

# Chapter 68

## Agent–Development Framework Based on Modular Structure to Research Disaster–Relief Activities

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### **ABSTRACT**

*This article describes approaches to the RoboCup Rescue Simulation league which is a part of the response to recent large-scale natural disasters. In particular, the project provides a platform for studying disaster-relief agents and simulations. The aim of the project is to contribute to society by making widely available the findings of our research into disaster relief. Some disaster-relief agents contain excellent algorithm modules, which should ideally be shareable among developers. However, this is hindered when the program structure of the agents are different among different teams. Therefore, this article designs and implements a modular agent-development framework that unifies the structure within RoboCup Rescue Simulation agents to facilitate such technical exchange.*

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## **SUMMARY OF THE RRS**

In this section, we explain the simulation content, agent type and behavior, themes of agent development and development environment issues.

### **Overview of RRS**

The RRS is a research platform that simulates disaster-affected areas and disaster-relief activities on a computer (Takahashi, 2001). It can handle disaster-relief activities over approximately 5 hours from the occurrence of a disaster.

Figure 1 shows the activities of agents in the RRS. In the disaster-relief activities, we control six types of agents, namely AmbulanceTeam, FireBrigade, PoliceForce, and the headquarters of each of these units (AmbulanceCentre, FireStation, and PoliceOffice). In addition, there are Civilian agents to simulate civilians in disaster situations.

- AmbulanceTeam  
These agents rescue other agents that cannot move by themselves. They rescue targets from debris and transport them to evacuation centers.
- FireBrigade  
These agents extinguish fires in buildings. They extinguish the fire by discharging the water stored in their tank. It is necessary to supply water when the tank becomes empty.
- PoliceForce  
These agents clear road blockages. They enable other agents to access certain areas by removing obstacles.
- AmbulanceCentre, FireStation, and PoliceOffice  
These agents are headquarters. These agents are only for enabling communication. They cannot move but they are also not injured.
- Civilian  
In the competition, these agents move automatically to evacuation centers.

The RRS simulator consists of a kernel that manages the progress of the simulation. In addition, there are sub-simulator components that simulate disaster situations and agent programs. The simulation proceeds at the rate of one step per minute. The time allowed for calculating one step of an agent is limited to 1 s. Before the start of the simulation, as a pre-calculation stage, it is possible to calculate initial data using only topographical information (Faraji, 2016).

The RRS can be used to research applications of artificial intelligence and information science to natural-disaster rescue problems. In the RRS, five research tasks of are advocated in particular, namely Group Formation, Path Planning, Search, Multi-task Allocation, and Communication (Skinner, 2010). Every year, competitions using agent programs are held for the purpose of technical exchange.

### **Agent Development in the RRS**

The disaster-relief problems handled by the RRS are complex compound problems in which damage situations such as fire, building collapse, and the availability or otherwise of wireless communication

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