Teaming Strategies: A Passing Network Analysis

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Abstract

Using network analysis to study team movement is a relatively new method. In response to Coach Husky's request, I analyzed how the complex interactions between players on the pitch affected their success by building a network model of passes, calculated the shortest path and the clustering coefficients of each binary and binary binary through the Floyd algorithm to find more successful formation patterns, and then speculated to determine an effective structural strategy. My goal is not only to study the interactions that lead directly to scoring, but also to explore team dynamics throughout the game and throughout the season to help identify specific strategies that can improve teamwork next season. Based on the complexity of the game, football cannot be interpreted by looking at individual players individually, but rather as a whole. Husky's data allows me to analyze and quantify the behavior of the team as a whole, as well as the role of each player. In this framework, a team's organization can be considered the result of interactions among its members. My idea is: A network of passes is built by observing the exchange of balls between players, in which each player on the team is represented as a node and a connection is created between the players, which becomes stronger as the number of passes increases. The data also includes the position of each player when passing the ball. In this way, you can build a one-way (i.e., links between players pointing in one direction), weighted (the weight of the link is based on the number of passes between players), and a time-evolved (i.e., the network constantly changing its structure) of the football delivery network. At the end of the game, this network is a strong record of how players connect and develop their games. The pass network model can also be adapted to other group movements for analysis, and I think teams need to generate new capabilities, such as systematic creativity and organizational learning, so that they can anticipate competition, enhance their strengths, create order and the best organizational structure, while creating "chaos" among their opponents, with the aim of creating an advantage situation. I think the two-person group is more efficient, and the three-person group and above can hinder team behavior to some extent due to their high heterogeneity and uncertainty about the identity of the group leader. Better teamwork by rationally arranging the number of team members is critical to the development of society.

Keywords

Pass network model; Floyd algorithm; Shortest path; Clustering factor.

1. Introduction: The Model Building Background

As societies become more interconnected, so do the challenges facing team sports. Exploring the team process in a competitive team movement is one of the most useful settings. Identify specific strategies to improve teamwork next season by exploring the complex interactions between players on the pitch. What I need to do is:

(1) Establish a pass network model to identify network patterns by using a passing network.

(2) To conclude what outcome strategy is effective for husky.

(3) To extend the model to the broad group movement, and draw conclusions to promote the effective development of the group movement.

The pass network model based on Floyd algorithm is an effective model for husky team pass analysis. The Floyd algorithm calculates the average position of the player on the field and the number of connections (weighted passes), where the state of the pass network before the scoring/receiving target is centrally analyzed, which allows information about what the network attributes associated with the team's ability to score/receive the target are extracted.

2. Organization of the Text

2.1 Hypothesis

1. Since the existence of random forces and the high complexity of their internal dynamics during the game, we use the Markov model as a starting point to unlock hidden patterns in the team's pass sequence (Lopez Penia, 2014), including only some of the specific characteristics of the player's movements that can be quantified and their decision-making ability.

2. The advance rate is independent of the number of passes and is therefore not considered to affect network parameters.

3. Entropy decreases with the development of the game, which is due to player fatigue. In addition, collective behavior decreases in complexity/irregularness over the time period, accompanied by an increase in the trend of deviation from the average.

2.2 Symbolic labels

The primary notations used in this paper are listed in the table below.

Tab. 1 The Symbols of Definition and Description

Symbol	Meaning(Units)
G	Goals
P	the number of passes
x	X-axis
y	Y-axis
S	shoots
A	Critical level
B	limitation
m 1	The growth rate
m 2	The maximum of market capacity
k	Scale factor

3. Explore the Problem

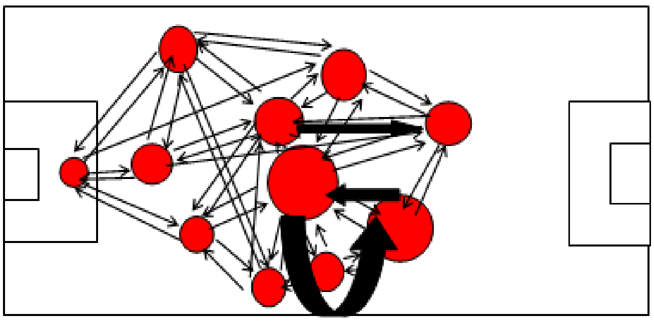

Figure 1. Average pass network

Figure 1 shows the Husky team's average passing network for 38 games. Note that in the figure, the (i) node (i.e. the player) is placed in the average position of the pass, (ii) the link is one-way and weighted according to the number of passes between the players (the width is directly related to the number of passes between the players). It should also be noted that the x and y coordinates of the player's position are limited to the range of 0,100 and are measured in "field units", as not all fields have exactly the same size. (iii) The radius of the node is directly related to the player's importance in the delivery network and is quantified by feature vector centrality.

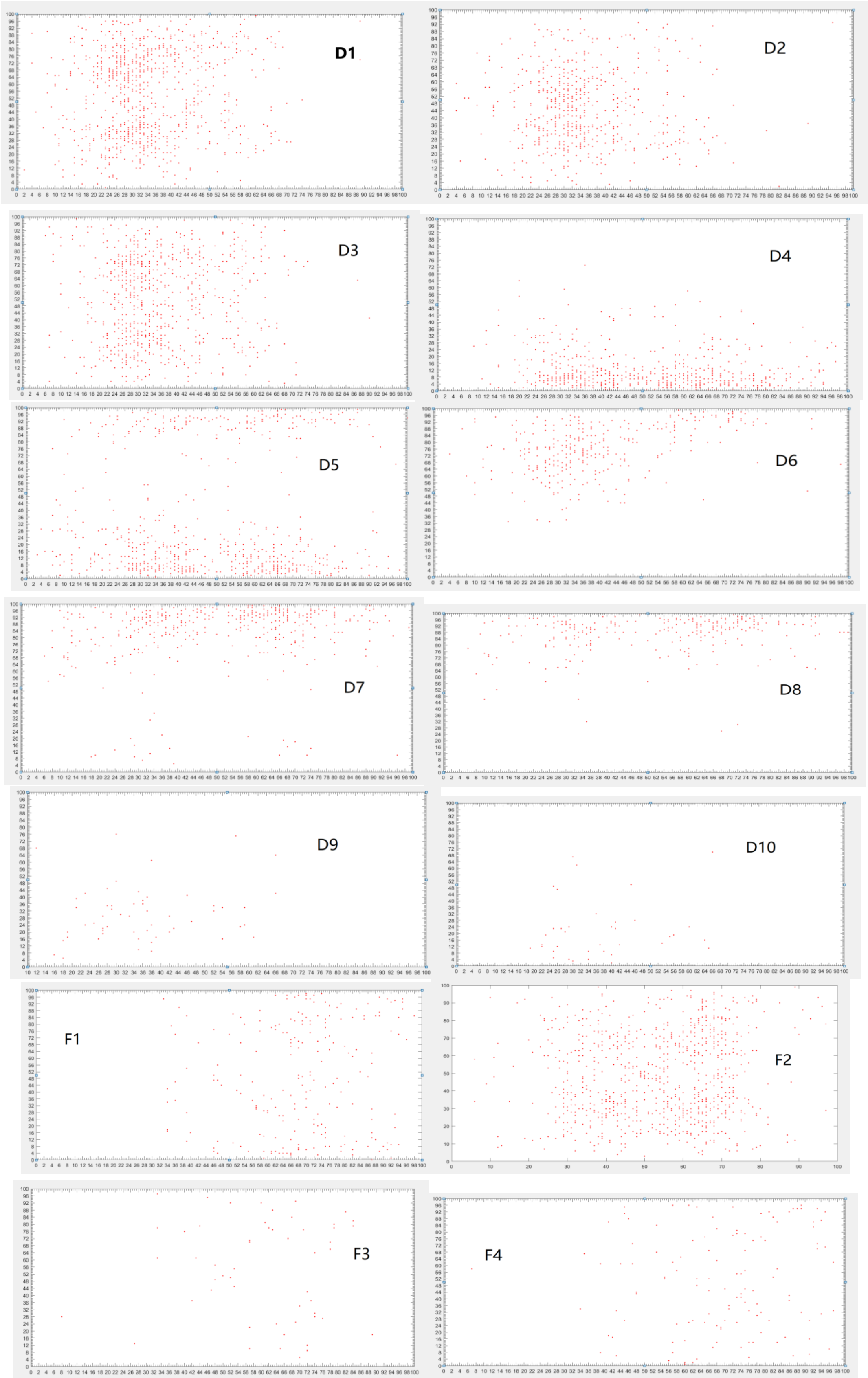

Figure 2: Scatter map of the player's position

(1) Node location: import player location data through MATLAB, use the Floyd algorithm to find scatter graph (Figure 2) and average position.

(2) Link: Import player passing events through MATLAB, calculate the number of times husky players pass to each other by Floyd algorithm, the width of the connector in figure 1 is directly in line with the number of times.

3.1 Microscale (pairs of players):

On the topological microscale, the importance of the two players is related to the following factors: the number of passes, the shortest path obtained from the characteristic vector of the adjacent matrix, and the aggregation coefficient C.

(1): Through the Floyd algorithm, we calculated the number of direct passes (figure4) by 30 players in the Husky Victory field, the most of which was M2-F1, followed by the following 33 groups.

M6-D5	D5-F2	D7-M1	D6-G1	F6-M4	F3-M1	D9-F2
M1-F2	D1-G1	D3-G1	M8-M1	M9-D6	M10-D7	M5-F2
M3-M1	M4-M1	F4-M3	F5-F2	M2-M3	M11-F2	M7-M1
F2-M1	D4-M1	D3-G1	M12-M3	M13-M1	D10-D1	

(2): Average minimum path d indicates the degree of connection between players in the team. It measures the "topological distance" that any two players in the ball connection team must go through. Because links through the network are weighted for the number of passes, the topological distance of a given link is defined as the countdown to the number of passes. The more passes the two players pass, the closer the topology between them (i.e., the smaller the number). In addition, since a ball propagates from one player to another, by calculating the shortest topological distance between two players, you can find the shortest path between any pair of players, whether it is directly connected or involves other players passing through the team. Finally, the team's average shortest path d is only the average of the shortest path between all pairs of players.

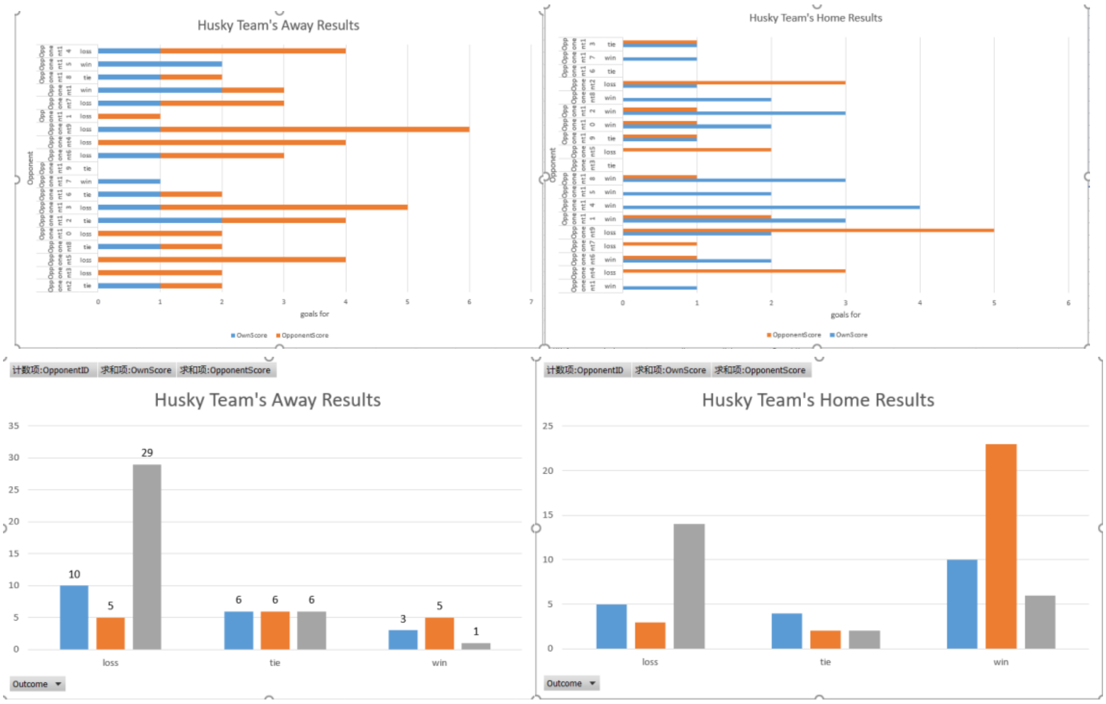

Figure 5. Husky's home-and-away goal percentage

(3) Draw the clustering factor C, which is related to the number of triangles created between any triple player. The clustering factor is an indicator of the local robustness of the network, because when

there is a triangle connecting three nodes (i.e. players) and the link between the two nodes is lost (i.e., it is not possible to pass), it is another way to reach the other node through the other two edges of the triangle. In football matches, the clustering factor ensures a triangular relationship between the three players. It is calculated that the combination with the highest clustering coefficient is F2-M1-M3.

3.2 Macro-scale

On the topological macro scale, I analyzed the husky team's home and away passes and goals (Figure 5) and found that various network metrics reflect the style and performance of the football team, such as the location of the network is closely related to the team's performance (the better). Based on the interrelation between players, a performance indicator is designed to show its relationship to the likelihood of winning the game. Other macro measures, such as changes in team averages (i.e. average passes) or player levels, are also presented as agents for evaluating team performance. The team's average clustering factor proved to be much higher than that of the equivalent random network during the game, revealing that creating a two-person group between players has an advantage over triplets. The latest research, which tracks player positions, suggests that it is best to maintain a balance and a high degree of tight balance between the nodes of the passing network.

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