UvA Rescue - Team Description Paper - Multi-Agent Challenge - Rescue Simulation League RoboCup 2014 - João Pessoa - Brazil

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Abstract. The UvA Rescue Team likes to concentrate their effort inside the Rescue Simulation League to a theoretical contribution, which is accordance with the Multi-Agent Challenge. The UvA Rescue Team has formulated the planning and coordination problem formally as a POMDP problem, which will allow to apply POMDP-solution methods in this application area. Inside the Multi-Agent Challenge the limits on communication no longer applies, which allows us to model communication actions as instantaneous and not limited by distance or bandwidth.

1 Introduction

The UvA Rescue Team has a long history. Yet, this will be the first participation inside the Multi-Agent Challenge. The UvA Rescue team has already experience in the Agent competition [8, 12] and the Virtual Robot competition was held [7, 13].

During those years the team published several theses, conference papers and journal articles. The latest article [1] gives a nice overview of the RoboCup Rescue Leagues.

2 Context

The Multi-Agent Challenge decomposes the problem of coordinating a large team of emergency responders into several subproblems, as described in [2].

The first subproblem is assigning fire-brigade agents to firefronts. This is a real multi-agent problem, working together could have non-linear benefits. In addition, too many agents can be counterproductive. The fire-agents for this benchmark could choose between three actions [3], while our fire-agents inside the Agent competition already have to consider seven actions [12].

This reduction in action space will allow to consider larger teams or to enlarge the planning horizon. In [2] several coordination algorithms were tested for the city Kobe with three ignition points, 12 fire-brigade agents and simulating 300 timesteps.

The second subproblem is to support the evacuation of 3000 civilians from a city (Berlin or Paris) after an earthquake. Many roads are blocked by debris, which could be cleared by police agents.

3 Approach

The intention of our team is to formulate the coordination problem of the Agent competition in such a way that solution methods of the MultiAgent Decision Process toolbox [9] can be used. The toolbox expects the coordination problem to be described as Distributed Partial Observable Markov Decision Process (DEC-POMDP), which means that the effect of the actions is stochastic and the state of the world is only partial observable. The benchmark describes the coordination as a Distributed Constraints Optimization Problem (DCOP), which means that the effect of the actions is deterministic and only the parameters of actions have to be optimized. Both problem descriptions assume that the reward function is known. In contrast, Distributed Coordination of Exploration and Exploitation (DCEE) agents can also reason about uncertain rewards (but not about the uncertainty in the action outcomes) [11].

4 The MultiAgent Decision Process Toolbox

The MADP toolbox[1] contains several planning algorithms. The planning library depends on the other libraries and contains functionality for planning algorithms. In particular the library contains:

- *Dec-POMDP solution algorithm:* BruteForceSearchPlanner, JESPExhaustivePlanner, JESPDynamicProgrammingPlanner [4], DICEPSPlanner [5], k-GMAA* and GMAA* [6].
- *POMDP solution techniques:* Perseus [10].
- *Heuristic Q-functions*: QMDP, QPOMDP, and QBG [6].

Part of the challenge will be to see which of those planning algorithms are applicable to the Multi-Agent Challenge.

5 Conclusion

The Multi-Agent Challenge is strongly aligned with the theoretical approach of the UvA Rescue Team, so the probability is high that our team will fully concentrate on this challenge for the competition in João Pessoa, Brazil.

[1] http://staff.science.uva.nl/ faolieho/index.php?fuseaction=software.madp

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