

# Learning Rewards of Multi-Agent Reinforcement Learning in Robot Soccer

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# 1 Introduction

This paper is prepared as a proposal for the future research about Machine Learning in Multi-Agent Systems. Robot Soccer is chosen as the application domain for the research topic due to its increasing popularity, its availability at the university and its suitability to the problem.

## 1.1 Motivation

Multi-Agent Systems and Machine Learning are two interesting and emerging topics in computer science which has lots of easy-to-reach well-rounded previous works. However, learning multi-agent problems still has great computational requirements due to curse of dimensionality.

In multi-agent problems, it is generally hard to find wide data sample sets in order to cover the whole problem space since the number of parameters to be learnt is great. Hence, reinforcement learning is widely used as the learning method in multi-agent domains. However, assignments of the rewards and the punishments in the learning scheme are still made empirically with an intuition of the domain.

## 1.2 Aim

The primary goal of this research is to generate a method to learn the rewards and punishments of the reinforcement learning in a multi-agent domain.

The ultimate aim of this research is to lower these computational requirements in order to allow an online learning mechanism for the agents.

# 2 Problem

## 2.1 Definition

Reward learning problem in multi-agent problems is a complex problem that consists of couple of subproblems. Hence, in order to solve it, following subproblems have to be resolved and combined together.

- applying reinforcement learning method to multi-agent domain
- determining state representation and evaluations of robot soccer problem
- generating reward and punishment learning scheme

## 2.2 Previous Work

Merikli in [3] generates both low-level and high-level state evaluation metrics for robot soccer. Additionally, [4] shows with using only simple and fast braitenberg principles, it is possible to make robots play soccer.

Also, in [2], a genetic algorithm is used in order to learn the rewards of the reinforcement learning in the robot soccer.

Merke and Riedmiller [5] modeled the robot soccer as a multi-agent Markov process, and applied a distributed reinforcement learning algorithms which is a extended version of single Q-learning algorithm.

## 2.3 Scope

As an initial research, scope of this problem would be limited with the robot soccer domain instead of a general multi-agent domain. All the proposed methods will be applied to this domain.

However, making real experiments in robot soccer is extremely time-consuming. Since, Teambots [1] is a well-rounded simulation of Robot Soccer under Java, it will be used in experiments in order to simulate the multi-agent robot soccer environment instead generating samples with actual robots in order to accelerate the experiments.

## 3 Schedule

Here is the estimated schedule of the proposed thesis.

Task	Estimated Deadline
Making a Survey	September 2009
Generating a Method	October 2009
Implementation on Teambots	December 2009
Making Experiments	January 2010
Preparing Reports and Presentation	February 2010

## References

- [1] Tucker Balch. TeamBots mobile robot simulator, 2000. <http://www.teambots.org>.
- [2] Meriçli Ç. and Akın H.L. A reward function generation method using genetic algorithms for multi-robot learning problems. 2008.
- [3] Cetin Mericli. Developing a novel robust multi-agent task allocation algorithm for four-legged robot soccer domain. 2005.
- [4] Tekin Mericli and Levent Akin. Soccer without intelligence. 2009.
- [5] Artur Merke and Martin A. Riedmiller. Karlsruhe brainstormers - a reinforcement learning approach to robotic soccer. In *RoboCup 2001: Robot Soccer World Cup V*, pages 435–440, London, UK, 2002. Springer-Verlag.