Virtual Werder

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1 Introduction

Virtual Werder is a new team in the simulation league. The team is the result of an initiative which has been formed from lectures on Artificial Intelligence at the Department of Mathematics and Computer Science at the University of Bremen.

The main focus of this team is to use the online coach for the detection of the opponents play system. The motivation and significance for this has been discovered during a structured interview with Thomas Schaaf, the manager of SV Werder Bremen.

2 Special Team Features

Our focus of research clearly is how to detect opponents strategies in a dynamic and real time environment. Our first thought was learning online but the available time to learn is not enough. We decided to manually create input/output pattern of 'typical' play systems and feed them into an artificial neural network. The plan is to learn the patterns and to use the online coach during a game to detect them. According to the classification an appropriate counter-attack will be chosen.

The technology of strategy detection could be useful for other application areas as well. Firstly, the quality of action predictions of physical agents can be improved which plays an important role within the control mechanisms of autonomous agents. Secondly, it is important to improve the robustness and security issues of electronic markets within the area of electronic commerce. We think that the proper analysis of the 'opponents' strategies in this area would help to improve the own situation.

To our knowledge work in the area of strategy detection has been done (see [3], [4], [2]). These approaches are designed for the analysis of games, off-line after playing, to gain new experiences for the next games. Frank et al. ([1]) present a real time approach which is based on statistical methods. A team will be evaluated statistically but there is no recognition of team strategies.

We think that the RoboCup platform is interesting for our research because we have to deal with a dynamic, uncertain, real time environment.

P. Stone, T. Balch, and G. Kraetzschmar (Eds.): RoboCup 2000, LNAI 2019, pp. 421-424, 2001.

3 World Model

Due to the fact that Virtual Werder relies on the basic capabilities provided by the CMU99 client we did not touch the way the client is representing its world model. In fact we added the ability to broadcast the ball position whenever an agent is close to the ball to minimize uncertainty.

However, we did the first steps to an own world model with the representation of agents on the basis of probabilistic networks but it hasn't been implemented yet.

4 Coach

Our online-coach observes the positions of the opponent's players at given points in time, currently twice per second. A bounding box around these positions divided into eight to eight cells gives an input pattern for a neural network (a player inside of a cell yields an input value of 1.0, an empty cell an input value of 1.0). The neural network was trained with patterns from last year's RoboCup logfiles and own examples. It is able to recognize sixteen different formations that turned out to be played most often. The result of the neural network is the formation the opponent's team most likely is playing, and a propability for this result. If the propability exceeds a demanded threshold, the result is declared valid.

A decision tree is used to integrate the neural networks's output and additional information, e. g. the size and position of the bounding box, the count of performed formation changes, the count of offsides and the score. This leads to a decision whether or not a new counter formation is advisable and of which kind it would be. A choosen change of formation is then broadcasted to the team during the next interruption.

5 Communication

We use two different types of messages: a common one for all players and a special one for defense coordination purposes.

The common message contains the identification of the sender, its position, its distance to the ball, the actual ball position and the degree of confidence of this information. Additionally it contains the identification of the intended receiver in case the ball is passed. The message is send by the agent who is closest to the ball. This avoids collisions between messages from different players.

The message for the defense coordination additionally contains the position of the defense line. It is only used by a special player determined to be the defense coordinator. In order to avoid collisions between the two types of messages they are restricted to certain cycles. The defense line is used to appoint the positions of the defensive players and to allow offside traps.

A problematic situation seems to arise when two or more players conclude that they are the player closest to the ball and set up a common message. In this

case the informations of both players should be so similar, that it is unimportant for their teammates which message they actually receive.

Basically every player is able to build its own world model, but the communication helps to make this model more precise. It is even possible to add positions of object that cannot be seen at all. With reduced or deactivated communication only additional informations are removed, leading to a worse but acceptable game. Especially the defensive would have the most problems since it needs a good working communication to synchronize the defense line.

6 Skills

Virtual Werder is based on CMU99, so most of the basic skills were already implemented, but we had to add skills to make our agents team-players.

We developed an evaluation function to determine how useful a pass to a position is, based on the distance and direction of the position and the number of opponents which may intercept the ball. This function is used by the player with the ball to find teammates to pass the ball to and by the players which want to receive a pass to get into a good position. The player with the ball evaluates the usefulness of passes to the positions of all its teammates. If teammates are in good positions it passes the ball to the one with the best evaluation result. To get into a good position the agent evaluates 80 random positions in a 60x60 square around it and then tries to get to the best one.

We also implemented a defense line which is organized by a central defensive player as described earlier in this paper.

7 Strategy

The main strategy of our team is to adapt our formation to the opponent by changing the behaviour of the players due to the calculations of the coach. To achieve this we have implemented 22 different agent behaviours. An agent starts with one of these behaviours, but is able to switch to another when necessary, especially when the coach changes the team formation. For the 2000 competition we had seven fixed formations for the coach to choose from, ranging from "cement mixer" (7-1-2) to "maniacle offensive" (0-5-5).

8 Team Development

We have developed a tool called export player to collect input data for our neural network. This graphic interface is used to sample data from logfiles and offers a list of play systems to classify a specific snap shot of a logged game. The tool provides an output file that is used as an input for the Stuttgart Neural Network Simulator (SNNSv4.1) [5]. This program creates C-code for a feedforward network.

Our team evolved from a lecture on artificial intelligence and became a self-organized student project. Virtual Werder has become the basis for further student activities at the Bremen university.

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Team Members:
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- Germany
- Assistant Professor
- did attend the competition

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- postgraduate students
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Web page http://www.virtualwerder.de

9 Conclusion

Virtual Werder will send a new team to the 2001 world championships. In terms of sports we try to achieve a place within the first 16 teams of the world. How do we want to do this? Firstly, we will put more work on the detection of the opponents play, not only the overall play system is of our interest but also 'little' strategies such as the four-chain defense line or a static play over the wings. Secondly, we focus on uncertainty, something what we tried to do for the 2000 team already. We believe, that the performance of our team can be improved by methods from this area. Currently, two Masters students are working on these matters.

References

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