be a material for a good discussion to 2010 competition and help to share the issues that our community has to solve through competitions after 2010.

1 Introduction

The RoboCup Rescue project was motivated by the Great Hanshin-Awaji earthquake, which hit Kobe City on January 17, 1995. This rescue project is intended to promote research and development in the disaster rescue domain at various levels. Rescue Simulation League (RSL) covers the domain from multiagent teamwork coordination, information infrastructure, standard simulator and decision support systems, evaluation benchmarks for rescue strategies and etc.

We have dealt and solved various issues related rescue domain. Section 2 surveys briefly the past competitions of RSL. The issues that we have presented are presented in Section 3. I propose a new style of RSL to answer the request of Rescue Project in Section 4.

2 History of Rescue Simulation Competitions

2000 Rescue simulation system and rescue robots were demonstrated and was approved that RoboCup Rescue League became one league of RoboCup.

2001 Seven teams participated and they competed on Kobe map(1/10) . "Human life is the most valuable" was competition 2001's principle and the first performance metric was set as $V_{2001} = L + 1 - (H/Hint \times B/Bmax)$.

2002 A manually produced Virtual City map was added and the metric was changed to $V_{2002} = (P + H/Hint) \times \sqrt{B/Bmax}$, because the life save factor (L) is leading in V_{2001}.

We had used a traffic simulator that could simulate the behaviors at intersections. The traffic simulator simulate at a micro step of one RoboCup Rescue Simulation time step. The traffic simulator has been replaced with a simple but stable one, because the micro simulation was unstable. [1]

The top two teams employed very different communication styles. One team thinks communications among agents is important at disaster situation, and the other team thinks the communication line would be damaged by disasters and would not be available as usual. [2] I think it is a good reference to the setting of communication among agents.

2003 RoboCup was held at Padova (Italy), Foligno [2] map was added. A rule that limits communication capacity was introduced. Rescue agents communicate within a team were required to send and receive a limited number of messages.

2004 Infrastructure Competition started to promote the development of systems. Random map generation tool was adapted and auto generated maps have been used at competition. This year, semifinals were selected by two different metrics. One is V_{2002} and the other metric is the robustness of agent performances. Teams run the same disaster situation three times and the sensing abilities of agents were changed at each time; normal ability, half of eyesight ability, and half of voice ability.

2005 RoboCup was Osaka (Japan), and a big Kobe map (1/4) was added. The fire simulator has changed to Freiburg fire simulator that was the winner of 2004 Infrastructure Competition. USARSim was demonstrated.

2006 The rescuecore package and TCP protocol connection to the kernel have been introduced. UDP connection was still available in 2006. [3] A crowd simulator, winner of 2005's infrastructure competition, was not used at 2006 competition, because it was unstable for competitions.

2007 Communication channel_0 have been introduced to implement walkie-talkie communication among a team. Scripts for competitions were improved to run games automatically. Teams have been required to submit programs with scripts.

2008 The number of Channel_0 messages and fire simulators has changed.

2009 RoboCup was Graz, and Graz and London maps were added. Score vector has been introduced to reflect that rescue task is the multi-objective problem.

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[1] The term (`Valid games: Are games valid when some simulators fail?`) in the rules was added at 2001 with respect of this unstable situation.

[2] http://en.wikipedia.org/wiki/Church_of_San_Giacomo_(Foligno). It was damaged by the earthquake of 1997.

[3] It is a pity that there was notice on UDP connection in 2008 rule.

3 Issues of agent based rescue simulation

Agent based simulation and distributed simulation are features of RoboCup Rescue simulation system. There are many issues that have been presented and discussed in our community. (Table 1) The referenced papers in the right column are ones that are presented in related conferences. [4] The issues in category *general* are the ones that we need when we explain rescue officials to explain the effectiveness of our approaches.

Table 1. Issues of rescue simulations and published papers

category & issues	references
research	
task allocation/planning	[13]
collaboration among agents	
homogeneous/ heterogeneous agents	
agent communication	
design agent	[1]
multi-objective problem	
system architecture	[12][25] [3]
size of simulation	[27]
number of agents	[16]
area size	
2D/3D	
integration of disaster simulations	[7][10][28]
integration of other simulators	[14]
application	[4] [24]
map generation/conversion	[22]
training system (human-in-loop)	[18][17][11][19]
decision support system	[23][29]
link to real world data	[15]
GPS, monitoring camera	[9]
data from rescue robots	
general	[8][21][20][5]
analysis of agents	[6]
verification of simulations	[26]

4 Proposal to new styles of competitions

The title of this proposal - Proposal: Rescue Simulation Agent Competition from Test bed to Practical Application - follows my paper at the beginning of RSL.

[4] The list is made to my knowledge. I would like to make the list as far as a complete one and I am glad your advices and suggestions. Thanks in advance.

[21] We have to test new ideas and to improve them in order to put the product of one's study to practical use. RoboCup competitions have been providing good opportunity for us.

4.1 proposal for platforms from 2010

It is hard to implement the new ideas into RCRS of Version 0.xx that architecture was designed one decade ago. At the infrastructure competition of RoboCup 2009, there are four presentations. [5] I propose we will use them as a platform from 2010.

- Kernel ver.1 by IAMRESCUE and traffic simulator by Hinomiyagura,
- Map generation tool by RescueFreiburg,
- Weather simulation by MRL.

While the teams will be required to open their softwares by the end of this year, agent teams will report bugs and their quality will be improved by RoboCup 2010.

4.2 proposal for award selection ways

We do not expect what kind of disasters will occur at what situations. Even disasters may occur at their home towns where rescue teams know well its map; the disaster may be beyond their assumptions. Rescue teams will be forced to change their rescue strategies after the initial operations of the prepared prevention plans.

multi objective optimization : The intents of rescue operations change according to situations. At earthquakes saving human lives important. At devastating blazes fire fighting is what comes first.

dynamical changing situation : Weather changes during rescue operations. Winds change their directions; they have rain, snow or fog. They will trigger a power failure, and stop communication lines.

SLAM problem : Simultaneous localization and mapping (SLAM) problem is one of key problems for robot field. Taking cases that catastrophic disasters change the whole situation of town into consideration, a kind of SLAM is necessary. For example, the maps before the disasters may not correct, so the agents are required to correct them.

Teams have been ranked by one performance metric and top three teams, top three teams have been awarded. I propose three awarded teams will be selected from different performance metrics. Followings are example of metrics, life saving by rescue operations, robustness of operation, and the ability of collecting data for search task.

[5] http://www.robocuprescue.org/wiki/index.php?title=RSL2009

4.3 proposal for managing competitions

Five days - three days for preliminary runs, one day for semifinal runs, and one for final runs - have been scheduled. So following schedule can be set up using 5 days.

preliminary runs : all teams are required to participate all three days.
- **day 1** : All teams will be ranked according to the life saving standard.
- **day 2** : All teams will be ranked according to the robustness standard.
- **day 3** : All teams will be ranked according to the sensing data standard.
- **selection of semifinalist** :
  1. Top two teams for each standard qualified to finalists. The number of qualified teams is from 2 to 6 at this point.
  2. Other teams are ranked according to the total points of three standards. From the top team, teams are qualified to finalists till the number of qualified teams becomes 8.

final runs : Two new maps are created by TC members.
- **day 4** : Eight final teams run on the new maps and debug the maps. One of two maps is selected by the eight final teams.
- **day 5** : The metric is selected from four standards, three standards and one mixed one, on the cast of the dice. Eight final teams run the selected map and are ranked by the selected metric.

At the end,I would like to appreciate Rescue Simulation community for the activities. I really expect this will be material for a good discussion of our challenge to new issues.

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