

ResQ Freiburg: Deliberative Limitation Of Damage

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The history of search and rescue services has repeatedly shown the difficulty of the coordination of rescue teams in disastrous situations. The RoboCupRescue domain is an attempt to simulate such situations, particularly the aspects of a dynamically changing environment, e.g. the distribution of fire, bandwidth limitation for communication and the high demand for collaborative sensing and acting in a large scale environment.

The task is to successfully coordinate teams of agents for the sake of the limitation of damage to people and buildings. There are two classes of agents: platoon and center agents. Platoon agents are small teams that operate in the field, for example a fire brigade, and center agents are stations that may instruct the teams in the field with new tasks. Groups of platoon agents take one out of three roles, namely fire brigade, ambulance team and police force. To each kind one center agent is associated.

The domain is a real multi agent scenario since most problems are not solvable by an agent on its own. Fire brigades, for example, rely on blocked roads cleared by police forces in order to reach their target. Buildings are extinguished more efficiently by more than one team, particularly if the fire spreads out in many directions. Moreover, the task is challenging due to limited communication bandwidth, the agents' limited field of view and the difficulty to predict how disasters evolve over time, e.g. how the structure of the city influences the burning speed and direction of the fire.

We implemented an agent development kit (ADK) that provides methods for communication, cooperative world modeling and path planning. Communication is carried out efficiently by compressing and routing messages via the center agents to the platoon agents which improve on their part their local world model with this information. Path planning is done by an extended A* method that takes uncertainty into account. Based on the ADK, specific skills for each agent type are implemented, such as *extinguishFire* or *clearBlockedRoad*. The decision about the execution of skills is decomposed on the one hand into a reactive part by the platoon agents and on the other hand into a deliberative part by the center agents. Platoon agents select the skill to be executed by means of hierarchical reinforcement learning [2] with respect to the current state of the environment. Central agents decide skill execution in the long term by allocating groups of platoon agents to particular tasks. Their decision making is based on a module for state prediction and abstraction that generates the input for a novel multi-agent planner [1].

References

1. Michael Brenner. Multiagent planning with partially ordered temporal plans. Submitted to IJ-CAI'03.
2. A. Kleiner, M. Dietl, and B. Nebel. Towards a life-long learning soccer agent. In *Proc. Int. RoboCup Symposium '02*. Fukuoka, Japan, 2002.