RoboCup HQ: A new benchmark focusing on AI, HMI and Autonomous Agents

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Abstract. The focus of the RoboCup Federation has expanded in the past two decades to include more AI and HRI. This paper describes a proposal for a new league which will be presented in December 2017. Typically a league is used as an international benchmark for scientific progress. This benchmark is called RoboCup HQ and runs in the cloud.
The benchmark consists of an online simulation environment and a virtual headquarters. In the simulation a near complete city, including infrastructure, is modelled in 3D. Similar to the cur-rent Robocup Rescue Simulation League, research groups can control agents such as emergency services. The control of the agents is both on the operational level and on the individual (driving) level. In addition Robocup HQ introduces possibilities for creating realistic population behavior using MAS. Last but not least a virtual HQ is introduced where a human controller has to make strategic and operational decisions. AI assisted Decision Support and Human Machine Interfacing need to be developed to assist those decisions.
Keywords: Benchmarking, disaster scenarios, AI driven HMI, autonomous agents.

1   Introduction to RoboCup

RoboCup started in 1997 as a response to the difficulties of benchmarking robots. Robots were operated in laboratories, but since all laboratories are different it is difficult to benchmark them. RoboCup started with soccer playing robots. Soccer added the complexity of a dynamic environment. It started with real world robots and robots in simulated environments. A few years later RoboCup Rescue was initiated, focusing on disaster scenarios such as a collapsed building and recently on the broken down nuclear reactor of Fukushima. In 2006 RoboCup@Home was initiated focusing on autonomous robots, natural human robot interaction and applicable technologies for domestic service robots. The idea was, and is, to create autonomous care robots and general purpose household robots. Also leagues focusing on logistics and warehousing were created by request from the industry. The simulation leagues were/are focusing on soccer and on disaster scenarios.

At the moment there are two rescue simulation leagues. One is focusing, akin the real world Rescue league, on a collapsed building scenario. The goal is to find victims

and call for human assistance. The other one is focusing on logistics of sending rescue workers and equipment. RoboCup HQ combines these league adding the complexity of an intuitive and adaptive interface for the controlling of emergency responses during an unfolding disaster.

In December 2017 SIM-CI will introduce the simulator and its ideas for the league to the RoboCup community at the Asia-Pacific RoboCup event (http://www.robocup-ap2017.org/) in Bangkok. During the event SIM-CI will give a workshop to discuss with interested parties on how to fill in the details of the competition and see what would be the most interesting path to follow.

2   RoboCup HQ benchmark details

RoboCup HQ provides an online simulation environment and a virtual headquarters. In the simulation a near complete city, including infrastructure, is modelled in 3D. Similar to the current Robocup Rescue Simulation League, research groups can control agents such as emergency services. The control of the agents is both on the operational level and on the individual (driving) level. In addition Robocup HQ introduces possibilities for creating realistic population behavior using MAS. Last but not least a virtual HQ is introduced where a human controller has to make strategic and operational decisions. AI assisted Decision Support and Human Machine Interfacing need to be developed to assist those decisions.

The Robocup HQ simulator provides a rich environment with several disaster scenarios. For example, flooding, earthquakes, cyberattacks and extreme weather.
The proposed challenges that can be developed include:
- Create realistic human crowds using MAS
- Create citizens with regular daily routines using MAS
- Create realistic traffic patterns using MAS
- Control swarms of drones for information gathering during a scenario
- Plan operations for emergency services with priority planning
- Control path planning for individual agents.

SIM-CI will provide different types of disaster scenarios such as flooding, earthquakes, cyberattacks and extreme weather. This creates a diverse set of challenges for the competitors. To create a lively city one of the first proposed challenges is to create realistic human agents. They should have normal daily routines but also extreme behaviors such as the possibility to plunder or flee a district or area. Potentially these human agents can add to the richness of the information by posting on 'social media' during the running of a simulation.

Taking near-future technology into consideration, it will be possible to control drone swarms and other autonomous robotic vehicles which act as sensors. This can be used, for example, to find dangerous situations and victims which require rescuing.

The HQ is the emergency management center where information is gathered and presented to a human controller. This controller has to make immediate decisions to get control of the emergency and mitigate its effects, for example to decide which place to evacuate. These decisions can have a large impact on the amount and type of victims. Autonomous emergency vehicles will have to adapt to these changing priorities.

Possible competition challenges are:
- Intuitive presentation of information (jury decision)
- Effective transformation of the data into information (jury decision)
- Intuitive interface to issue commands

3   Social importance

The long term goal is that this simulation helps to design more resilient cities. The HQ, where humans are interacting with the simulator, can be offered to local chiefs of police and other emergency response officers as a special training program. For this reason the HQ should be intuitive and easy to use, preferably also adapting itself to the users.

4   Continued development

At the RoboCup Asia-Pacific (http://www.robocup-ap2017.org/) the first workshop will be held for the interested teams. The details of the competition like rules, challenges and richness of the world will be worked out together with the participating Robocup Community. We aim to create a benchmark with a resiliency index and other metrics in order to give a score to a participating team. Other research areas are invited to assist in creating the resiliency index.

SIM-CI will continuously develop the simulator as it is based on the same technology as used for its commercial customers. We aim for ease of use, creating a low threshold to start using the simulator. This opens the competition up to more groups. Also the visuals are very important to SIM-CI which results in a more attractive event at the RoboCup. To lower the barriers even further 100k€ of compute time on the Google Cloud Platform is made available for participating teams during the first year. An example of the simulator can be found at: https://vimeo.com/233472131