

Exploratory Visualization Toolkit for Tactical Analysis of Team Sports

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INTRODUCTION

Recent years witnessed the emergence of **massive individual-based movement data** due to the **location-aware devices** such as global positioning system (GPS), mobile phones and radio-frequency identification (RFID).

There is a growing need in **team sports** to utilize tracking devices to analyze the performances of athletes. **Movement pattern** is critical in **tactical analysis** especially for **collective movements** of multiple players in team sports such as football, soccer, and basketball.

Recent studies that utilize tracking devices solely focus on the physiological aspects of athletes such as heart rate, total travel distance, and sprint speed. Although findings from these studies provide insights to understand physical motion characteristics of athletes, they do not discuss the **characteristics** of the movement regarding the positions.

OBJECTIVES

This study focuses on two major objectives below:

1. To develop **metrics** to analyze both individual and collective movement patterns of soccer players in three domains. They are
 - Individual-based analysis
 - Position-based analysis
 - Team-based analysis.

2. To develop a **graphical user interface** for coaches and players to **explore** the data with the proposed tool to find **meaningful patterns**.

DATA

- Data of soccer matches of FSU Women's soccer team is provided by **Prozone Inc.** (www.prozonesports.com).
- **All home games** of 2012 season are utilized.
- Prozone provides **video clips** of all the games.



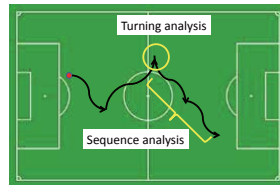
METHODOLOGY (METRICS FOR DATA ANALYSIS)

INDIVIDUAL-BASED ANALYSIS

The individual-based analysis focuses on summarization of the movement patterns of individual players.

Example Metrics:

- temporal change in turning angle
- traveled distance per second
- spatial distribution of sprints
- Area that each player moved

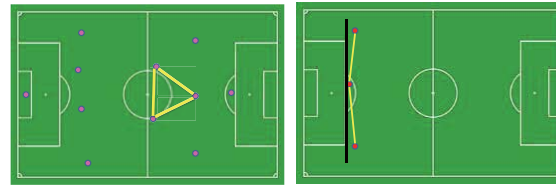


POSITION-BASED ANALYSIS

The position-based analysis enables to detect patterns of players that interact heavily during a game such as three mid-fielders that position themselves mainly at the center of the soccer field. Another example is the interaction among defense players.

Example Metrics:

- Polygon area that multiple players constructs (convex hull)
- Linearity of the defense line

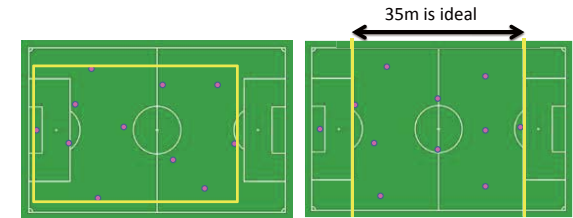


TEAM-BASED ANALYSIS

The team-based analysis focuses on the movement of the whole team of eleven players. For example, metrics of compactness is proposed and analyzed to discover patterns of the collective movements of all players.

Example Metrics:

- compactness (distance between the top player and the bottom player)
- Area that encompasses all player positions



IMPLEMENTATION (EXPLORATORY VISUALIZATION TOOL)

Exploratory Visualization Toolkit

The graphical user interface developed with Python programming language and PostGIS spatial database.

1. Database Connection

Load data in the database.

- Player location data
- Ball location data

2. Data Selection

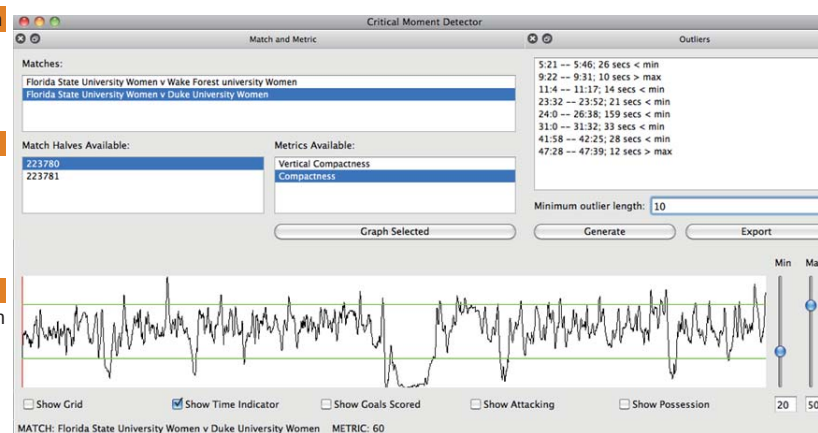
Choose the game information of interest.

- Match name
- Half (1st/2nd half)
- Metric name

3. Visualize Metric Value

"Graph Selected" button generates a chart of time series data of the metric of interest.

This enables visual exploration of the value over time.



4. Data Exploration

- Move the vertical bar in red to find the relationship between the metric value and the corresponding time of the game.
- Change Max/Min slider bar to find outlier value for the metric selected.
- Checkboxes at the bottom provide contextual information
 - a. Time of the goal
 - b. Time range that the team is attacking
 - c. Time range that the team possesses the ball

5. Prozone software

Further data exploration with Prozone software (Prozone3)



6. Outlier Detection

Outlier values with time ranges based on the Max/Min values are shown when "Generate" button is clicked. The list of outliers can be exported as a text file for further analysis using video clips.

5. Threshold

The horizontal bar of Max/Min values of the metric enables visual understanding of outlier values of the metric over time.

FUTURE WORK

1. The graphical user interface needs to be tested by the coaches and players of the FSU Women's soccer team.
2. More metrics should be developed and added to the toolkit. This involves discussions with the coaches and players to identify useful metrics to be added.