Technical Analysis Using Tracking Data & Event Data

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Concepts

- **Ball Location**
  1) In which third is the ball? (penalty box. final third, midfield third, defensive third)
- **Press Classification**
  2) What kind of press is being employed? (press type e.g., direct, indirect)
- **Running Total of Effective Time**
  3) Possession (%)
- **Running Total of Ball Out of Play**
  4) Ball out of Play (%)
- **Progression Classification**
  5) Progression from defensive third to midfield third (% & totals)
  6) Unsuccessful progressions from defensive third to midfield third (% & totals)
  7) Progression from midfield third to final third (% & totals)
  8) Unsuccessful progressions from midfield third to final third (% & totals)
- **Pass Classification**
  9) Straight passes
  10) Diagonal passes

Data

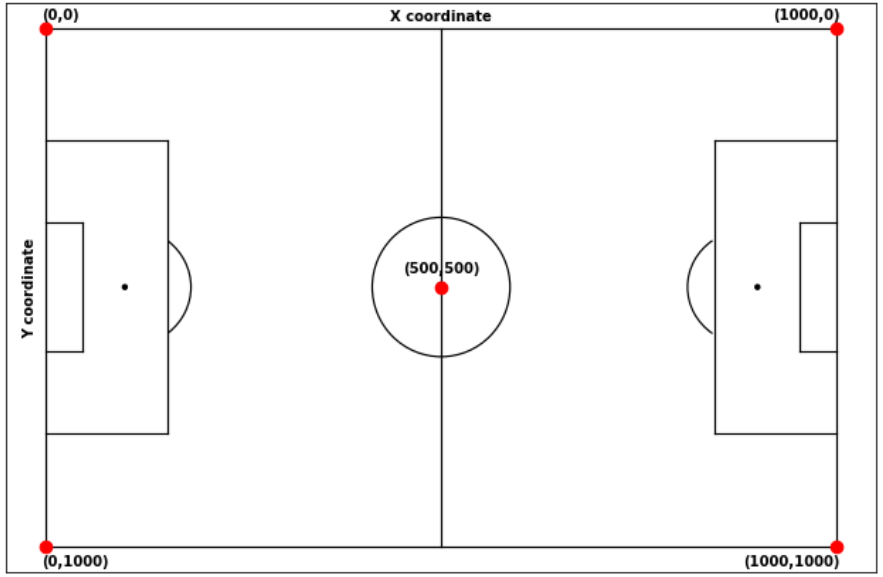
- Event Data:
  - Records of events that took place in the match.
  - For each event (record) it basically provides the information about:
    - Type of the event (e.g., pass, shot)
    - Team involved
    - Players involved (e.g., sender and receiver of a pass event)
    - Spatial location of start and end locations

- Tracking Data:
  - Consists of several snapshots, often referred to as frames, taken throughout the match.
  - Frame: Observation (snapshot) at a specific moment in the game with a sampling rate 25 fps (frames per second). It includes the possession information and spatial locations of players and the ball at a specific moment.

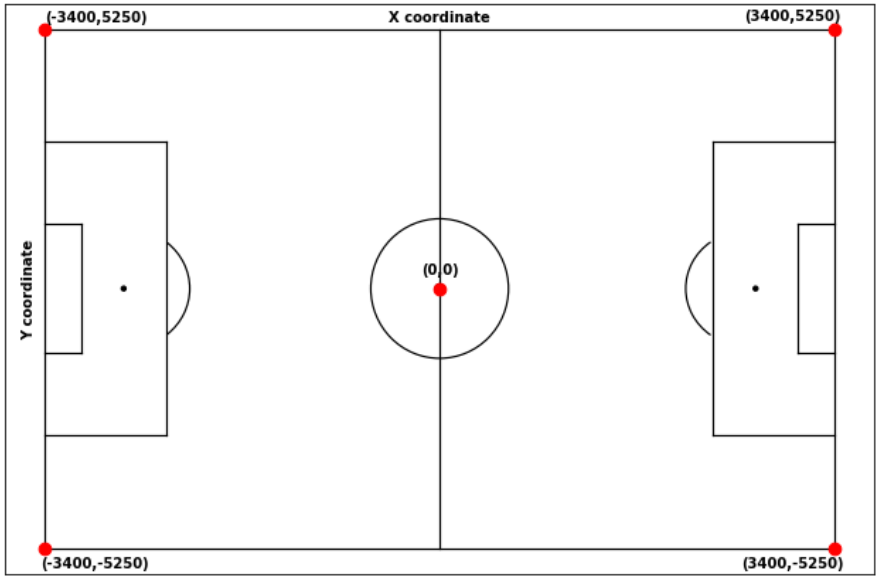
Data

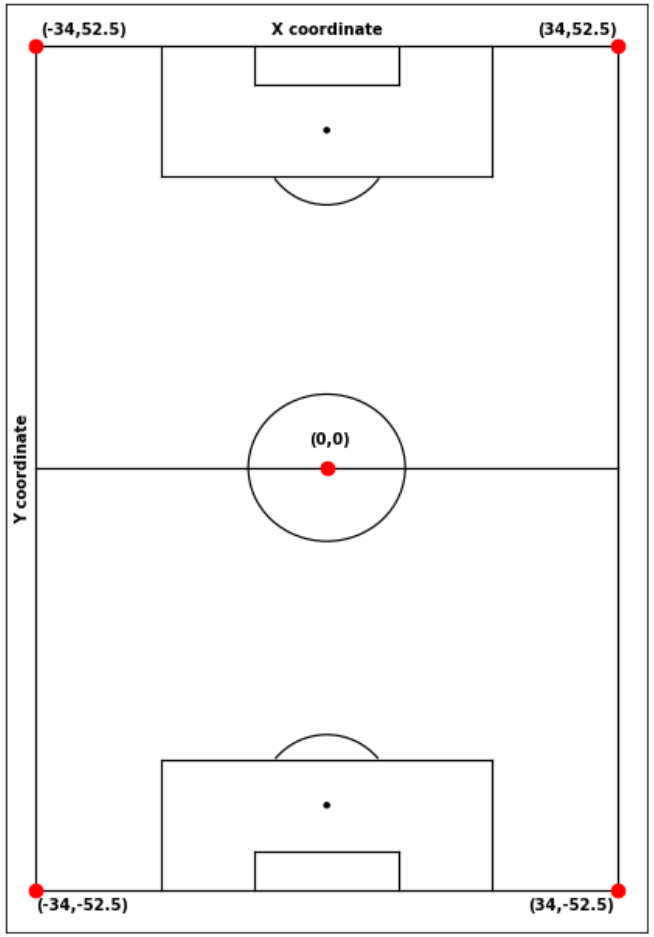
Conversion from event data and tracking data coordinate systems to a vertical coordinate system which aligns with real pitch dimensions

Event Data



Tracking Data





Parser Class

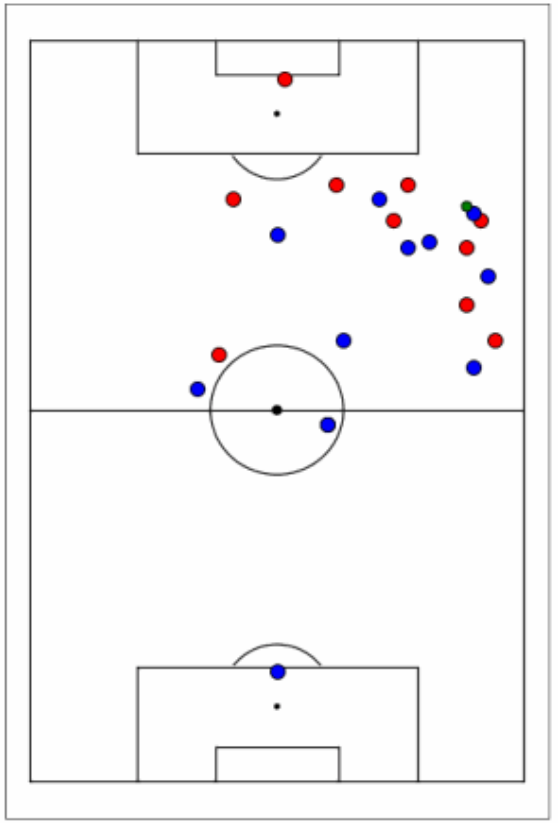
- A class to fetch general match information and technical information from tracking data.
- Technical information:
  - Ball status (alive or dead)
  - UTC (time stamp)
  - Half information
  - Possession information (home or away)
    - Throughout the match
    - Only when the ball is alive
  - Player and ball coordinates (to vertical coordinate system)
    - Throughout the match
    - Only when the ball is alive
    - Mirrored versions (only when the ball is alive)

Analyzed Match

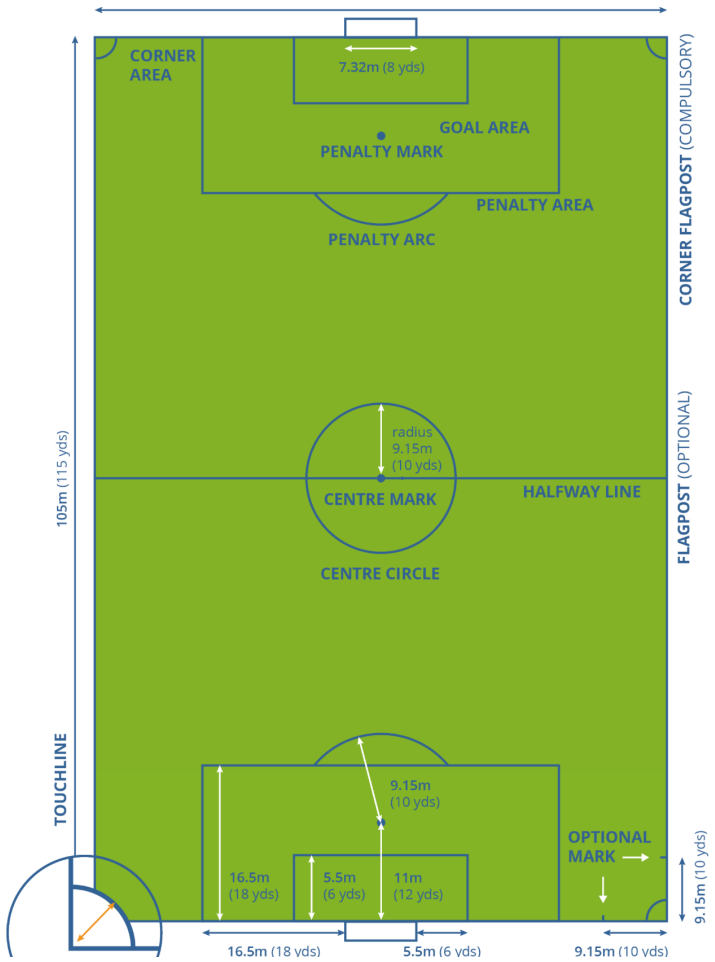
LOSC (0) - Ajax AMSTERDAM (2)

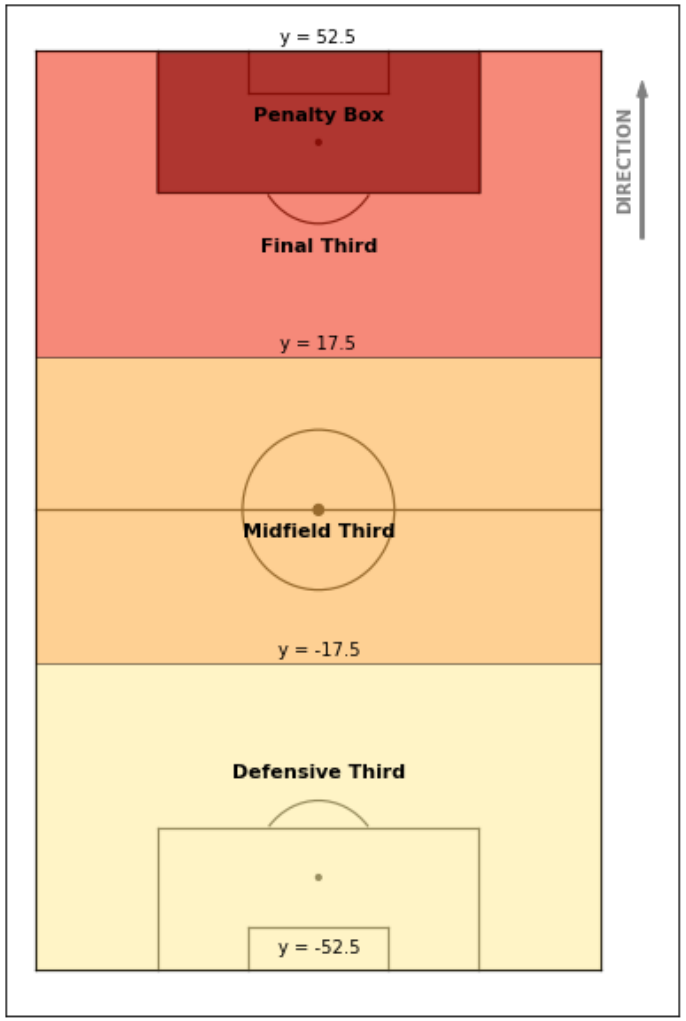
27 November 2019

First Goal
Ajax



Ball Location

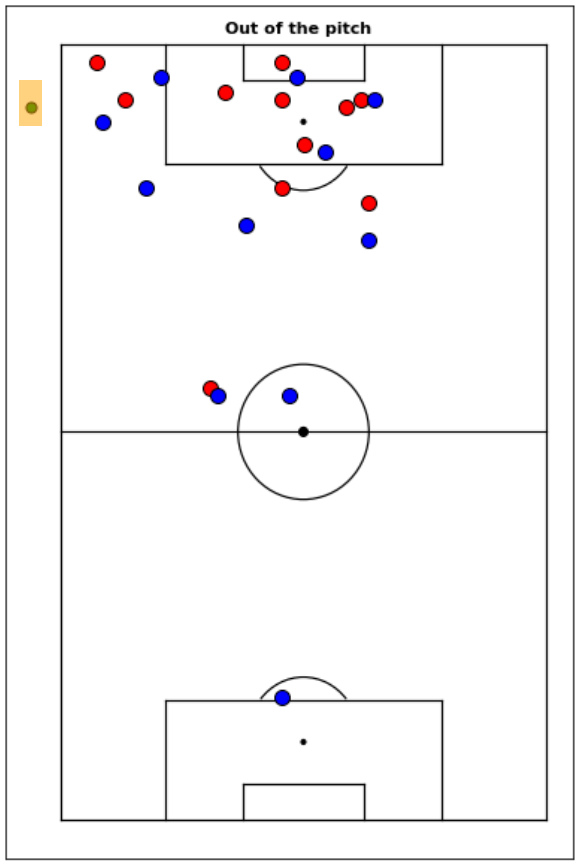


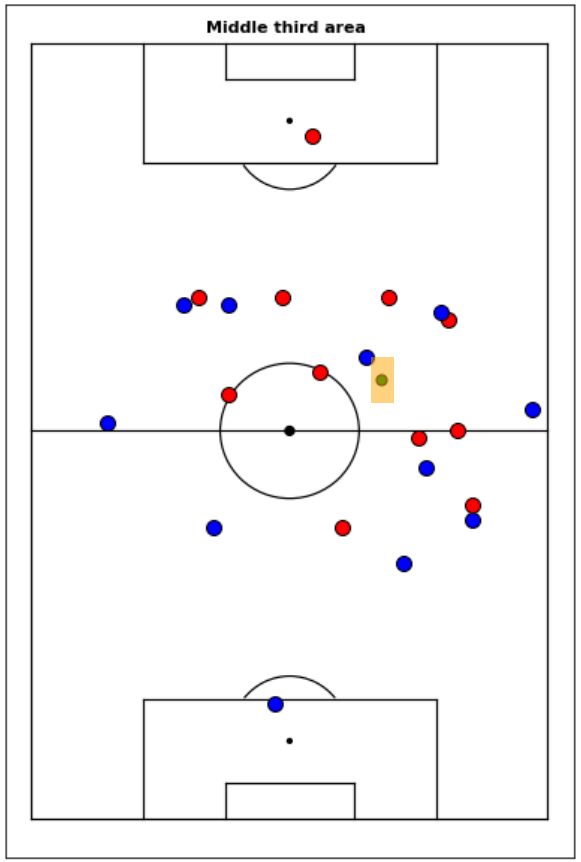


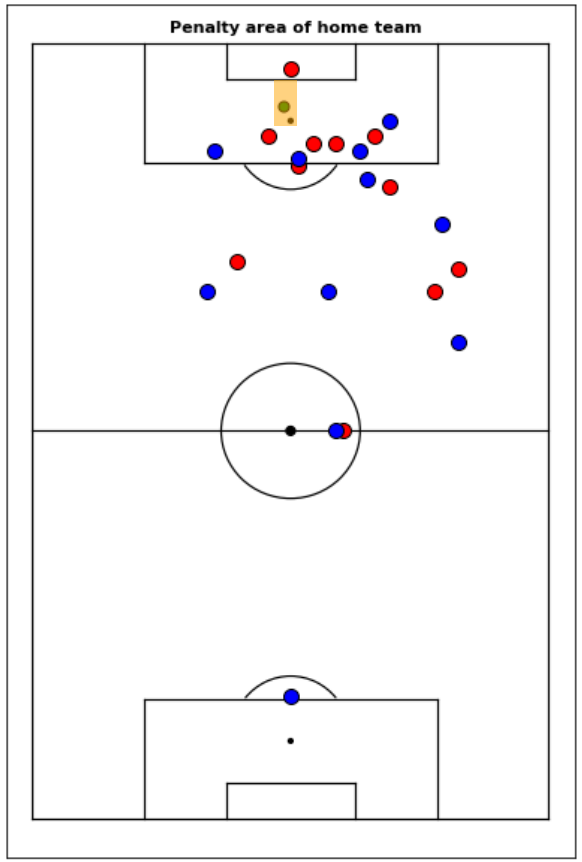
- Use mirrored spatial location of the ball according to one of the two teams to determine the direction of play and, consequently, the ball's location.
- Frame-Level analysis.

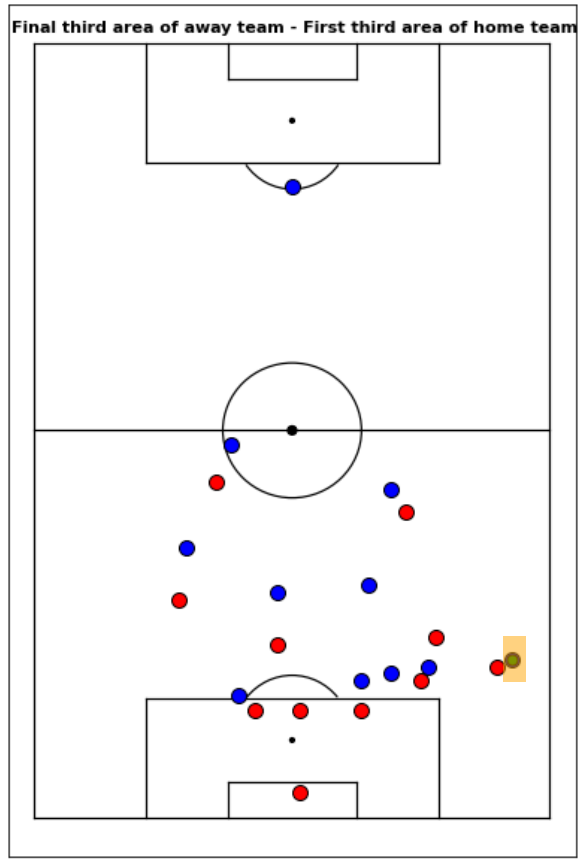
Ball Location

Red dots: Home team
Blue dots: Away team
Green dot: Ball









Press Classification

- Frame-Level Analysis

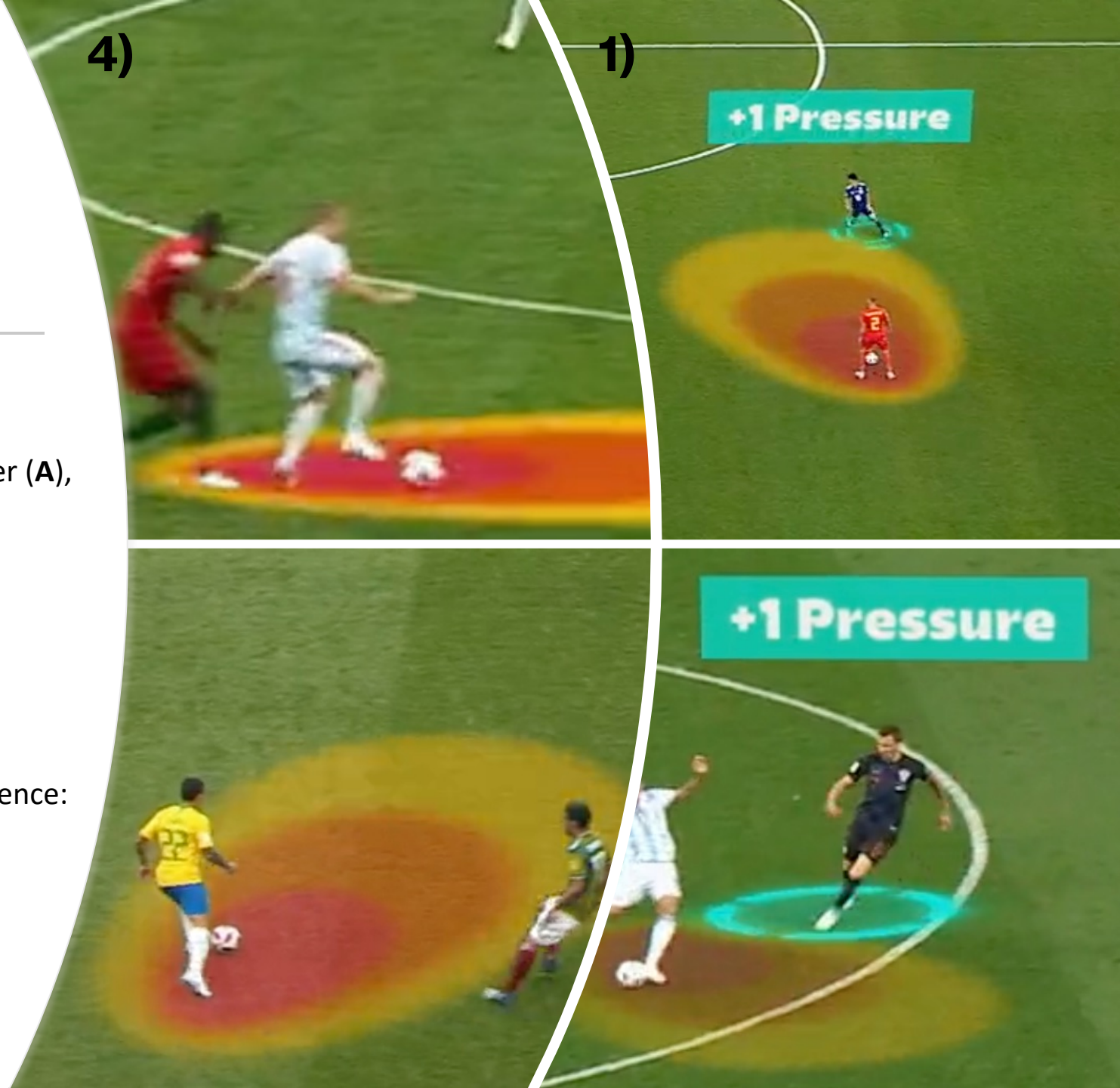
- Direct Pressure:
  - Defensive action of a player, reducing the distance between themselves and the opponent in-possession of the ball.
  - The defending player applies aggressive pressure on an opponent who has possession of the ball.

- Indirect Pressure:
  - Defending players position themselves to block passing lanes, cut off the ball carrier's options, and apply pressure without committing to a full-on tackle or interception.

- No Pressure:
  - If no player is in control of the ball (within 3 meters distance to the ball).
  - Neither Direct nor Indirect pressure applies.

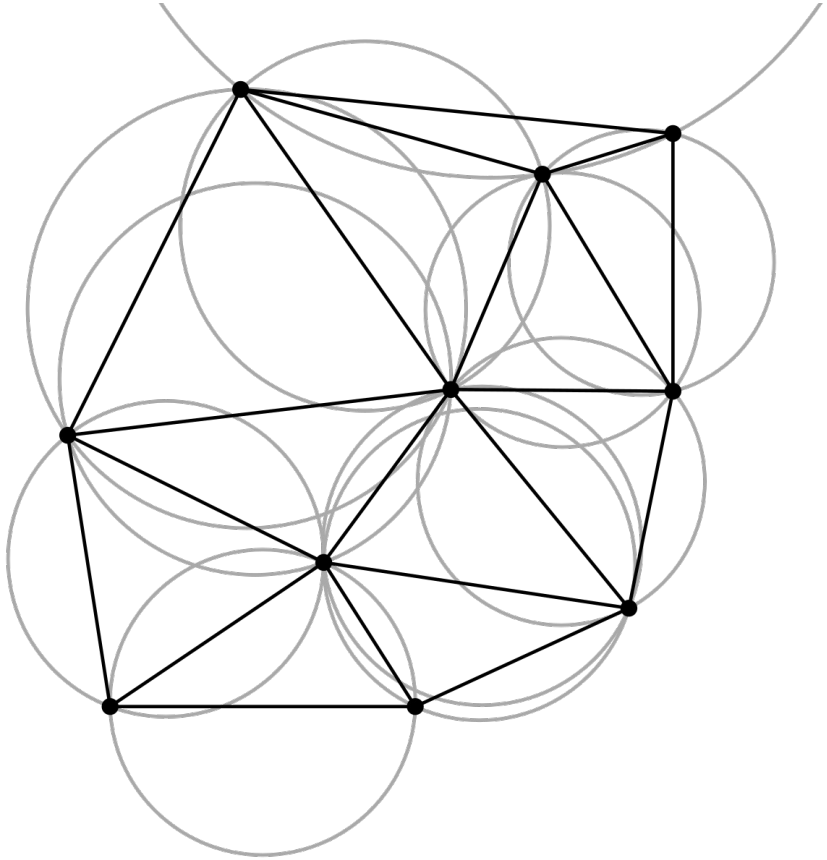
Pressure Classification

- **Direct Pressure**
- Examine the geometrical relationship between the attacker (**A**), defender (**D**), and the ball (**B**).
- Key factors to include:
  - Edge (**AD**)
  - Edge (**AB**)
  - Angle ($\boldsymbol{\theta}$) between the edges **AD** and **AB**
  - Distance ($\boldsymbol{d}$) between **D** and **B**
- There are four cases that classify a frame as pressure presence:
  1) $0° \leq \boldsymbol{\theta} \leq 30°$ and $\boldsymbol{d} \leq 3\ meters$
  2) $30° \leq \boldsymbol{\theta} \leq 60°$ and $\boldsymbol{d} \leq 2.5\ meters$
  3) $60° \leq \boldsymbol{\theta} \leq 90°$ and $\boldsymbol{d} \leq 2\ meters$
  4) $90° \leq \boldsymbol{\theta}$ and $\boldsymbol{d} \leq 1\ meters$



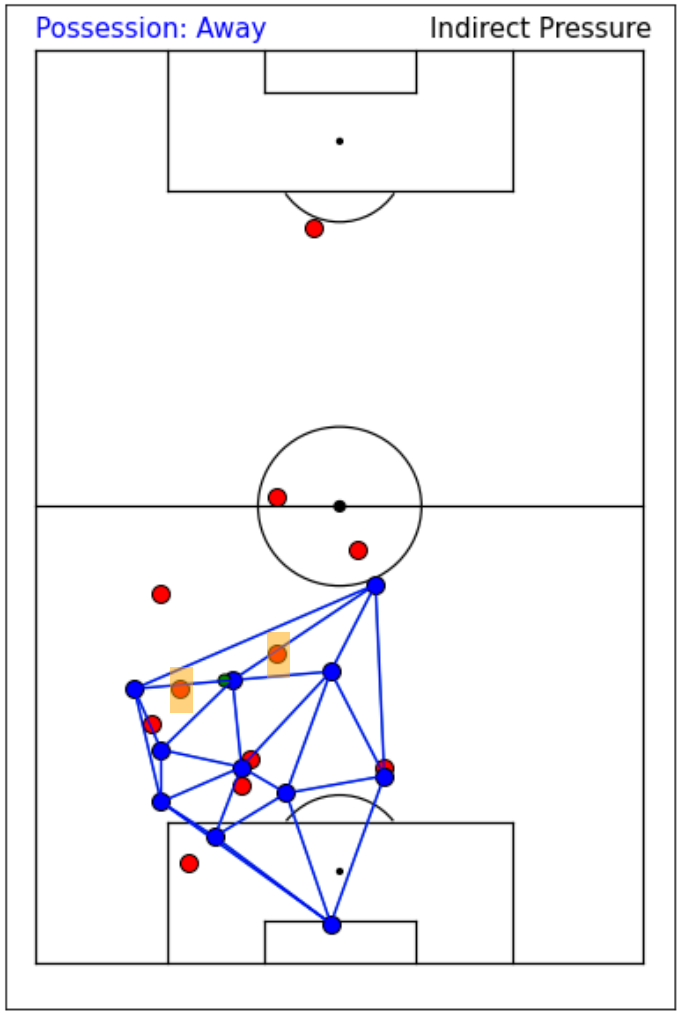
Pressure Classification

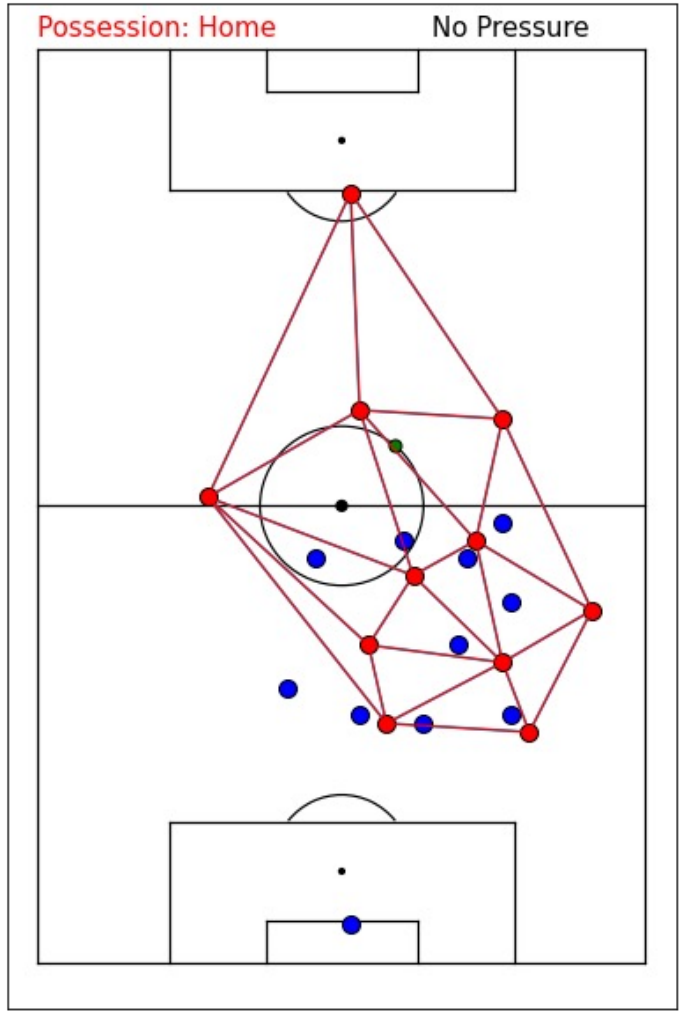
- **Indirect Pressure**
- Construct the Delanuay Triangulation of the points representing the team in-possession.
  - Delaunay Triangulation connects points with triangles, maximizing triangle quality and ensuring no points are inside a triangle's circumcircle.
- The edges constructed between players represent the passing lanes.
- Determine the neighboring players hence the passing options of the Attacker.
- Check if there is an opponent within a 2 meters perpendicular distance to the passing lane.

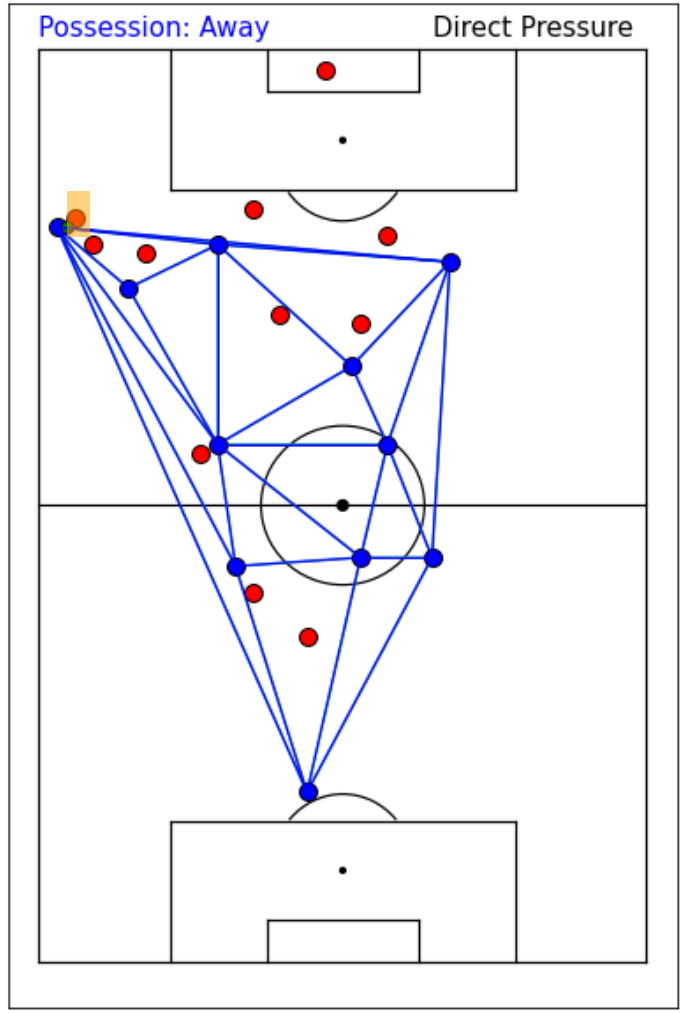


Pressure Classification

Red dots: Home team
Blue dots: Away team
Green dot: Ball





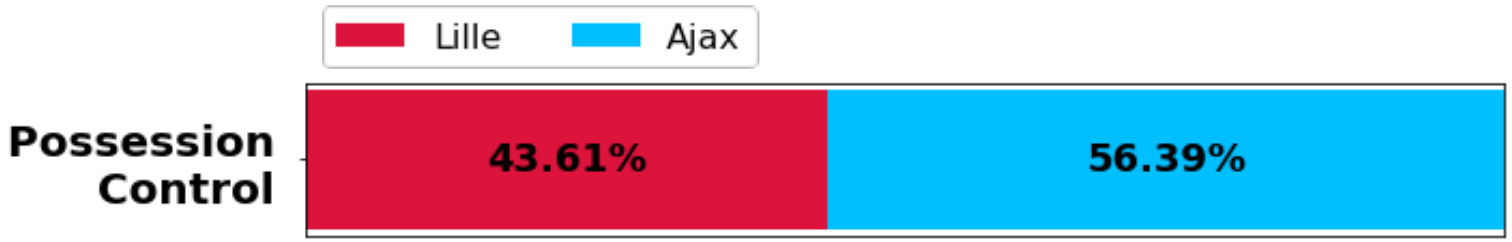


Running Total of Effective Time

- Utilizing the available possession information which is either home or away, the running total of effective time is distributed to establish possession % of each team.

- For the F^{th} ball alive frame, the possession distribution obtained in the interval [0, F] is computed and assigned accordingly to that frame.

- According to logic of the analysis, the last frame's possesion distribution represents the possession distribution throughout the match.



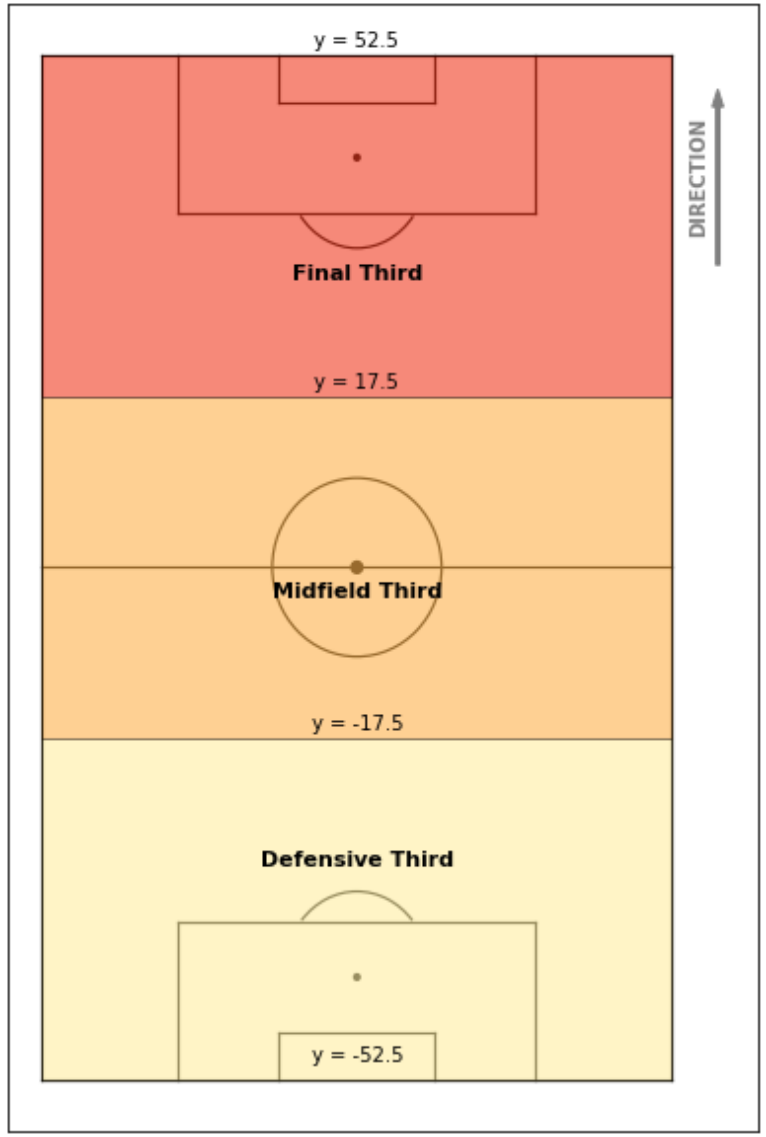
Running Total of Ball Out of Play

- The frames for the match start, half-time start, half-time end, and match end are established using the possession and half information.
- Status of the ball within the first half and second half are filtered.
- Employing the available ball status indicating whether a ball is alive (1) or dead (0), running total of ball out of play is obtained.
- According to logic of the analysis, the last frame's calculation represents the ball out of play % throughout the match which is 39%.
- Considering that there were 2 minutes stoppage time added to half time and 3 minutes added to the end of game, ball was not alive for 37 minutes.
  - 95 (total) = 58 (alive) + 37 (dead)

Progression Classification

- Successful and unsuccessful progressions from
  - Defensive Third to Midfield Third
  - Midfield Third to Final Third

- A progression can take place via:
  - Dribbling (Ball carrying)
  - Passing

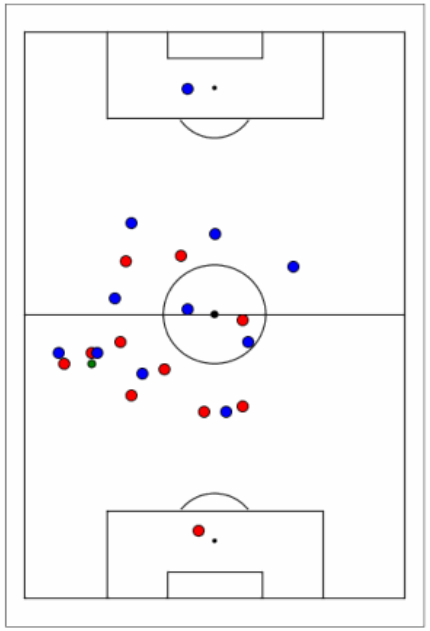


Progression Classification

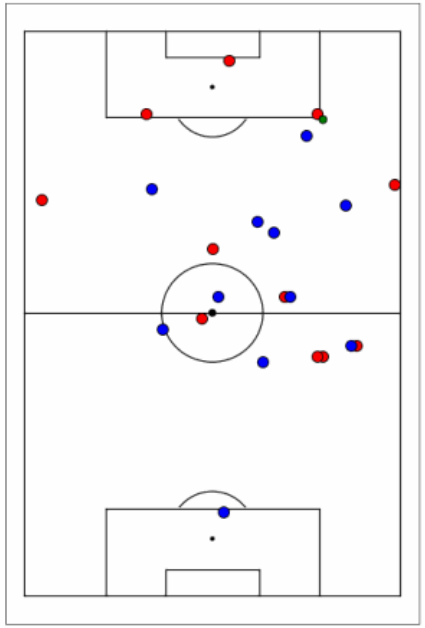
- Use possession information and mirrored spatial location of the ball to detect the team and progression zone.
- After progression between zones, ensure that the team has the possession within 60 frames.
- Besides dribbling, progressions can also occur through passing. Ensure that after 10 frames of the zone progression and before 60 frames, the progressing team has ball control, defined as the ball being within 3 meters of a player.

Progression Classification

Dribbling Progression



Pass Progression



Progression Classification

Defensive Third to Midfield Third	#Successful progressions	#Unsuccessful progressions	Success rate (%)
Lille	45	37	55%
Ajax	62	40	61%

Midfield Third to Final Third	#Successful progressions	#Unsuccessful progressions	Success rate (%)
Lille	35	44	44%
Ajax	44	40	52%

Pass Classification

- Diagonal Passes:
  - Kick or move the ball diagonally across the field.
  - Change the direction of the ball's movement.
  - Can be short or long.

- Straight Passes:
  - Characterized by their simplicity and efficiency.
  - Typically, short and precise.

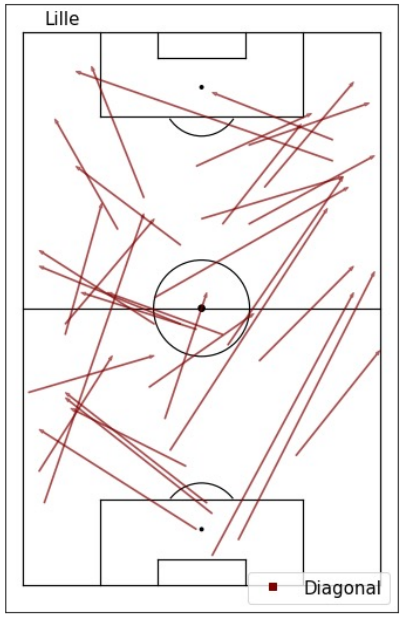
- Other Passes:
  - Neither classified as diagonal nor straight.

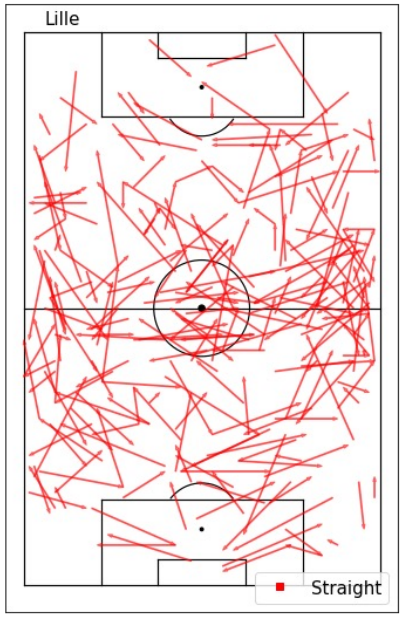
Pass Classification

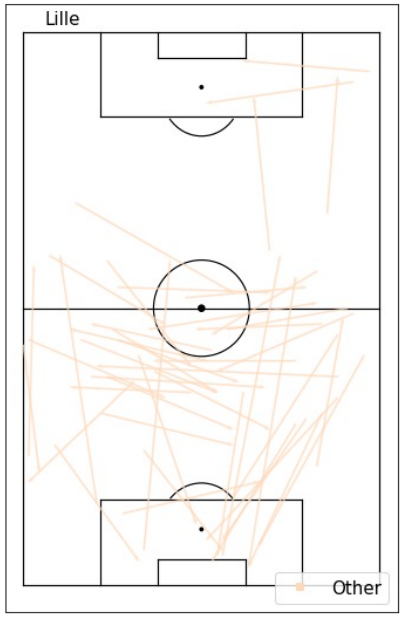
- Filter out the unsuccessful passes by checking the sender and receiver team IDs.
- Consider the edges constructed by start and end locations of the passes.
- Calculate the distance covered. (Distance threshold = 23 meters).
  - $distance = \sqrt{(x_{end} - x_{start})^2 + (y_{end} - y_{start})^2}$
- Calculate the absolute value of the slopes of these edges and calculate the slope of the degree thresholds.

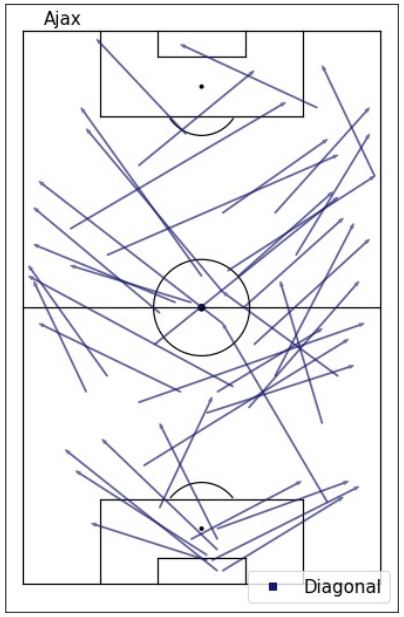
  (Degree thresholds: θ_{low} = 15°, θ_{high} = 75°)
  - $slope = \left|\frac{y_{end} - y_{start}}{x_{end} - x_{start}}\right|$
  - $slope_{threshold} = \arctan(\theta°)$
- Diagonal Pass:
  - $Distance_{pass} > Distance_{threshold}(23\ meters)$
  - $Slope_{low} \leq Slope_{pass} \leq Slope_{high}$
  - $y_{end} > y_{start}$
- Straight Pass:
  - $Distance_{pass} \leq Distance_{threshold}(23\ meters)$

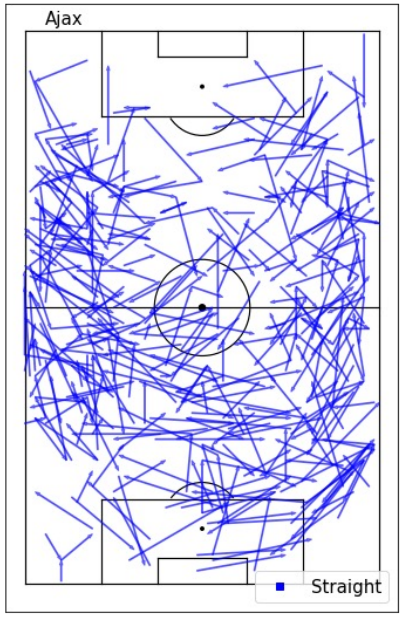
Pass Classification

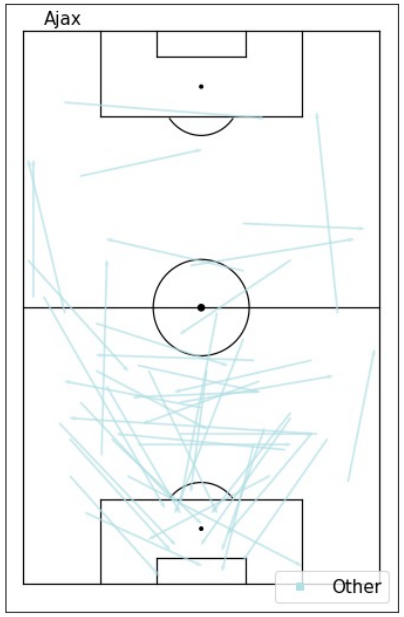












Limitations & Future Work

- Synchronization of event data and tracking data.
  - Provided event data lacks UTC value of the recorded events.
  - Precisely detecting events (e.g., passes) in the tracking data allows more efficient analysis.

- Clear and precise defintions of the concepts would enhance the stability and accuracy of the resuts.
  - Determination of paramters significantly affects the metric outputs.

Conclusion

- In this project, the implementation of several concepts were established using the tracking data and event data.
  - Ball location - tracking data
  - Press classification - tracking data
  - Running total of effective time - tracking data
  - Running total of ball out of play - tracking data
  - Progress classification - tracking data
  - Pass classification - event data

- The data and its processing steps, the implementation of the concepts and their respective outputs are explained in technical level and demonstrated with visuals and animations.

- Encountered limitations and potential future works were highlighted.

Q&A

- Thank you for listening!