Evaluation of Off-the-Ball Actions in Soccer

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Motivation

- Individual players have possession of the ball for less than two minutes (Link and Hoernig, 2017).
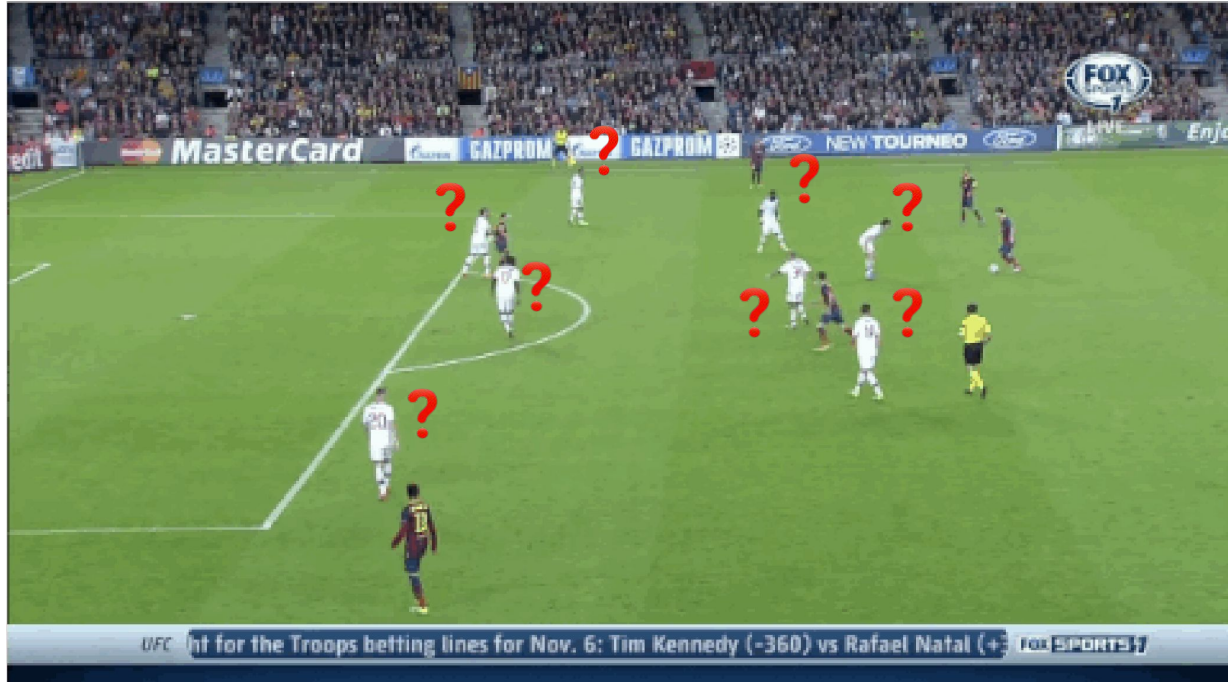
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Motivation

- How to evaluate **defenders** who **don't have the ball**?

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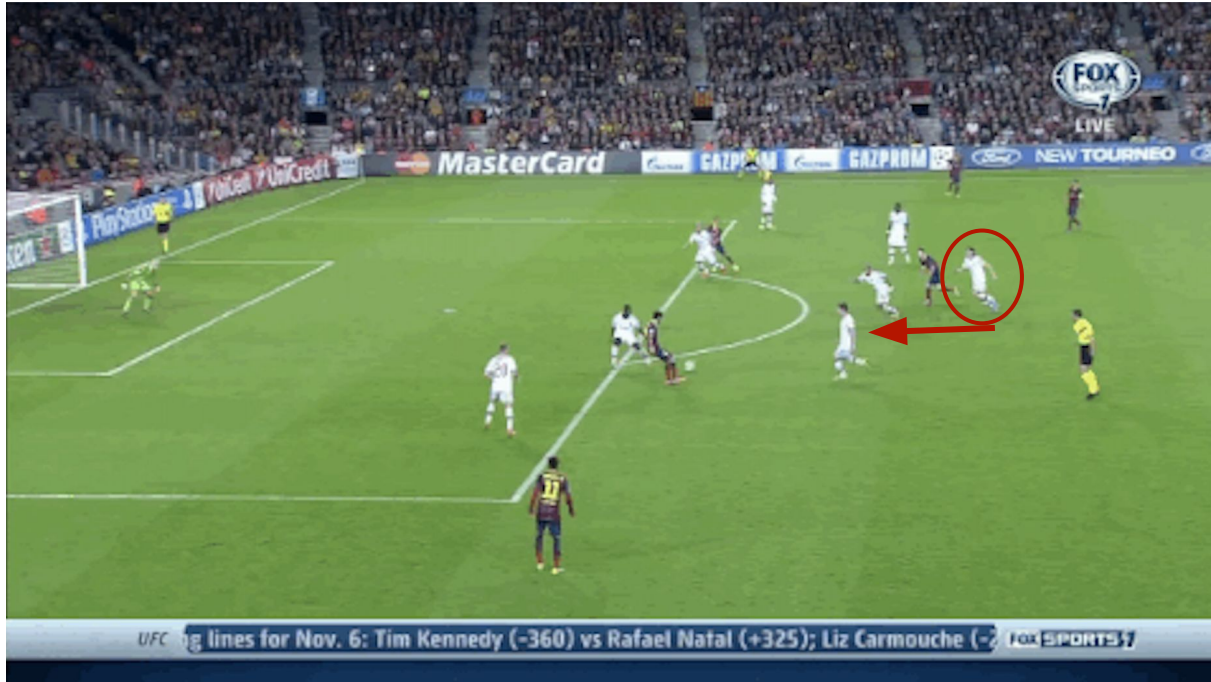- How to evaluate **defenders** who **don't have the ball**?

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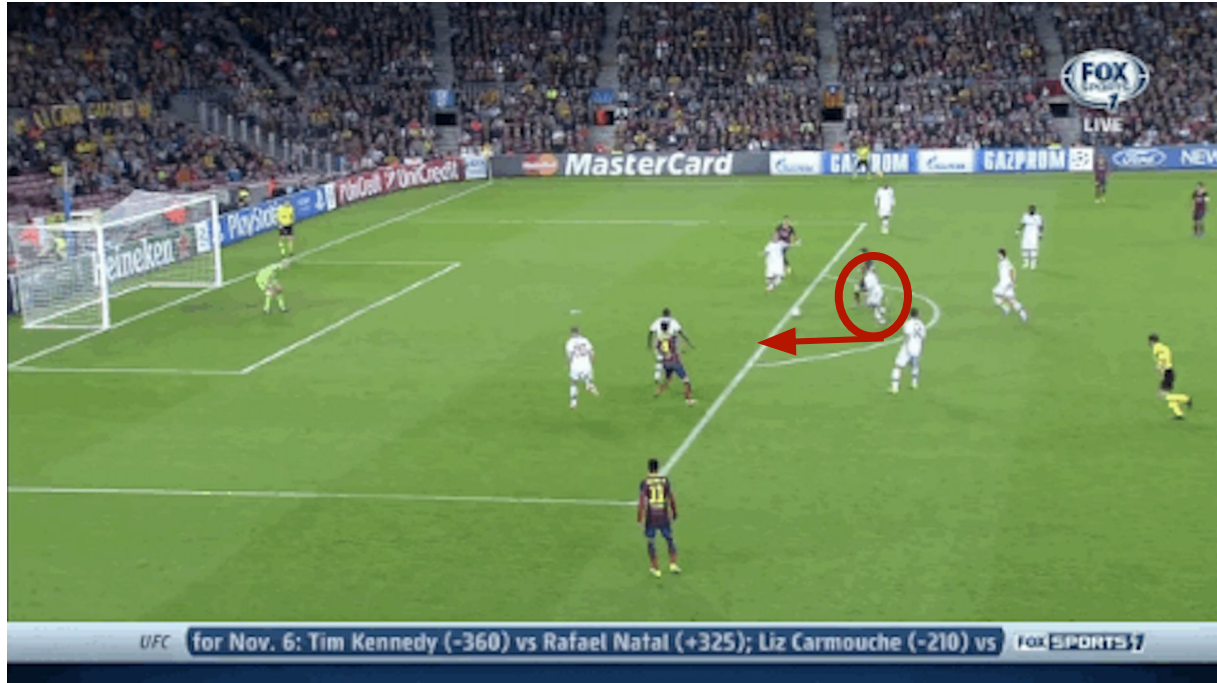
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Rationale & Objective

- Evaluate how defensive players move in a given situation (defensive anticipation)

- Recognize similar match situations to understand what an average defender would do

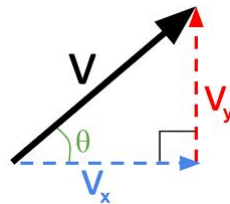# Rationale & Objective

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- Prediction of velocity given a set of spatial-temporal covariates/features

$$\mathbf{V} = f(\mathbf{X})$$

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Covariates/Features

$$V = f(\qquad\qquad\qquad)$$

- f() could a highly complex function

- Hand-crafted covariates/features based on soccer knowledge

  - Player of interest (fixd a given defender), ball, teammates, opponents, game context

- x,y coordinates
- player velocity half seconds before
- distance of the player to the ball
- distance of the player to offensive goal
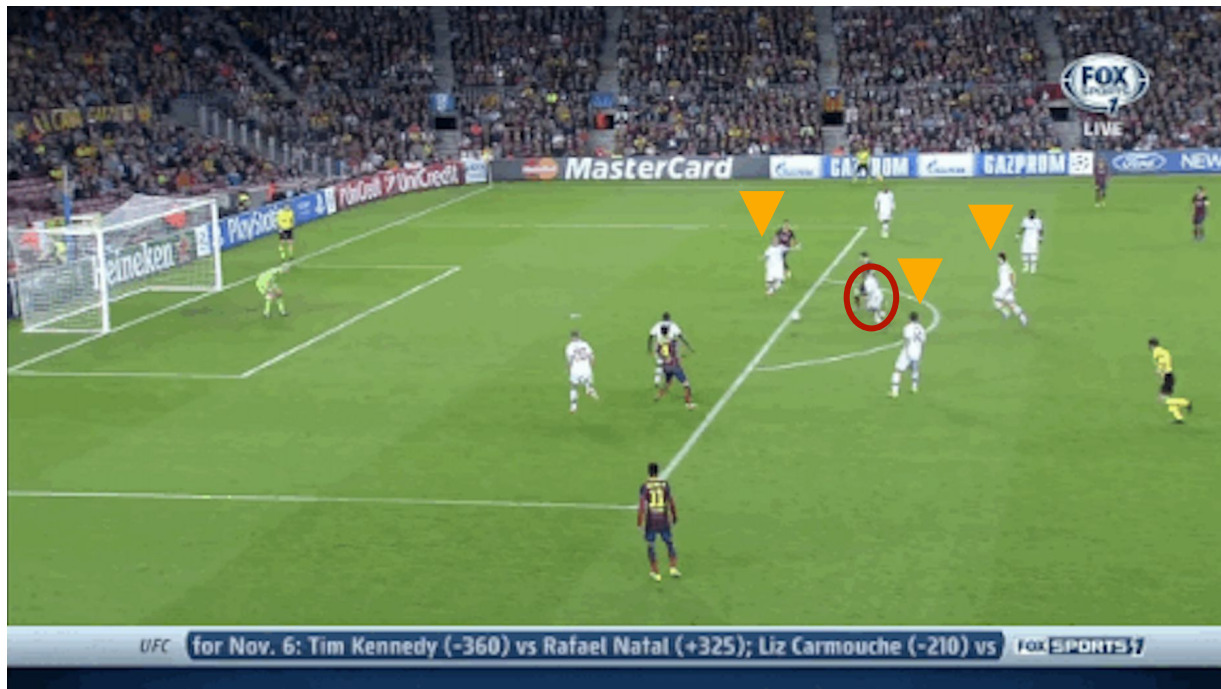- angle of the player to offensive goal

$$V = f(X^{player}, X^{ball}, X^{teammates}, X^{opponents}, X^{context})$$

- x,y coordinates of the ball
- ball speed

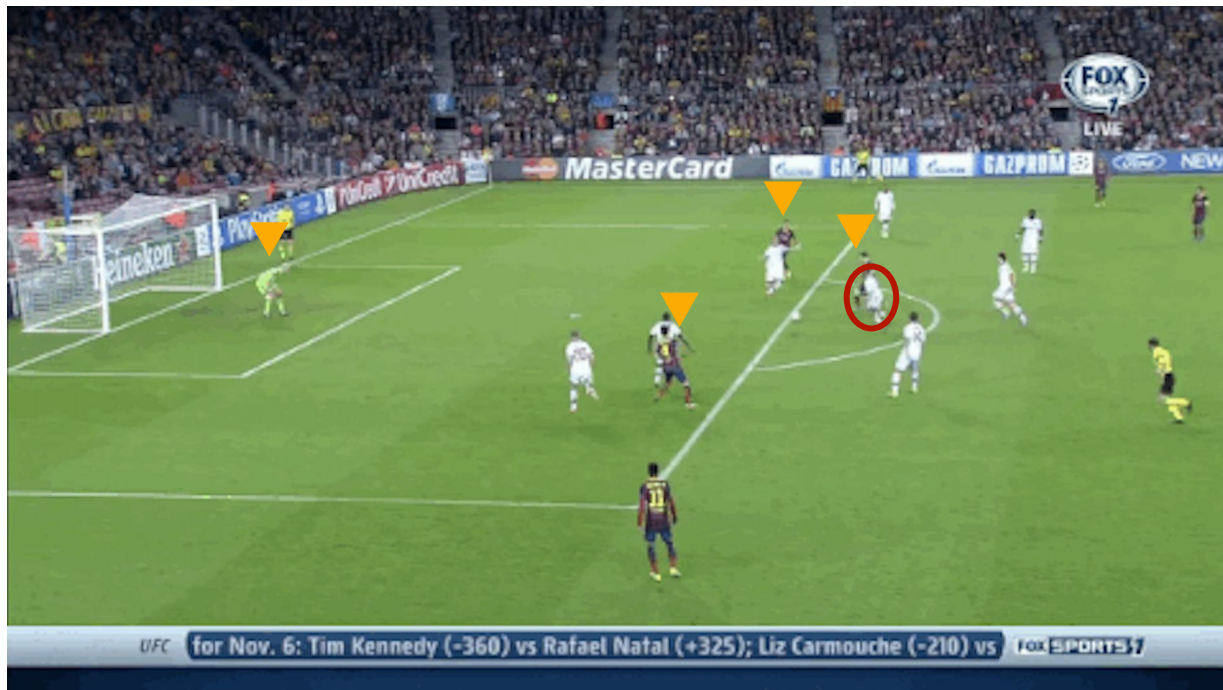$$V = f(X^{player}, X^{ball}, X^{teammates}, X^{opponents}, X^{context})$$

- 3 nearest teammates
- x,y coordinates
- velocity of teammates
- distance of the player to teammate
- distance of the ball to teammate
- relative angle of the teammate to the player of interest

$$\mathrm{V} = f(\mathrm{X}^{player}, \mathrm{X}^{ball}, \mathrm{X}^{teammates}, \mathrm{X}^{opponents}, \mathrm{X}^{context})$$

- **3 nearest opponents**
    - x,y coordinates
    - velocity of opponent
    - distance of the player to opponent
    - distance of the ball to opponent
    - relative angle of the opponent to the player of interest
    - xT at the current location
- x,y coordinates of the goalkeeper
- distance of the player to goalkeeper

$$V = f(X^{player}, X^{ball}, X^{teammates}, X^{opponents}, X^{context})$$

- home or road team
- seconds remaining in the half of the game
- seconds remaining in the full game
- indicator for the player on offensive or defensive side of the field

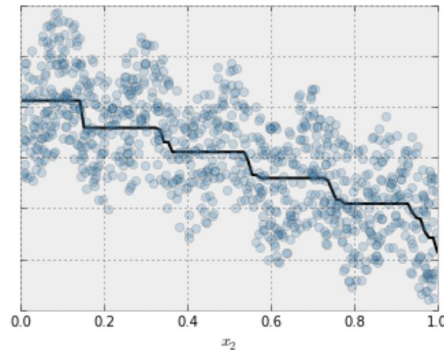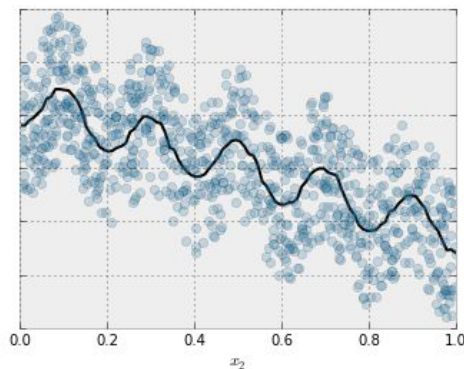$$V = f(X^{player}, X^{ball}, X^{teammates}, X^{opponents}, X^{context})$$

Data

- Player tracking data Chinese Super League in 2019 season (~200 games)

- 61 covariates/features

  - $\mathrm{X}^{player}, \mathrm{X}^{ball}, \mathrm{X}^{teammates}, \mathrm{X}^{opponents}, \mathrm{X}^{context}$

- 10 times per second -> downsample to every second

- Focus on the case when opponent has maintained possession

Model

- Gradient boosting model

  - Works well on tabular data empirically

    - 17/29 Kaggle winning solutions in 2015 used XGBoost (Chen & Guestrin, 2016)

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  - Faster to train and tune

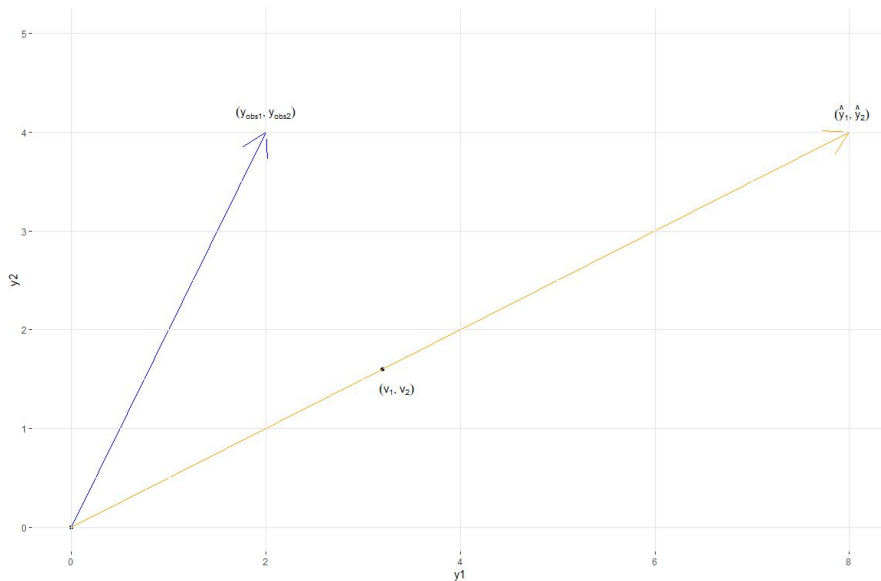 - Enforce monotonicity constraints on features

Defensive anticipation metric

For a given player

$$p = \begin{cases} \left(\sqrt{v_1^2 + v_2^2} - \sqrt{\hat{y}_1^2 + \hat{y}_2^2} \right) / \sqrt{\hat{y}_1^2 + \hat{y}_2^2} & v_1 \hat{y}_1 \geq 0 \\ \left(-\sqrt{v_1^2 + v_2^2} - \sqrt{\hat{y}_1^2 + \hat{y}_2^2} \right) / \sqrt{\hat{y}_1^2 + \hat{y}_2^2} & v_1 \hat{y}_1 < 0 \end{cases}$$
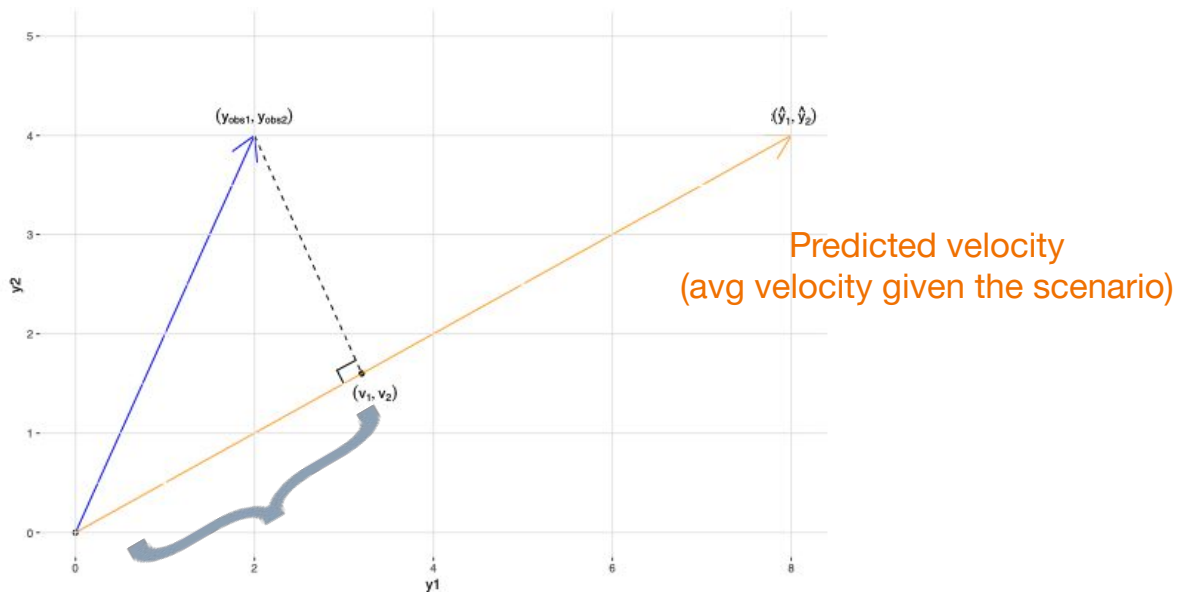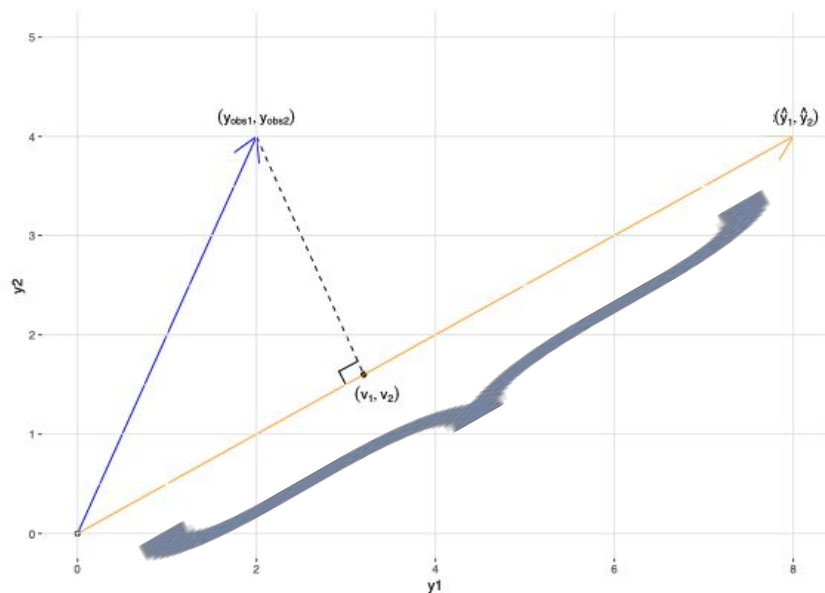
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Defensive anticipation metric

Predicted velocity
(avg velocity given the scenario)

For a given player

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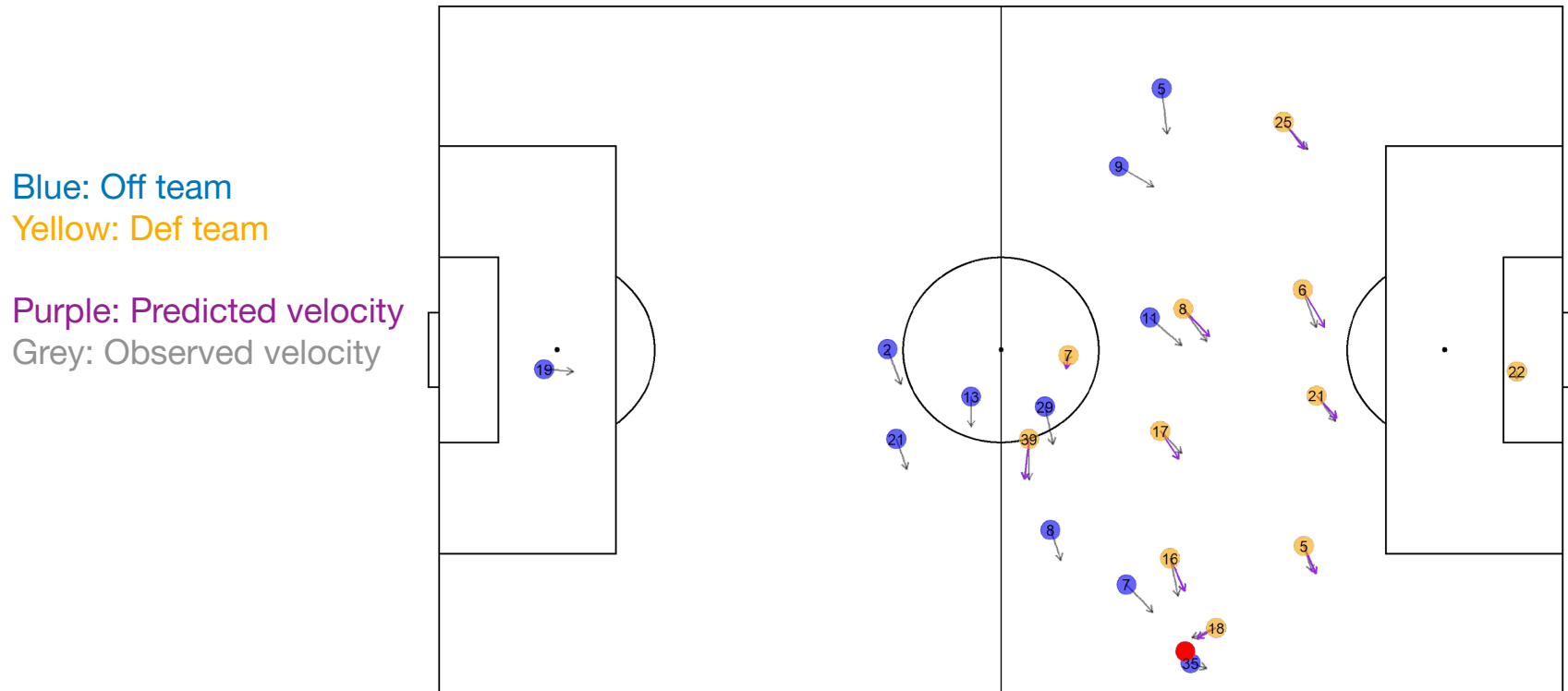
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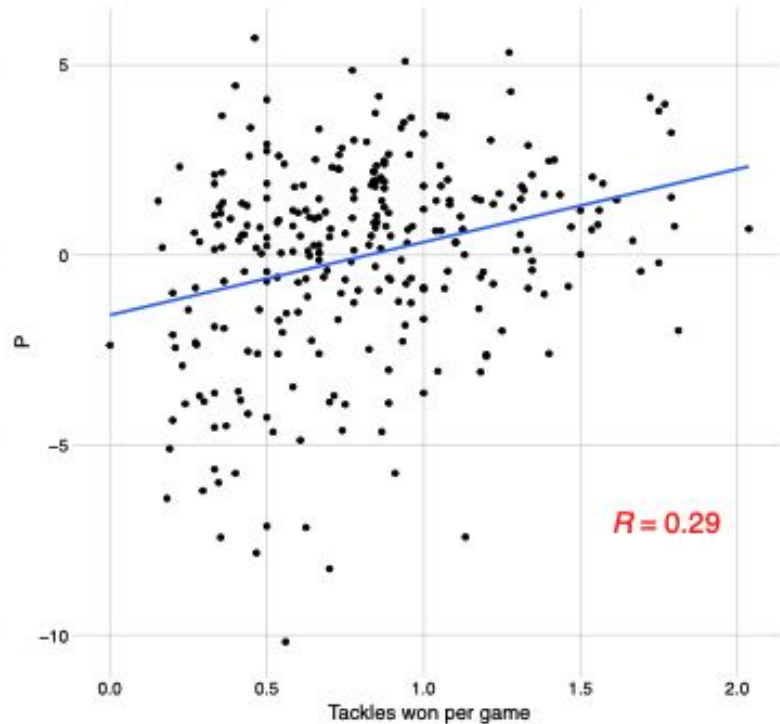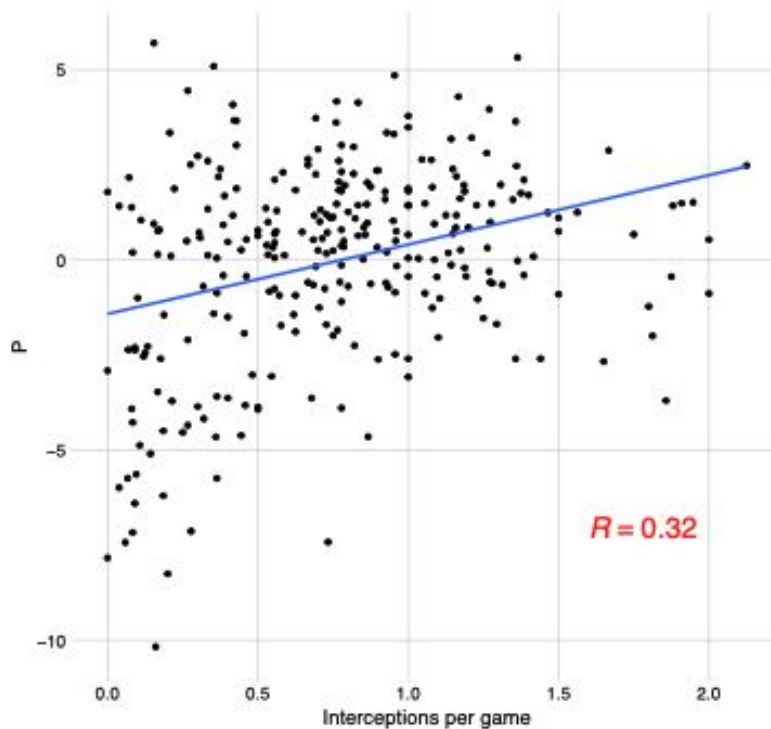
Results

Defensive anticipation metric for all defenders

Blue: Off team
Yellow: Def team

Purple: Predicted velocity
Grey: Observed velocity

Results

Correlation of defensive anticipation vs interceptions/tackles

Discussion & Future work

- Spilt data into odd/even weeks and out-of-sample player rankings are consistent

- Combine the predicted velocity with pitch control models

- Condition on soccer tactics and styles of play