

AxiomOfChoice 2D Team Description Paper

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Abstract. AxiomOfChoice is a robot football team for RoboCup 2D simulation. In this paper, the analyzing system structure, and our Pass will be presented. The proposed analyzing system based *Pearson product-moment Correlation Coefficient* method. All these methods used for finding and comparing similar pre-produced information to inputs which produced during the match. Each information is on the format of graph and according to some output parameters of each graph, the most similar graph to pre-produced graph can be found. Result of this system has direct impact on decision making and strategy selecting. Output of proposed system has some information which help to find out weakness of opponent team in attack and defense situations.

1 Introduction

Radian Project was established in 2006 at *Allame Tabatabaei high school* and has continued its activities under support of *Iran University of Science and Technology* since 2011 as AxiomOfChoice. We have achieved the fourth place in China Open 2009, fifth of AUTcup 2011, thired of Iran Open 2011 and qualified in RoboCup 2010 as ex-called *ShahedTech*. AxiomOfChoice is implemented in C++ and it is developed based on the base code of agent2d and the corresponding base library librcsc, which are developed by Hidehisa Akiyama [3]. Also we released two source codes based [1][2] on UvA under license of GPL. In this paper we introduce our Analyzing System in Section 2 and Section 3 describes Pass Model.

2 Opponent Behavior Analyzing System

Opponent Behavior Analyzing System which proposed in this paper is under developing since January 2011 and it will be completed before May. This system is for finding more similar graphs. It devides football field into 357 areas and with each entrance of opponent players, a score will be added to the score of the area, so after sufficient cycles all areas have their final score. A graph will be produced by using these scored areas and will be compared to pre-produced graphs. Each

pre-produced graph leads team to a particular main strategy. In other words the main strategy of team will be the main strategy of similar pre-produced graph. Opponents Behavior Analyzing System contains: *Observer*, *Graph Builder* and *Pattern Recognizer*.

2.1 Observer

Observer detects all opponents' positions in each cycle. In this system Coach is the best choice for this task. Analyzing system will be enabled for sufficient terms of time while opponent team is in defense situation. *Observer* collects data about positions of opponents in each cycle and sends them to *Graph Builder*.

2.2 Graph Builder

Graph Builder is the part which makes graphs through input data from *Observer*. Football field includes a set of vectors with length range from -54 to 54, and width from -34 to 34 so there are 6720 vectors on match field. *Graph Builder* divides match field to 357 quadrilaterals with length of 5m and width of 4m, which has default score of 10.

For the sufficient terms of time, each time an opponent player enters to an area, 10 scores will be added to previous score of mentioned area. As we described in Section 2.1, best conditions is when the opponent team is under pressure, they are on their side and the ball is under our control. So after those terms of time, we have a set of scored areas that has 2 inputs:

Fig. 1 shows a scored graph which is defensive movement lines of defense opponent players during 2000 cycles.

2.2.1 Overall Score of Graph

One of the important parameters in this analyzing system is sum of all area's score. As the total score is higher, the activity movements in opponent's field are more.

2.2.2 Finding Number of Low Scored Areas

Number of low scored areas is one of the effective parameters in analyzing. These areas are the best choices for attacking movements.

2.3 Pattern Recognizer

Pattern Recognizer is the most important section of this Analyzing System. As we described in Section 2.2, overall sum of areas' score as W , number of low scored areas as N are parameters. *Pearson product-moment correlation coefficient (PMCC)* is the method for finding similar graph and this section is made up from two steps :

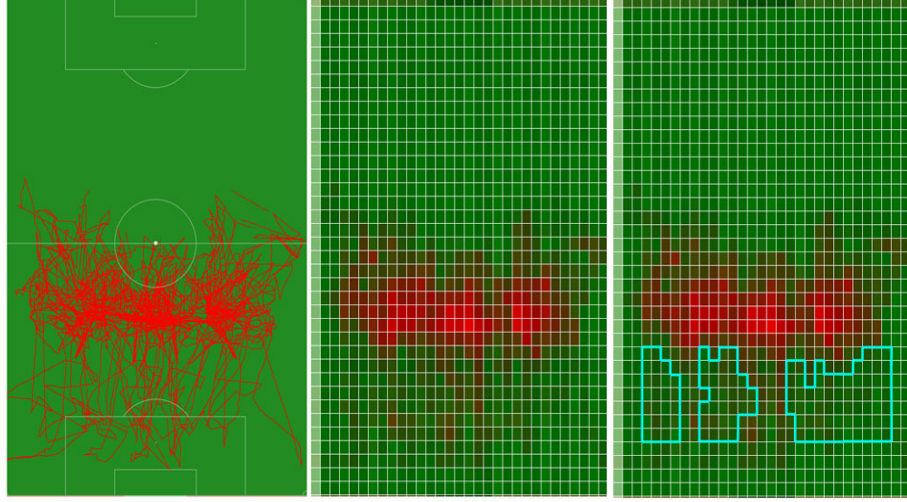


Fig. 1. A scored graph which makes during a match between AxiomOfChoice and HELIOS2010.

2.3.1 Step One :

This step tries to find similar graphs with proposed above parameters and uses *PMCC* which is a statistical method [5] and a slightly complex method to find the similarity between graphs [4]. *PMCC* outcomes a measurement for the correlation between variables X and Y . In statistics *PMCC* is defined as covariance of two variables by the product of their deviations.

$$\frac{(\sum XY) - \frac{(\sum X)(\sum Y)}{n}}{\sqrt{(\sum X^2 - \frac{(\sum X)^2}{n})(\sum Y^2 - \frac{(\sum Y)^2}{n})}} \quad (1)$$

Outcome value of formula always fall between -1 and +1 and the value does not change if all values of either variable are converted to a different scale [4]. For computing result, it assigns X as number of low scored areas and Y as overall score of graph from 5 pre-produced graphs and 5 graphs produced in the sufficient terms of time during a match and n is number of graphs. Pre-produced selected graphs are similar to each other, so if the result is near to 1, it shows, inputs are similar to each other and if it is near to -1 they have less similarity.

2.3.2 Step Two

This step's task is to find especial points in low scored areas of found similar graphs in step one. These points are weaknesses of opponent's defense line, which has direct impact on dribble targets and through passes. In each area, when the number of low scored areas is greater than the number of areas with scores higher than *AVG*, the point will be calculated according to the average of lengths and

widths of low scored areas.

Note: *AVG* value is a specific content gained during the match.

3 Pass

Pass is the most important part in withball skills. Pass skill contains direct and indirect passes. This skill uses two rating system for finding best teammate to send the ball :

3.1 Safety Score

Safety score is a variable between 0 and 100, and indicates the probability of reaching the ball to the target. It uses two methods for calculating the variable. There are 5 polygons between reciever and sender player, according to number of opponent players in each polygon, a specific score will be added to Safety Score. Another parameter which has effect on Safety Score is the difference between reach cycles of each opponent in the polygons to a specific point in the pass route and the cycles wich ball takes to be in that point. As the difference gets bigger, the added value to Safety Score will become greater.

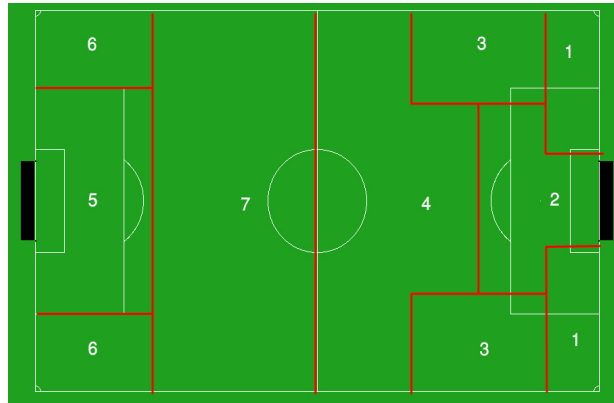


Fig. 2. Field dividing for pass areas.

3.2 Situation Score

Situation Score depends on two parameters which are the concentration of opponents around the receiver and areas of sender and receiver. Fig. 3 shows the pass area dividing. In the first parameter a score will be subtracted from Situation Score for each opponents around the target player and in the second parameter a

score will be added to Situation Score for each ball transmissions between every two specific disparate areas. After calculating scores for every teammate, players will be sorted by their Situation Score and sender will pass the ball to target which has best Situation Score with an acceptable Safety Score.

4 Conclusion and Future Work

This research develops an analyzing system for detecting opponent behaviors during a game. In this system, we consider football field as a graph, which divided to quadrilaterals for recording opponents' movements. Output of analyzing system are some parameters which has direct impact on results. We can find especial points as offensive targets and select strategy according to datasets. We are currently working on this method and hopefully we can use it in RoboCup 2011 and in future we will try to applying new methods like *Jaccard Coefficient* and *Decision Tree* on *Pattern Recognizer* Section.

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