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Graph Neural Network Recommendation System for Football Formation

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ABSTRACT
In usual, the flow of a football game have different phase, and change from one to another, and the coach is due to observe them, understand and solve the tasks in the game by using appropriate structural strategies.
Therefore, it is a critical issues for a coach to decide what kind of structural strategies have been effective for their own team. Therefore, we propose 3 different views to help to the coach to make decisions. First of views, we formulate the passing ball path as a network (passing net- work. More specific, we utilize clustering coeffcient to determine the relations between players. It turnouts that core player will have a strong cluster ability. And our propose network focus not only on local network, but global passing relations.-Final of views, we propose a novel reinforcement learning based Graph-to-Graph framework to decide structure of team. We formulate the positions of players as a graph, and we use the current graph as input, while our deigns return award will effect the structure of team by change the positions step by step. In experiment, we simulate the result of our team versus 3 different level team**[1]**

Keywords: reinforcement learning, clustering network, evaluation system, graph network

I. INTRODUCTION

A good team is like a clock, with the cooperation of the front court and the back court, and good logistics, the team will have a good chemical reaction. I am a big fan of my hometown football soccer team Husky. The coach of Husky has asked us to help understand the team's dynamics. In particular, the coach has asked me to explore how the complex interactions among the players on the field impacts their success.

- Explore network models in teams and analyze team interaction patterns from multiple perspectives.
- Identify what performance indicators that reflect successful teamwork. And build a scoring mechanism, considering from multiple aspects, so that we can build an evaluation model.[2]
- According to different situations, use the network model to tell the coach what adjustments need to be made by analysing of the Husky enables you to consider group dynamics in a controlled team sports environment.\
- A good team is like a clock, with the cooperation of the front court and the back court, and good logistics, the team will have a good chemical reaction. I am a big fan of my hometown football soccer team Husky. to help understand the team's dynamics. In particular, the coach has asked me to explore how the complex interactions among the players on the field impacts their success. Trying to find a solution, faces the problems below:[3]

1.1 Analysis and Approach Overview

1. We are going to build a network of husky players' passing relationships, and find out the network model from a micro to macro perspective. The first step is to find the main plastic surgery by combining the two sets of data given. The second step is based on the passing. According to the frequency of passing between the two players, we construct a passing net and connect them through topology to describe the passing relationship network.
2. Find out the team's evaluation factors from internal and external factors. And make evaluation model according to EOL rating standard

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3. According to the graph neural network semi-supervised learning, the situation on the field isused as the input end, and the output end is omitted to suggest how the coach should make adjustments in various situations.

1.2 Analysis and Approach Overview

1. For problem 1, we are going to build a network of husky players' passing relationships, and find out the network model from a micro to macro perspective. The first step is to find the main plastic surgery by combining the two sets of data given. The second step is based on the passing. According to the frequency of passing between the two players, we construct a passing net and connect them through topology to describe the passing relationship network.[4]
2. To solve problem 2, Find out the team's evaluation factors from internal and external factors. And make evaluation model according to EOL rating standard
3. According to the graph neural network semi-supervised learning, the situation on the field issued as the input end, and the output end is omitted to suggest how the coach should make adjustments in various situations.

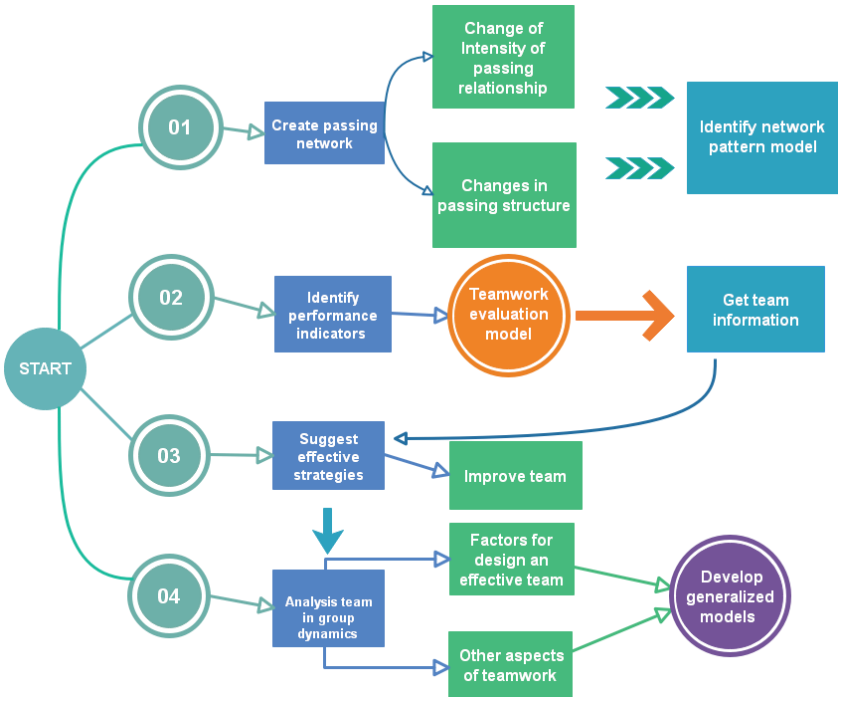

Figure 1: Problem analysis

II. METHODOLOGY

In the world of sports, team sports involving passes between players provides one with interesting examples of networks. Football is a teamwork game consisting of striker, mc, defender and goalkeeper. Each player has his own task, the forward is responsible for scoring, the midfielder is responsible for connecting the team called the team metronome, the defender is responsible for destroying the opponent's offense, and the goalkeeper is the last line of defense. The goal of a game is to score more goals than they are scored.[5]
\\The most important thing is that the network of football passing relationships is very mathematical. The essence of the network is topology and graph theory. Therefore, we propose that each player is regarded as a node N, and if there is a pass between the two nodes, then it is regarded as the joint path of the two nodes. The number of passes between them is considered to be. When an we consider these two nodes to be strongly connected. And we removed the data that the players themselves passed to themselves. Because self-connectedness doesn't make any sense.

$$A_{ij} = \{0 \quad if\ pass\ = 0 \quad pass \quad if\ pass\ \neq 0, A = [0 \quad \dots \quad a_{1n} \quad \vdots \quad \ddots \quad \vdots \quad a_{1n} \quad \dots \quad 0)_{30\times:30}$$

III. OUR APPROACH

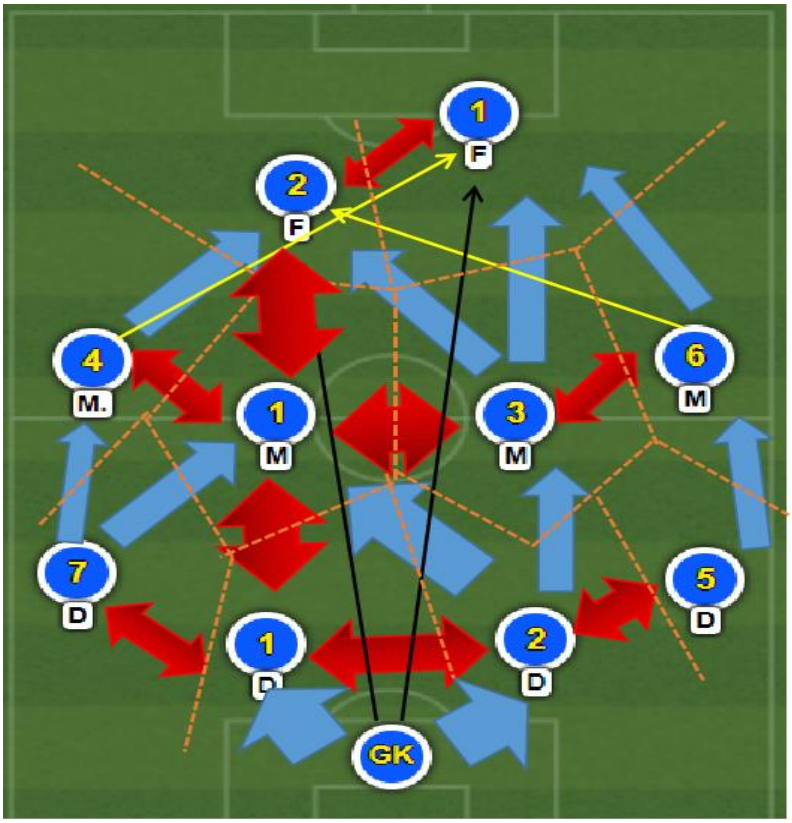

Figure2: This is the one season main player's passing relationship network. The red double arrow indicates that he is a two-way strong connection, and the blue single arrow indicates a strong connection in one direction. Black refers to long passes, and single yellow arrows to cross. The width of the connected path rep-resents the frequency of the pass

The pass network aggregation coefficient is a coefficient used to describe the degree of clustering between vertices in a graph. Specifically, it is the degree to which adjacent points of a point are connected to each other. For example, in the offensive, attackers practice multiple tactics. Or the midfield's trained transition[6] skills will make the communication between nodes more frequent than his other communication. The nodes tend to form relatively dense network groups. In other words, compared to a network obtained by randomly connecting two nodes, the aggregation coefficient of the real-world network is higher. We need to find closely related groups (two or three or more tuples) in the passing network[7]

We defined the coefficient as a node weight, representing the total number of passes thrown by the player associated to this node. In this coefficient, we only consider the direct links and the link strength between the player and his neighbours, not taking into account the relations between the player and neighbours but to validate the local triangle relation or Multiple relations.

The strength of the communication between the main players [9]will also be different. In fact, the communication between the forward and the defender is weak, and the forward and the forward are relatively strong. What is special that the midfield has a relatively strong relationship with any position, especially the connection between the midfield and the midfield is very strong. [1]This is because the position of the midfield is special, responsible for the task of organizing and connecting the team. Control the team by passing and control the team's rhythm.

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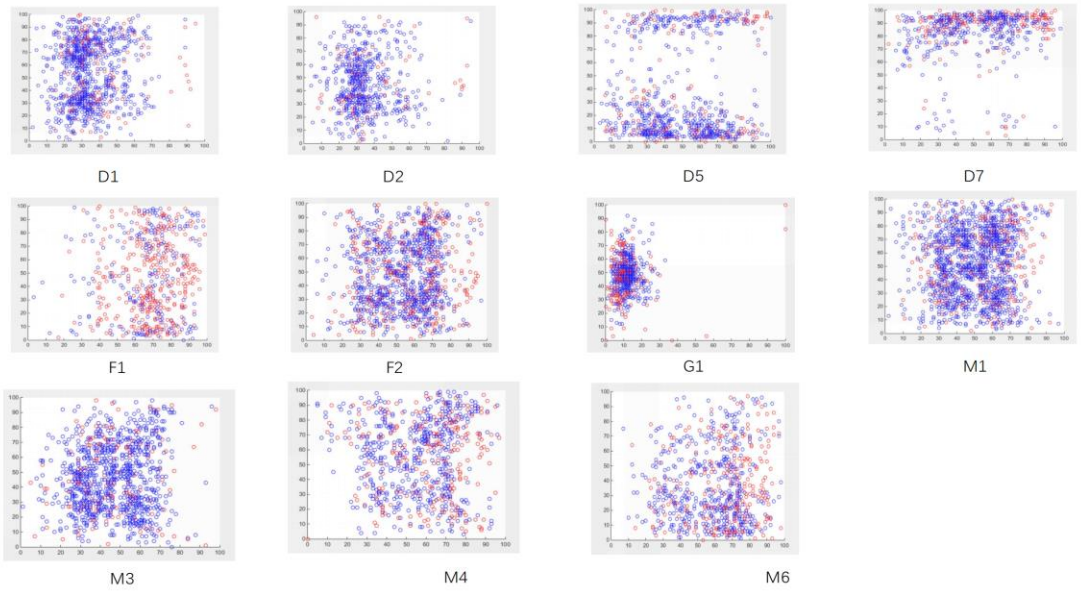


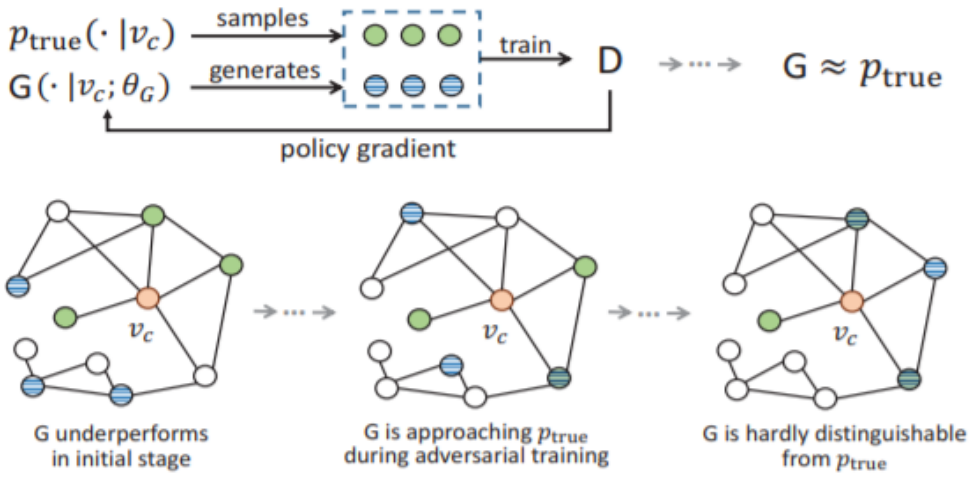
Figure 3: This is a figure demo. The main player's passing position map:
Blue: It represents the coordinates when receiving the ball.
Red: It represents the coordinates when passing

We defined the coefficient as a node weight, representing the total number of passes thrown by the player associated to this node. In this coefficient ,we only consider the direct links and the link strength between the player and his neighbours, not taking into account the relations between the player and neighbours but to validate the local triangle relation or Multiple relations.[10]

$$i_B^C = \frac{s_i(k_i - 1)}{1} \sum_{j,k} \frac{2}{A_{ij} + A_{jk}} a_j a_{jk} a_{ik}$$

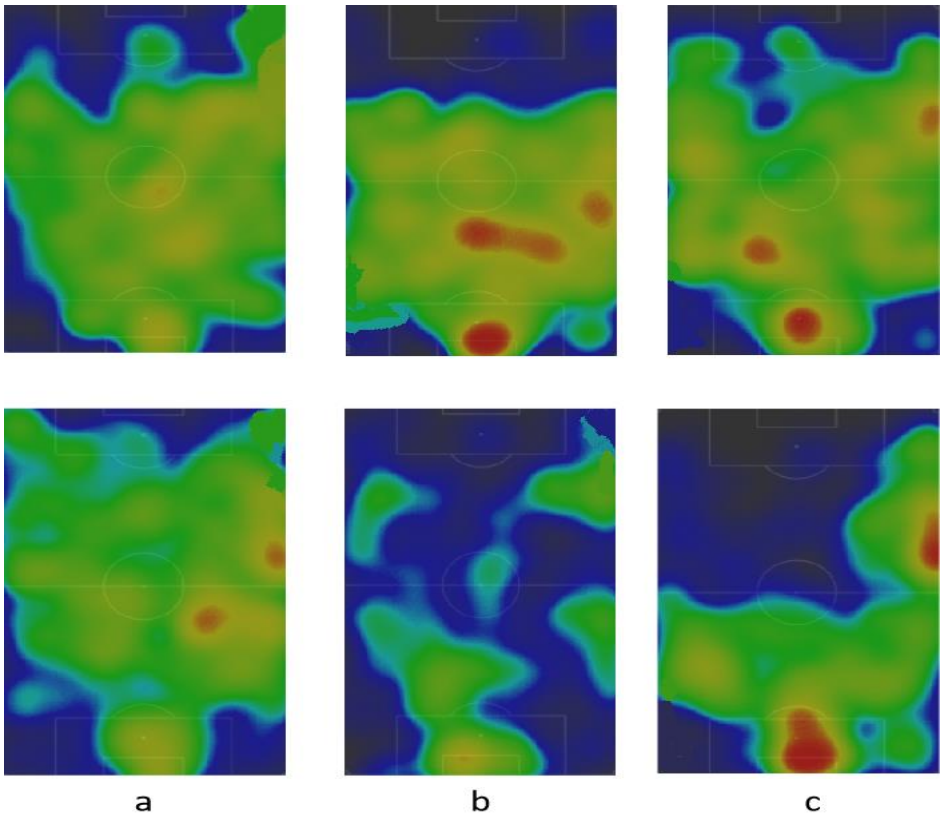
where aij = 1 if there is an link between i and j, and aij = 0 otherwise, siis the weight sum of the links starting from i, and ki is the number of neighbours of i. The number of received passes can also be determined transposing the passing matrix, so that the value of Aij will become the old Aji value[11]

The network may change differently at different points in time, and it is difficult for a network to cope with different situations. So the network changes at different points in time are also very interesting. We can see that as the season progresses. There may be a missing node, such as a player being injured. Or when you meet a strong team. There may also be special situations, such as when changing coaches. It is also necessary to switch networks and nodes, so that the team's passing network is more changed to adapt to different situations.[12]



$$\frac{\partial J}{\partial \theta} = \mathbb{E}_{a_0, a_0, \ldots, s_T}[\sum_{t=0}^{T} \nabla \log \pi_\theta(a_t \mid s_t) Q(s_t, a_t)]$$

The network structure of football matches is very frequent. The change between nodes and the contact methods between sections will also change, such as from short pass to long pass tactics. These will cause different results. Node replacement is difficult to judge by a standard good or bad. A corrector is needed to optimize the configuration in the network. Replace the nodes at the right time, change the contact information, and change the parity between the nodes. This is where the coach's left and right as a corrector, control the passing network.[13]



IV. CONCLUSION

A well-performing team has very obvious characteristics, and this characteristic is not necessarily to win or score every game. In fact, this evaluation system has nothing to do with winning or losing goals. There are many factors to describe a good team. For example, good style, good chemical reaction[14], each person performs his or her own job in its own position, and maintains good communication with each other. In this way, the entire team will develop in a good direction, and their capabilities will be improved differently. Such a team has entered a good development.

In our study we make use of the Kaggle European Soccer Database This dataset includes all the games (21,374 in total) from 11 European leagues 3 between the seasons 2008-09 and 2015-16. For every game, information about the final result as well as the starting lineups are provided. So it's important to confirm the indicators of the evaluation team.[1]

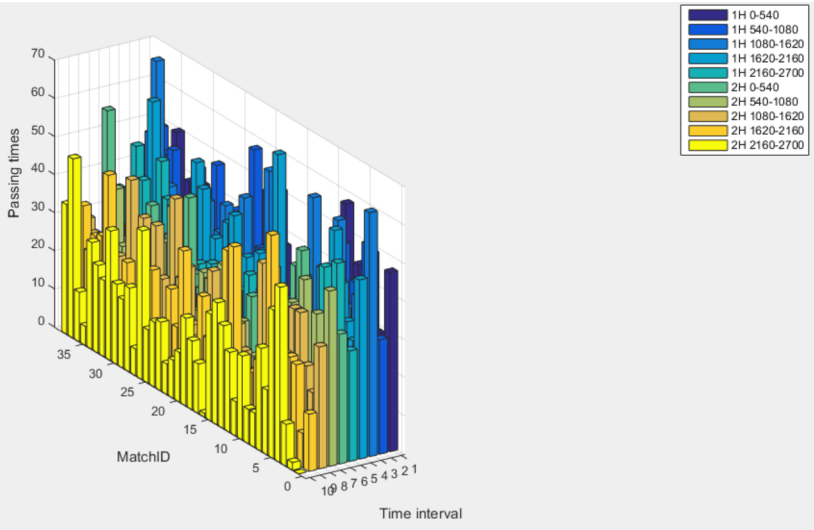


Figure 4: This is a three-dimensional map of the total number of passes in the season over time. The x-axis represents the increase in the number of games, the y-axis represents the change in 90 minutes per game, and the z-axis is the number of passes

Different players have different p rate indicators, and each character has different evaluation criteria[15]. In fact, after each game, a professional evaluation agency will score the players. Evaluate whether they also perform their respective roles in their own positions. [16]For example, the forward is mainly responsible for shooting and shooting, and the midfield is mainly for transitional football, ball control and passing. The defender takes the siege to destroy the opponent's offense as an indicator. Of course, the key indicators of goals and assists are also very important, but we will not discuss these here. But more to discuss a team.[17]

And even if it is a midfielder, there are also wingers or midfielders, and there are different differences in the same position. For example, Pirlo is good at metronome, but the same CM Vidal is good at defense. So we use the cluster first regression model, the combine cluster regression model (CCR).[18]

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